Thesis

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THE DEPARTMENT OF AGRICULTURAL ECONOMICS, UNIVERSITY OF NATAL

ECONOMIC ANALYSIS OF CROP PRODUCTION IN LESOTHO: A HOUSEHOLD-BASED PROGRAMMING APPROACH

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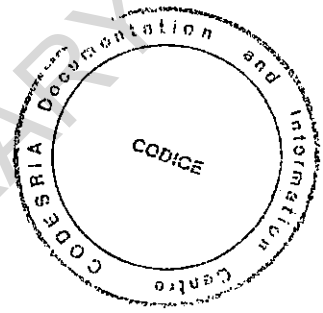

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I hereby certify that, unless specifically indicated to the contrary in the text, this dissertation is the result of my own original work.

None R. Mokitimi

ABSTRACT

Agriculture in Lesotho is a key sector and a major source of employment within the country, with approximately 85 percent of the population living in rural areas. Crop farming is characterised by a high proportion of subsistence farming with most production being kept for home consumption. Lesotho's agriculture has shown declining production despite government intervention in the form of area-based development projects and massive international aid. Approximately 40 percent of Lesotho's male labour force is, at any time, engaged in employment in the Republic of South Africa (RSA) as migrants. Migrant workers' remittances account for approximately 50 percent of GNP. Agriculture as the main source of income has decreased substantially while dependence on migrants' remittances and foreign aid has increased.

The purpose of this study is to identify factors affecting crop production in Lesotho and to analyse different economic policies on resource allocation. The study applies household economics theory which recognises the fact that most farm households in developing countries are deficit producers and as such are engaged in both production and consumption, this being the situation in Lesotho.

The purpose of the study was achieved by using a mathematical programming model to predict responses to several economic policies. The programming model aggregates enterprise levels for four representative household types to form a sector model. Representative farm households were selected using principal component and cluster analyses. Aggregate resource levels in each household type were computed as the product

of the representative (mean) household resource levels and the estimated number of households in the group. Data were obtained from a sample survey of 160 crop producing households located in northern Lowlands and Foothills of Lesotho. To account for risk, a linear approximation of the gain-confidence limit (E,L) criterion suggested by Baumol (1963) was used. Risk aversion coefficients were estimated independently for each representative household by simulating its observed enterprise mix.

To account for differences in wage earning potentials, offer wage rates were estimated for all household members not wage employed. Offer wage models predicted that men have a higher wage earning potential than women. Results of the offer wage models indicate that people wage employed within Lesotho are relatively more educated than those employed as migrants in RSA. For those wage employed within Lesotho women tend to be more educated than men.

Several economic policies were simulated and results compared with the base solution. Most of the policies examined focus on maize prices because maize is the most important staple food in Lesotho and changes in its price are expected to affect rural households' resource allocation and welfare.

Results from a household-based programming model indicate that even though agriculture is the key sector in Lesotho, Basotho households are more responsive to consumer than producer prices. This is attributed to the fact that the majority of rural households are net consumers of maize. Deregulation of the RSA maize marketing system is expected to lead to lower maize import prices which is simulated to increase household welfare as the

majority of households are net consumers of maize. This deregulation is also expected to result in reduction in maize production in Lesotho and increased wheat production and fallow land. There is an increase in maize imports, a decrease in maize self-sufficiency but households' affordability to purchase maize improves thus enhancing food security.

A simulated increase of 10 percent in maize producer prices with maize consumer prices held constant, does not have any effect on crop production. Simulations of the model indicate that maize producer prices have to be increased by over 100 percent in order for households to produce maize for market purposes. This shows that most of agricultural production in Lesotho will remain for subsistence even under relatively high maize prices. A reduction in workers wage employed in RSA and Lesotho is simulated to have little impact on crop production but has a significant negative impact on household welfare. An interest rate subsidy aimed at farmers operating under the Food Self-Sufficiency Programme (FSSP) has almost no effect on household welfare and leads to an increase in FSSP maize production and this results in minimal increases in total maize production. Results also indicate that land rental arrangements can lead to increased production but transaction costs exceed the rental value and this has resulted in the non-existence of a land rental market in Lesotho.

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INTRODUCTION

Agriculture in Lesotho is the key sector and a major source of employment within the country. Approximately 85 percent of the population lives in rural areas and about 60-70 percent of the population derives supplemental income from agriculture. Lesotho's agriculture is characterised by low and declining production. This is despite large government intervention in the form of area-based development projects and massive foreign aid. The foreign aid is used to establish marketing organisations, credit facilities, extension services, and roads. Crop farming is characterised by a high proportion of subsistence farming with over 80 percent of the production being kept for home consumption. The major crops produced include maize, sorghum, wheat, beans and peas. As a result of the low and declining agricultural production, Lesotho is increasingly relying on imports and foreign aid to feed its growing population.

Lesotho exports labour to the Republic of South Africa (RSA) because of limited resources and lack of employment opportunities in the country. Approximately 40 percent of Lesotho's male labour force is at any point in time engaged in employment in RSA. In 1986 migrant workers' remittances accounted for 47 percent of Lesotho's GNP. Agriculture, as the main source of income in the country, has decreased substantially while dependence on the RSA and foreign aid has increased. In 1978/79 agriculture contributed 49 percent of rural households' income but by 1986/87 this had decreased to 34 percent. Migrant workers remittances in 1978/79 contributed 30 percent and this had increased to 47 percent by 1986/87 (Bureau of Statistics, 1988).

In addition to low and declining agricultural production, the country is faced with chronic soil erosion problems, severe overstocking, a growing population, and the possibility of increasing unemployment because of retrenchments in RSA mines.

The purpose of this study is to identify factors affecting crop production in Lesotho and to analyze effects of different economic policies on resource allocation. The study also provides policy recommendations aimed at improving agricultural production in Lesotho and increasing the welfare of farm households.

Chapter 1 gives the background to the resources and economic opportunities of rural households in Lesotho and how these relate to crop production. Chapter 2 provides a review of household economics theory. Household economics theory recognises the fact that most farm households in developing countries are deficit food producers and as such are engaged in both production and consumption. For this reason it is argued that household economics is appropriate in analysing farm households' response to policy-related variables in Lesotho. The major policy-related variables expected to have significant impact on crop production in Lesotho are producer prices, retail (consumer) prices, off-farm wage rates, import prices, and interest rates.

In Chapter 3 a mathematical programming model is developed in order to simulate the effects of various economic policies on resource allocation in agriculture. The programming model aggregates enterprise levels for four representative household types to form a sector model. The results of the predicted responses to lower maize import prices, reduced off-farm employment, high maize prices, lower interest rates and land rental costs are presented in

Chapter 4. Policy implications are presented in Chapter 5 while conclusions are presented in Chapter 6. Chapter 7 presents the summary of the study.

CHAPTER 1

SOCIO-ECONOMIC CONDITIONS IN RURAL LESOTHO

This chapter provides the background to the resources and economic opportunities of rural households in Lesotho and how these relate to crop production. A background to the major crops produced in Lesotho and the crop marketing system is also presented.

1.1 The Country

Lesotho is a small country with an area of 30 350km^2, completely surrounded by the RSA. The country lies between the 28^0 and 31^{0}latitudes in the south and is bordered by the 27^0 and 30^0 eastern longitudes. Lesotho, formerly known as Basutoland, gained its independence from Britain in 1966. The country is one of the three monarchies left in Africa, the other two being Swaziland and Morocco. Only 13 percent of the total area of the country is deemed suitable for crop production while the rest consists of rocky mountains and foothills. For the entire country, the elevation is no less than 1 500 metres above sea level with the highest peak rising to 3 482 metres above sea level. About 17 percent of the country is Lowlands ranging from 1 524 to 1 981 metres above sea level. The Lowlands are mainly situated in the west of the country while the Mountains are to the east.

Lesotho is divided into four ecological zones namely, the Lowlands, the Foothills, the Senqu (Orange) River Valley and the Mountains (Figure 1.1). The Lowlands are below an

elevation of 1 981 metres above sea level and occupy a narrow strip of land along the western border. This zone covers 17 percent of the total area and has the highest population density and is also where most of the country's urban centres are located. The largest proportion of arable land is situated in the Lowlands. The Foothills consist of land between elevations of 1 981 and 2 286 metres above sea level and situated between the Lowlands and the Mountains. The Foothills cover 17 percent of the total land area. The Mountains cover elevations of above 2 286 metres above sea level and cover 65 percent of the land area. Livestock farming is the major agricultural activity in the Mountains. The Senqu (Orange) River Valley is geographically situated within the Mountains but has lower elevations because it cuts across mountains on its long journey to the Atlantic Ocean. The Senqu River Valley covers one percent of the total land area. In addition to the four ecological zones, the country is divided into ten administrative districts.

The climate of Lesotho is temperate. Winters are cold and dry, becoming harsher in the Highlands where the mountains are usually snow-clad during June, July and August. Summers are generally warm but cool in the mountains. Annual rainfall averages 750 mm but varies considerably with ecological zones, with the Mountains having a higher rainfall. The rainy season runs from October to March with January/February receiving most rain. Rain typically falls in high intensity and this contributes to the serious problem of soil erosion which is further exacerbated by the topography of the country.

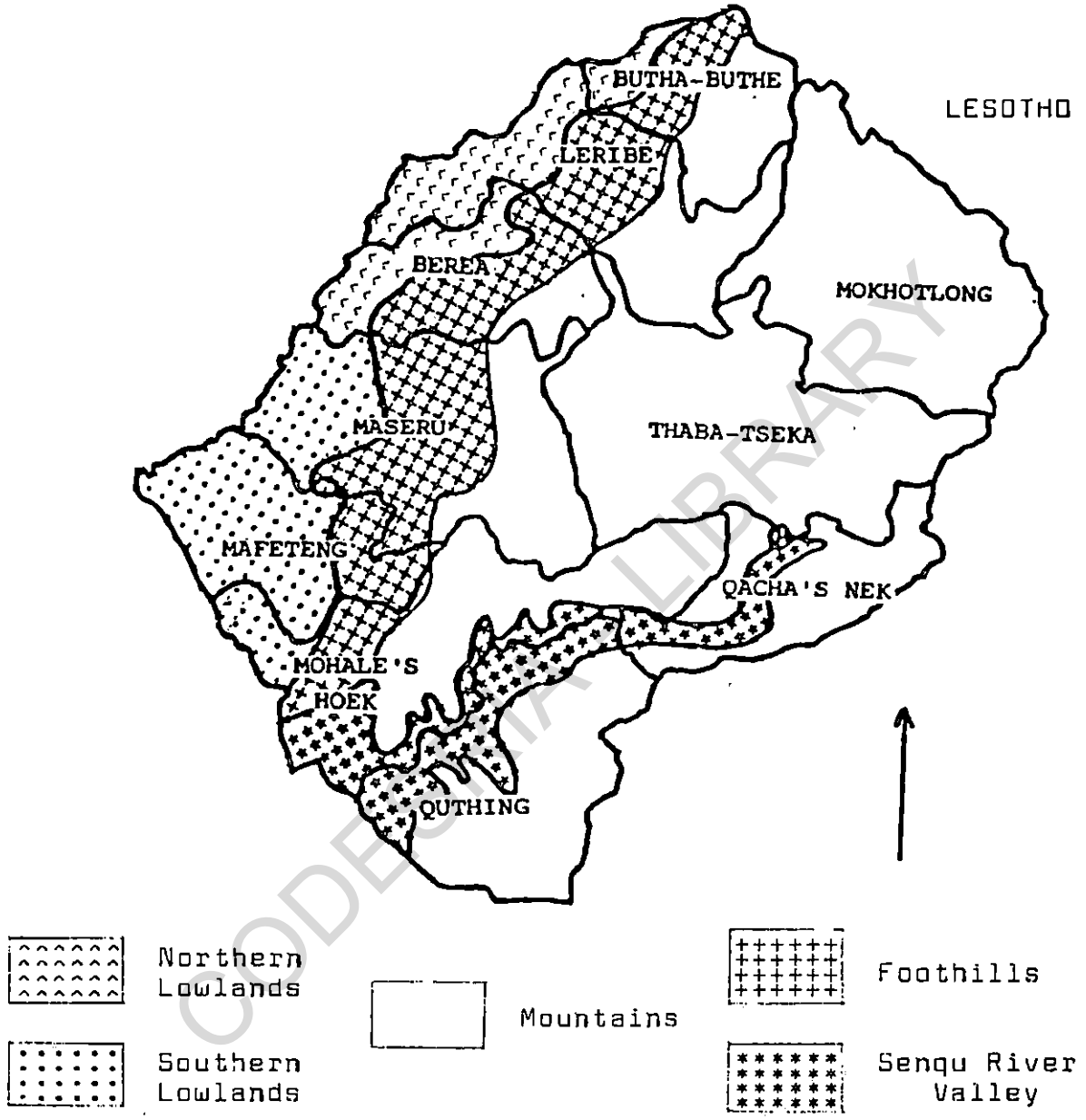

Figure 1.1: A map showing geo-climatic regions of Lesotho

Source: Swallow, B.M. *et al* (1987)

1.2 The economy of the country

Lesotho's economic structure is essentially characterised by agrarian and labour exporting features. Migrant labour remittances contribute significantly to the economy of the country (Table 1.1).

Generally the pattern of the Lesotho economy is that final consumption (government and private) exceeds GDP by a large margin. The flow of income from outside the country, a large part of which is made up of migrants' remittances, plays an important role in generating revenue for the importation of goods and services. For example, in 1985 Lesotho imported goods and services worth R797 million and exported goods worth around R60 million which consisted mainly of wool, mohair and diamonds. The manufacturing contribution to GNP increased substantially in 1988 as a result of the establishment of textile industries in Lesotho by industrialists from Asian countries. This has led to a dramatic increase in exports.

