"A COMPARATIVE STUDY OF LAND AND LABOUR PRODUCTIVITY IN SMALLSCALE AND LARGESCALE COFFEE FARMS WITH PARTICULAR REFERENCE TO KIAMBU DISTRICT"

By

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A Thesis Submitted in Partial Fulfilment for the Degree of Master of Science in Agricultural Economics at the University of Nairobi

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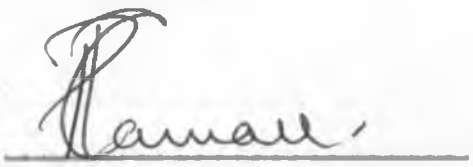
September 1981

I hereby declare that this thesis is my original work and has not been presented for a degree in any other University.



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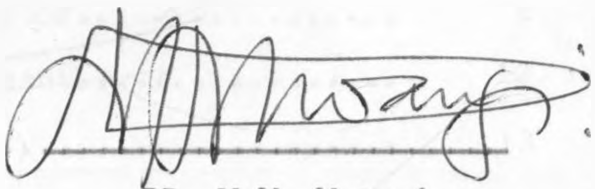

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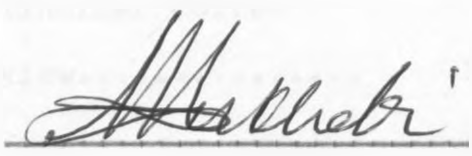

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The author is deeply indebted to all those who made this work a reality and especially the University Supervisors namely Prof. M.J. Dorling, Dr. Doppler, Dr. Mwangi and Dr. Mukhebi who at one time or another offered their suggestions, comments and criticisms.

Secondly I would like to register my sincere gratitude to all those farmers and especially the smallholder coffee farmers who offered their time to provide the necessary data.

Thirdly I would like also to register my gratitude to the German Academic Exchange Service (D.A.A.D.) for providing me with the Scholarship to carry out this study.

I would also like to thank Lily Ogola for her tireless effort to type the earlier drafts and also for typing the final draft amid other pressing duties.

Lastly but not least I would like to thank my wife for her patience and constant encouragement without which the task would have been enormous.

A B S T R A C T

This study estimates the marginal value products for both land and labour in estates and smallholder Coffee farms. It is shown that land productivity is substantially higher in estates than in smallholder farms. The mean MVP for land in estates stands at Kshs. 25,246.00 compared to a mean of Kshs. 4677.70 in smallholder farms. Similarly, labour productivity is also shown to be higher in estates as compared to the smallholder farms. The mean MVPs for labour ranges from Kshs 78.80 to Kshs 94.35 per manday in estates compared to mean of Kshs 16.00 to Kshs 23.10 per manday in smallholder sector. This led to the conclusion that resources are more efficiently used in estates than in smallholder coffee farms.

Regression results from smallholder sector indicates that coffee production would be increased considerably if more fertilizers and fungicides are used. This led to the conclusion that intensive use of these inputs would increase productivity of the various factors from this sector.

The study observes that the estates have almost attained their peak in terms of production, and in prescribing where improvements are needed, the study concludes that these are urgently needed mainly in the smallholder sector.
To improve the lot of the smallholder farmers, the study suggests that:-

(I) Lower input levels which are both economical and attainable by smallholder farms should be defined.

(II) Farmer training should be intensified to make them more aware of the benefits of using recommended inputs.

(III) Renumerations to labour should be reviewed, with an aim of increasing them, or more labour should be employed.

(IV) Land prices should be standardised to reflect productivity if land has to be used more efficiently.

I

CHAPTER ONE

INTRODUCTION

1.1. Coffee in the National Economy

Coffee was first planted in Kenya at around 1893 at Bura Mission in Taita Hills (7). Since its planting and subsequent increase in hectarage over the years coffee has continued to play a significant role in the economy of this country. First, and foremost it is the major export crop and also the major foreign exchange earner for this country. Among the other major export crops like tea, sisal and pyrethrum, coffee stands out as the most important. Of the total domestic exports which includes manufactured goods, basic materials and food stuffs coffee contributed on average 27.6% from 1974 to 1978 as compared to tea with average of 12.4%, sisal 2.7% and pyrethrum 1.6% as is indicated in table 1.

Table 1.1. The Contribution of Coffee and other major Export Crops to the Total Domestic Exports in Kenya, 1974 - 1978. (%)

CROP / YEAR	Coffee	Tea	Sisal[1]	Pyrethrum[2]	Total All Exports
1974	18	9	8	3	100
1975	16	11	3	2	100
1976	26	10	1	2	100
1977	42	15	0.8	1	100
1978	33	17	1	1	100
Average	27.6	12.4	2.7	1.6	-

SOURCE: Calculated From Statistical Abstract 1979, P.62

1) Includes Sisal fibre and tow

2) Includes pyrethrum flowers and pyrethrum extract.

It is clear from the figures presented in the table that coffee is an important crop to Kenya. The figures also indicate that even the average contributions of the other three crops i.e. tea, sisal and pyrethrum over the five year period is less than that of coffee by 10.9%. However the high figure for coffee in 1977 can be explained by the fact that the coffee prices at that time were very high in the region of K£ 3000 per tonne (11,p.1).[1] But irrespective of that, in the other years we still observe that the contribution of coffee still stands well above the others.

Not only does coffee contribute significantly to the principal domestic exports but it is also a major source of employment. This is especially important in the sense that here in Kenya we have a labour surplus economy. Figures for 1970 indicate that of a total labour force of 3.5 million people, about 1 million people or 28% were employed directly in the coffee industry either in full or part-time employment (8,p.11). Considering that the coffee hectarage has increased from about 60,000 hectares in 1970 to the present 119,160 hectares in 1979 (11), it is only logical to assume that the labour force engaged partly or

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1. Coffee Board of Kenya Annual Report 1978/79.

full-time in coffee has also increased considerably if not doubled. However, the only problem is that most of these people may be employed seasonally during peak picking period which also coincides with peak period at the factories where processing is done.[1] Otherwise the percentage employed full-time could be low and this brings the question of the relative productivity of this labour. Besides these two aspects coffee does also contribute directly to the Government revenue through export duty, which is levied when coffee prices are above K£ 1000 per tonne.[2] For instance in 1979/80 crop year the revenue raised this way was K£ 4,819,255 (11,P.23).

All in all, it can be observed that coffee is an important crop for Kenya not only to the growing community who receive direct monetary benefits but it also engages other people e.g. in processing and marketing. Finally we can also see that it contributes to Government revenue.

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1. After processing, alot of labour is required to dry the coffee especially in turning to facilitate uniform drying of beans, not to mention sorting, hand picking and bagging.

2. Export duty is only charged when coffee prices are above K£ 1000 per ton and the amount charged per ton increases as the price increases. The marketing levy of 3% is charged irrespective of the Coffee prices. Kenya coffee Vol.45, No. 530, P. 152, May 1980.

1.2. The Smallholder Coffee Sector

Coffee planting in the smallholder sector which is sometimes referred to as the Co-operative sector started in 1937. Prior to this Africans were not allowed to grow coffee or any other cash crop. The main reason behind this policy was that Africans were required to provide labour to estates which were then exclusively run by Europeans.

The general attitude existing then among the Settlers and also the Colonial Government is clearly reflected by Sir Donald Stewart's letter addressed to the Secretary of State which had this to say.

".....the question of an adequate and reliable native labour is an important one for the whole protectorate now that we are on the eve of a major colonisation movement..... To a planting community of Settlers the native labour is a most important factor of success....." (7,p.16).

It is therefore clear why Africans were not allowed to grow coffee then, though even after 1937, the growth of the smallholder sector was slow owing to the stringent control measures applied. Initial planting was only limited to 100 trees per individual and planting was restricted between 1647 metres and 1769 metres above sea level on the slopes of Mt. Kenya until 1950.

planting in a big way started after 1950 and production from this sector did not reach significant proportion until the end of 1950's (30,p. 109).

The turning point for the smallholder sector came about in 1954 when the Swynnerton Plan was published (32). According to the plan coffee was to be an important part of the planned expansion and the smallholder sector hectarage was to be increased from 1,920 hectares in 1954 to 17,408 hectares in 1963 (32,p.15). This target which looked ambitious at the time was exceeded already by 1961. At the end of 1961 already there were 17,820 hectares of coffee in the smallholder sector. (30,p.109).

To date the area under coffee in the smallholder area has increased tremendously and represents 74% of the total area under coffee in the country (11). The actual hectarage under coffee in smallholder sector amount to 89,165 and most of these are to be found in the main coffee growing areas like Meru, Nyeri, Murang'a, Kiambu, Embu, Kirinyaga, Machakos and other few districts. From 1970/71 to 1979/80 the hectarage under coffee in this sector increased from 53,800 to 71,172.

Table 1.2. Major Smallholder Coffee Producing Districts in Kenya, 1980.

District	Ha.	Production in Tonnes	% Smallscale Sector
Meru	15100	12150	100
Murang'a	9400	8000	68
Nyeri	6200	5520	81
Kiambu	6300	4850	27
Kirinyaga	5100	3850	100
Machakos	3700	3560	91
Gusii	6700	3380	100
Embu	3900	2703	100
Bungoma	3500	910	100
Others	2674	460	51

SOURCE : Coffee Board of Kenya Annual Report 1979/80 P.6

This increase was quite magnificent, but the increase in average productivity has not been as magnificent. The highest average productivity ever recorded in this sector has been 844Kg/ha. (Table 1.2). It is also worthwhile to note that the average productivity has been fluctuating from year to year. Though this fluctuation was expected, in some cases it has been decreasing instead of increasing even where there are increases in hectarage. As of 1978/79, this sector was accounting for 60% of the total coffee produced in the country while it was accounting for 74% of the total area under coffee (11,P. 7).

1.3. The Estate Sector

Coffee planting in this sector started at around 1903. Progress was quite fast and by the middle of 1930's about 38,000 hectares were under coffee and by 1935/36, production had reached 22,000 tons, and this marks the first zenith of the first phase of the industry's history. From there on the second phase was marked by a period of low prices and the coming of the second world war. The problems faced by the industry are clearly shown by the large decrease in area under coffee within this period.

Table 1.3. Area and Coffee Production in Smallholder Sector in Kenya, 1970/71 - 1979/80.

Year	Area in Ha.	Production in Tonnes Clean Coffee	Average Production Kg/ha.
1970/71	53800	26302	489
1971/72	55555	28663	510
1972/73	55309	34734	628
1973/74	55600	40864	735
1974/75	57786	35465	627
1975/76	56638	36135	638
1976/77	56600	47660	842
1977/78	56600	47744	844
1978/79	62574	41540	663
1979/80	71172	51900	729

SOURCE: Coffee Board of Kenya Annual Reports 1970/71 - 1979/80.

In 1949 the area under coffee had declined to about 24,000 hectares (30,P.107).

The third phase starting from about 1950 was a period of rehabilitation and by about 1955/56 the rehabilitation programme was paying dividends as during this period a record yield of 23,000 tons was obtained. With increased intensive cultivation and high standards of management production increased considerably though this meant production at a higher cost (30,P.109).

The area under coffee in this sector in the 1970's registered minimal increases as can be observed from table 1.4. The same thing cannot be said of the production, which has shown a slight upward trend, but the over all land productivity from this sector has been almost constant.

Table 1.4. Area and Coffee Production from the Largescale Sector in Kenya, 1970/71-1979/80.

Year	Area in ha.	Production in Tonnes Clean Coffee	Average Production Kg/ha.
1970/71	29900	28600	956
1971/72	29535	29985	1015
1972/73	29535	39043	1322
1973/74	29129	31714	1089
1974/75	28903	29985	1048
1975/76	28607	37675	1317
1976/77	27821	49685	1786
1977/78	30888	33685	1091
1978/79	29921	26809	896
1979/80	31232	39109	1252

SOURCE: Coffee Board of Kenya Annual Reports 1970/71 - 1979/80.

1.4. Problem Statement.

In all farming systems the critical problem is one of choice between many and varied enterprises. The problem of choice is due to limited resources available (10).

At the farmer's disposal are certain factors of production. The factors are land, labour, capital and his managerial ability. These four items are to a large extent influenced by climatic conditions, socio-economic and cultural factors. The choice of any enterprise has to be viewed within this broad framework.

Though it is generally accepted that productivity of factors is higher in large commercially run farms than in small fa mily farms, (20), (29), this is only a generalisation which does not give us the magnitude of these variations. The coffee industry in Kenya is made up of two sectors namely: - the estate and the smallholder sector. The two operate apart from each other and are independent of each other. Though it is generally accepted

that productivity is higher in estates than in the smallholder coffee farms the problem remains in that, of the two major factors of production at their disposal i.e. land and labour, little is known about their productivity. Besides the magnitudes with which these differences vary are not known.