Lesotho is a signatory to two regional economic arrangements: the Southern African Customs Union (SACU) and the Common Monetary Area (CMA). SACU was formed in 1910 and is an agreement between RSA, Botswana, Lesotho and Swaziland. SACU was renegotiated in 1969 and in 1990 an independent Namibia became a member. SACU involves the free movement of commodities between member states. The customs revenue forms a significant part of Lesotho's GDP and GNP. For instance, customs revenue amounted to R161,1 million in 1983 and this constituted 47 percent of GDP and 18,2 percent of GNP (Mochebelele and Mokitimi, 1992). Customs receipts are tied to the earnings of migrants

working in RSA. As mine wages increase in RSA, imports by Lesotho from RSA increase and this leads to increased customs revenue to the government of Lesotho.

Lesotho, Swaziland and RSA are members of the CMA. The South African Rand is a legal tender in member states of the CMA. In 1980, Lesotho introduced a national currency, the Maloti, which circulates with the Rand and is pegged at par to the Rand.

Table 1.1: Sector contribution to GNP (percent), Lesotho, 1971-1988.

Year	Remittances & mine wages	Agric.	Manufacturing	Trade, Constr. & Mining	Private & Govt. Services	Others
1971	20,8	22,4	2,8	16,7	22,2	15,1
1972	22,5	15,7	3,2	17,2	24,4	17,0
1973	23,2	21,8	2,9	14,1	22,3	15,7
1974	24,7	24,7	2,9	11,7	18,4	17,6
1975	30,5	20,1	3,0	11,9	17,6	16,8
1976	41,4	14,7	2,6	10,7	17,9	12,7
1977	40,7	18,4	2,3	10,1	16,7	11,8
1978	39,1	16,8	2,1	12,8	16,3	13,3
1979	35,5	17,0	2,5	13,3	17,1	14,6
1980	36,2	16,3	2,6	13,3	18,1	14,0
1981	39,8	11,5	2,7	13,5	21,2	10,8
1982	44,2	10,5	2,8	11,9	20,7	8,9
1983	51,6	9,8	3,1	11,1	16,9	7,6
1984	52,4	7,1	2,8	9,0	16,3	10,6
1985	51,2	10,6	2,7	6,8	16,5	12,2
1986	47,4	8,8	4,8	12,3	12,8	16,1
1987	47,0	9,0	5,8	12,9	12,2	16,1
1988	42,0	11,1	20,3	8,7	20,3	8,7

Source: Bureau of Statistics (1992).

1.3 Demography

At independence in 1966, the population of Lesotho was 970 000. Between 1966 and 1976, the annual population growth rate averaged 2,3 percent. For the 1976-1986 inter-censal period the population growth rate had increased to 2,6 percent. The population of Lesotho was estimated to be 1,7 million in 1990. It is projected that the population will be 2 million by 1996. In 1986 there were 277 586 rural households in the country (Bureau of Statistics and Ministry of Agriculture, 1990).

The average population density for the total area was 53 persons per km^2 in 1986 compared to 46 in 1982. Approximately 70 percent of the population lives in the Foothills and Lowlands and this has resulted in great pressure on arable land. In 1986, the average population density on arable land was 560 persons per km^2. It seems the average household size in Lesotho is increasing. In 1976 the average household was made up of 5,0 members while in 1986 it had increased to 5,3 (Bureau of Statistics, 1987).

Approximately 48 percent of households in rural Lesotho are composed of two or more adults and three or more children (Table 1.2). The extra adult might be a relative or domestic servant.

Most households in Lesotho have some members working as migrants in RSA. A large proportion of migrants originate from the rural areas and this is plausible given that most of the population lives in rural areas. In 1985, 47 percent of rural households had one or more members as migrant workers in RSA as compared to 23 percent for urban households.

Table 1.2: Households' composition in rural Lesotho.

Variable	Percent of households
1 adult only	6,9
1 adult, 1-2 children	5,1
1 adult, 3+ children	3,5
2 adults only	7,1
2 adults, 1-2 children	15,5
2 adults, 3+ children	23,6
3+ adults only	3,4
3+ adults, 1-2 children	9,7
3+ adults, 3+ children	24,6

Source: Bureau of Statistics (1988).

Estimates of unemployment rates in Lesotho range from 23-45 percent. According to the Fourth Five-Year Development Plan, the unemployment rate in Lesotho was 45 percent in 1985/86 (Kingdom of Lesotho, 1987). This is in contrast to the findings of the Labour Force Survey which reports the unemployment rate to be 23 percent. It seems the discrepancy between the two estimates is from differences in the definition of the labour force (i.e. economically active persons). The Labour Force Survey defines the labour force as healthy individuals of 12 years and above while the Fourth Five-Year Development Plan defines the labour force as individuals of 16 years and above. Paid employment for regular wage/salary earners is found mostly in government and to a lesser extent in the private sector and parastatals. Approximately 22 percent of the economically active population are regular wage/salary earners (Bureau of Statistics, 1990).

1.4 Land tenure

In Lesotho land belongs to the Basotho nation and the King holds it in trust for the nation. The administration of land is by the chiefs on behalf of the King. The underlying concept of the land tenure system is that land is a national and social asset to be utilised for the benefit of the nation. The system entitles all households to have access to land for residential and agricultural (arable) purposes. With increasing population pressure, landlessness has been increasing. According to the 1970 Census of Agriculture, landless households accounted for 13 percent of the total population in 1970; this increased to 25 percent in 1986 (Bureau of Statistics and Ministry of Agriculture, 1990). Around 16 percent of rural households have no fields and livestock and these constitute the rural poor (Table 1.3). It is projected that by the year 2000 landless households will account for 50 percent of total households.

Every adult male, which means every married male, has the right to be allocated a portion of arable land to provide for his subsistence and that of his family and dependants. Once land is allocated, the recipient has certain rights to use the land for his lifetime. Cultivation of arable land is one of the requirements for retaining use of the land. If the allocatee either fails to cultivate his fields for three successive years or cultivates his fields improperly, the land is returned to the chief for reallocation; this is, however, uncommon in practice.

Each household is entitled to three fields although this no longer happens because of population pressure. The average arable land per household is 1,2 hectares (Mochebelele and Mokitimi, 1992). Even though there is increasing pressure on arable land, land under

cultivation declined from 450 000 ha in 1960 to 301 369 ha in 1988/89 (Bureau of Statistics and Ministry of Agriculture, 1990). Coupled with this is increasing fallow land. Between 1973/74 and 1988/89 fallow land averaged 20 percent of the total arable land per year (Bureau of Statistics and Ministry of Agriculture, 1990). The Land Act (1979) introduced to address the land tenure system in the country provided for the leasehold system of land tenure. The traditional laws and practices relating to land use and tenure have prevailed to this day, despite the passage of the Land Act (1979) which has remained largely unimplemented.

Table 1.3: Proportion of rural households possessing fields and livestock.

Variable	Percent of households
Fields and livestock	47,4
Fields only	28,0
Livestock only	8,0
No fields and livestock	16,4

Source: Bureau of Statistics (1988).

1.5 Household incomes and expenditure

The 1986/87 Household Budget Survey concluded that the average monthly cash income for urban Maseru was R410, for other urban areas R361 and for rural areas R211. The average monthly cash income per household for the country was R236. Indications are that average monthly household income increases as the household size increases. The income distribution in Lesotho is very skewed. Using Lorenz-curve analysis, it was found that 50 percent of the population with the lowest total income accounts for 10,3 percent of the total

incomes, while the 10 percent with the highest income has 47 percent of the total income (Bureau of Statistics, 1988).

Indications are that 37 percent of rural households' major source of income is migrant cash remittances. Approximately 26 percent of the rural households' main source is subsistence farming, as shown in Table 1.4.

Table 1.4: Main sources of income for rural households - 1986/87.

Source	Percent of households
Migrant cash remittances	37,4
Subsistence farming	25,7
Cash cropping and livestock	12,6
Wages and salaries	11,1
Business income	2,7
Other sources	10,5

Source: Bureau of Statistics (1988).

Migrant remittances contributed 52,7 percent of total rural households' income followed by subsistence farming which contributed 16,1 percent (Table 1.5). The major cash crops grown in Lesotho are asparagus and beans. Under livestock, the sale of wool and mohair are the major sources of cash income.

Table 1.5: Contribution of total rural household income by main source - 1985/86

Variable	Percent of total income
Migrant remittances	52,7
Subsistence farming	16,1
Wages and salaries	11,1
Cash cropping and livestock	10,6
Business income	4,6
Other sources	4,9

Source: Bureau of Statistics (1988).

Food and beverages account for a large proportion of rural households' expenditure, followed by clothing and footwear. This is indicated in Table 1.6. Maize meal accounted for 9,5 percent of total household expenditure while wheat meal and bread flour accounted for 4,3 percent. This means approximately 14 percent of total household budget is spent on cereal consumption. Results from the 1986/87 Household Budget Survey indicated that households classified as subsistence farmers produce 25 percent of their consumption needs. This means that 75 percent of their consumption needs are purchased. The annual per capita consumptions of maize, sorghum and wheat in Lesotho are 120 kg, 35 kg and 55 kg respectively (Eckert, 1983). This makes the total cereal consumption per capita 210 kg (Eckert, 1983). This may be compared with FAO/WHO recommended levels of 66 kg for maize, 36 kg for sorghum and 22 kg for wheat, totalling 160 kg per capita. This shows that diets in Lesotho are in favour of cereal consumption.

Table 1.6: Distribution of income expenditure-1986/87.

Expenditure item	Percent
Food and beverages	37,7
Clothing and footwear	18,6
Furniture and household	12,4
Rent, fuel and power	4,8
Transport and communication	4,4
Education and recreation	3,4
Medical and health	2,0
Miscellaneous goods and services	16,8

Source: Bureau of Statistics (1988).

1.6 Crop production

Grains are the most important crops in terms of area allocated to their production. The average area allocated to grain production was 75 percent of the total arable land in Lesotho for the years 1973/74-1988/89 (Bureau of Statistics and Ministry of Agriculture, 1990). Most crops in Lesotho are grown in summer. Wheat and peas are grown in winter and summer. Winter wheat and peas are grown in the Lowlands while summer wheat and peas are grown in the Mountain region.

Lesotho's crop agriculture has experienced a continuous decline since 1978/79 but recovered in 1985/86 as a result of good rains. The overall index of food production (encompassing the five major crops) indicates that from 1973/74 to 1984/85 production on the average declined by about five percent per annum. Maize is the only crop which shows a slight upward trend. Causes of the declining crop production include drought, low yields, low fertilizer applications, low and erratic rainfall, hail, frost and soil erosion. In addition, the

level of money wages in RSA is recognised as a factor affecting agricultural production since suitable levels of subsistence can be reached by most households through mine remittances. It has been postulated that because of this, there exists little incentive to engage seriously in agriculture. Also mine employment means the able-bodied male labour force is not engaged in agriculture and so agriculture is left to women, children and older men.

Table 1.7: Lesotho Crop Production-1964/65-1988/89. ('000 tons).

Year	Maize	Sorghum	Wheat	Beans	Peas
1964/65	110,0	54,0	50,0	1,3	6,6
1965/66	109,0	53,8	58,0	2,1	7,6
1966/67	110,0	55,0	50,0	2,0	6,7
1967/68	106,7	50,0	53,8	2,4	6,5
1968/69	101,9	48,3	59,7	3,1	4,7
1969/70	66,5	56,9	57,9	3,7	4,5
1970/71	74,0	64,0	58,0	4,0	5,0
1971/72	59,0	20,0	24,0	2,0	3,0
1972/73	70,0	43,0	36,0	4,0	4,0
1973/74	122,5	84,0	57,0	7,5	7,2
1974/75	70,3	37,4	45,3	13,4	5,8
1975/76	49,1	24,5	44,6	8,7	5,8
1976/77	125,9	62,3	61,4	20,9	7,0
1977/78	143,2	85,8	57,9	10,8	4,4
1978/79	124,9	70,0	33,6	8,4	6,9
1979/80	105,6	59,3	28,2	3,6	4,6
1980/81	105,7	47,7	17,0	3,5	3,2
1981/82	83,0	26,2	14,5	4,9	4,5
1982/83	76,2	30,7	14,8	1,6	3,4
1983/84	79,4	33,8	17,1	1,3	3,6
1984/85	92,4	54,8	18,4	2,5	3,3
1985/86	86,5	33,5	11,0	3,8	1,5
1986/87	94,9	31,2	18,5	3,3	1,5
1987/88	159,7	53,4	19,2	7,4	2,6
1988/89	137,2	31,1	29,7	9,7	1,5

Source : Bureau of Statistics and Ministry of Agriculture (1990)

Crop production in Lesotho is characterised by significant year to year variations. Crop production reached peaks in the years 1976-1980 and then declined but picked up again

around 1984/85 with maize production reaching record levels in 1987/88 and 1988/89 (Table 1.7). The declines during the early 1980s were mainly caused by drought which affected the whole of Southern Africa. Production increased in 1984/85 when favourable weather conditions were experienced. One of the causes of low crop production in Lesotho is the poor yields realised. Between 1973/74 and 1988/89, the average yields in Lesotho were 775 kg/ha for maize, 767 kg/ha for sorghum, 738 kg/ha for wheat, 404 kg/ha for beans and 493 kg/ha for peas (Bureau of Statistics and Ministry of Agriculture, 1990). As result of low crop production Lesotho is only able to meet about 50 percent of its total maize requirements and 20 percent of its wheat requirements. The shortfall is usually imported from RSA while donations have been received mainly from the EU and the USA.

The government of Lesotho, with assistance from donors, promotes agricultural production in the form of area-based development projects. The following provides an example of such a project in grain production. In 1976 the government undertook to share-crop large areas in the Lowlands for growing winter wheat. This project was known as the Co-operative Crop Production Programme (CCPP) and was based on the traditional concept of share-cropping, with the government and farmers as partners. The objective of the CCPP was to increase the country's winter wheat production by exploiting the large portion of land which usually lies fallow in winter. The government supported all expenses except for harvesting where combine harvesters could not operate. After harvesting the produce was divided equally between the government and land-holders.

The CCPP encountered problems which included a shortage of competent staff to manage the project, causing contractors to be overpaid, and excessive fertilizer and seed used. This

resulted in substantial losses to the government. The programme was modified for cost-sharing between government and farmers, except for ploughing costs, which were to be contributed by government as a subsidy. The modification did not solve the problem of substantial losses and as a result the project was terminated in 1979. The CCPP was replaced by the Food Self-Sufficiency Programme (FSSP) in 1980. The FSSP operated in the Lowlands and Foothills only. Initially the FSSP was financed by the Republic of China (Taiwan) for five years. The objectives of the FSSP were outlined as follows:

(a) to achieve self-sufficiency in maize and sorghum production within a period of 5 years;
(b) to achieve utilization of government-owned farm machinery and equipment; and
(c) to initiate agricultural production based on village co-operatives. (United Nations Food and Agriculture Organization, 1983).

It was intended that in the first year, the programme would aim at demonstrating the reliability of the technology used and all inputs were to be borne by the programme. After harvesting, the output was again to be shared equally between government and farmers. In the second year, farmers were to pay half the production costs and receive three-quarters of the output. From the third year onwards, all costs were to be borne by farmers. In this case farmers would be renting government machinery with the output belonging to them.

The FSSP also encountered problems, the major problem being that its technology was highly capital intensive and expensive. When it came to sharing the output, the FSSP wanted to recover its costs which were high. This resulted in the FSSP taking all the output and farmers became discouraged from participating in the programme. The FSSP is still in

operation albeit in a modified form, at present providing credit to farmers through the Lesotho Agricultural Development Bank to undertake all the production tasks from ploughing up to seeding with farmers having to pay back all the costs.

1.7 Crop marketing

Prior to 1973/74, the marketing of crops, livestock and their products and the supply of agricultural inputs rested largely in the hands of private traders. In 1973, the government established two parastatals, namely, the Produce Marketing Corporation (PMC) and the Livestock Marketing Corporation (LMC). The PMC became the sole agency under which grains and pulses could be marketed while the LMC was involved in the marketing of livestock, wool and mohair. With the introduction of parastatals the role played by traders in the agricultural marketing system diminished. Since traders were only allowed to be involved in the agricultural marketing system as agents of the parastatals they withdrew from the agricultural marketing system though a few traders did remain in the marketing of wool and mohair.

The PMC was dissolved in 1980 due to several reasons including lack of skilled management, insufficient operating margins, no rational pricing structure for crop purchases and lower volumes of marketed throughput than planned (Mokitimi, 1990). Its operations were taken over by Co-op Lesotho. Co-op Lesotho is registered as a co-operative but is a parastatal because government owns 98 percent of the share capital. It also survives on government hand-outs. For example in 1988 the government had to subsidise Co-op Lesotho with R6,2 million (Mokitimi, 1990). At present Co-op Lesotho is the designated marketing

institution for crops and agricultural inputs. The other major players are the mills. Maize is milled at the Lesotho Maize Mills which is government owned, at Maseru Roller Mills and by the Lesotho Milling Company, both owned by Tiger Oats (RSA) and the Lesotho government. Wheat is milled at the Lesotho Flour Mills, a government mill. At present Co-op Lesotho owns about 43 marketing outlets which are mainly concentrated in the Lowlands. Before 1982/83 farmers sold grain only to Co-op Lesotho, which then delivered the grain to the mills. Since that time, farmers have been allowed to deliver directly to the mills.

The grain pricing system followed in Lesotho is termed import parity pricing while for pulses it is termed export parity pricing. This is because Lesotho imports grains and exports pulses. For grains the Lesotho producer price is equal to the RSA marketing boards' selling prices plus transport and handling charges to Lesotho. Maize and sorghum prices are set at the start of the harvesting season, i.e. May/June, and are valid until the next May/June. Wheat prices are set in November/December. For pulses, the Lesotho producer price is equal to the RSA canners' prices minus transportation and handling charges to the RSA. Producer prices for pulses are not fixed as they are for grains.

The agricultural marketing system is being liberalised and this came about with the IMF/World Bank Structural Adjustment Programme which Lesotho adopted in 1988. Under this programme the private sector, including individuals, farmer co-operatives and associations, are allowed to participate in the marketing of agricultural products so as to promote competition. Under this programme Co-op Lesotho was dissolved in 1992 but plans are underway to revive it.

CHAPTER 2

MODELLING FARM HOUSEHOLDS

This chapter provides a review of household economics theory. Household economics theory recognises the fact that most farm households in developing countries are deficit food producers and as such are engaged in both production and consumption. For this reason it is argued that household economics is appropriate in analysing farm households' response to policy-related variables in Lesotho. The major policy-related variables expected to have a significant impact on crop production in Lesotho are producer prices, retail (consumer) prices, off-farm wage rates, import prices and interest rates.

2.1 Introduction

Recently household economics theory has been applied extensively in analysing the behaviour of farm households in developing countries. Household economics literature can be traced back to original contributions by Chayanov (1966) and Becker (1965). These and contributions by Mellor (1963), Sen (1966), Hymer and Resnick (1969), Krishna (1970) and Nakajima (1970) provided a basis for the more recent models described by Barnum and Squire (1979) and Low (1986) (Lyne, 1989:27).

Hazell and Norton (1986:139) indicate that agricultural decision problems involve choices at least two levels: at one level (the macro level) a policy maker is trying to decide how best to allocate funds in the face of more than one objective and in the face of uncertainty about

what all the allocational consequences will be, and at the other level (the micro level) farmers have their own decision problem: how best to respond to the new policy environment, given their own objectives and limitations of actions.

In developing countries there is much government intervention in the agricultural sector and in most cases policy makers do not know how farmers will respond to alternative policies. Government intervention can be in the form of policies aimed at influencing production, consumption, marketing or international trade. Government intervention can also be aimed at generating revenue, subsidising consumers and producers, secure self-sufficiency, increase foreign exchange or improve rural households' income. In Lesotho, as previously mentioned, government has intervened in the agricultural sector in various ways with not much success. The major problem seems to be that policy makers are uncertain of farmers' responses to the various policies so that several policies have been tried to see which one will illicit the expected responses.

Household economics theory provides a theoretical and empirical analysis of how farm households respond to government interventions in the agricultural sector. Household economics models are designed to capture several factors which determine households' resource allocations so that results of the analysis can be applied empirically to illuminate responses to policy interventions. Agricultural household models provide insight into three broad areas of interest to policy makers: the welfare or real incomes of agricultural households; the spill-over effects of agricultural policies on the rural, nonagricultural economy; and, at a more aggregate level, the interaction between agricultural policy and international trade or fiscal policy (Singh *et al*, 1986:30).

Household economics theory has been applied mostly in Asian countries, e.g. Barnum and Squire (1979) and Ahn *et al* (1981). Studies which have applied household economics theory in Southern Africa are Low (1986), Cartwright (1988), Lyne, Cartwright and Ortmann (1989), Mudenda (1989), Lyne (1989), Becker (1990), Lyne, Ortmann and Vink (1991), and Holden (1992).

2.2 The Chayanov model

The Chayanov model is sometimes termed drudgery averse peasant theory or demographic model of household decision making. It was first advanced by A.V. Chayanov in the 1920s. He was trying to analyze the behaviour of Russian peasants. In this model the focus is on the subjective decision made by the household with respect to the amount of family labour to commit to farm production in order to satisfy its consumption needs.

The assumptions of the model are:

(a) there is no market for labour - this means there is no hiring of labour by the household nor wage employment outside the household by members of the household;

(b) farm output may be retained for home consumption or sold in the market and is valued at the market price;

(c) all farm households have flexible access to land for cultivation;

(d) in each peasant community there is a socially determined minimum acceptable income per person and thus by implication, the household as a unit has a minimum acceptable consumption level (Ellis, 1988).

The household is seen as having two opposing objectives: an income objective which requires work on the farm, and a work-avoidance objective (because of the drudgery of farm work) which conflicts with income generation. The main factor influencing the trade-off between the income and work-avoidance objectives is the size of the household and its composition between working and non-working members, i.e. the demographic structure of the household.

The economic problem facing the farm household is to maximize utility subject to three constraints: (i) the production function, (ii) the minimum acceptable income, and (iii) the maximum number of working days available. Thus Max $U = f(Y,H)$

s.t. $Y = Py.f(L)$

$Y \geq Y^*$

$L \leq L^*$

Where Y = income, H = leisure, Y^* = minimum acceptable income, L^* = maximum number of working days available.

Assuming that it is the production function rather than the other constraints which is binding, the solution to the problem occurs where marginal rate of substitution of leisure for income equals the marginal product of labour, i.e. $MU_h/MU_y = dY/dH = MVP_L$. According to the model, the MVP_L in peasant production is variable between households according to their demographic structure. At equilibrium, the marginal product of labour equals the subjective

value of family labour time (dY/dH), i.e. the amount of income required to compensate for the loss of one unit of leisure.

2.3 Becker's allocation of time model

Becker's allocation of time model is considered the basis of the new household economics. Unlike conventional theory, in which an individual consumer has a utility function which represents his/her preference ordering between the range of market goods and services he/she can purchase, the new household economics emphasises the fact that market goods and services are not themselves the agents which carry utility but rather are inputs in a process that generates commodities which in turn yield utility. The utility or happiness resides in the goods and services themselves. A household is seen as a production unit which converts purchased goods and services, as well as domestic resources, into a set of final use values yielding utility in consumption. It is recognised that market goods and services are not the only inputs in the production process, the other input being consumers' time.

Households combine time and market (purchased) goods via a production function to produce basic commodities called Z-goods and choose the best combination of the commodities in the conventional way by maximising utility subject to its production function, a total time constraint and a money income. The utility function is in the form $Z = (Z_1, Z_2, \ldots, Z_n)$. Home production is given by $Z = f(X,T)$, where X is purchased market goods and T is total time. The total time constraint (T) is given by work time outside the household (Tw) and the sums of the times allocated to Z-good production (ΣTi), i.e. $T = Tw + \Sigma Ti$. The

money income constraint (Y) is determined by the market wage rate multiplied by the time allocated to wage work (WTw). In equilibrium this money income must equal the value of X-goods used as inputs into Z-good production ($\Sigma PiXi$), where the Pi are prices of the X-goods. This means $Y = WTw = \Sigma PiXi$.

However, the time constraint is not independent of the income constraint. Time can be converted into money income by valuing all units of the household's time (T) at the market wage rate. By combining the time and income constraints, the "full income" constraint (S) is obtained, i.e. $S = WT = W\Sigma Ti + PiXi$. A unit of Zi can be written as the sum of prices of the purchased goods and the time used, i.e. $Z = bPx + tW$ where b and t are the inputs of X and Ti per unit of Z respectively.

For a linear production function, the equilibrium condition is obtained by maximising $U = f(Z)$ subject to $(bPx + tW)Z$ and $Z = f(Xi, Ti)$. The equilibrium is obtained where $dU/dZ = y\ (bPx + tW)$ where y measures the marginal utility of money income and $bPx + tW$ represents the full price or marginal cost of producing a unit of Z. If the production is not linear, the marginal cost of producing a unit of Z is $Px/MPx + W/MP_L$. This means the marginal cost of Z is the sum of market prices multiplied by the inverse of the marginal products of the purchased commodities used in its production, and the wage rate multiplied by the inverse of the marginal product of the household time allocated to its production. The Becker's allocation of time model can be shown graphically as in figure 2.1.

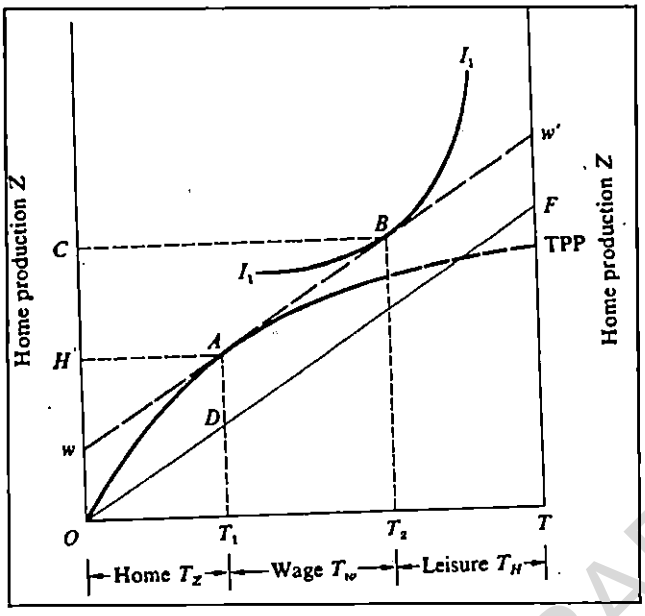

Figure 2.1: Becker's home production model.

Source: Ellis (1988:125)

In Figure 2.1, T = Total time available for all activities of the household and Tz is home work time. Tw is wage work time while Th is leisure time. Thus T = Tz + Tw + Th. The opportunity cost is given by the real market wage (W/P) where W is the money wage and P is the general price level of purchased goods. OF, which has a slope of W/P, describes the rise in total real income as hours increase. Point F represents the full opportunity costs of household time obtained by valuing the total hours available (T) at the real wage, i.e. F = WT/P. TPP is the production function which represents the transformation of home work time (Tz) into final home output, Z. Ii is the indifference curve which represents a given level of utility obtained by different combinations of leisure and Z. WW' represents the opportunity cost of time in terms of market prices.

In the production of Z, the equilibrium of the household is given at point A, where MPP of home work equals the real wage rate, i.e. MPP = W/P or MVP = W. In the consumption of Z, the equilibrium of the household is given at point B, where the marginal rate of substitution of leisure for Z (MU_l/MU_z) equals the ratio of the opportunity cost of leisure to the market price of the ingredients of Z (W/P).