Therefore this study has undertaken to determine land and labour productivity in coffee farming in the two sectors with the aim of highlighting differences by measuring them and also trying to explain why these differences occur.

1.5. Study Objectives.

This study has the following objectives.

(1) To estimate the productivity of land and labour in both sectors of the coffee industry by way of marginal value products.

(2) To explain why these differences in Productivity occur within the two sectors and how they can be rectified.

1.6. Hypotheses to be Tested.

The study proposes to test the overall hypothesis that productivity is higher in the estate sector than in the smallholder sector. The two main hypotheses to be tested are that.

(1) The productivity of land is higher in the estate sector than in the smallholder sector

(2) Similarly the productivity of labour is higher in estates.

Evidence from Tanzania indicates that where there is low use of fertilisers, fungicides etc. in coffee production, productivity of other factors is low (25). This is because these inputs do enhance the productivity of the other factors.

1.7. Area of Study.

This study was conducted in Central Province of Kenya in Kiambu District with particular reference to Ndumberi location. Central Province is the major coffee producing area in the country as shown in table 1.5. Kiambu district in that province is the leading estate district and it is ranked fourth in terms of smallholder sector coffee production[1] (11). In Kiambu district, unlike in the other coffee growing districts it is not unusual to find smallholder coffee farms bordering estates.

1. Coffee Board of Kenya Annual Report 1979/80, p6.

Table 1.5. Coffee Production in Six Provinces of Kenya 1975/76 - 1979/80.

Clean Coffee in Tonnes

YEAR / PROVINCE	1975/76	1976/77	1977/78	1978/79	1979/80
Central	52870	64663	53694	44626	61251
Eastern	15193	19734	22403	21178	20846
Rift Valley	2293	8309	2085	2077	3148
Nyanza	2276	3539	2474	3836	2395
Western	709	1031	703	1094	1178
Coast	69	69	70	77	84

SOURCE: Coffee Board of Kenya Annual Reports 1975/76 - 1979/80.

1.8. Estates and Smallholder Coffee Farms: An Overview.

As we observed earlier, the production side of the coffee industry can be divided into two distinct and separate sectors, estates and smallholders. The estate sector consists of the large commercial coffee plantations of twenty acres or more in size. A unique characteristic of the estates is that they take coffee production a stage further than the smallholder (34,p.2). The estates have their own coffee processing factories and at the same time they have their own transport. Besides, most of the operations in estates are mechanised. In the smallholder sector, the producers do not own coffee factories, or transport individually but these are owned by the society, and all the operations are done by hand.

While labour hiring is a common practice in estates, in smallholder coffee farms it is the family labour which predominates. Likewise, the two main inputs in the smallholder are land and labour. Purchased inputs like fertilizers and fungicides are minor items of expenditure. This is in contrast to the estates where such inputs are widely used.

A unique characteristic of the smallholder farms is that besides producing coffee, the farmers also engage in growing subsistence crops like maize, beans and potatoes which are used to feed the family. The excess production of these food crops may sometimes find its way to the local markets. At the same time the farmer may keep one or two cows for milk production either for his own home consumption or for sale. On the other hand, the estates are essentially monoculture except in few cases where mixed farming maybe in practice.

Finally the estates are geographically apart from the smallholdings, and this was due to their historical development. Though the two may border each other in a number of areas they are not interspersed. The estates and smallholding essentially represent two completely different cultures.

CHAPTER TWO

LITERATURE REVIEW

Literature on coffee is available widely and covers a wide range of subjects. A few relevant studies are reviewed here.

Bunyasi (1) carried out a study of labour in the Kenyan Coffee Industry which looked at the market for agricultural labour. He argues that hiring of labour is dictated by the crop diversity in the farm and so long as marginal product of labour is rising more labour is likely to be hired. He found also that there is quite a substantial hiring of labour in the coffee industry which reflects the importance of labour in coffee production. In concluding he suggests that there is a need to improve employer/employee relationship, besides increasing the wages which were found to be low. He also suggests that the amenities provided to the labourers in estates should be improved.

Waters (34) in his study of the Cost Structure of the Coffee Industry in Kenya showed that labour is the highest cost item in coffee production as it accounts for 50% of the total costs. He also showed that land was second to labour as a cost item in coffee production. He went on to delineate farmers into

high cost and low cost producers based on the opportunity cost of growing coffee compared to other crops. The policy implications of this study were that the high cost producers should opt out of coffee production and grow other crops which were shown to have better margins than coffee. It was also his contention that there is a need for crop diversification in the coffee growing areas.

Njagi (24) studied the relative productivity of some tree intensive system of coffee growing in Kenya. The study looks at the increased land productivity as a result of intensive coffee cultivation and the resulting profitability. He showed that by using the multiple stem system, a farmer could expect a return of about 57% on invested capital which is an improvement of 20% over traditional system.

This indicates that with increased tree density per unit area, land productivity is increased considerably, but this should also be accompanied by high managerial ability, coupled by enough capital outlay. The policy implication of this study were that coffee production could be increased through intensification of land use, and an increase of one and half times in coffee production per unit area would be expected.

The ultimate achievement of the system is that land productivity will be considerably increased. However, the study fails to show whether the resulting increased profitability is a result of increased land productivity or higher coffee prices.

Mbilinyi (20) did a study on the economics of peasant coffee production in Tanzania. The study covered the whole smallholder sector and looked at the productivity of the various factors used widely in coffee production by small holder sector. Using a Cobb-Douglas production function it was shown that there was a low use of labour and chemical inputs like fertilizers in the small holder coffee sector. It was also shown that land was highly responsive to coffee production. The policy implication of the study were that, to increase production there was a need for the optimal use of land and labour in order to improve their productivity. To improve on land and labour productivity he recommends intensive use of chemical inputs, manures and so forth. It is also his contention that with improved farmer training and advisory services, labour quality and productivity could greatly be enhanced.

Penny and Zulkifli (29) used value added per hectare for land, and value added per manday of labour, in their comparative study of estates and subsistence farms in Indonesia. The aim of the study was to test the general hypothesis that estates were more efficient in labour and land use compared to subsistence farms. However, the study showed that the subsistence farms were more efficient in land use compared to estates. On the other hand the estates were more efficient in labour use compared to subsistence farms. The implications were that for a country, trying to achieve self sufficiency in food production, production of high value of food crops per hectare than estates is more important for the country.

FAO (33), in their study conducted in Colombia on Coffee productivity and future prospects, it was shown that relationship exists between labour input and farm size. Diminishing labour productivity is associated with small farm sizes. It is argued that this is due to increased labour use at harvesting thus lowering over all labour productivity. However, it is also argued that the greater the labour input (as it constitutes such an important factor in coffee cultivation) so far as the law of diminishing returns allows and assuming other factors to be equal, the higher will be the total yield.

Maitha (17) studied coffee in the Kenyan economy. His study indicated that there was a strong relationship between coffee prices and productivity. He showed that both small holder and estates coffee farmers were responsive to price increases. When prices are high farmers respond by increasing productivity in the short run and in the long run more hectares are brought under the crop. The policy implications of study were that coffee supposedly a plantation crop need not be planted on a large scale to be profitable. He advocates the sub-division of estates into small units. However, such a policy should be viewed cautiously under the current situation where estates seem to be doing better than the small holder sector (11,p3).[1] Besides where estates have been bought by co-operatives no sub-division has been done, rather the farms are run as a unit for the benefit of the members.

A closer look at the studies reviewed indicate that coffee has been a subject of much interest to scholars. However, we feel that labour and land productivity here in Kenya has not received the attention it deserves.

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1) Coffee Board of Kenya Annual Report 1979/80

CHAPTER THREE

METHODOLOGY

3.1. SAMPLES AND SAMPLING TECHNIQUE.

The time reference for this study was from 1st March 1979 to 28th February 1980 which is one calender year. The choice of the period was to alarge extent influenced by the crop pattern. Normally, estates run their crop year from October to September of the year following, whereas their financial year runs from April to March of the following year. To strike a balance and not to miss any crop harvested within any one year the period specified above was considered appropriate. This is because the main crop harvest ends sometimes in December/January and sometimes extends to February, and there is a rest period of about two months. The next crop picking begins sometimes in late April or May and continues up to December or January. Hence the choice of this period.

The sample for the smallholder sector farms was selected from one society namely Ndumberi Coffee Society, which was in the location of the study. The society had 1,247 members out of which only 992 members were active members.

By active members it is meant that these were the farmers (members) delivering coffee to the society's factory for processing during the material time. The balance of 255 members were inactive in the sense that they were not delivering their coffee to the Society. There is a possibility that their coffee was newly planted and such it had not come to maturity. This was not surprising because there were alot of new planting after the coffee boom of 1976/77.

Bearing this in mind, it was decided to pick the sample from the population of active members. The population of active members was listed first, and it is from this population that, thirty farmers were selected randomly, using random number tables.

For the estates sector, three farms were selected using a similar method as above. The population of estates in the location consisted of twelve farms. The reason behind the choice of such a small sample in case of estates was that it was clear from the onset that not much difference would be observed from the estates irrespective of the number of farms selected.[1]

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1. In the area of study, of the total twelve farms, 10 farms were being run on behalf of the owners by one estate management company and as such not much difference was expected. Hence the choice of such a small sample.

3.2. Data Collection

Each small holder farmer selected was visited individually and the household head was interviewed using a pre-designed questionnaire(See appendix 1). Normally the man is the household head though it was found necessary to interview them together with the wife. The reason being that it is the wife who is involved in running the farm on a day to day basis. In case of estates the same procedure was followed, though in this case it was the managers who provided the information. However, to gather all the information required from the estate it took more than one day and even up to a week. In both cases, all the questions asked related to mature coffee enterprise.[1]

3.3. Data Collection Problems

A few problems were experienced in data collection, but this was expected. According to Norman (27) and Collinson (3) there are wide and varied problems in collection of farm management data.

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1. For the purposes of this study mature coffee was taken as that coffee which had been harvested at least for four seasons, or that coffee which was at least seven years old.

The first problem was related to obtaining reliable input and output data for coffee. Since the smallholder farmers kept no records, this information was not easy to get. To overcome this problem the author had to rely on the society where farmers collected their inputs like fertilizers, fungicides etc. and also delivered their coffee. Proper records of inputs and deliveries of coffee were kept at the society offices.

Another problem experienced was in obtaining reliable labour input data. Since again the smallholder farmers kept no records of labour input into coffee except in very few cases, it was hard to get this information. Where no information was forthcoming the author had to estimate labour inputs after measuring the size of the mature coffee plot. Labour inputs were then estimated using the district guidelines from Ministry of Agriculture (12).[1]

However, all these problems should not be viewed as insurmountable and as such should not lower the credibility of the data collected.

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1) Though the District Guidelines are an annual publication, the basic labour data is the same from year to year. However, prices for various inputs e.g. fertilizers do change depending on price increases.

3.4. Methods of Analysis

Having looked at data collection and the problems encountered, it is only fair now to state the methods used for data analysis. To achieve the two objectives stated inter-alia, two methods of analysis were used. The two methods are residual accounting and regression analysis. These two analytical tools have been used elsewhere e.g. residual accounting has been used to determine land rents by Clarke (2). In our case the method is extended further to cover labour besides land. This tool is used to analyse data from both sectors, and it provides the basis for productivity comparison.

Regression analysis is a tool which has been used widely in socio-economic studies (17), (21), (35), (20). This analytical tool was used only on data from smallholder farms. It could not be used on data from estates as the sample was too small for this kind of analysis. The tool provides the basis for explaining the observed differences between the two sectors.

3.4.1. Residual Accounting Models.

This method can be used and is used in this content to estimate "residual" income to land and labour. The use of this method assumes that the other factors are being rewarded or remunerated in accordance with their marginal productivity and that there are no substantial economies of scale and therefore the average return to land or labour should approximate to the marginal though under most circumstances this is not always the case (2,P.58)

Clarke (2,p.15) also points out that average and marginal productivities of land are very closely bound up with the extent of the inputs of other factors, and not only with the quantities of these other inputs (mainly labour) but also with their prices. This clearly indicates that the average and marginal productivities of land will be to a large extent influenced by other inputs. Low use of other inputs e.g. labour, means the average and marginal productivities would be expected to be low. It should also be made clear that this method was first and foremost developed for residual or rent for land. In our case however it is extended to cover labour as well. The model

is slightly modified from the original Clarke's model, and the models used for deriving marginal value products for land and labour are specified below.

(a) Model for Land: This is specified as follows:

Value of Gross Output - Expenditure on purchased inputs[2]

Total Factor Income

Minus Cost of Permanent Labour

" Cost of Casual Labour

" Management Cost (Estates)

" Family Labour Cost (Smallholder).

= Return to Land and Capital

Minus Capital Cost (Depreciation and interest on capital).

= Return to Land

Return/Hectare = $\frac{\text{Return to Land}}{\text{Total Hectarage}}$ = "MVP"[3] for Land

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2. Purchased inputs in this case refer to things like fungicides, fertilizers, herbicides, insecticides and so forth.

3. According to the assumption of the model the average product can be approximated to the marginal.

The model used for derivation of marginal products for labour is specified below:

(b) Model for labour

Value of Gross Output - Expenditure on Purchased Inputs[4]

= Total Farm Income

Minus Opportunity Cost of Average Fixed Capital Investment

= Labour Earnings

Minus Perquisites[5] (In smallholder where applicable)

Minus Management Cost (Estates)

= Return to Labour (Manual)

Return/Man-day = Return to Labour (Manual)

Total Mandays Expended

= "MVP" for Labour

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4. Same as in page 29.

5. Refers to payments in kind e.g. gifts if any.

In using this model for the derivation of the marginal products for both land and labour in both sectors, the following working assumptions were made.

(i) It was assumed that the cost of capital (opportunity cost of capital) was 9% p.a. This figure was arrived at from the on going interest rates in the banks during the material time. For an ordinary saving account the interest rate is 6% p.a. and for a fixed deposit account it is about 12% p.a. It was assumed that the average of these two i.e. 9% will be a more representative figure for the opportunity cost of capital at farm level. However, this figure is debatable considering that there are many and varied alternatives open to the farmer to invest his money.

(ii) In both cases i.e. estates and smallholder for depreciation purposes, straight line depreciation was used. Mostly this was only applicable in the estates sector where there were a lot of equipment as opposed to smallholder sector where equipment were almost nil.

(iii) In case of model (a) for land, it was assumed that the opportunity cost of family labour was equivalent to that of hired, labour who were being paid Kshs. 10.00 per Manday[1]. This figure was assumed also to be the opportunity cost of family labour per each man-day worked. Like in the above case again this assumption is also debatable considering that the farmer may not be employed full time.

(iv) The value of a mature coffee tree was assumed to be Kshs 20.00 per stump. This was the value reported by most farmers and was used in all calculations.

(v) For land valuation purpose two values were adopted. These were reported values by farmers, and the other figures were those figures assessed as reflecting the true market value of land. In case of smallholder sector the values used were Kshs 98,800 per hectare which were the reported values by the farmers and Kshs 29,640 per hectare which was assessed as close to the true market value of land in the smallholder.[2]

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1. The figure of Ksh. 10.00 per manday was obtained during the cause of the survey. This was the wage per day's work.

2. The figure of Kshs 29,640, was arrived at after some discussions with Mr. S.B.C. Njagi who was a Valuer with Ministry of Lands and Settlement for 8 years.

3.4.2. Regression Analysis

3.4.2.1. The Model

To study the inter-relationship between the various inputs used in coffee production in smallholder sector, regression analysis was used. The basic aim in using this method was to assess the productivity of the various inputs or in other words assess their relative contribution to the total yield. For the assessment of the productivity of these factors the Cobb-Douglas function was employed. This function has been used extensively in socio-science research work to estimate the marginal productivity of given factors and it can be written as:

$$Y = A\ X_1^{B}1\ X_2^{B2}\ldots\ldots\ldots\ldots\ldots\ldots X_n^{B}n + e \ldots\ldots (1)$$

Where Y is the gross output

A is a constant.

$X_1 \ldots\ldots\ldots X_n$ are input factors

$B_1 \ldots\ldots\ldots B_n$ are regression co-efficients (i.e. elasticities of production)

e is the error term.

The function allows for either constant, increasing or decreasing returns to scale depending on whether the sum of the co-efficients is one or more than one or less than one respectively.

The function can be transformed into the logarithms and the equation linearized. The logarithmic form is as shown below:-

$$\text{Ln } Y = \text{Ln } A + \sum_{i=I}^{n} B_i \text{ Ln } X_i + e \quad \ldots\ldots\ldots\ldots\ldots\ldots 2$$

The regression co-efficients B_1 - Bn derived from the logarithmic form are the production elasticities of the individual resources (4).

3.4.2.2. Specification of the Model

The model was standardized by dividing through with land and labour.

The standardization subjected the results to per hectare and per man-day basis. The standardized Cobb-Douglas function is as shown below:

$$\text{Ln } (Y/L) = \text{LnA} + B_1 \text{ Ln } (X_1/L) + \text{---} B_n \text{ Ln } (X_n/L) + e \ldots\ldots 3$$

$$\text{Ln } (Y/L) = \text{LnA} + \sum_{i=1}^{n} B_i \text{ Ln } (X_i/L) + e \quad \ldots\ldots\ldots\ldots\ldots 4$$

Where $Y/_L$ is a gross value of production divided by land.

(L) is land

A is a constant

$X_{1/L}$.....$X_n/_L$ are input factors divided by land.

B_1 .....B_n are regression co-efficients

e is the error term.

Similar standardization was done with labour. These two models for land and labour were named E_1 and E_2 respectively

The standardization serves the purpose of reducing the multicollinearity among the independent variables and this improves the efficiency of estimation (31).

3.5. Definition of Variables Used in the Models.

To justify the inclusion of the variables in the models, zero order correlation matrices were run in the computer. The aim of these matrices was to show the interrelationship between the independent (explanatory) and the dependent variables.

The correlation between the independent variables was tested at 5% level of significance. Since no significant correlation was observed between them, they were all included in the models.

The variables used in the model were as follows.

(i) Output of Coffee in Kilogrammes (Y) - This was the total amount of coffee produced from the mature coffee trees during the period specified. The quantity was in kilogrammes cherry delivered to the factory for processing and subsequently to be sold as parchment coffee by the society on behalf of the farmer. In some cases the farmers had delivered Mbuni,[1] instead of wet cherry. In such cases since the quantities were quite small (in almost all cases not exceeding 20Kg), they were regarded for the purposes of this study to be the same as wet cherry.

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1. Mbuni is coffee which has been dried by "dry processing". This involves two methods. Firstly the coffee can be picked as ripe cherry and then dried in the sun. The second method is where the cherries are left to dry out in the field; they are collected from the trees and from the ground. Coffee dried by the former method is more superior on quality than that dried with the latter method though both are referred to as Mbuni.

(ii) Labour Input - Labour was converted into man-days which included both children labour, family adult labour and hired labour. For weighting purposes children above 15yrs. of age were considered to be adults. Children between 8 yrs. to 15yrs. were allocated a value of 0.5 man equivalent. Women above 15yrs. were equated to 0.75 man-equivalent whereas males above 15yrs. were taken as equal to one man equivalent. The upper limit was not defined as the majority of farmers were less than 55 years of age at which it was assumed they would still be able to do a day's work. Others have differentiated age and sex along the same lines; (20,5,26) but there seems to be no general consensus on age groups. Labour being one of the important factors of production it is expected that the co-efficient will be positive.

(iii) Value of Fertilizer - This was the amount of fertilizer used on mature coffee during the period of study. The quantities were first identified though the commonest fertilizer in use among the sample farmers was Calcium Ammonium Nitrate (C.A.N.).

Few cases of Diammonium Phosphate (DAP) were also noted. Irrespective of whether one or both were used, the quantities used were converted into money value. The price charged at the society for fertilizer was used. Coffee has been shown to respond to fertilizer application (31) and as such we expect the co-efficient of fertilizer will be positive.

(iv) Value of Fungicides - It was observed that the farmers were using different types of fungicides, though copper based fungicides were in commonest use. Other fungicides in use were Captafol (Ortho-Difolatan), Delan, Benlate and two cases of Bravo 6F. It would have been almost impossible to enter each of these fungicides as a separate variable in the model. Thus, the number of times each was used by a certain farmer were noted and the respective quantities. These were converted to their money value which was the figure entered in the model. Fungicides are important for control of diseases in coffee and their non-use can mean considerable loses. Thus, it is expected that the co-efficient will be positive.

(V) Value of Herbicides and Insecticides used: These two were lumped together as one variable as the quantities used were relatively small. Furthermore the normal recommendation from Coffee Research Foundation (C.R.F.), is that insecticides should not be used routinely (13). For herbicides, if the recommendations are followed the number of applications should not exceed six (15). Their use has not caught up yet though they have been shown to be cheaper to use than hand weeding and besides allow for releasing of labour (9). This labour could be used for other operations in the food crops (see labour conflicts in Table 4.4.). The respective quantities were noted and converted to their money value, which is used in the model. It is expected that the co-efficient for this variable could be positive.

(VI) Manure - Among the sample farmers there was a widespread use of manure mainly cattle manure. The manure used on mature coffee for the period of inquiry was converted into Kilogrammes (Kgs) nitrogen equivalent. According to Mehlich (22), one debe (tin) of manure varies in weight from 5.45 to 6.8Kgs.

Besides he also goes on to say that one debe supplies about 97 to 121 grammes (gm) of nitrogen. The average of the latter figures i.e. (97 + 121) gm = 109gm., was used as the average contribution of a debe containing on average 6Kg. of manure. Using this figure it was possible to convert the amount of manure used into Kilogrammes nitrogen equivalent. Except for the nutrient composition manures are similar in a way to chemical fertilizers. In this case we should expect the co-efficient to have a positive value like that of fertilizers.

(VII) Land refers to land under mature coffee in hectares during the study period, and it was entered that way in the model. Land being one of the traditional factors of production without which little or no production can occur, it is expected that its co-efficient will be positive.

CHAPTER FOUR.

RESULTS AND DISCUSSION

4.0. Residual Accounting Based Marginal Value Products For Land and Labour.

In this chapter the overall analytical results are presented and discussed. In this first part the marginal value products (MVPs) for both Land and Labour derived from residual accounting method for both sectors are presented starting with those of smallholder sector. However, before the results of these residual accounting based marginal productivities are discussed it is only proper to highlight the limitations of this model.

Residual accounting model has been criticised, firstly due to the fact that the information obtained is general and often is not enough to enable the situation to be remedied.

The second criticism is that the procedure has very limited value for interfarm comparisons (28). Other problems

associated with the use of this procedure are in the choice of the interest rate to be used. In all cases the interest rate used will influence the derived MVPs. Normally it is quite hard to come up with the most appropriate interest rate on capital especially that which is invested in the farm, bearing in mind that there are all sorts of opportunities open for investing that capital.

Another thing that has to be borne in mind is that the results obtained from residual accounting relate to the average, though under certain assumptions we approximate them to the marginal. In the light of all these limitations associated with this model, it is only fair that the results are interpreted cautiously, but this does not mean that the results are not relevant.

4.1. Marginal Value Products for Land- Smallholder Coffee Farms.

The marginal value products for land for all the sample farms were worked out and these are presented in table 4.1. The results indicate a wide variation between farms as was expected.

The farms with lowest MVPs for land indicate negative productivities of minus Kshs 2463.30 and Kshs 301.80 respectively. The highest MVP stands at Ksh 14247.80 per hectare of mature coffee. The farms with negative productivity indicate that the farmers could be better-off not growing coffee. This is because for every hectare that they bring under coffee, they would be losing Kshs. 2463.30 and Kshs 301.80 respectively, given their level of operation. In an attempt to explain why the two farmers are still growing Coffee, it is possible that they view it as a security crop, which may not pay this year but could pay in the next. It was also observed that most of the inputs applied were in the form of insecticides which as we shall observe later do not really contribute significantly to increased yield. Another possible explanation is that the amount of labour input could have been inflated. Over all it can be concluded that they are not utilising their land optimally.

The positive MVPs indicate that the farmers are not operating below costs. For example, the farm with the highest MVP of Kshs 14247.80, indicates that the farmer would get that much for any extra hectare that he brings under mature coffee.

For an optimal situation, theory tells us that MVPx = Px i.e. marginal value product of factor X should be equal to the prices of X. If we assume that the price of land is as we had assessed at Kshs 29,640 per hectare, it would appear that none of the coffee land in our sample was being used optimally. However, we cannot rule our the possibility that the MVPs calculated could as well be more representative of land productivity at farm level. The mean MVP of our sample was Kshs 4677.70 per hectare of mature coffee. It is apparent that the market land values as reported by farmers bears no relationship to the relatively low shadow prices (MVPs) of land in the smallholder coffee farms. The land values as reported and assessed were Kshs 98,800 and Kshs 29,640 respectively per hectare. In the first case the shadow price is only about one twentieth of the value while in the second case it is one sixthieth of the value. Waters (34,pp.131-132) points out that land values in Kenya are subject to considerable non-market forces and as such it is not surprising that land whose shadow price is low goes for about six or twenty times its value. Besides since 1976/77 coffee boom, when coffee prices rocketed to well over K£3000 a tonne, the market value for land in the coffee areas has become so speculative that productivity is hardly taken or considered as a criterion when selling it.