2.4 The Barnum-Squire model

The Barnum-Squire model was developed in 1979 and this model is important because it provides a framework for generating predictions about the responses of the farm household to changes in domestic variables (family size and structure) and market (output prices, input prices, wage rates and technology) variables. The assumptions of the Barnum-Squire model are (Ellis, 1988):

(a) there exists a market for labour so that farm households are able to hire in and hire out labour at a given market wage;

(b) land available for the farm household is fixed, at least for the duration of the production cycle;

(c) "home" activity (production of Z-goods) and leisure are combined and treated as the same consumption item for the purposes of utility maximization;

(d) an important choice for the household is between own consumption output (C) and sale of output in order to purchase non-farm consumption needs (M);

(e) uncertainty and behaviour towards risk are ignored.

The utility function is given as $U = f(Tz, C, M)$ where Tz is leisure plus time spent in producing Z-goods, C is the share of farm output consumed, and M is the quantity of purchased goods. The production function is written as $Y = f(A, L, V)$ where A is the fixed land area, L is total labour (both household and hired) and V is other variable inputs used in production.

The household utility is maximized subject to the production function, time and income constraints. The time constraint is given by $T = Tz + L - Tw$ where Tw is time allocated to wage work. $Tw > 0$ if labour is hired in and $Tw < 0$ if labour is hired out. The household's own farm labour can be defined as Tf and hired labour as Th, i.e. $L = Tf + Th$. The income constraint requires that the set money income should equal expenditure on purchased consumption goods. The income constraint is written as

$$Py(Y-C) + WTw - WTh - XPx = NPn$$

where Py is the market output price, (Y-C) is the share of output sold, W is the market wage, Px is the price of purchased variable inputs and Pn is the price of purchased consumption goods. As in Becker's model, the time and income constraints can be collapsed into a single full income constraint,

$$S = WTz + PyC + NPn = \pi + W(Tz + Tf)$$

where WTz is the opportunity cost of the time constraint in producing Z-goods, PyC is the market value of own farm output consumed, NPn is the value of purchased consumption goods, π is the net farm income and W(Tz + Tf) is the value of total household time.

If there is perfect substitution between household and hired labour in production and between farm produced and market purchased goods in consumption, factor demand equations derived from the profit function can be expressed in terms of input and product prices. The profit maximising conditions of the factor demand equations (labour and other variable inputs) indicate that production decisions are independent of consumption decisions. Such a model is said to be recursive or separable. However, it can be shown that consumption choices are not independent of production decisions because net farm income is part of the full income.

Assuming that households strive to maximize farm profits, full income becomes

$$S^* = \pi^* + W(Tz + Tf)$$

where π^* denotes maximized profits, $\pi^* = PyY^* - WL^* - X^*Px$ and Y^*, L^* and X^* represent profit maximizing levels of output, labour and market inputs respectively. At the second stage of decision making, households are assumed to maximize utility subject to their production function and the modified full income constraint $WTz + PyC + NPn = \pi^* + W(Tz + Tf)$.

The assumption of independence of production and consumption decisions in the Barnum and Squire model allow the empirical estimation of the model to be solved in a sequential way.

First the production function is estimated, and this is used to generate the output and net farm income available to the household. From this an estimate of π^* is computed. For example Ahn *et al* (1981) and Delforce (1994) estimate π^* using linear programming. Second, demand functions for the three consumption choices (Tz, C, N) in the utility function are estimated using a demand system that includes the modified full income constraint. The Linear Logarithmic Expenditure System (LLES), the Linear Expenditure System (LES), Quadratic Expenditure System (QES) and Almost Ideal Demand System (AIDS) are commonly used in estimating the demand equations. Barnum and Squire (1979) and Mudenda (1989) employed a LES model, Strauss (1986) employed a QES model and Delforce (1994) applied an AIDS model. The estimation of demand functions allows profits generated in farm production to influence consumption.

Policy implications of the Barnum-Squire model are analyzed in two stages. Firstly the total response elasticities, measuring the percentage change in an endogenous variable (e.g, food consumption) resulting from a one percent change in an exogenous variable (e.g, food price (Px)) when other exogenous variables are held constant, can be compared for the average sample household using the estimated demand parameters. These household response elasticities (η^*) will differ from conventional response elasticities (η) owing to the inclusion of farm profits in the household budget constraint. According to Barnum and Squire (1979) the total response elasticities can be broken down into component partial elasticities as:

$$\eta y_p = \eta^* y_p + \eta_{ye} \cdot \eta_{e\pi} \cdot \eta_{\pi p}$$

where ηy_p is own price elasticity of food consumption when food profits are allowed to vary; $\eta^* y_p$ is the own price elasticity of food consumption obtained when farm profits are held constant and comprises the usual income and substitution effects of a price change; η_{ye} is the elasticity of food consumption with respect to household expenditure; $\eta_{e\pi}$ is the elasticity of household expenditure with respect to farm profit (π); and $\eta_{\pi p}$ is the elasticity of farm profit with respect to food price.

It is evident that $| \eta^* y_p |$ is likely to be larger than $| \eta y_p |$. Estimates of ηy_p by Barnum and Squire (1979) and Ahn *et al* (1981) in Malaysia and Korea respectively were positive. The positive ηy_p implies that an increase in the price of a crop which is both produced and consumed will affect household consumption directly, because of the increased price, and indirectly because of the increase in the level of farm profits which shifts the household's full income. In the cases of Malaysia and Korea, where rice is the staple food, an increase in the price of rice increases farm profit and hence the real budget constraint to raise rice consumption. The indirect effect, through which farm production influences household consumption is termed the "profit effect" (Singh *et al*, 1986).

Barnum and Squire's (1979) study and similar studies conducted in other Asian countries predicted negative household supply response with respect to product prices (Singh *et al*, 1986). The decline in household labour supply (leisure being a normal good) dramatically increased the demand for hired labour. In the case of Lesotho many household members are employed in off-farm jobs in South Africa as migrants and urban areas in Lesotho and this means the profit effect is unlikely to occur in Lesotho. If farm earnings increase in Lesotho, as a result of a maize (which is the staple food) price increase, it can be expected that more

household workers would stay in agriculture. This means the total household labour input in agriculture may increase even if individual effort decreases. Nieuwoudt and Vink (1989) have pointed out that the Barnum-Squire model does not draw a distinction between individual effort and the combined effort of all members of the household.

The second stage of the model involves the examination of how the responses interact at market level. For example, a rise in the output price of paddy rice is observed to increase greatly the demand for labour. Barnum and Squire (1979) estimated that a 10 percent increase in paddy price would raise wages by 13,4 percent and that this would convert the positive paddy output response predicted at household level to a negative supply response at market level. Nieuwoudt and Vink (1989) point out that Barnum and Squire do not consider the effects of incomes on the opportunity cost of leisure and this is why the Barnum-Squire model overstates the effect of product price increases on demand for hired labour. In Lesotho, the market supply of farm labour is expected to be price elastic owing to high rates of unemployment and the high proportion of migrant wage workers. This means more household members may decide to stay in agriculture rather than engage in off-farm employment in response to increased farm income.

The Barnum-Squire model is separable and this means it is assumed that hired labour is a perfect substitute for family labour. If hired labour is not a perfect substitute for family labour, the recursive property of the Barnum-Squire model breaks down. The recursive property of the model breaks down further if there are differences between buying and selling prices of output as is the case in Lesotho. In a separable model it is assumed that no risk prevails. If uncertainty and risk aversion prevail, the recursive property does not hold.

Basotho farmers face several farming risks which include drought, hail, frost, pests and diseases and there is evidence that they are averse to risk. When the recursive property of a model does not hold, estimation of the model becomes complex and has been attempted only by a few researchers. Roe and Graham-Tomasi (1986) and Lopez (1986) applied non-separable Barnum-Squire type models to risk aversion and labour market imperfections respectively. The separable model appears to have limited applicability yet it is very common among researchers. Singh *et al* (1986) suggest that separability should be assumed unless there is compelling evidence to the contrary. The main reason for separable models being popular is that they are relatively simple to estimate using econometric procedures.

It seems the Barnum-Squire model is more applicable where producers have marketable surplus as in the Asian countries. The Lesotho case is different in that very few rural households produce marketable surpluses. Indications are that less than 10 percent of the maize production in Lesotho is marketed. Consumption responses using a recursive approach (η^*) would most likely be very similar to conventional response estimates (η). For example, Nieuwoudt and Vink (1989) estimated the own price elasticity of demand for food staples in KwaZulu as -0,53 for food deficit producers and as -0,43 (η) for all producers. This indicates that the impact of profit effects in surplus producing households on η is small. Similar results may be observed in Lesotho as the situation in Lesotho is similar to that of KwaZulu.

On the production side, the Barnum-Squire model maximizes farm profit in the usual way but omits the effects of minimum consumption requirements, risk and leisure preferences on household profit maximizing behaviour (Lyne, 1989:41). In the Barnum-Squire model, the

production side is only relevant in that it generates a profit effect to be included in the full income available for household consumption. Details of how this profit is obtained are of little concern in such a model because it is mainly intended for use in studies of household consumption. This means that the Barnum-Squire model may not be appropriate for a study aimed at investigating farm production. Delforce (1994) suggests that for a researcher primarily interested in consumption or expenditure behaviour of households, the separable approach is superior and if the researcher is interested in production activities, the separable approach may prove inadequate and the programming approach is the preferred method.

2.5 Low's model

Low (1986) developed a household economics model applicable to rural households in Southern Africa. A major characteristic of the less developed areas of Southern Africa is that they are next to an advanced economy of RSA, so that household members have opportunities for engaging in off-farm employment. Low's model is based on Chayanov's subjective equilibrium analysis and Becker's model of time allocation.

The major assumptions of the model are: (i) household members strive to maximize a family utility function; (ii) farm gate and retail prices of farm products are not equal; and (iii) labour can be sold and household members have different wage earning potentials. Low treats a subsistence crop produced on the farm for own consumption as a Z-good.

In Low's model, household utility is expressed as a function of Z-goods. Maximizing utility subject to a full income constraint implies cost minimization in the production of Z-goods. Low assumes that the production function is linear and this is done for convenience sake. The marginal cost of producing a unit of Z-good is given as: $Cz = PxXi + WiTi$ where Cz is the marginal cost, Px is the price of purchased variable input X, X is the amount of input required by household member i to produce a unit of Z-good, Wi is the wage rate of household member i and Ti is the amount of time required by member i to produce a unit of Z-good. In general, the member with the lowest potential wage rate will be allocated to the production of Z-goods. This depends on his/her marginal productivity (1/X and 1/Ti for a linear production function). It is also assumed that Z-goods like subsistence crops can be purchased at retail prices. Assuming that the time required to buy such a Z-good is negligible relative to growing it, the purchase option involves retail market prices (Pz) and savings incurred by not growing it. When $Pz < PxXi + WiTi$, the subsistence requirement will be purchased rather than grown by household member i. Rearranging the above inequality $(Pz - PxXi)/Ti < Wi$ is obtained. Low calls the left hand side of the inequality the "opportunity cost of purchase" for member i and reflects the net money cost of not applying a unit of member i's time to own food production. If the i'th member can earn wages in excess of his/her opportunity cost of purchase with a unit of his/her time, he/she will acquire the subsistence Z-good by engaging in wage employment and purchasing it rather than by growing it.

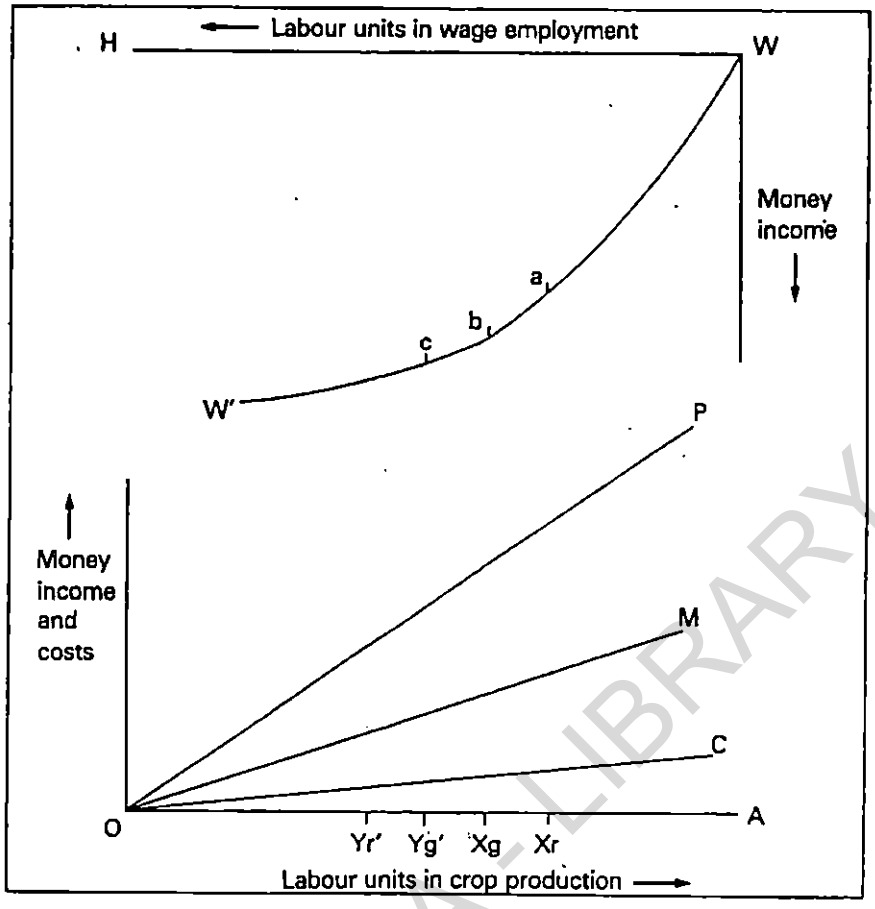

Figure 2.2: Deficit and surplus producers in Low's model

Source: Low (1986:43).