The big divergence between the values used in the calculation and the calculated MVP's for land indicates that there is an anomaly somewhere. In our sample farms the level of purchased inputs e.g. fertilizers, fungicides etc. was low with expenditure standing at Kshs 1046 per hectare. Work carried out by Njagi (24) indicates that one needs to spend about Kshs 4840[1] on coffee inputs per hectare excluding labour. This indicates that our farmers were spending only about one fifth of the recommended levels of inputs as opposed to the full dose of the recommendation. It is possible then to assume that the low productivity of land in the smallholder farms could be a result of the low use of the purchased inputs like fertilizers, fungicides and so forth.

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1. Njagi was using 1978 prices. The prices have now increased considerably and as such the expenditure on purchased inputs per hectare have also increased.

4.1.1. Marginal Value Products for Labour - Smallholder Coffee Farms.

Marginal value products for labour are presented in tables 4.2. and 4.3. (See Appendix 4). The MVPs were calculated on two basis i.e. using the reported value for land by farmers and in the second case using land value based on market assessment. It was observed that when MVPs were calculated using the land value as reported by farmers, the MVPs were generally lower, than when the assessed market value for land was used in the calculation. However, the differences were not all that big. Nevertheless, this does indicate that the MVPs calculated will be influenced to a certain extent by the value of land used in the calculation. The higher the value of land the lower the MVP and vice-versa. This may be due to the fact that the higher land value as reported by farmers may be higher than the opportunity cost of land and as such some of the labour's contribution to production is attributed to land, hence the lower values.

Where higher land value is used the mean MVP for labour was found to be Kshs 16.00 per man day, whereas when market value was used the MVP was found to be Kshs 23.10 per manday. The wage rate during the period of study was Kshs 10.00 per manday. This indicates that the MVP, which is also the shadow price of labour is higher than the wage rate or the price paid to labour. In assence what our results indicate is that the on going wage rate at the time of the study was lower than the calculated shadow price for labour. While one can easily recommend an increase in the wages in order to equate it to the MVP on a purely theoretical basis, it would be appopriate first to analyse critically what has led to that kind of situation.

In our case only coffee was considered, though it was not the only crop being grown by the farmers. Besides coffee, they were also growing subsistence crops like maize, beans and potatoes. Specifically looking at the area of study, the calculated land: labour ratio of 0.32:1 for the smallholder coffee farms can be said to be low. However, it should be pointed out that this included all the labour on the farm irrespective of its contribution to the production process. On close observation, it was found out that the bulk of the labour that went in to the farm i.e. including coffee and all the other enterprises was generally provided by women.

Taking into account that women are also involved in other household chores there is a cause to believe that additional mandays would increase the average labour productivity, per unit of input. In the light of this it can be concluded that most of the smallholder coffee farmers could be operating in stage 1 of production. As such more labour would be called for to increase over all productivity.

Another thing that we cannot forget is that besides coffee those farmers were growing other crops like maize, beans and potatoes, which were making demands from the same labour. Certain operations in coffee and food crops do overlap as it can be observed from table 4.4. Considering that coffee payment is not regular unlike in tea where farmers are paid monthly, it is possible that the farmers will strive first and foremost to satisfy their subsistence needs and this will be done at the expenses of the cash crop (Coffee). It is likely that the overall farm productivity could be increased with more labour in the smallholder coffee sector. This would help the farmer distribute his labour more equitably in order to overcome the labour constraints indicated in table 4.4.

Table 4.4. Timing of Various Labour Operations in Coffee and Food Crops in Smallholder Farms, Kiambu, 1979/80.

CROP	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
Coffee	Hav. Pru.	Pru. Spr.	Spr.	Weed Spr. Har.	Spr. Har. Fer Han	Spr Har.	Spr.	Har.	Spr. Fer	Spr. Har.	Har.	Har
Maize	L/P	L/P	Pla. Har	Weed	-	Weed	-	L/P	Hav. L/P	Pla	Weed	Weed
Bananas	Har L/P	L/P	Pla.	Weed	-	Har	-	L/P	L/P	Pla.	Weed	-
Potatoes	Har L/P	L/P	Pla.	Weed	-	Har	-	L/P	L/P	Pla.	Weed	-

SOURCE: Survey Data 1979/80.

K E Y.

Land Preparation .....L/P
Planting ---------- Pla.
Harveting -------- Har.

Spraying ----- Spr.
Weeding ----- Weed
Handling ----- Han.

Pruning --- Pru.
Fertiliser, Application-----Fer.

This should be more so in those months that labour operations in coffee are in direct conflict with those of food crops.

4.2. Marginal Value Products for Land-Estates.

The calculated MVPs for land in estates are presented in table 4.5. The smallness of the sample cannot allow too much room for generalisation but the results can be taken as indicative of general land productivity in the estate sector despite all the limitation mentioned earlier. The mean MVP at Kshs 25,246.00 per hectare is less than half the reported prices by the farm owners thus indicating that the calculated shadow price of land is far much lower. The reported sale price was Kshs. 61,750.00 per hectare. To understand the low productivity compared to the value attached to land, there is a need to understand that land has been a centre of controversy

Table 4.5. Marginal Value Products for Land in Estates, with Management Partially Accounted for, Kiambu, 1979/80

I	2	3	4	5	6	7	8	9	10
A Farm	Area under mature Coffee ha	Production Tons Clean Coffee	Revenue Value of Output @ 26,000/per Ton Kshs	Cost of Inputs Kshs	Cost of Labour and Management Kshs	Capital cost (1) Kshs	Total costs (5+6+7) Kshs	Return to Land Kshs	MVP for Land per hectare Kshs
A	79.75	195	5070000.00	636346.20	856172.50	326073.40	1818592.10	3521407.90	40770.00
B	52.63	81.70	2242000.00	404749.15	627719.50	206435.40	1238904.05	1003295.95	19063.00
C	101.57	137.80	3582800.00	783270.90	839725.90	344276.10	1967272.90	1615527.10	15905.00
								Mean	25246.00

SOURCE: Survey Data 1979/80.

1) Capital Costs include; depreciation and interest on Capital

here in Kenya. According to Mellor (23,P.179), there are few satisfactory alternatives to land as an instrument of earning against future financial crises. He goes on to say that the consequences of land relative desirability as an investment of saving drives land prices to levels which provide low rates of return under existing conditions of technology. This then to alarge extent explains why land prices are normally higher than the actual productivity of that land.

In Kenya this general thesis as presented by Mellor is applicable, as good land is a rare commodity and with the increasing population at an alarming rate of about 4% per annum, then the unit land holding per head is decreasing considerably. In view of this observation land prices are bound to be higher than the actual productivity of that land.

The calculated MVPs were worked out with management cost taken as the cost of paying the manager and the supervisory cadre of staff. If these are viewed as the management cost they may not reflect the true cost of management per se. It was observed that the managers were normally under paid. To avoid this bias and get a more realistic picture of the situation, management was taken as being equal to 13% of the net return[2].

2. Net return in this case refers to total revenue minus the cost of inputs and manual labour costs.

The figure was derived from Njagi's work (24,P.44). and Waters (34,p.214-217). Njagi gives management cost as accounting for 37% of the fixed costs, and according to him, fixed costs account for 30-35% in the total production cost. In this case management would account for 11.1% - 13% in the total production cost. Figures derived from Waters study show that management accounts for about 11.5%. Figures from both authors seem to support each other. For this reason the 13% figure representing the upper limit was used in re-calculating the marginal value products and the area presented in table 4.6.

Comparing the mean MVPs from tables 4.5. and 4.6., it can be seen that when management is not fully accounted for, the mean MVP is slightly higher in table 4.5. by about 12%. This indicates that when management is not fully accounted for, some of the management's contribution is attributed to land. This bias would lead to overall wrong conclusions.

Table 4.6. Marginal Value Products for Land in Estates with Management Fully Accounted For, Kiambu, 1979/80.

I	2	3	4	5	6	7	8	9	10
Farm	Area Under mature Coffee ha.	Production Clean Coffee Tons	Revenue Value of Output @ 26,000/per Tons Kshs	Cost of Inputs Kshs	Cost of Labour and Management (1) Kshs	Capital Costs Kshs	Total cost (5+6+7) Kshs	Return to Land Kshs	MVP for Land/ Hectare Kshs
A	79.75	195	5070000.00	636346.20	1247817.10	326073.40	2210236.70	2859763.30	35857.80
B	52.63	81.70	2242000.00	404749.15	739744.60	206435.40	1350929.10	891280.85	16934.65
C	101.57	137.80	3582800.	783270.90	1005760.30	344276.10	2133307.30	1449492.70	14270.90
							Mean		22354.45

SOURCE: Survey Data 1979/80

1) In order to calculate this column, a co-efficient was derived from Njagi's work (24) and Waters (34).

4.2.1. Marginal Value Products for Labour-Estates.

The MVPs for labour were calculated on two basis i.e. with land values as reported and management cost as reported and with management taken at cost. In the second case the MVPs were calculated using what was assessed as the market value of land and management at the two levels as above. The results are as shown in tables 4.7. and 4.8.

The figures as can be observed indicate a high productivity of labour[3] in estates. Unlike in the smallholder farms where labour may be idle during off-peak periods if only coffee was being cultivated, in estates there is enough work to keep the labourers busy throughout the year. Here we should make a distinction between the two categories of labour i.e. permanent and casuals. The permanent labourers are those residing on the farm throughout the year and are employed on a permanent basis. The casual as the word suggests are hired only when there is too much work that permanent labourers cannot be able to copeup with. On the other hand the results of labour productivity with the lower value for land are higher than those shown in table 4.7. and 4.8. The results using the lower value for land are as shown in tables 4.9. and 4.10.

3. This refers only to manual labour.

Table 4.7. Marginal Value Products for Labour in Estates with management Partially Accounted for and Land Value as Reported, Kiambu, 1979/80.

I	2	3	4	5	6	7	8	9	10	11
Farm	Area Under mature Coffee ha.	Production Clean Coffee Ton	Revernue Value of Output @ 26,000/per Ton Kshs	Cost of Inputs Kshs	Management Cost (1) Kshs	Opportunity Cost of Average Fixed Capital Investment Kshs	Total Costs (5+6+7+) Kshs	Return to Labour Kshs	Total Mandays Spent	MVP for Labour/ Manday Kshs
A	79.75	195	5,070,000.00	636,346.20	84,400.00	417,888.70	1,138,634.90	3,931,365.10	36660	109.20
B	52.63	81.70	2,242,000.00	404,749.15	52,000.00	337,641.40	794,390.55	1,447,809.40	16032	90.30
C	101.57	137.80	3,582,800.00	783,270.90	102,000.00	484,865.55	1,307,136.40	2,212,663.50	36117	61.30
								Mean		86.25

SOURCE: Survey Data 1979/80

1. Only management Cost is reflected here, and the same applies to table 4.8, 4.9.and 4.10. The MVPs calculated are for the manual labourers.

Table 4.8. Marginal Value Products for Labour in Estates With Management Fully Accounted for and Land Values as Reported, Kiambu, 1979/80.

I	2	3	4	5	6	7	8	9	10	11
Farm	Area Under Mature Coffee ha	Production Clean Coffee Tons	Revenue Value of Output @ 26,000/per Ton Kshs	Cost of Inputs Kshs	Management Cost Kshs	Opportunity Cost of Average Fixed Capital Investment Kshs	Total Costs (5+6+7) Kshs	Return to Labour Kshs	Total Mandays Spent	MVP for Labour/ Manday Kshs
A	79.75	195	5,070,000.00	636,346.00	476,044.60	417,888.70	1,530,279.50	3,539,720.00	36660	96.55
B	52.63	81.70	2,242,000.00	404,749.15	164,025.10	337,641.40	906,415.65	1,335,784.30	16032	83.30
C	101.57	137.80	3,582,000.00	783,270,90	268,034.50	484,865.55	1,536,170.90	2,044,629.10	36117	56.65
								MEAN		78.80

SOURCE: Survey Data 1979/80

The results in the second case were slightly higher though this was expected due to the lower value which was attached to land, i.e. Kshs 17290 per hectare. From tables 4.9 and 4.10, we can see that there is quite a big difference between the wage rate and the calculated shadow prices for labour. The mean MVP stands at Kshs 70.00 per manday while the wage rate stands at Kshs 10.00 per manday, we can only assume or conclude that labour was being under paid. This simply means that labour is not being remunerated according to its productivity. However, although Bunyasi (1) points out that other amenities provided to labourers in estates are minimal, it would be worthwhule to look at the other side of the coin i.e. the labour supply and its opportunity cost and also the fact that wages are institutionally fixed.

Though our calculated MVPs do differ greatly from the wage rate, normally the wages to be paid to the various categories of labourers in estates is discussed and fixed for a period of two year between the Kenya Coffee Growers Association and the Trade Unions. However, the only thing which is not clear, is the factors that are taken into consideration in fixing the minimum wage rate for the labourers. On the supply side, it is known that labour is normally a constraint and especially during harvesting time (6). But this cannot be attributed only to lack of labour, but rather to the general distaste for manual work. It is unlikely

Table 4.9 . Marginal Value Products for Labour in Estates With Management Partially Accounted for and Land at Market Value, Kiambu,1979/80.

1	2	3	4	5	6	7	8	9	10	11
FARM	Area under mature coffee ha	Production Tons Clean Coffee	Revenue: Value of Output @ Kshs 26000 per Ton. Kshs	Cost of Inputs Kshs	Management Cost Kshs	Opportunity Cost of Average Fixed Capital Investment Kshs	Total costs (5+6+7) Kshs	Return to Labour Kshs	Total Mandays Spent.	MVP for Labour/ Manday
A	79.75	195	5070000	636346.20	84,400	258335.50	979081.70	4090918.30	36660	111.60
B	52.63	81.70	2242200	404749.15	52,000	183761.70	640510.85	1601689.15	16032	99.90
C	101.57	137.80	3582800	783270.90	102,000	220663.35	1105934.25	2476865.75	36117	68.60
								Mean		94.35

SOURCE: Survey Data 1979/80.

Table 4.10. Marginal Value Products for Labour in Estates With Management Accounted for and Land Values at Market Value, Kiambu 1979/80

1	2	3	4	5	6	7	8	9	10	11
Farm	Area under mature coffee ha.	Production Tons: Clean Coffee	Revenue Value of Output @ 26,000/Ton Kshs	Cost of Inputs Kshs	Management cost Kshs	Opportunity Cost of Average Fixed Capital Investment Kshs	Total Costs (5+6+7) Kshs	Return to Labour Kshs	Total Man-days Spent	MVP for Labour per Manday Kshs
A	79.75	195	5070000	636346.20	476044.60	258335.50	1370726.30	3699273.70	36660	100.90
B	52.63	81.70	2242200	404749.15	164025.10	183761.70	752535.75	1489664.05	16032	92.90
C	101.57	137.80	3582000	783270.90	268034.50	220663.35	1271968.75	2310831.25	36117	64.00
								Mean		85.90

SOURCE: Survey Data 1979/80

that the opportunity cost of labour would be higher than the wage rate given the fact that alternative employment in other sectors is not readily available. However, though most of the operations in coffee are amenable to mechanisation there are certain crucial operations like pruning and harvesting which can only be done by hand. Although the interests of the estate owners have to be taken into consideration and the risks they are exposed to, given our calculated MVPs it can still be argued that labour is underpaid.

4.3. Regression Based Marginal Value Products For Land and Labour in Smallholder Coffee Farms.

The main aim of using the regression model was to assess the use of other factors besides land and labour in the smallholder coffee farms. The results of the two regressions in this case using the Cobb-Douglas production function besides showing productivity of land and labour will also show the productivity of the other factors and at the same time show which factors need intensification in order to increase productivity in the smallholder sector.

Before embarking on the interpretation of the regressions it would be in order to point out some of the limitations or criticisms of the Cobb-Douglas function. Firstly, the function cannot be satisfactorily used for data where there are ranges of both increasing and decreasing marginal returns. Secondly, it cannot be used satisfactorily for data which might have both positive and negative marginal products. Thirdly, the maximum product is never defined in a Cobb-Douglas function. Lastly; unless an economic optimum is defined for small magnitudes of inputs the function may overestimate the input X which equates marginal revenue to marginal cost (4).

The function has the advantage in that the regressian co-efficients immediately give the elasticities of production which are independent of unit of measurement. In the interpretation of the results, these factors should all be borne in mind.

4.3.1. Regression Results for Labour and Other Variables

The results computed for labour and other variable, using the standardised model E_1 are presented in table 4.11.

The value of R^2 (o.60) shows reasonable fit of the Cobb-Douglas function. This indicates that the independent variables explain 60% of the variation.

All the Beta (B) coefficients for the variables are positive as was expected though none is significant at 5% level of significance. However, at 10% level, labour, fertilizer and fungicides are significant. The co-efficient for use of labour indicates that an additional one manday per hectare would result in 0.74 per cent increase in yield. According to Massel (18) the marginal productivity can be calculated from the estimated elasticities. The marginal productivity of a factor k in producing crop i is denoted by fk_i and is given by:

$$fk_i = E_{K_i} \frac{Yi}{X_{K_i}} \qquad \text{.....(1)}$$

Where E_{K_i} = Elasticity of factor k in producing crop i.

Yi = The output of crop i.

X_{K_i} = The amount of input k used in producing crop i.

Table 4.11. Production Elasticities For Labour and Other Variables in Smallholder Coffee Farms in Kiambu, 1979/80.

Variables	Constant	Labour X_1	Fertilizer X_2	Fungicides X_3	Herbicides and Insecticides X_4	Manure X_5
Regression Co-efficient	0.28	0.74	0.28	0.20	0.06	0.07
Standard Error (1)	0.26	0.39	0.20	0.15	0.18	0.33
t - Values	0.11	1.65	1.38	1.33	0.32	0.22
Variables Significant at 5% level *	-	-	-	-	-	-
Variable Significant at 10% level *	-	*	*	*	-	-
No. of Observation (n)	30					
Degrees of Freedom	24					
R^2	0.60					

SOURCE: Compiled From Survey Data and X DS3 Computer Printout.

1) For Explanation on multicollinearity see Appendix 3.

Using this formula the marginal product for labour was calculated and this was found to be 7.38Kg of cherry per manday. To obtain the marginal value product for labour, the marginal product was multiplied by the price of coffee at the material time which was Kshs 3.70 per Kg. Cherry. Hence the calculated marginal value product was Kshs 27.30 per manday of labour expended into a hectare.

In estimating marginal productivities most studies have used the geometric mean, (36), (19), (35). Owing to its widespread use this study also employed the geometric mean in the calculation of marginal products.

Comparing the results obtained from residual accounting method which were Kshs 16.00 and Kshs 23.10 at the lower and the higher end, the figures do not seem to be all that different, from that estimated from regressions. Looking at the figure from regression, it means that there is still more room to improve labour productivity in the smallholder sector. According to theory the marginal value product of a factor would be equal to its price of the resources are allocated efficiently. Where there is a divergence between the marginal value product and its marginal factor cost (price), this is taken as evidence of

inefficient resource use. In that case then we can say that there is an inefficient use of resource labour because its marginal value product differs from its price which stands at Kshs 10.00 per manday compared to its MVP of Kshs 27.30. On purely a theoretical basis, to bring these two figures to line and achieve efficiency there would be a need to employ more labour. The more labour is employed the lower the MVP will become according to production theory

4.3.2. Regression Results for Land and Other Variables

The regression results for land and other variable are as presented in table 4.12. The effect of land on coffee production is observed with labour held constant. The Cobb-Douglas function shows a reasonable fit with an R^2 of 0.61. In other words the independent variables explain sixty one percent of the variation in production. Fertilizer (X_1), and fungicides (X_2) are statistically significant at 5% level.

The other variables i.e. land, manure and herbicides and insecticides are statistically insignificant both at 5% and 10% levels of significance though they show low positive signs. In terms of beta (B) co-efficients fertilizer and fungicides stands out as the important factor of production. Fertilizer (X_1) has an elasticity of production of 0.39 which means that an additional fertilizer worth Kshs 1.00 will increase yield by 0.39 per cent and the results of other variables can be interpreted similarly.

In case of land the response though positive as expected seems to be quite low. Land (X_5) has an elasticity of production of 0.03 which means that for every other hectare of land brought under coffee we only expect an increase of 0.03 per cent in gross output. This fact can be explained in that, whereas land stands as an important factor of production, its productivity cannot be increased in isolation. In order to improve its productivity, other factors have also to be used concurrently. If we specifically look at our study area i.e. Kiambaa division

Table 4.12. Production Elasticities for Land and Other Variable in Smallholder Coffee Farms in Kiambu, 1979/80.

Variables	Constant	Fertilizer X_1	Fungicides X_2	Herbicides and Insecticides X_3	Manure X_4	Land X_5
Regression Co-efficients	1.79	0.39	0.24	0.05	0.04	0.03
Standard Error (1)	0.22	0.15	0.11	0.12	0.37	0.12
V t- Values	8.11	2.49	2.09	0.43	1.21	0.29
Veriables Significant** at 5% level	**	**	**	-	-	-
Variables Significant at 10% level *	*	*	*	-	-	-
No. of Observations (n)	30					
Degrees of Freedom	24					
R^2	0.61					

SOURCE: Compiled From Survey Data and XDS3 Computer Printout.

1) For Explanation on Multicollinearity see Appendix 3.

it has an area of 190 square kilometres (sq.km) with a population density of 521 persons per sq.km. This indicates that population pressure is high. Unlike other factors which can be increased over time land is fixed, thus its production can only be improved through intensive use of fertilizers and so forth.

The low response shown by herbicides and insecticides should not be surprising. Though Coffee Research Foundation (C-R-F) has issued technical circular on control of weeds in Coffee using herbicides, their use has not caught up yet. The circular emphasises that use of herbicides in Coffee weed control enables the farmer to achieve greater efficiency in the timing of farm operations. Kamau (9), showed that there are no defined yield differences between hand-weeded coffee and herbicide weed control in Coffee and this could be one of the possible reasons for their low use. Another possibility is that though labour is released, weeding labour might not be a constraint as such, hence there might be no need for them to use the herbicides. Another possibility which might be more important is that the farmer may not be in a position to use herbicides as this entails extra cash expenditure on his part.

Besides purchase of the herbicides, the farmer will also require to invest in a sprayer which requires a cash outlay of between Kshs 800-1500/- for a hand operated sprayer.[4]

As for the insecticides their use should be limited only to those times when there is an insect attack which reaches economic threshhold. But it was observed that in the smallholder, mainly due to ignorance the farmers were applying insecticides routinely.

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4. The author has observed in the course of his work at C.R.F. that most farmers do not own sprayers. They normally depend on hiring from people specialising in spraying who also own sprayers. Hence the need to own a sprayer might not be urgent. However, this method has a draw back especially in disease control. Timeliness in the application of fungicides is essential if the disease has to be controlled, and these people might not be available to the farmer. A delay of a few days when spraying is due could mean a considerable loss in yields.

4.4. Productivity Interpretations and Comparison of Smallholder and Estate Coffee Farms.

Having reviewed the productivity in the three estates and also having observed some of the limitations, this last section attempts to compare the two sectors. Besides some of the reasons which could have contributed to the productivity differences are discussed. The discussion is based on two main topics i.e. land and labour and a third section which tries to explain why these differences occur.

4.4.1. Land Productivity: Estates Versus Smallholder.

The results of land productivity in both sectors were discussed earlier. Our aim here is to compare the results. The overall mean land productivity was Kshs. 4677/70/ha in the smallholder and Kshs. 25,246/ha when management is paid for in Estates. If we concentrate on the latter figure in the estates and compare it with that of the smallholder farms, we observe that land is about five times more productive in the estates than in the smallholder farms. Despite the fact that the figures were not tested statistically due to the simple fact that our sample of estates was too small to

be amenable to statistical testing, the magnitude with which they differ confirms that they are substantially different.

Our first hypothesis stated that the marginal productivity of land in estates is higher than in smallholder coffee farms. These figures confirm our first hypothesis. Basically land being the major factor of production in the two sectors, and more so in the smallholder sector it is surprising that its productivity is lower in the smallholder farms. On the onset it was observed that the capital invested on per hectare basis in estates is higher than in smallholder. Besides yield per unit area was also observed to be generally higher in estates. However, not too much faith can be put on the average figures and a better explanation has to be sought.

We observed that the rate of inputs in the smallholder was generally much lower than in the estates. The rate of input use per hectare was worth Kshs. 1046/ in the smallholder sector as compared to a cash expenditure on inputs of Kshs 7793/75 per hectare in estates on average.

This indicates a cash expenditure on inputs like fertilizers, fungicides, insecticides etc. but excluding labour of about seven times that of the smallholder. For any factor to be productive be it in the industrial or agricultural sector, there is a need to supply other inputs or factors which help to enhance the productivity of the factor in question. On the same token there is a need to use more fertilizer, fungicides etc if the productivity of land has to be enhanced. Considering that these factors are essential for production and their use is called for, then it is not surprising to find that where they are used intensively, productivity tends to be higher than where their intensity of use is low. Hence the low productivity of land in the smallholder sector farms may be a direct result of this.