Low's model for a deficit and surplus producer is presented in Figure 2.2. In Figure 2.2, OA measures the total amount of household labour. Labour units are arranged in increasing order of comparative advantage in wage employment along the OA axis. WH is the corollary of OA and is the amount of labour units allocated to wage employment. Money income is measured along the vertical axis. OM represents commercial returns, OP represents the opportunity cost of purchase while OC represents market input costs per standard labour unit. Workers' potential wage rates are given by the slope of the wage line W'W.

Household subsistence requirements can be measured in terms of the labour units needed to grow it (because of the assumption of a linear production function with constant input proportions). A family with OA units of labour and a high consumer:worker ratio may have subsistence requirements met by allocating OXr labour units to farm production. At OXr the wage rate is given by the point a on the W'W line. For the labour unit at OXr, the wage rate exceeds the opportunity cost of purchase (i.e. the slope of W'W is greater than that of OP) and this labour unit will be allocated to wage employment rather than to the production of the subsistence requirements on the farm. Only labour units to the left of Xg will be allocated to the production of the subsistence crop requirements on the farm since to the right of point b the slope of W'W is greater than that of OP. This household would be a deficit producer, purchasing OXr-OXg of its requirements.

A second household with fewer consumers per worker may be able to meet its consumption requirements with OYr' labour units since at Yr' the slope of OP is greater than the slope of W'W. This household will allocate OYg' labour units to subsistence crop production since the slope of W'W to the left of point c and Yg is less than that of OM. To the right of Yg' and point c, labour units earn a better return in wage employment than producing the subsistence crop for sale to generate income. This household will produce a surplus of OYg'-OYr'. Although this household is a surplus producer, it might allocate more labour to wage employment than a deficit producer.

Lyne (1989:47-51) mentions some of the problems which are inherent in Low's model. These include:

(a) the way the model allocates household enterprises (on and off the farm) is no different from what microeconomic theory would predict in the given circumstances;

(b) it is assumed that household labour can be sold at different rates in off-farm employment while the possibility of hiring farm labour is not considered;

(c) the analysis does not permit input substitution;

(d) household food consumption is fixed at a subsistence level and does not vary with changes in income or food prices;

(e) leisure and risk are not treated explicitly;

(f) the effects of capital and land constraints, seasonal production, lumpy labour inputs and variations in soil fertility and bioclimate on resource allocation are ignored.

2.6 Variables expected to impact on crop production in Lesotho

The major policy-related variables expected to have significant impact on crop production in Lesotho are producer prices, retail prices, off-farm wage rates, import prices, and interest rates.

2.6.1 Producer prices

Changes in producer prices will have different impacts on deficit food producers and surplus food producers. For deficit food producers, an increase in producer and consumer prices is

expected to reduce household welfare as the household has to purchase the shortfall in consumption needs. An increase in producer prices with no increase in consumer prices can be expected not to affect deficit food producers. An increase in producer prices is expected to lead to the transfer of marginal household labour from non-farm work to farm work and to encourage deficit producers to substitute purchased food with own production. The consumption of leisure is expected to fall as the price increase raises the opportunity cost of leisure and lowers real household income. For surplus food producers, increase in producer prices is expected to be beneficial. A transfer of marginal household time from non-crop activities to crop activities can be expected. Household income and welfare can be expected to increase. Thus an increase in producer prices is expected to lead to increased food production but because a large proportion of households in Lesotho are deficit producers, producer price increase is not expected to have a substantial impact on crop production. This means a small decrease in fallow land is expected to occur.

A decrease in producer prices is expected to have a greater impact on surplus food producers than on deficit food producers. A decrease in producer prices is expected to have opposite effects to an increase in producer prices for surplus producers.

2.6.2 Retail prices

The impact of changes in retail (consumer) prices on both deficit producers and surplus producers are the same as changes in producer prices. An increase in retail prices is expected to affect deficit food producers more than surplus food producers. As the majority

of farmers are deficit producers, retail price increases harm a large proportion of the population.

2.6.3 Off-farm wage rates

An increase in off-farm wage rates will raise the opportunity cost of time spent in crop production and this may lead to a removal of marginal labour from on-farm work. Household welfare should increase. The impact on crop production is however not clearcut. On the one hand crop production is expected to fall as farm labour is diversified to wage employment. On the other hand, high off-farm wage rates encourage farm households to seek and adopt timesaving technologies, which enable them to devote more time to wage employment or raise their returns to time spent on farm production (Low, 1986).

A decrease in off-farm wage rates should reduce household welfare and may lead to a decrease in fallow land thus increasing planted area. There may be an increase in the level and intensity of labour used in crop production.

2.6.4 Import prices

A vast majority of rural households in Lesotho are deficit food producers. The shortfall in consumption requirements are met through imports which are paid for by off-farm wage remittances. A *ceteris paribus* increase in import prices is expected to have negative effects on deficit producers. As with retail prices, an increase in import prices is expected to affect deficit producers more than surplus producers. An increase in import prices is expected to

lead to increased food production as households substitute own production for imported food. Fallow land is expected to decrease.

A *ceteris paribus* decrease in import prices is expected to increase households' welfare. Because the majority of households are deficit producers, the decrease benefits a large proportion of the people. It is expected that there will be an increase in imports of affected food crops and production of unaffected crops will increase.

2.6.5 Interest rates

Changes in interest rates are expected to affect households participating in FSSP. Households participating in FSSP comprise a very small proportion of the population so that changes in interest rates will not have much effect on the overall population. A *ceteris paribus* increase in interest rates is expected to lead to a decrease in the welfare of households participating in FSSP. With regards to production, an increase in interest rates is expected to lead to a decrease in FSSP production and an increase in own production. This may lead to a decrease in fallow land as yields under own production are relatively lower and a larger area is needed to substitute for FSSP production.

A *ceteris paribus* decrease in interest rates is expected to increase FSSP production which may lead to an increase in total production if households' own production does not change. Total production may not change if the increase in FSSP production is coupled with a decrease in own production. Fallow land may decrease because FSSP yields are relatively higher so that a smaller area is needed to substitute for own production.

CHAPTER 3

MODELLING APPROACH

This chapter provides a description of the development of a mathematical programming model used to simulate the effects of various economic policies on resource allocation in agriculture. The programming model aggregates enterprise levels for four representative household types to form a sector model.

3.1 Mathematical programming models

The primary focus of the study is on crop production activities and how these are affected by policy-related variables. It was noted in section 2.1 that the Barnum-Squire model is not appropriate where the focus is on production activities. Low's model is considered to be suitable for the study. In farm households models there is allocation of resources between competing activities and mathematical programming is thought to be an appropriate tool for such situations. In mathematical programming models it is simple to combine both production and consumption aspects in the same model. The effects of risk and leisure preferences, lumpy labour inputs, resource constraints, factor substitution, seasonal production and differences in agronomic conditions in household resource allocation can be accounted for in mathematical programming models. A further advantage of mathematical

programming is that representative farms can be aggregated to a sector level to allow investigation of some of the wider implications of production changes.

3.2 Data source

A survey of 160 crop-producing households was undertaken from October 1992 to January 1993. The survey covered rural areas in the northern Lowlands and Foothills of Lesotho, consisting of the districts of Butha-Buthe, Leribe, Berea and Maseru. These regions were selected as the study area because they comprise the largest proportion of arable land and are the major crop producing regions of Lesotho.

A three-stage sample method was applied, each enumeration area, as designed by the Lesotho Bureau of Statistics, was taken as the primary sampling unit. The villages were the secondary sampling units, and crop-producing households the third stage sampling units. The primary sampling units were selected with probability proportional to size (PPS). Villages and farm households were selected randomly. Four enumeration areas were selected in each region. In each enumeration area, two villages were selected and in each village 10 crop-producing households were selected. This means that in each enumeration area, 20 crop-producing households were selected. In some cases a village made up an enumeration area and in such cases 20 crop-producing households were selected from that village. The total sample size of 160 households consisted of 80 from the Lowlands and 80 from the Foothills.

3.3 Household types

In this study, Low's model of agricultural households in Southern Africa is applied. The central thesis of Low's model is that different household members face different off-farm wage earning potentials and that the household member with the greater off-farm wage earning potential will be allocated to wage employment and the household member with low off-farm wage earning potential will be allocated to subsistence production on the farm (Low, 1986). In order to classify household members into those with high and low wage earning potential, offer wage rates had to be predicted for household members not wage employed.

In each selected household, information was recorded for all household members between ages of 16 and 59 as they were considered economically active. In the sample of household members, 95 men and 95 women were from the Lowlands and 116 men and 121 women were from the Foothills. Table 3.1 presents the wage employment situation in the two regions.

It is evident from Table 3.1 that more men than women are wage employed. Most of the wage employed men work in RSA while a significant proportion of women work within Lesotho. Fewer women are wage employed because of low employment opportunities in Lesotho. As a result of the low average monthly wage earned by women compared to men and the difference in average schooling years for men and women, offer wages were analysed separately for men and women.

Table 3.1: Wage employment, monthly wages and schooling years of males and females sampled in northern Lowlands and Foothills of Lesotho, Oct. 1992-Jan. 1993.

	Men	Women	Total
Total sample	211	216	427
Lowlands sample	95	95	190
Foothills sample	116	121	237
Wage employed	75	34	109
Wage employed in RSA	58	7	65
Wage employed in Lesotho	17	27	44
Average monthly wage (Rands)*	728,80	358,88	-
Average schooling (years)	4,2	7,8	-

* For those employed

The effect of education on wages that can be earned outside agriculture can be studied through reservation and offer wage models. The supply curve of off-farm labour represents the quantity of labour supplied to the market at a given market wage. It is usually assumed that wage employees participate in the labour market because the offer wage (market wage) exceeds their reservation wage. This means that those not participating in wage employment do so because offer wages are less than their reservation wages. According to Mincer (1974) there are usually limited observations on the dependent variable in offer wage models. The dependent variable (wage) is observed only within a limited range (wage$>$0). In such cases ordinary least squares (OLS) regression estimates of the model may not be unbiased and consistent.

The offer wage model can be written as (Mincer, 1974):

$$OW_i = aX_i + u_i \qquad (1)$$

Where OW_i = Offer wage of the i^{th} wage employee.

X_i = A vector of personal attributes (e.g. education and work experience) of the i^{th} wage employee.

u_i = A disturbance term.

The reservation wage depends upon an individual's opportunity cost of engaging in wage employment, his/her preference for leisure and the type of work involved. The reservation wage model can be shown as (Ryan and Wallace, 1985):

$$RW_i = bY_i + v_i \qquad (2)$$

Where RW_i = Reservation wage of the i^{th} employee.

Y_i = A vector of attributes affecting the opportunity cost and preferences (e.g. age, education, farm size and number of dependents) of the i^{th} individual.

v_i = A disturbance term.

If $OW_i > RW_i$ the individual will participate in wage employment otherwise he/she will not participate. The probability of engaging in wage employment is determined by the probability that $OW_i > RW_i$ or $Pr((aX_i - bY_i)/\delta > Z_i)$ where δ is the standard deviation of $(u_i - v_i)$ and Z_i is a standardised normal deviate. If u_i and v_i are jointly normal, participation in wage employment may be analysed using a probit model with the dependent variable set to one for participants and zero for non-participants and explanatory variables drawn from both X_i and Y_i (Ryan and Wallace, 1985).

To avoid sample selectivity bias which may arise when model (1) is estimated using OLS, the Heckman (1979) approach was adopted. The Heckman (1979) approach checks for sample selectivity bias if error terms are assumed to be normally distributed. Heckman (1979: 156-159) recommends inclusion of an intensity ratio as an additional explanatory variable in a regression model of offer wage rates for those participating in wage employment. The intensity ratio (λ_i) is computed as:

$$\lambda_i = \phi(Z_i)/\Phi(Z_i)$$

where ϕ and Φ are the density and cumulative distributions of a standard normal variable:

$$Z_i = aX_i/\delta$$

The index Z_i is calculated from the probit function. The ratio λ_i is a function of the probability that a member of the household (worker) is selected into the sample of wage employees. If sample selectivity bias exists, OLS regression coefficients estimated for λ_i will be statistically significant while coefficients estimated for explanatory variables in the model will be consistent. If sample selectivity bias is not present, λ_i will be statistically insignificant and may therefore be excluded from the model. If λ_i is statistically insignificant, the labour force participants represent the entire sample.

Data were pooled as no significant slope or intercept differences were detected between the two regions. The variables included in the probit model are education (in number of years), age (years), a measure of dependency (PDEP) and VLPROD (Rands). PDEP represents the number of children under 16 years of age plus adults of over 59 years of age expressed as a fraction of all household members. Adults of over 59 years of age are considered dependents in the absence of old-age pension in Lesotho. VLPROD represents the value of total production and this is valued at local village level (farm gate) prices.

Before the offer wage model (equation 1) was estimated, a probit model was fitted using data obtained in the survey. Table 3.2 presents results of the probit model in which the dependent variable is 1 if wage employed and 0 if not wage employed. Results indicate that education has a positive but insignificant effect on off-farm employment decisions of men. For women, education has a positive and significant effect on off-farm employment decisions. Age has a positive and significant effect on off-farm employment decisions of both men and women. Results suggest that participation in the wage market follows a quadratic age pattern. A very large proportion of Basotho men work in RSA mines as migrants. The Lesotho Labour Force Survey (Bureau of Statistics, 1990) indicates that approximately 50 percent of male migrants working in the mines were in the age group 20-34 years. Due to the physical nature of mining work, preference is given to young and able-bodied men.

Table 3.2: Probit analysis of off-farm employment decisions by males and females sampled in northern Lowlands and Foothills of Lesotho, Oct. 1992-Jan. 1993.

Dependent	variable= 1 wage employed, 0 otherwise			
	Males		Females	
	Coeff.	t-statistic	Coeff.	t-statistic
Intercept	-0,513	-0,504	-1,718	-1,089
EDUCATION	0,034	1,117	0,237	4,521**
AGE	0,264	4,932**	0,179	2,487*
$(AGE)^2$	-0,003	-4,767**	-0,002	-2,210*
PDEP	1,673	0,974	3,484	1,149
$(PDEP)^2$	-3,328	-1,601	-2,948	-0,963
VLPROD	-0,003	-0,398	-0,002	-0,945
DF	204		209	
N	211		216	
Wage employed	75		34	
Not wage employed	136		182	

** Statistically significant at the one percent level of probability.
* Statistically significant at the five percent level of probability.