4.4.2. Labour Productivity: Estates Versus Smallholder.

Our results indicate that the marginal value productivity for labour in estates range from Kshs. 78/80 to 94/35 with management accounted for fully and partially and at different

land values (see table 4.7, 4.8, 4.9, and 4.10). In the smallholder farms the marginal value product of labour ranges from Kshs. 16.00 to 23/10 per man-day at different land values. This indicates that at the low level, productivity of labour is about five times and at the upper level it is about four times in estates than in the smallholder farms. The differences as observed are large and though no statistical test was done due to the smallness of the estate sample, we accept the hypothesis that labour productivity is higher in estates than in smallholder farms.

From the previous discussion this may not be unexpected, because the productivity of a factor like labour will depend on other factors of production and cannot be improved in isolation. An increase in the use of other factors is necessary if the productivity of labour has to be enhanced. Low use of other factors means that the resultant productivity of labour will also be low and would decrease, if more labour is put in without a concurrent increase in the use of other factors.

Continuous use of labour will lower its marginal productivity to zero or even to negative value as indiscriminate use of labour continues, without a reciprocal increase of other factors. According to theory, efficiency is attained when marginal value product of a factor equals to its price. This condition is attained under the assumption of perfect competition in both factor and product markets. The farmer may not be in a position to change the market imperfections which are beyond his control. However, the farmer could intensify the use of other factors like fertilizers, fungicides e.t.c. which will results in high quality coffee which would fetch more money. The increased return will mean an increased proportionate share for the factors of production, which will mean that the observed differences could be narrowed considerably. Besides this will also mean that he could be approaching efficiency.

On the other hand the smallholder farmer is his own food producer and he requires labour for operations in food crops, which is also to alarge extent seasonal. Hence the seasonality nature of labour then dictates the times when labour is maximally used and the need arises for hiring. During off-peak periods when there are few operations to be done on the farm, labour remains idle and especially if there are no ways of employing it productively or if the farm is too small. It is clear then that use of labour is not constant throughout the year. The objectives of the smallholder farmer are multiple and he may not necessarily be out to maximise profits and as such he may not be interested in maximising labour productivity.

In the estates, on the other hand we have a different picture altogether, here we have permanent manuals who are employed fulltime throughout the year. The estate is able to maintain these people fully occupied throughout the year. During the peak periods when the permanent labour cannot cope with all the work casual labourers are hired and this happens mainly during picking time.

The thing to understand here is that the estates are run on a commercial basis and on the assumption that their motive is to maximise profits, then it becomes clear why idle labour would be unwelcome in such a set up. However, it is not only the nature of labour which promotes these differences but there are other factors that contribute to the differences. Some of these other factors are discussed here below.

4.4.3. Other Factors Contributing to Productivity Differences.

In our second objective, our contention was to explain why differences would be observed between these two sectors of the coffee industry. In an attempt to find out the productivity of other variables in the smallholder, regressions were run. It was clearly observed that the smallholder farmer would be better off using more fertilizer and fungicides both of which showed high response to production.

Though land and labour are perhaps the two major factors of production at our disposal, without an addition of capital and management their productivity would be low. In coffee production whether in estates or smallholder much emphasis is laid on the use of fertilizer, fungicides, and timeliness in the various operations. From our regression results we observed that fertilizers and fungicides do respond to production as pointed out earlier. However, even though they respond to production, their use is low and erratic in the smallholder farms. We showed that there was only an expenditude of Kshs 1046/- per hectare on purchased inputs as opposed to Kshs 7793/75 in estates. From these figures it is clear why these productivity differences occur. Besides use of these inputs in the proper amount, timeliness in the application of these inputs is of crucial importance if their full benefits are to be realised.

According to the Technical Circular Number 45 of Coffee Research Foundation, for the control of Coffee Berry Disease and Leaf Rust, the minimum number of applications of the recommended fungicide should be eight times (14). Surprisingly enough the total average number of times this was applied among our smallholder sample farmers was only three times, which is well below the recommendation. Another thing that was not adhered to was the quantity to be applied per application per given unit area. The most important thing in disease control is to adhere strictly to the time of application and the quantity to be applied. Under use and non-observance of timeliness results in considerable losses in yield. This means that the farmer loses his crop and on top of it he loses the amount spent and besides the overall productivity is also affected. However, the farmers perception may be different from the researchers point of view and as such he may discount the recommendations to suit his resources outlay. This in itself is a rational behaviour but also indicates a risk averse attitude.

On the side of fertilizer use in the smallholder sector we find that there is also under use, though it was shown to be responsive to production. It has also been shown by Njagi (25) that fertilizers are responsive to production. According to the technical circular No. 47 (16), from Coffee Research Foundation on fertilizer recommendation for an expected yield of 1000 kgs. clean coffee per hectare it requires a minimum of 80 kg of Nitrogen per hectare. This results in an expenditure of Kshs 615/35[5] per hectare on fertilizer[6]. This represents 58% of what our sample farmers were using on all inputs. What we are trying to say is that these levels are rarely achieved by the smallholder, thus the productivity is low.

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5. Using 1979 prices.

6. Only Calcium Ammonium Nitrate is considered in this case though other fertilizers should be applied. Thus this cost in an under estimate.

To conclude we can observe that there is a lot of room to improve land and labour productivity in the smallholder sector and subsequently the overall productivity. However, this calls for an intensive use of those inputs that are responsive to production. Besides their use, the manner in which they are used requires to be improved i.e. timeliness in applying inputs and the recommended quantities should be observed.

C H A P T E R V.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.10. Summary.

This study has examined the productivity of land and labour in coffee farms both estates and smallholder. The study was carried out in Kiambu but with special emphasis on Ndumberi Location. The study covered thirty smallholder coffee farms and three coffee estates. The study had the aim of measuring productivity differences (Land and Labour) and compare them in the two sectors of the coffee industry and at the same time attempt to explain the cause of these differences.

One of the main objectives of this study was to estimate marginal productivities for both land and labour in both sectors and compare them. The second objective was to explain why the observed differences in productivity occur within the two sectors. Two hypotheses were tested. The first hypothesis stated that the productivity of land is higher in estates than in smallholder farms. Using residual accounting model on data from both sectors the marginal value product for land and labour were calculated.

It was found out that the marginal value products for land were higher in estates than in smallholder farms. Though the means were not statistically tested, due to the smallness of the estate sample, the magnitude with which they varied was substantial to show they were different. As a result of this our first hypothesis was accepted.

The second hypothesis stated that labour productivity was higher in estates than in the smallholder coffee farms. Though the means were not statistically tested, due to the reasons given above, the magnitude with which they varied was enough to show that they were substantially different, and as a result our second hypothesis was accepted.

Data from the smallholder farms was used to run regressions using a Cobb-Douglas production function. The function was linearized by transforming it into the logarithms. The aim of running the regression was to try and highlight why productivity differences occured. It was shown from the function that increased use of fertilizers and fungicides would result in increased coffee production in the smallholder sector.

5.2. Conclusions.

In most economic studies the interpretations and recommendations are made within a framework of certain assumptions and limitations imposed by the analytical tools used. This study is no exception to this rule. Within the confines of this framework we can draw the following conclusions from this study.

The first conclusion that we can draw from this study is that the productivity of land and labour is higher in estates than in the smallholder farms. It was shown that the mean MVP for land in estates was Kshs. 25,246.00 per hectare compared to a mean of Kshs. 4677.60 per hectare in smallholder farms. The mean MVP for labour in estates ranges between Kshs. 78.80 to Kshs. 94.35 per manday compared to a mean of Kshs. 16.00 to Kshs. 23.10 per manday in smallholder farms. The conclusion that we can draw from these figures is that the land and labour resources are more productive in the estates compared to the smallholder farms. This also indicates that there is still more room for improving land and labour productivity in the smallholder farms to achieve high levels of efficiency.

Another conclusion that we can draw from this study is that there is a big difference between the calculated marginal value products or the shadow prices of land and labour compared to their prices in the two sectors. Comparing the MVPs for land and the quoted selling prices for land, this reveals substantial differences. The selling prices quoted stand at Kshs. 98800.00 and Kshs 67500.00 per hectare compared to the mean MVPs of Kshs 4677.60 amd Kshs. 25246.00 per hectare in both smallholder and estates respectively. The conclusion that we can draw from these figures is that land is over valued and prices hardly reflect its productivity. On the other hand the calculated MVPs for labour ranges between Kshs 16.00 to 23.10 and Kshs. 78.80 to 94.35 per manday in smallholder and estates respectively, compared to a wage rate of Kshs. 10.00 per manday. This indicates that labour is under paid and there is a need either to employ more labour inorder to lower the MVPs or pay higher wages.

Another important conclusion that we can draw from the study is that increased use of fertilizers and fungicides would greatly enhance coffee production in the smallholder sector. These two inputs were shown to be highly responsive in coffee production. The elasticity of production for fertilizer and fungicides was 0.39 and 0.24 respectively. The figures are high enough to justify intensified use of these inputs.

The use of these inputs is so important, if coffee production has to be increased from this sector and ultimately increase individual factor's productivity. The use of these factors has to be given first priority. It was surprising to find that even farmers with experience in coffee growing for over ten years are not aware of how to use these inputs, they were not also aware of the quantities to apply.

Finally, we can also observe that other inputs like manures, insecticides and herbicides may also need to be used intensively. Though their response to production was shown to be low with elasticity of production of 0.04. and 0.05, for manure, insecticides and herbicides respectively, their use has been shown elsewhere to be responsive to production (20).

5.3. Recommendations.

Under normal circumstances no policy should be static. If development has to be initiated, then policies have to be reviewed constantly and adjusted to reflect thanging socio-economic conditions. In view of our conclusions the following suggestions for improvement are made.

From our conclusion we observed that land and labour were not as productive in the smallholder sector compared to the estates. It was especially shown that increased use of fertilizers and fungicides in coffee production would enhance productivity.

It was also shown that there was under-use of these inputs in smallholder sector which suggests that the inputs could either be too expensive for the farmers to use or the recommended levels could be uneconomical to use given other constraints prevailing in the smallholder sector. Njagi (25) observed that recommendations to farmers should not only adjust to agro-ecological conditions but should also adjust to changes in the market conditions. He goes on to say that recommendations that do not take account of these changes are unlikely to be adopted by farmers, who normally operate under severe capital limitations. It is our recommendation that Coffee Research Foundation should specify lower input levels which are both economical and attainable by smallholder farms, which later can be reviewed upwards as farmers get to realise the benefits accruing from use of these inputs. It is worthwhile to note that technical optimal is not necessarily synonymous to economic optimal.

Another recommendation that we can make is that there is an urgent need to make farmers more aware of the benefits accruing from use of the recommended inputs.

This can be accomplished through training of farmers either by extension service of the Ministry of Agriculture or through research advisory services of Coffee Research Foundation. Under the Smallholder Coffee Improvement Project (SCIP), the Government of Kenya has realised the need for training, but unfortunately farmer training is not included as one of the components.

There is a need to intensify training for farmers on the best methods of using the various inputs and mainly on the benefits that can accrue to the timely use of these inputs and in the proper quantities. The task of this training can be taken by the Ministry of Agriculture through their extension services and also Coffee Research Foundation through their Training Extension and Advisory Section. The most effective way to reach many farmers would be through field days, demonstrations and barazas.

In relation to labour it was shown that the shadow price of labour was considerably higher in both sectors compared to the wage rate prevailing then. This indicates that there is room for more employment and especially in the estate sector where the shadow price of labour was shown to be considerably higher compared to the wage rate. However,it is not easy at this juncture to say what would be the required

extra mandays per hectare. This is because, besides labour we have to consider other factors like the enterpreneurs profit, the risks that he faces e.t.c. It suffices to say here that there are possibilities of employing more people. On the other hand it is also possible to review wages with an aim of increasing them, inorder to try and bridge the gap between the high shadow prices and the wage rate. Thus, labour would be compensated for its high productivity.

In case of land it was shown that land prices are highly exaggerated compared to the marginal value productivity or shadow price. It is our observation that land prices should more or less reflect the productivity of that land. It is long overdue for the standardisation of land prices if land has to be used more intensively as a means of production rather than a tool for speculation purposes.

It suffices to say here that if these few problems are alleviated, we would expect increased resource productivity and especially from the smallholder sector. Not only will productivity be increased but this will also mean high incomes for the farmers and more foreign exchange for the country.

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A P P E N D I X I

Questionnaires Used For the Survey

Questionnaire Used to Collect Data in Small-Scale Coffee Farms.

I IDENTIFICATION

Farmer's Name.....

District.....

Division.....

Location.....

Date of Interview.....

II FAMILY BACKGROUND

No. of wife/wives.....

No. of Children.....

Main Occupation of Family Head.....

.....

Subsidiary Occupation of Head of Family.....

.....

Family Member	Age	Level of Education	Children Attending Boarding School	Children Attending Day School	Indicate Whether Living At Home Or not
Husband					
Wives 1 2 3					
Children 1 2 3 4 5					
Other Relatives Living On The Farm 1 2 3 4 5 6 7 8 9					

- Do you have any other source of income apart from farming?...
.....YES/NO.

- If Yes state source and amount obtained/month/year
Source.....Amount/Month/Year.....

III SIZE OF FARM AND OWNERSHIP.

a) What is the total area of farm?.....Acres/Ha.

b) Land Use March 1st 1979 to 29th February 1980

U S E		L.R.	S.R.	L.R.	S.R.
Amount of Land	1 2				
under permanent crop.	3 4				
Crop by Crop (a)					
Amount of land under	1 22				
annual crops	3				
Crop by crop	4 5				
Amount of land under grass /pasture					
Area occupied by building, hedges, fences etc(estimated).					

a) If area is not known ask for the number of trees for permanent crops.

CROPS	NUMBER OF MATURE TREES	NUMBER OF IMMATURE TREES	TOTAL
1 2 3 4 5 6			

IV ENTERPRISES

(i) Mature Coffee

a) Number of Mature Trees _____

b) Date of planting, year of planting and spacing

YEAR	NUMBER PLANTED	SPACING	ORIGINAL PRICE/TREE
I			
2			
3			
4			
5			

c) What is the estimated value of a mature coffee tree ?

K. Shs. _____

D) TIMING OF OPERATION AND LABOUR USE IN MATURE COFFEE

OPERATION	WHEN DONE MONTH	FAMILY LABOUR	PERMANENT LABOUR NO. OF DAYS	CASUAL LABOUR NO. OF DAYS EMPLOYED
WEEDING	1 2 3 4 5			
FERTILIZER	1 2 3 4			
SPRAYING	1 2 3 4 5 6 7 8			
PRUNING	1 2 3			
HANDLING	1 2 3			
PICKING	1 2 3 4 5 6 7 8			

c) USE OF IMPUTS ON MATURE COFFEE

INPUT TYPE	QUANTITY USED (Kg/Litres)	PRICE AT SOURCE
FERTILIZER 1 2 3 4		
FUNGICIDES 1 2 3 4 5		
INSECTICIDES 1 2 3 4 5		
HERBICIDES 1 2 3 4		
OTHERS		

d) Total Output from mature coffee trees: Kgs. Cherry.....

e) Value of output - KShs.....

f) Picking cost/debe - KShs.....

g) Total picking cost - KShs.....

h) Pruning cost/tree - KShs.....

i) Weeding cost/tree - KShs.....

j) Transport cost per bag from farm to factory - KShs.....

k) Total transport cost - Kshs.....

OTHER CROP ENTERPRISES

CROP OR CROP MIXTURE.....

a) Seasons, Yield, etc.

ITEM	LONG RAINS	SHORT RAINS
Month of planting		
No. of plots		
Estimated area planted (acres)		
Month of harvest		
Quantity harvested(Kg/bags)		
Value of Quantity harvested (Kshs.)		
INPUTS Fertilizer (Kg)		
Spray (litres)		
Seed (Kgs)		
Manure		
Others		

c) OPERATION AND LABOUR TIMING.

OPERATION	LONG RAINS				SHORT RAINS			
	MONTH	Family Labour man-days/man-hours	Hired labour labour manday/man-hours	TOTAL Man-day/ man-hours	MONTH	Family labour man-days/ man-hours	Hired kabour man-days/ man-hours	TOTAL man-day/ man-hours
Land prep.								
Fertilizing								
1st Weeding								
2nd Weeding								
3rd Weeding								
Dust/Spray								
Harvesting/ Threshing								

d) INPUT VALUATION

INPUT	QUANTITY BOUGHT	QUANTITY USED	PRICE AT SOURCE
Fertilizers			
Dust			
Sprays			
Seeds			
Manure			

V: LIVESTOCK ENTERPRISES

TYPE	NUMBER	AGE AS AT 29 FEB.	ESTIMATED VALUE AS AT 31ST MARCH 1979	ESTIMATED PRESENT VALUE
Cows in milk				
Dry cows				
Heifers				
Bulls				
Calves (Females)				
Calves (Bulls)				
Goats				
Sheep				
Donkies				
Pigs 1 Sows 2 Boars 3 Gilts 4 Piglets				
Others: 1				
2				
3				
4				
5				

b) Sale of Animal and Animal Produce

TYPE OF ANIMAL OR PRODUCE	QUANTITY OR NUMBER SOLD	VALUE PER UNIT	DATE OF SALE
COWS			
Bulls			
Calves			
Sheep			
Goats			
Milk			
Hides/Skins			

VI: a) LAND AND RELATED INVESTMENT

KIND OF INVESTMENT	VALUE
Land	
Building	
Drainage Works	
Irrigation Works	
Fences, hedges, etc	
Trees	
Crops in the Field	
Others: 1	
2	
3	
4	
5	

b) Farm Machinery Tools and Equipment

(i) For tool, equipment and machinery having a useful life of more than one year

TYPE	NUMBER	DATE OF PURCHASE	PRICE OF PURCHASE	ESTIMATED PRESENT VALUE
1) Tractor				
2) Vehicle				
3) Tools and Implements				
a)				
b)				
c)				
d)				
e)				
f)				
g)				
h)				
i)				
j)				
k)				
l)				
m)				
n)				
o)				
p)				

VII: a) LABOUR PERMANENT & CASUALS

1) Do you have any permanent labourers?.....Yes/No.

2) If yes, how many?.....

3) How much do you pay him/her per month? Kshs.....

4) On average how many hours does he/she work per day and for how many days/month
.....HRS/day,.....days/month.

5) Do you employ casual labourers?.....Yes/No.

6) If yes, in which month are they employed and what type of work do they do?

Month	Task employed to do and crop	Average no. employed
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

7 How much are they paid per day? KShs.....

b) Family Labour

How many family members are available for farm work fulltime?

Family Labour	Average No. of hours worked per day	Average No. of days worked in a week	Average No. days worked in a month
Husband			
Wife/Wives 1 2 3			
Young men over 15 yrs.			
Young women iver 15 yrs.			
Relatives below 60 yrs. and above 15 yrs.			

A P P E N D I X 2

Questionnaire Used to Collect Data in Estates

1: IDENTIFICATION

DISTRICT: _____

DIVISION: _____

LOCATION: _____

DATE OF INTERVIEW: _____

ENUMERATOR: _____

11: LAND AND LAND USE PATTERN

a) Land

TYPE OF OWNERSHIP	AREA (Ha)
Owned Rented Total	

b) Land Use

USE OR ENTERPRISE	AREA OF FARMLAND	
	OWNED	RENTED
a) Farmstead(including houses, stores, roads, fences etc).		
b) Area under mature coffee		
c) Area under immature coffee		
d) Others		
e) Waste land		

INPUTS USE IN MATURE COFFEE

	INPUT TYPE	QUANTITY	PRICE/UNIT AT SOURCE
1)	FERTILIZERS		
	a)		
	b)		
	c)		
	d)		
	e)		
	f)		
2)	INSECTICIDES		
	a)		
	b)		
	c)		
	d)		
	e)		
	f)		
3)	FUNGICIDES		
	a)		
	b)		
	c)		
	d)		
	e)		
	f)		
4)	HERBICIDES		
	a)		
	b)		
	c)		
	d)		
	e)		
	f)		
5)	MULCH		
6)	MANURE		
7)	OTHERS		
	A)		
	b)		
	C)		
	d)		

TIMING OF VARIOUS OPERATIONS AND LABOUR USE

OPERATION	MONTH DONE	MANDAYS SPENT PERMANENT LABOUR	MANDAYS SPENT CASUAL LABOUR	TRACTOR HOURS
1) WEEDING	1 2 3 4 5 6			
2) FERTILIZING	1 2 3 4 5			
3) PRUNING	1 2 3 4 5 6			
4) HANDILING	1 2 3 4 5			
5) PICKING	1 2 3 4 5 6 7 8			
6) SPRAYING	1 2 3 4 5 6 7 8 9			
7) MULCHING	1 2 3 4			

Continued

8) IRRIGATION	1 2 3 4 5 6 7			

IV: Is the area under coffee divided into blocks?.....Yes/No

If yes, how many?.....

BLOCK	AREA (Ha)	NO.OF TREES	SPACING	YEAR OF PLANTING
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

FARM MACHINERY, TOOLS AND EQUIPMENT

Type	No.	Capacity	Year Purchased	Purchase Price	Estimated present value
TRACTORS a) b) c) d) e)					
VEHICLES a) b) c) d) e)					
PLOUGHS a) b) c) d) e)					
MOTORISED SPRAYERS a) b) c) d) e)					
SPRAYERS (HAND) a) b) c)					
COFFEE FACTORY (excluding Building)					
OTHERS a) b) c) d) e) f) g) h) i)					

PRODUCTION AND OTHER RELATED QUESTIONS

a) How many kg/tonnes of coffee were produced during the crop year 1979/80?.....

b) How much money did you receive for the crop? Kshs....

c) What is the estimated value of an acre/ha of land without coffee Kshs.....acre/ha.

d) Estimated value of land with coffee/acre/ha? Kshs....

e) No. of labour houses?.....

f) Estimated rental value/month/house in Kshs.....

g) What is the estimated value of a mature coffee tree. Kshs.....

h) Estimated value of a young coffee tree. Kshs.....

i) Is free transport offered to pickers?.....Yes/no...

j) If yes, how much do you spend per annum to transport pickers? Kshs.....

k) How much does it cost to pick a debe of coffee? Kshs.

l) About how many debes of cherry make one tonne?..... debes.

m) How much money did you spend between March 1979 and February 1980 on operating the farm? Kshs.....

n) How much diesel was spent within the same period and how much did it cost?.....Litres, Kshs.....

o) How much petrol was spent within the same period and how much did it cost?.....litres, Kshs.....

p) Do you provide free fuel to your labourers?.....Yes/no

q) If yes, how much do you expect is spent on this fuel? Kshs.....

r) For the months shown below, indicate how much was paid to the following categories of workers:

MONTH	MANAGER OR MANAGEMENT	AMOUNT PAID TO			
		PERMANENT LABOUR	CASUAL LABOUR	OTHER	(SPECIFY)
March 1979					
April 1979					
May 1979					
June 1979					
July 1979					
August 1979					
September 1979					
October 1979					
November 1979					
December 1979					
January 1980					
February 1980					

A P P E N D I X 3

ZERO ORDER CORRELATION MATRIX BETWEEN INDEPENDENT VARIABLE AND THE DEPENDENT VARIABLE FOR REGRESSION E_1

VARIABLES	Output Y	LABOUR x_1	FERTILIZER x_2	FUNGICIDES x_3	HERBICIDES AND INSECTICIDE x_4	MANURE x_5
Output Y	1.000					
Labour x_1	0.499	1.000				
Fertilizer x_2	0.380	0.350	1.000			
Fungicide x_3	0.412	0.375	0.138	1.000		
Herbicides and Insecticide x_4	0.173	0.160	-0.074	0.316	1.000	
Manure x_5	-0.035	-0.006	-0.232	- 0.095	0.185	1.000

SOURCE: Survey Data Regression Results 1979/80

The results of this matrix indicate a high correlation between labour, fertilizer and fungicides and the output (y). Herbicides and insecticides are also positively correlated to output though not highly. Manure shows a negative correlation to output. When the variables were tested at the 5% level of significance none of them was found to be significant except labour and fungicides whose inter-correlation was found to exceed the critical value but only by very small margins. However, it can be observed that there was no serious multicollinearity and as such all the variables were included in the model.

APP.3 Contd.

ZERO ORDER CORRELATION MATRIX BETWEEN INDEPENDENT VARIABLES AND THE DEPENDENT VARIABLE FOR REGRESSION E_2

VARIABLE	OUTPUT (Y)	FER. X_1	FUNGICIDE X_2	HERBICIDES AND INSECTICIDE X_3	MANURE X_4	LAND X_5
utput Y	1.000					
ertilizer X_1	0.391	1.000				
ungicides X_2	0.443	0.073	1.000			
erbicides and ecticides X_3	0.174	- 0.033	0.309	1.000		
anure X_4	0.111	- 0.274	0.014	- 0.021	1.000	
and X_5	0.145	- 0.114	0.234	0.054	0.247	1.000

RCE: Survey Data Regression Results: 1979/80.

the matrix we observe the high correlation between fertilizer and gicides to the output. Herbicides/Insecticides, manure and land icate a low correlation to the output.

Appendix 3. Contd.

The inter-correlation between the other variables can be observed, e.g. fertilizer is positively correlated to fungicides though insignificantly whereas it is negatively correlated to herbicides/insecticides, manure and land. We also observe that there is no serious multicollinearity between the independent variables and as such all of them were included in the model.