The PDEP for both men and women has a positive and insignificant effect on off-farm employment decisions implying that a higher proportion of dependents in a household has no significant effect on wage employment. VLPROD has a negative and insignificant effect on off-farm employment decisions of both men and women. The latter finding concurs with results by Simpson and Kapitany (1982:804), Van Kooten and Arthur (1985:28) who observed off-farm employment decisions negatively related with value of farm assets. The probit model predicted 88 percent of the wage employed individuals correctly and 80 percent of individuals not wage employed correctly.

Estimates of the offer wage model (equation 1) are presented in Table 3.3 using data from the survey and results obtained from the probit model. An interactive dummy (D_i) which is equal to 1 if an individual is wage employed in Lesotho and 0 if wage employed in RSA is included in the offer wage equation. The purpose of the dummy is to asses whether there is a change in the magnitude or the significance of the education variable depending on whether an individual is wage employed in Lesotho or as a migrant in RSA. In this case the natural logarithm of the monthly wage rate is a function of D_i (Dummy), education, D_i *education, experience, experience squared and λ. Experience is defined as age-education-6 (Furtan *et al*, 1985:215 and Lyne, 1989:81). Results of the Heckman equation are not presented as they were inconclusive. Firstly, the additional variable (λ) was not significant for both male and female equations. Secondly, there was multicollinearity in which λ was highly correlated with education. As a result all the variables became statistically insignificant in the Heckman equation. Thus conclusions as to whether sample selection bias is present or not could not be made.

The OLS results (Table 3.3) show that for men place of employment and the interaction between education and place of employment have a statistically significant effect on off-farm wages. The offer wage equation for men employed in Lesotho and RSA have different intercepts and slopes. Both intercepts and slopes of the offer wage equations are statistically significant indicating that offer wages equations are different for men employed in Lesotho and RSA. The intercept is higher for men wage employed in RSA indicating that wages are higher in RSA than Lesotho. The slope of the offer equation is higher in Lesotho and the interaction term is significant indicating that education is a more significant factor in off-farm wages in Lesotho as compared to RSA. The higher coefficient of the slope of the men offer wage equation in Lesotho implies at the higher levels of education, wages are relatively higher in Lesotho than in RSA.

Table 3.3: OLS offer wage equations for wage employed males and females sampled in northern Lowlands and Foothills of Lesotho, Oct. 1992-Jan. 1993.

Dependent variable=ln (monthly wage)				
	Males		Females	
Explanatory Variable	Coeff.	t-statistic	Coeff.	t-statistic
Intercept	5,497	14,910***	6,153	6,731***
D_i	-1,368	-5,921***	-1,934	-2,716***
EDUCATION	0,023	1,054	0,008	0,086
D_i*EDUCATION	0,082	2,194**	0,157	1,719*
EXPERIENCE	0,077	3,122***	-0,001	-0,024
$(EXPERIENCE)^2$	-0,001	-2,820***	-0,0001	-0,177
N	75		34	
R^2	0,560		0,437	
F		19,839***		6,131***

*** Statistically significant at the one percent level of probability.
** Statistically significant at the five percent level of probability.
* Statistically significant at the ten percent level of probability.

For men wage employed in RSA, i.e. $D_i=0$, the offer wage equation is (t-values in parentheses);

Ln (monthly wage) = 5,497 + 0,023*EDUC + 0,077*EXPER - 0,001*(EXPER)^2

(14,9) (1,0) (3,1) (-2,8)

highlighting the non significant effect of education on off-farm wages. This is plausible given the situation that most men in Lesotho work as migrants in RSA mines. The Labour Force Survey (Bureau of Statistics, 1990) indicates that 81 percent of male migrant workers had not completed primary school education. The Labour Force Survey results show that men with no formal education had a high labour force participation rate of 89 percent. According to Van der Wiel (1977) the better educated men are more often able to find suitable employment in Lesotho, and that it tends to be the illiterate and poorly educated who work in RSA. This is understandable as work in the mines is mainly based on the health and physical abilities of the workers. OLS results show that an extra year of schooling adds approximately two percent to the monthly wage of men employed in RSA even though education is not statistically significant at the 5 percent level of probability. Low "returns to education" for men wage employed in RSA might be caused by the high proportion of men working as migrants in RSA mines requiring physical work where education may not be as important as the sex of the workers. In most cases young males in rural areas do not attend school and instead herd livestock. At approximately 18 years of age they seek employment in RSA mines.

For men wage employed in Lesotho, i.e. $D_i=1$, the offer wage equation is (t-values in parentheses);

Ln (monthly wage) = 4,129 + 0,106*EDUC + 0,077*EXPER - 0,001*(EXPER)^2

(3,1) (-2,8)

showing that for men wage employed in Lesotho education has a greater positive effect on off-farm wages. The effect is also significant as the interaction term is significant at the 5 percent level of probability. The estimated "returns to education" for men employed in Lesotho is 11 percent, indicating that an extra year of schooling adds approximately 11 percent to the monthly wage of men employed in Lesotho. Most men in Lesotho work as teachers and civil servants and these job categories require an educated labour force. The Lesotho "returns to education" of 11 percent for men employed in Lesotho are comparable with estimates from other studies. Lyne (1989:82) estimated "returns to education" of eight percent for men in KwaZulu while Donaldson and Roux (1994) reported "returns to education" of 8,7 percent for black RSA men. Furtan *et al* (1985:217) reported "returns to education" of 9,6 percent for men in rural Saskatchewan (Canada).

The offer wage equation for women as far as the effect of education is similar to that of men. As in the offer wage equation for men, the intercept and slope coefficient of the women offer wage equation are different. The intercept is higher in the RSA indicating that wages are relatively higher in RSA than Lesotho. The slope coefficient is higher in Lesotho indicating that eduction is a significant factor in off-farm wages in Lesotho compared to non-significant in RSA.

For wage employed women in RSA, i.e. $D_i=0$, the offer wage equation is (t-values in parentheses);

Ln (monthly wage)=6,153+0,008*EDUC-0,0009*EXPER-0,0001*(EXPER)^2

(6,7) (0,09) (-0,02) (-0,18)

showing that for women wage employed in RSA education is not a significant factor in off-farm wages. An extra year of schooling adds approximately one percent (although non-significant) to the monthly wage of women. This is understandable because most women working as migrants in RSA work as domestic servants and hawkers. These jobs do not need skilled labour and education is not in important factor in such job categories. A small proportion of women work as migrants outside Lesotho.

For women wage employed in Lesotho, i.e. $D_i=1$, the offer wage equation is;

Ln (monthly wage)=4,220+0,1648*EDUC-0,0009*EXPER-0,0001*(EXPER)^2

indicating that for women wage employed in Lesotho education has a larger and more significant effect (interaction term significant at 10 percent level) on off-farm wages. An extra year of schooling adds approximately 16 percent to the monthly wage of women. In addition to being employed in similar jobs as men, many women are employed as nurses. Population censuses (1966, 1976 and 1986) show that the female population of Lesotho is better educated and more literate than their male counterparts - a fact which is contrary to what is usually observed in most developing countries (Bureau of Statistics, 1991d). The 16

percent "returns to education" for women employed within Lesotho are similar to estimates of 11 percent for women in KwaZulu (Lyne, 1989:82) and 10,5 percent for black women in RSA (Donaldson and Roux, 1994). Furtan *et al* (1985:217) provide estimates of 8,7 percent for women on Saskatchewan farms.

Although the results indicate that in Lesotho women tend to be more educated than men, indications are that at the highest levels of education the proportion of men is greater (Bureau of Statistics, 1993). This has resulted in men dominating high ranking positions in the country. Some people, especially those in rural areas, still reject the idea of educating women, as it does not benefit their maternal families, but rather that of their husbands (Bureau of Statistics, 1993).

A main difference between the male and female offer wage equations is that experience is significant for males but non significant for females. This is attributed to the nature of the employment market as experience is an important factor in determining wages for males working in RSA mines. The R^2 values compare favourably with those reported in similar studies. Sumner (1982:505), Rozenzwieg (1984:232) and Lyne (1989:81) reported R^2 values of between 0,157 and 0,380.

During the course of their service outside the country, migrant workers send remittances periodically to their families and immediate relatives. The remittances are either sent as deferred payments, formal remittance or informal remittances. The deferred pay system was introduced in 1974 and involved miners being given 40 percent of their monthly salaries and 60 percent is deposited with Lesotho Bank in Lesotho. Miners receive the 60 percent of their

salaries in Lesotho at the end of their contracts. This meant miners could only remit part of the 40 percent given to him. The deferred pay system was changed in 1991 and miners are now given 70 percent of their salaries and 30 percent is deposited with Lesotho Bank. Formal remittances are sent to dependents through the mines. The dependents receive the money at the recruiting agencies in Lesotho. Informal remittances are brought home by the miners when they come home for weekends, holidays and leave.

It is assumed that households' cash income is from (i) the sale of produce (cropping activities) and "net" wage remittances, (i.e. remittances net of food and travel expenses) (ii) off-farm wage workers provide for all of their own consumption requirements out of non-remitted wage income. A double-log OLS net remittance wage equation was estimated from observations on migrant workers to predict "high" and "low" net remittances corresponding to the mean "high" and "low" wage rates computed for each region (Table 3.4).

Table 3.4: OLS remittance equation estimated for migrant workers sampled in the Lowlands and Foothills of Lesotho. Oct. 1992-Jan. 1993.

Explanatory variable	Dependent variable= ln(monthly remittance)
Intercept	0,866834 (2,058)*
ln(monthly wage)	0,735104 (10,913)**
Adjusted R^2	0,52699
F Value	119,0975**
Valid cases	107

** Statistically significant at the one percent level of probability

* Statistically significant at the five percent level of probability

The wage rate separating high and low wage earning potential was set at a median value of predicted wage rates which was R531 in the Lowlands and R452 in the Foothills. Over 80 percent of household members not wage employed had predicted offer wage rates less than the median values in each region. The median value of observed monthly wage rates in the Lowland was R725 and R630 in the Foothills. Over 90 percent of observed women's monthly wage rates were below the observed median monthly wage rates in both regions.

The categorisation of low and high wage earning potential according to age and sex means men have high wage earning potential while women have low wage earning potential. Men can either be allocated to on-farm work, low income off-farm employment (within Lesotho) and high income off-farm employment (in RSA) while women can either be allocated to on-farm work or low income off-farm employment (within Lesotho or in RSA).

3.4 Representative households

Sector models are usually based on a representative farm approach which involves classifying the universe of farm households into a smaller number of homogeneous groups, and constructing a model for each representative farm for each group. The representative farm models are then aggregated in the sector model using the number of farms in each group as weights. This weighting procedure is only correct if the representative farm is the mean farm. If other types of representative farms are chosen, such as median or modal farms, then the weighting procedure may have to be rather more complex (Hazell and Norton, 1986:144). In order to minimise aggregation bias a representative farm should exhibit technological homogeneity, pecunious and institutional proportionality (Day, 1963). Some

of the requirements were met by initially sorting households according to the agro-climatic regions of Lowlands and Foothills. In this study it was decided to have a representative farm household as the arithmetic mean of the farm households in the group (cluster). Using the average farm household as the representative farm household is appealing because the average farm household is 1/k times the aggregate farm households, where k is the number of farm households in the group (cluster).

Representative farm households from each region were selected using principal component and cluster analyses. A selected group of socio-economic variables were selected so as to bring out the different technologies used by households, their resources, off-farm sources of income, total area, productivity, and access to credit, for example. The objective of principal component analysis (PCA) is to economise on the number of variables by identifying a relatively small number of components that can be used to represent relationships among the set of many interrelated variables (Norušis, 1990:313). This is achieved by obtaining k linear combinations PC_1, ...,PC_k, of *m* variables X_1,..., X_m, observed on *n* individuals i.e.

$$PC_i = a_{i1}X_1 + a_{i2}X_2 + \ldots + a_{im}X_m$$

If there are *m* original variables then *m* principal components can be obtained. The principal components PC_1,...,PC_k are orthogonal (i.e. uncorrelated) and therefore measure different dimensions in the data. If a relatively large set of original variables are explained by one or two components, each component can be interpreted as a measure of some underlying dimension in the data (Manly, 1986:60). However, if the original variables are uncorrelated,

then PCA will be unable to transform a large set of variables into a smaller set of transformed variables.

The coefficients or factor loadings a_{ij} indicate the contribution of each variable X_j to a component. The factor loadings a_{ij} are chosen such that PC_1 captures the largest amount of variation in the original variables. The factor loadings a_{2j} are chosen in a similar way so that PC_2 captures the second largest amount of variation. The remaining components are defined in the same way. Together the components account for all of the variance in the original data.

It is desirable that the eigenvalues (variances) of most of the components should be so low as to be negligible. If this is the case, the variation in the original data can be adequately accounted for by the first few components and some degree of economy is achieved. In order to transform the initial factor matrix into one that is easier to interpret, the matrix is rotated.

There are two problems associated with the use of PCA. The first is identifying the number of components which adequately describe the variation in the original variables. The most popular criterion, known as Kaiser's criterion, is to retain components with an eigenvalue greater than one. The second problem is the interpretation of components. Magnitudes and signs of factor loadings of standardised variables can be used as guidelines to interpreting components. Usually, only loadings greater than 0,3 are considered relevant in a component.