A P P E N D I X 4

Tables 4.1 - 4.3, showing land and labour productivity from the smallholder coffee farms.

Table 4.1. Marginal Value Products for Land in Smallholder Coffee Farms in Kiambu, 1979/80

1	2	3	4	5	6	7	8	9	10
Farm	Area Under Mature Coffee ha.	Production Kgs.Cherry	Revenue Value of Output @ 3/70 per Kg.Cherry	Cost of Inputs Kshs.	Costs of Hired Labour Inclusive of owner/Operator Labour Kshs.	Capital Costs Kshs.	Total costs (5+6+7) Kshs.	Return to Land (4 - 8) Kshs.	MVP FOR LAND Kshs.
1	0.07	139.5	516.15	86.30	216.00	48.15	350.45	165.70	2367.70
2	0.68	1924.0	7118.80	1340.00	1960.00	418.80	3718.40	3400.40	5000.60
3	0.20	191.0	706.80	60.00	280.00	124.65	464.65	244.05	1210.25
4	0.18	382.0	1413.40	323.00	370.00	249.30	942.30	471.10	2617.20
5	0.45	1354.0	5009.80	552.00	1332.20	273.80	2157.80	2852.00	6337.70
6	0.15	422.0	1661.40	141.50	547.50	370.35	1059.35	502.05	3347.00
7	0.15	574.0	2123.80	296.50	479.50	200.00	996.00	1127.80	7518.60
8	0.74	505.0	1868.50	700.00	980.20	138.40	1818.60	49.90	70.30
9	0.27	468.0	1731.60	214.50	612.50	170.55	997.55	734.05	2718.70
10	0.58	1800.0	6660.00	1081.00	1929.	434.50	3444.50	3215.50	5543.90
11	0.30	94.0	347.80	327.00	569.00	190.80	1086.80	- 739.00	-2463.30

Table 4.1. Contd.

1	2	3	4	5	6	7	8	9	10
12	0.06	240.0	888.00	146.00	242.50	38.00	426.50	461.50	7691.60
13	0.30	151.0	588.70	48.00	431.45	199.80	679.70	-90.55	-301.80
14	0.12	151.0	1154.60	69.00	439.00	148.70	656.70	497.70	4147.50
15	0.15	295.0	1091.50	175.00	538.00	112.00	820.50	266.00	1773.30
16	1.20	1324	4898.80	1594.00	1867.00	730.80	4200.80	697.70	581.40
17	0.67	2237	8276.80	1019.50	1376.00	411.40	2806.90	5469.90	8184.00
18	0.60	3358	12424.60	1518.40	1991.50	366.00	3875.90	8548.70	14247.80
19	0.52	708	2619.50	6.60	632.50	346.95	1595.45	1024.05	1969.30
20	0.29	937	3466.90	160.00	695.20	183.60	1038.80	2428.10	8372.75
21	0.22	260	962.00	-	461.70	143.00	604.70	557.30	1624.00
22	0.26	670	2479.00	255.50	722.60	160.00	1138.10	1340.90	5157.30
23	0.21	961	2555.70	334.50	776.00	219.90	1330.40	2225.30	10596.60
24	0.33	842	3115.40	357.50	1150.40	208.70	1716.60	1398.80	4238.80
25	0.18	852	3152.40	333.00	597.50	119.60	1050.10	2102.30	11679.45

Table 4.1. Contd.

1	2	3	4	5	6	7	8	9	10
26	0.30	577	2134.90	350.50	800.20	252.30	1403.00	731.90	2439.65
27	1.07	2011	7440.70	306.00	1316.00	652.20	2274.20	5166.50	4828.50
28	0.15	400	1480.00	135.50	593.00	93.15	821.65	658.30	4389.00
29	0.37	1200	4440.00	433.00	784.00	232.50	1449.50	2990.50	8082.40
30	0.28	509	1883.30	870.00	631.00	172.35	1173.35	709.95	2535.50

SOURCE: - Survey Data 1979/80.

Table 4.2. Marginal Value Products for Labour with Land at Market Value in Smallholder Coffee Farms in Kiambu, 1979/80.

1	2	3	4	5	6	7	8	9	10
Farm	Area Under Mature Coffee ha.	Production Kg.Cherry	Revenue Value of Output @ 3/70 per Kg.Cherry	Cost of Inputs Kshs.	Opportunity Cost of Average Fixed Capital Investment Kshs.	Total Costs (5+6) Kshs	Return to Labour Kshs.	Total Mandays Spent	MVP for Labour/ Manday Kshs.
1	0.07	139.5	516.15	86.30	125.10	211.40	304.75	21	14.50
2	0.68	1924	7118.80	1340.00	1177.20	2517.20	4601.60	149	30.90
3	0.20	191	706.70	60.00	351.00	411.00	295.70	30	9.85
4	0.18	382	1413.40	323.00	322.20	642.20	768.20	37	20.75
5	0.45	1354	5009.80	552.00	783.00	1335.00	3674.00	133	27.60
6	0.15	422	1561.40	141.50	261.00	402.50	1158.90	54.75	21.15
7	0.15	571	2123.80	296.50	261.00	557.50	1566.30	48	32.60
8	0.71	505	1868.50	700.00	923.40	1623.40	245.10	98	2.50
9	0.27	468	1731.60	214.50	469.80	684.30	1047.30	61.25	15.50
10	0.58	1800	6660.00	1081.00	1929.00	434.50	3444.50	3215.50	22.50

Table 4.2. Contd.

1	2	3	4	5	6	7	8	9	10
11	0.30	94	347.80	327.00	569.00	896.00	-548.20	58	- 9.45
12	0.06	240	888.00	146.00	242.50	38.00	426.50	461.50	39.85
13	0.30	151	558.70	48.00	360.00	408.00	150.70	43	3.50
14	0.12	312	1154.40	69.00	208.80	277.80	876.60	44	19.90
15	0.15	295	1091.50	175.00	268.20	443.20	648.30	55.5	11.70
16	1.20	1324	4898.80	1594.00	2088.00	36.80	1216.80	187.5	6.50
17	0.67	2237	8276.80	1019.50	1171.80	2191.30	6085.50	152.5	40.00
18	0.60	3358	12424.60	1518.40	1042.20	2560.60	9864.00	199	50.00
19	0.52	708	2619.50	616.00	910.80	1526.80	1092.70	63.5	17.20
20	0.29	937	3466.90	160.00	512.10	672.10	2794.80	69.5	40.20
21	0.22	260	962.00	-	388.80	388.80	573.20	45.75	12.50
22	0.26	670	2479.00	255.50	455.40	710.90	1768.10	72	24.50
23	0.21	961	3555.70	334.50	437.40	771.90	2783.80	77.5	36.00

Table 4.2. Contd.

1	2	3	4	5	6	7	8	9	10
24	0.33	842	3115.40	357.50	583.20	940.70	2174.70	115	19.00
25	0.18	852	3152.40	333.00	322.20	655.20	2497.20	59.5	42.00
26	0.30	577	2134.90	350.50	360.00	710.50	1424.40	82	17.40
27	1.07	2011	7440.70	306.80	1863.90	2169.90	5270.80	132	40.00
28	0.15	400	1480.00	135.50	268.20	403.70	1076.30	59	18.20
29	0.37	1200	4440.00	433.00	640.80	1073.80	3366.20	18.5	41.30
30	0.28	509	1883.30	370.00	484.20	854.20	1029.10	63	16.30

SOURCE:- Survey Data 1979/80.

Table 4.3. Marginal Value Products for Labour with Land Values as Reported in Smallholder Coffee Farms in Kiambu,1979/80.

1	2	3	4	5	6	7	8	9	10
Farm	Area Under Mature Coffee ha.	Production Kg.Cherry	Revenue Value of Output @ 3/70 per Kg.Cherry Kshs.	Cost of Inputs Kshs.	Opportunity cost of Average Fixed Capital Investment Kshs.	Total Costs (5+6) Kshs.	Return to Labour Kshs.	Total Mandays Spent	MVP for Labour/ Manday Kshs.
1	0.07	139.5	156.15	86.30	213.30	299.60	216.55	21	10.30
2	0.68	1924	7118.90	1340.00	2034.00	3374.00	3744.80	149	25.00
3	0.20	191	706.70	60.00	603.00	663.00	43.70	30	1.45
4	0.18	382	1413.40	323.00	549.00	872.00	54.40	37	14.60
5	0.45	1354	5009.80	552.00	1350.00	1902.00	1307.80	133	23.40
6	0.15	422	1561.40	141.50	450.00	591.50	969.80	54.75	17.70
7	0.15	574	2123.80	296.50	450.00	746.50	1377.30	48	28.70
8	0.71	505	1868.50	700.00	2133.00	2833.00	964.50	98	- 9.80
9	0.27	468	1731.60	214.50	810.00	1024.50	707.10	61.25	11.50
10	0.58	1800	6660.00	1081.00	1743.40	2824.00	3835.60	202.50	18.90
11	0.30	94	347.80	27.00	900.00	927.00	579.20	58	- 9.90

Table 4.3. Contd.

1	2	3 3	4	5	6	7	8	9	10
12	0.06	240	88.00	146.00	180.00	326.00	562.00	16	35.00
13	0.30	151	558.70	48	900.00	948.00	- 389.30	43	- 9.00
14	0.12	312	1154.40	69.00	360.00	429.00	725.40	44	16.50
15	0.15	295	1091.50	175.00	457.20	632.20	459.30	55.5	8.30
16	0.20	1324	4893.80	1594.00	3600.00	5194.00	- 300.20	187.5	- 1.60
17	0.67	2267	8276.80	1019.50	2016.00	3035.50	5241.30	152.5	34.30
18	0.60	3358	12424.60	1518.40	1798.20	3316.60	9108.00	199	45.80
19	0.52	708	2619.50	616.00	1566.00	2182.00	437.50	63.5	6.90
20	0.29	260.	3466.90	160.00	877.50	1037.50	2429.40	69.5	35.00
21	0.22	260	962.00	-	666.00	666.00	296.00	45.75	6.50
22	0.26	670	2479.00	255.50	792.00	1047.50	1431.50	72	19.90
23	0.26	961	3555.70	334.50	783.00	1117.50	2438.20	77.5	31.50
24	0.33	842	3115.40	357.50	999.00	1356.50	1758.90	115	15.30

Table 4.3. Contd.

1	2	3	4	5	6	7	8	9	10
25	0.18	852	3152.40	333.00	549.00	882.00	2270.40	59.5	38.10
26	0.30	577	2134.90	350.50	900.00	1250.50	884.40	82	10.80
27	1.07	2011	7440.70	306.00	3212.10	3518.10	3922.60	132	29.70
28	0.15	400	1480.00	135.50	450.00	585.50	894.50	59	15.10
29	0.37	1200	4440.00	433.00	1107.00	1540.00	2900.00	18.5	35.60
30	0.28	509	1888.30	370.00	837.00	1207.00	676.30	63	10.70

SOURCE: - Survey Data 1979/80.

APPENDIX 5

Determination of Market Values for Land.

There is no simple and straight forward method of determining land value. This is due to the fact that the market for agricultural land differs from most other markets in that supply is virtually fixed. Unlike for most other commodity markets agricultural land market lacks a central agency like the stock exchange. It is informal, decentralised and usually the transactions are normally guarded.

The demand for land is usually intensified by increase in population and wealth, and this cause its price to rise faster than would be the case if its supply was elastic. It is not unlikely that more often than not in this country land is bought for speculative purpose without taking into consideration its productivity.

In determining the market value for land in the case of this study only one method of valu ation was considered as suggested by Njagi. The method considered was that known as capitalisation of net returns. The method involved obtaining

detailed particulars about the farm, its permanent improvements, crops acreages and the yields, machinery loose assets etc. After detailed estimation of current prices and possible future trends, a budget is prepared detailing crop and livestock outputs. From the individual enterprise outputs the variable costs of production are deducted to leave the enterprise gross margins. From total farm gross margins are deducted the fixed costs to arrive at the budgeted annual gross profit for the farming operations. The profit is capitalised with a year's purchase to arrive at the capital value of the farm.

This method was used, but a concession was given for the smallholder farms in that according to Njagi[1], small portions of land are normally sold at a higher price than when land is sold in huge chunks.

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1. Mr. S.B.C. Njagi was a valuer with the Ministry of Lands and Settlement from 1972 - 1978. According to him there is no foolproof method of valuation and sometimes the valuer's judgement has to be called upon. However, the values of Kshs 7,000 per acre in the Estates and Kshs 12,000 per acre in the smallholder farms are a more realistic representation of market value for the purposes of borrowing than the values that were quoted by the farmers in our case.