Principal component analysis of the Lowlands households are presented in Table 3.5. The factor matrix was rotated using Varimax rotation. The PCA extracted 9 factors and these attributed 74,1 percent to the variation contained in variables included in the analysis. Only 3 factors are presented because as the factors increased, the underlying interpretation became difficult. For example Factor 9 had only household size and harvesting labour as variables attributing the variation contained in variables included in the analysis. Factor 1 represents a farmer who uses tractors for ploughing, discing and planting. He also uses improved seed, LAN, fertilisers and pesticides. He has access to credit for purchasing inputs. His yields from fields operated under FSSP are good. He hires harvesting labour. This component attributes 24,6 percent to the variation contained in variables included in the analysis. It is concluded that this factor represents a "mechanised farmer". In the context of this study a "mechanised farmer" is a farmer participating in FSSP.

Factor 2 represents a farmer having a large land area. He rents some land which may explain his larger land. He is a surplus producer and receives remittances. He uses tractors for ploughing and applies fertilisers in his fields. This component attributes 13,4 percent to the variation contained in variables included in the analysis. It is concluded that this factor represents an "emerging farmer". This farmer does not participate in FSSP. Factor 3 represents a farmer who has a large land area and cattle. He receives remittances and rents some land. He applies fertilizers in his fields and hires labour for hoeing. This component attributes 7,6 percent to the variation contained in variables included in the analysis. This farmer, as with the farmer represented by factor 2, does not participate in FSSP. It appears the farming technology used by farmers represented by factors 2 and 3 is similar and so they can be grouped into farmers not participating in FSSP.

Table 3.5: Principal component analysis of farm households from the northern Lowlands of Lesotho.

Variable	Factor 1	Factor 2	Factor 3
TRPLA	0,92780		
QLAN	0,91594		
TRDIS	0,90944		
QPSCD	0,88989		
AVFSY	0,77156		
CREDT	0,56855		
TRPLO	0,90944		
HLHVT	0,31136		
QMFET	0,34502	0,73695	0,40046
TAREA		0,44534	0,46578
QSOLD		0,82669	
QISED		0,75087	
MNREM		0,39612	0,84138
PLHOE			0,61341
RENTL			0,47627
NCATT			0,46481
Eigenvalue	7,13182	3,87612	2,20373
Percentage of variance	24,6	13,4	7,6

VARIABLE	MEANING
HHSZ	Household size
MNREM	Monthly remittances received by household (Rands)
AVMZY	Average maize yield (Kgs/Ha)
AVFSY	Average maize yield from fields operated with FSSP (Kgs/Ha)
TAREA	Total area operated by household(own, FSSP & sharecropped) (Ha)
QSOLD	Quantity sold (Kgs)
RENTL	Land is rented from other farmers
CREDT	Household uses credit for agriculture
NCATT	Number of cattle owned by household
TRPLO	Household uses tractor to plough
TRDIS	Household uses tractor to disc
TRPLA	Household uses tractor to plant
QISED	Quantity of improved seed used (Kgs)
QNSED	Quantity of normal seed used (Kgs)
QLAN	Quantity of LAN used (50 kg bag)
QMFET	Quantity of mixed fertilizers used (Kgs)
QPSCD	Quantity of pesticide used (Litres)
HLHOE	Household hires labour for hoeing
HLVT	Household hires labour for harvesting.

Principal component analysis for Foothills households is presented in Table 3.6. The PCA extracted 9 factors which attributed 79,9 percent to the variation contained in variables included in the analysis. Only 3 factors are presented. Factor 1 represents a farmer who uses tractors for ploughing, discing and planting. He also uses improved seed, LAN, fertilisers and pesticides. He has access to credit for purchasing inputs. His yields from fields operated under FSSP are good. This component attributes 26,9 percent to the variation contained in variables included in the analysis. As in the Lowlands, this factor represents a "mechanised farmer". This farmer participates in FSSP.

Factor 2 represents a farmer who has cattle and receives remittances. He applies fertilisers in his fields and uses improved seed. He hires labour for hoeing. This component attributes 13,1 percent to the variation contained in variables included in the analysis. This farmer does not participate in FSSP. Like in the Lowlands, this farmer may be termed an "emerging farmer".

Factor 3 represents a farmer with a large land area. He uses a tractor for ploughing and uses improved seed. He also applies fertilizers in his fields. He is involved in sharecropping. This component attributes 10,5 percent to the variation contained in variables included in the analysis. As this farmer does not participate in FSSP he can be grouped with the farmer represented by factor 2.

Table 3.6:Principal component analysis of farm households from the Nothern Foothills of Lesotho.

Variable	Factor 1	Factor 2	Factor 3
TRDIS	0,95469		
QLAN	0,95276		
TRPLA	0,95213		
QPSCD	0,94860		
TRDIS	0,94227		
AVFSY	0,93579		
CREDT	0,75632		
TRPLO	0,52963		0,67271
QMFET	0,32763	0,90591	0,35761
MNREM		0,90282	
NCATT		0,82336	
PLHOE		0,39842	0,59432
QISED		0,73695	
SHACR			0,86163
Eigenvalue	7,81172	3,80608	3,05389
Percentage of variance	26,9	13,1	10,5

Cluster analysis was carried out using the CLUSTER procedure in SPSS. The two cluster analysis methods used were the unweighted pair-group method using arithmetic mean (UPGMA), commonly known as the average linkage method, and the centroid sorting method. The average linkage method is preferred to the single and the complete linkage methods in cluster analysis because it uses information about all pairs of distances not just the nearest or the furthest (Norušis, 1990:362). In the centroid sorting method a case is assigned to the cluster for which the distance between the case and the centre of the cluster (centroid) is smallest. The same variables used in principal component analysis were used as criterion for clustering. The number of clusters to be selected was predetermined to be two. The basis of selecting a two-cluster analysis was prior knowledge obtained from principal component analysis of the same data using the same socio-economic variables. The two cluster analysis methods gave similar results.

Cluster analysis for the Lowlands gave the following results: N=80, cluster 1=78, cluster 2=1 and one household was excluded because of missing values. It was apparent that a two-cluster analysis was not appropriate for the Lowlands. A dendrogram was used to determine the appropriate number of clusters. A dendrogram shows the clusters being combined and the value of coefficients at each step (Norusis, 1990:356). The dendrogram showed that two outliers were present and a four-cluster analysis was appropriate. A four-cluster analysis gave the following results: cluster 1=61, cluster 2=16, cluster 3=1, cluster 4=1 and one household was excluded because of missing values. The 61 households in cluster 1 are not involved in FSSP. In cluster 2, 15 of the households are involved in FSSP while one is not. Both households in cluster 3 and 4 are not involved in FSSP. The one household excluded because of missing values is not involved in FSSP. A two-cluster analysis without the two outliers gave the following results: N=78, cluster 1=68 cluster 2=15 and one household was excluded because of missing values. The 13 of the 15 households in cluster 2 are involved in FSSP while 2 are not involved. The 68 households in cluster 1 are not involved in FSSP. The household excluded because of missing values is not involved in FSSP. It can be concluded that the cluster analysis supports principal component analysis in which the farm households are selected into those participating in FSSP and those not participating.

Results of the cluster analysis for the Foothills were as follows: N=80, cluster 1=76, cluster 2=1 and 3 households were excluded because of missing values. As in the Lowlands, it was apparent that a two-cluster analysis was not appropriate for the Foothills. The dendrogram showed that two outliers were present and a four-cluster analysis was appropriate. A four-cluster analysis gave the following results: cluster 1=60, cluster 2=14, cluster 3=1, cluster 4=2 and 3 households were excluded because of missing values. The 60 households in

cluster 1 are not involved in FSSP. The 13 households in cluster 2 are involved in FSSP while one is not. The households in clusters 3 and 4 are not involved in FSSP. The three households excluded because of missing values are not involved in FSSP. A two-cluster analysis without the two outliers gave the following results: N=78, cluster 1=62, cluster 2=13 and 3 households were excluded because of missing values. The 62 households in cluster 1 are not involved in FSSP and the 13 in cluster 2 are involved. The three households excluded because of missing values are not involved in FSSP.

Results of principal component and cluster analyses show that in each region the farm households can be grouped into two major clusters: namely, the ones involved in FSSP and those not involved. Sample sizes and mean characteristics of the household types in each region are presented in Table 3.7. From Table 3.7 it is evident that in both regions farm households participating in FSSP have bigger household sizes than the ones not participating in FSSP. Farm households participating in FSSP also have a larger number of dependents, i.e. children and old adults, than those not participating in FSSP. Farm households participating in FSSP tend to have larger land areas, higher maize yields and production. This supports the contention that in Southern Africa farm sizes increase with household size (Low, 1986:32). Households participating in FSSP tend to use more improved seed, lime ammonium nitrate (LAN), mixed fertilizers, credit and tractors. This is expected because these inputs are provided as a package to the farm households by FSSP. The two types of farm households tend to have the same number of migrant workers in each region.

Table 3.7: Mean characteristics of household types in each region.

	LOWLANDS		FOOTHILLS	
Household particulars	FSSP (n=14)	NONFSSP (n=66)	FSSP (n=13)	NONFSSP (n=67)
Household size	6,6	5,9	5,9	5,6
Adults (16-59 years)	3,0	3,0	2,7	3,1
Children (<16 years)	2,9	2,3	2,6	2,2
Old people (>59 years)	0,7	0,5	0,6	0,5
Wage employed	0,7	0,7	0,6	0,6
Total arable land (ha)	1,62	1,45	1,32	1,23

3.5 Work and leisure choice activities

The labour requirement used in this study were obtained from a survey which relied on the recall of respondents. When comparing the labour requirements used in this study with labour requirements used by the Agricultural Research Division of the Ministry of Agriculture, this study's labour requirements are almost 1,5 times the ones used by the Ministry. The labour requirements for the maize, wheat and sorghum used by the Agricultural Research Division of the Ministry of Agriculture range between 350-450 hours/ha. Lyne (1989) and Cartwright (1988) labour requirements for maize in KwaZulu range between 350-400 hours/ha for traditional technology. The labour requirements used by the Ministry of Agriculture in Lesotho and the ones used by Lyne and Cartwright in KwaZulu appear similar. It is possible that the study's labour requirements are on the high side because respondents tended to exaggerate labour requirements. This is mainly so because respondents relied on recollection in answering questions unlike the Ministry of Agriculture which has empirically observed the labour requirements. It is argued that the

overestimated labour requirements are not expected to have much impact on the needed labour per household because of the small area operated by households. The average arable land operated by household range between 1,23-1,62 ha. Labour would have constrained production if land could be rented or land be consolidated.

Leisure time is considered to be a form of household consumption and so should be included in the model. Each additional hour of work undertaken has a cost in terms of leisure time foregone. In order to account for leisure time sacrificed for work, Hazell and Norton's (1986:65-66) suggestion of costing leisure in the objective function was followed. Hazell and Norton (1986) suggest that leisure time sacrificed for farm work should be costed in the objective function at a cost reflecting the marginal value of leisure to the household. This is achieved by costing leisure sacrificed with the cost per unit of time increasing as more leisure is sacrificed. The essence of this approach is to treat household labour in the same way as hired labour. The stock of household time available for work and leisure is divided into segments bearing successively higher unit charges (0,20w; 0,40w; 0,60w; and son on, where w is the cost of hired farm labour) for time allocated to work.

Following Lyne (1989:85) a similar approach was adopted in this study with the exception that the household's stock of on-farm work and leisure time was allowed to vary inversely with the number of off-farm workers. This is based on the assumption that the estimated wage remittances would reflect these preferences. The year was divided into four production periods.

The going hourly rate (w) for hired farm labour in the two regions was R0,50 and this was treated as the buying price. On-farm time available for work and leisure, in each production period, was divided into four equal segments. Time applied to household cropping activities (or sold at the local farm labour market) was charged at an increasing rate, starting at R0,20 (0,40w) for each hour drawn from the first segment and rising to R0,40 (0,80w) for each work drawn from the fourth segment. Work drawn from the first two segments was charged at a rate lower than the selling price of farm labour as some households do sell labour on the local market. Integer activities were included in the model to ensure a unique choice between on-farm and off-farm employment. A mixed integer programming using LINDO (Linear INteractive Discrete Optimizer) was used to solve the programming problems.

3.6 Cropping and food consumption activities

Four crops were considered in both regions, maize, sorghum, winter wheat and pulses (mainly beans). Summer wheat was excluded because it is grown in the Mountains and Orange River Valley. Maize production was divided into own production and FSSP production for households operating under FSSP. Crop rotations ensured that wheat and pulses could not be cropped more than once in three years. Livestock activities were not considered because, firstly, policy choices regarding the livestock sector are less important than policy choices regarding the crop sector in Lesotho. Secondly, government policies have a much more important impact on crop production than on the livestock sector. Thirdly, the major agricultural activities in the two regions is crop production.

Food consumption requirements were specified as seasonal minimum constraints with the subsistence requirements in each season being allowed to vary inversely with the number of off-farm workers. The food consumption requirements were obtained from the National Early Warning Unit of the Food Management Unit. The estimated consumption requirements per season are presented in Table 3.8. Hazell and Norton (1986:65-71) show that it is possible to express food and leisure consumption as a function of income in the programming model, but this has problems as this procedure invokes the assumptions associated with separable models. Any home produced grain consumed by the household is milled before consumption and the cost is reflected in the objective function.

Table 3.8: Estimated consumption requirements/person/season (Kg)

Particulars	Maize	Sorghum	Wheat	Pulses
Adults	33,9	4,7	11,8	6,03
Old people (>59 years	33,9	4,7	11,8	6,03
Children	17	2,4	5,9	3,01

Source: National Early Warning Unit, Food Management Unit.

3.7 Technology choice

The model presented in this study is rigid in that no other technology (more capital intensive) options were considered. This is because the policy issues considered would not be expected to have major impact on the choice of technology. The study considered the traditional technology, i.e. labour intensive technology, because there is already significant labour unemployment in Lesotho. This has resulted in labour being relatively cheap. It is unlikely that with retrenchments occurring in RSA mines farmers in Lesotho will substitute labour for

capital as a result of this. For that reason the current labour intensive technology was considered more appropriate.

3.8 Risk consideration

Crop production in Lesotho is risky due to unstable crop yields. Neglect of this risk in programming can lead to a considerable overestimation in the size of risky enterprises, specialised cropping patterns, biased estimates of commodity supply elasticities, overestimation of the value of resources and the incorrect prediction of technology choices (Hazell, 1982). As a result a linear approximation of the gain-confidence limit (E,L) criterion suggested by Baumol (1963) was used to account for risk. Baumol's E,L criterion involves maximization of expected crop income (E) for given levels of $L=E-\Theta\sigma$ where σ is the standard deviation of E, and Θ is the risk aversion parameter. A popular adaption of the E,L criterion is to assume that a farmer maximizes L for given levels of Θ (Hazell and Norton, 1986:92-93). Like the E,V criterion, the E,L criterion implies that household utility (U) is a quadratic function of income or that crop incomes are normally distributed. Although quadratic utility implies positive marginal utility only within bounded range and increasing absolute risk aversion, Tsiang (1972) has argued that the E,σ criterion (and hence the closely related E,V and E,L criteria) is a good approximation for more desired decision criteria if the risk taken is small relative to the total wealth of the farmer. This condition is not unreasonable in Lesotho where farm income usually comprises less than 10 percent of the de facto household income.

The objective function employed in the model is (Lyne, 1989):

$$MAX\ L=\sum_{I=1}^{N}[P'(YX-Z)]_i+[I'O]_i-[C'X]_i-[W'H]_i-[F'B]_i-\theta_i[X'\Omega X]_i^{0.5}$$

Where:

[P'(YX-Z)] = crop income, P being a vector of unit product prices, Y a diagonal matrix of yields, X a vector of crop areas, Z a diagonal matrix of own consumption.

[I'O] = off-farm income, I being a vector of net wage remittances per recipient and O a vector of migrant workers and welfare recipients.

[C'X] = total market production costs, where C is a vector of per hectare production costs excluding family labour but including hired labour.

[W'H] = family labour costs, H being a vector of hours worked and W a vector of (rising) hourly time charges, the largest of which is lower than the wage for hired farm labour.

[F'B] = purchased food costs, F being a vector of unit food prices and B a vector of food purchases.

Θ_i = an aggregate 'risk-aversion' coefficient for all households in homogeneous group i.

Ω = a variance-covariance matrix of per-hectare crop incomes, so that [X'ΩX] represents variance in crop income.

N = the number of homogeneous household types (four in this model) each with its own Θ.

Variance-covariance matrices were approximated for each region using the Mean Absolute Deviation (MAD) approach described by Hazell (1971) and Hazell and Scandizzo (1974). The term $[X'\Omega X]^{0.5}$ was replaced with its MAD estimator:

$$Est(X' \ \Omega \ X)^{0.5} = \sqrt{\eta} \sum_t \ |\sum_j (d_{j_t} - \bar{d}_j)| \ X_j \ /T$$

Where $\eta = T\pi/2(T-1)$ is a correction factor that converts the square of the MAD to an estimate of the population variance assuming the population is normally distributed (Hazell and Scandizzo, 1974). The term T represents the number of periods considered, $(d_{jt} - \bar{d}_j)$ the deviation from mean revenue for crop j and time period t, and π the mathematical constant.

3.9 Results of the household programming models

Solutions to the household programming models were generated for a range of risk aversion (Θ) values. The solutions are presented in Table 3.9 and these solutions were selected as

they provided the closest fit, measured in terms of percentage absolute deviation (PAD) between predicted and actual crop areas. Comparison with results from other studies cast some light. Dillion and Scandizzo (1978) measured a mean Θ value of 0,9 for a sample of farmers in northeast Brazil and Brandao, *et al* (1984) report values of between 0,9 and 1,2 for land lords and tenant farmers in Brazil. Brink and McCarl (1978) observed a majority of cornbelt farmers in the USA midwest had Θ values of less than 0,25. Lyne (1989) and Cartwright (1989) reported Θ values of between 0,85 and 2,66 for traditional (subsistence) farmers in KwaZulu, while Elami and Rogers (1992) report Θ values of between 1,50 and 2,54 for smallholder traditional farmers in western Sudan.

It should be noted that it would be incorrect to compare the Θ estimates with the optimum Θ presented in Table 3.9. This is because Θ is simply a fine-tuning device which not only captures the effects of risk but also the effects of model specification (e.g. the exclusion of fixed management and information costs, and the omission of capital constraints), data errors, and risk sharing (Hazell, 1982). If farmers have access to risk-sharing institutions such as crop insurance or futures markets, their farm-planning decisions will not reflect their real risk preferences.

Hazell and Norton (1986:271) argue that a PAD below 10 percent is good, a PAD of 5 percent is exceptional and a PAD of 15 percent or more indicates the model may need improvements. In terms of these measures the predicted crop mixes appear to simulate actual crop levels reasonably well.

Table 3.9: Solution levels for key activities in the household programming models.

	Lowlands				Foothills			
	FSSP		NON-FSSP		FSSP		NON-FSSP	
	θ=2,70		θ=2,70		θ=0,50		θ=0,83	
Activity	Actual	Pred.	Actual	Pred.	Actual	Pred.	Actual	Pred.
Own maize	0,40	0,43	0,65	0,60	0,55	0,51	0,60	0,63
FSSPmaize	0,25	0,28	-	-	0,20	0,24	-	-
Sorghum	0,26	0,28	0,23	0,30	0,20	0,24	0,15	0,20
Wheat	0,10	0,10	-	-	-	-	0,10	0,08
Pulses	0,30	0,28	0,25	0,25	0,23	0,20	0,18	0,15
Fallow	0,31	0,30	0,32	0,30	0,15	0,16	0,20	0,18
Total	1,62	1,62	1,45	1,45	1,31	1,31	1,23	1,23
PAD		6,8		11,1		11,6		16,6

3.10 Regional programming model

It was assumed that (i) all households in parts of Lesotho similar to the areas sampled could be grouped into household types defined earlier without altering mean resource levels in the original groups and (ii) that with each homogeneous region, the distribution of households across household types approximated the distribution observed in samples. The additional districts are Mafeteng, Mohale's Hoek and Quthing. The Mountain districts of Mokhotlong, Thaba Tseka and Qachas Nek were excluded from the model. In the Mountain districts livestock farming is the major agricultural activity. These districts also differ from the sampled areas in respect of population density and access to markets. The Mountain districts tend to be sparsely populated and isolated so that access to markets is limited. The regions included in the model account for 75 percent of Lesotho's arable land and 71 percent of the total population.

The representative household programming models were combined to form a sector (regional) model. Interfarm and interregional resource trade were effected by means of transfer rows. Aggregate resource levels in each household type were computed as the product of the representative (mean) household resource levels and the estimated number of households in the group. The regional model comprised more than 400 rows and 500 columns including 20 integer activities. A partial mini-tableau for the regional model is presented in Table 3.10.

Optimum Θ values estimated for the representative households were substituted in the regional model and solutions generated by maximizing the objective function:

$$MAX\ L=\sum_{i=1}^{N} a_i[P'(YX-Z)]_i+[I'O]_i-[C'X]_i - [W'H]_i - [F'B]_i - \theta_i[X'\Omega X]_i^{0.5}$$

Where:

N is the number of homogeneous household types (four in this model), a_i scalar computed from the estimated population of households in homogeneous group i so that representative households carry equal weight in the aggregate objective function and the other terms are as defined earlier.

Table 3.10. A partial mini-tableau for the regional model.

	Lowlands						Foothills							
	FSSP						NONFSSP							
	Prod.	Consumption					Prod.	Consumption				Regional		
		Own	Buy	Sales				Own	Buy	Sales		Purchases	Rural sales	
	X_1		B_1	local	urban	sum_1	X_4		B_4	local	urban	sum_4			RHS
Restraints1	A_1														$\leq D_1$
Commodity balances1	$-Y_1$	1	-1	1	1										≤ 0
Objective1	$-C_{11}$		$-F_{11}$	P_{11}	P_{21}	-1									$=0$
Restraints4							A_4								$\leq D_4$
Commodity balances4							$-Y_4$	1	-1	1	1				≤ 0
Objective2							$-C_{14}$		$-F_{14}$	P_{14}	P_{24}	-1			$=0$
Purchases									1						$=0$
Rural sales										1			-1	-1	$=0$
Local marketings													1	-1	≥ 0
Objective function						a_1						a_2			Max!

3.11 Market assumptions for the region

It was mentioned earlier that Lesotho is member of the Southern Africa Customs Union, and this means there is free movement of goods between Lesotho and RSA. Given that Lesotho's population and economy are small compared to those of RSA, Lesotho can be regarded as a "small" country and as a result cannot influence the South African economy. This means Lesotho faces a perfectly elastic demand curve for its exports to RSA and a perfectly elastic supply curve for imports from RSA. In other words, Lesotho is a price-taker on RSA markets and as such supplies of market inputs and purchased food were assumed to be perfectly price elastic. Market demand for food crops that fetch higher prices on local markets than on urban markets was treated as a single-step function. Quantities of crops sold locally were restricted to a level less than or equal to local purchases. Demand for off-farm labour was treated as price elastic in both "high" and "low" wage markets but the supply of farm workers from each representative household was not permitted to exceed the levels of observed wage workers. Labour transfers rows ensured that quantities of hired farm labour would equal sold farm labour. Any farm labour hired in excess of this level was charged at a rate equivalent to the hourly earnings of off-farm workers in the "lowest" wage category.

3.12 Validation of the model

To validate a model it is necessary to have a set of base data against which predicted results can be compared. The study was undertaken in 1991/92, a drought year, and considered not suitable as base year. It was thus decided to use data between 1980/81 and 1990/91 as a

base. The Lesotho Bureau of Statistics (BOS) has conducted Agricultural Production Surveys (APS) annually since 1973/74. The APS are made up of three surveys: crops and area, livestock population, and meat production. The crops and area survey presents statistics on planted area, harvested area, crop production, fallow area, and crop failure for the major five crops. The statistics are estimated by a random sample of holdings and objective measurement of fields is undertaken by enumerators. In addition, the BOS conducts an agricultural census every 10 years. The first agricultural census was conducted in 1969/70, the second in 1979/80 and the third in 1989/90. It should be noted that the agricultural census does not entail a complete enumeration of all agricultural households but only a sample of them. This is mainly because of time, staff and financial limitations.

According to the official statistics the average pulse production for the two regions for the years 1981/82-1990/91 was 5 100 tonnes. When using the official per capita pulse consumption estimates, total pulse production is twice the average production for the ten years. Since Lesotho is an exporter of pulses, it means the official statistics are suspect. Consumption data were considered as more reliable than production data and the annual consumption was thus used as an estimate of production. As a result it was decided to double the average pulse production in validating the model.

A comparison between base and predicted results of area and production is presented in Table 3.11. The PAD for the area is 10,7 while for production it is 9,7. Predicted area allocated to grain production comprises 57 percent of the total area and this compares favourably with official estimates of 70 percent provided by the Bureau of Statistics and

Ministry of Agriculture (1990). Predicted fallow land is 30 percent of the total area and this also compares favourably with official estimates of 22 percent.

Table 3.11: Base and predicted area and production in the Foothills and Lowlands of Lesotho.

	AREA (Ha)			PRODUCTION (Tons)		
Crop	Base	Predicted	PAD	Base	Predicted	PAD
Maize	103 555	99 044	4,4	77 666	71 780	7,6
Sorghum	15 200	13 313	12,4	11 917	11 917	7,8
Wheat	6 107	5 982	2,1	3 985	4 985	6,8
Pulses	23 182	26 720	15,3	11 757	11 757	15,3
Fallow	58 400	61 435	5,2	-	-	-
Total	206 494	206 494	-	-	-	-

Population statistics were used on the demographic input data and aggregation weights (a_i) in the model. The Bureau of Statistics conducts a decennial population census. Since Lesotho attained independence population censuses were conducted in 1966, 1976 and 1986. Table 3.12 presents the number of rural households in the four ecological zones of Lesotho. According to the FSSP, 9 074 households were operating under FSSP in the Lowlands and 1 008 in the Foothills in 1991/92.

Table 3.12: Estimated number of rural households in Lesotho-1989/90

Region	No of Households	No of HHs with wage earners	No of wage earners
Lowlands	93 373	35 206	60 888
Foothills	59 229	21 091	38 887
Mountain	50 148	15 027	30 510
Senqu River Valley	26 542	9 335	18 082
Lesotho	229 292	80 659	148 367

The de facto population estimates by the Bureau of Statistics for the area modelled are presented in Table 3.13.

Table 3.13: Estimated de facto rural population in the Lowlands and Foothills of Lesotho-1991*

Population category	Lowlands	Foothills	Total
Male children	154 501	91 512	246 103
Female children	146 447	85 526	231 197
Total children	300 948	177 038	277 986
Male adults	191 112	111 383	302 495
Female adults	197 70	115 886	313 589
Total adults	388 815	227 269	616 084
Male old adults	15 377	8 552	23 929
Female old adults	24 896	14 539	39 435
Total old adults	40 272	23 091	63 364
Total population	730 036	427 398	1 157 434

*Projected from the 1986 population census at 2,6 percent per annum growth rate.

Source: Bureau of Statistics (1991c).

According to the Bureau of Statistics estimates, 1 157 434 people were resident in the two regions modelled (Bureau of Statistics, 1991). This estimate is 10 percent below the prediction of the model.

CHAPTER 4

PREDICTED RESPONSES TO ECONOMIC POLICIES IN LESOTHO

The results of the predicted responses to high maize prices, reduced off-farm employment, lower maize import prices and lower interest rates are presented in this chapter. Several economic policies were simulated and results compared with the base solution. A base solution was obtained first to verify the model. After that the model was altered in a way that reflected the new policy. Results of the new policy are then compared with the base solution. It should be noted that the model's results reflect static equilibrium solutions and therefore imply complete adjustment to the change. Most of the policies examined focus on maize prices because maize is the most important staple food in Lesotho and changes in its price are expected to affect rural households' resource allocation and welfare. The results of the base solution and several economic policies are presented in tables 4.1 to 4.4.

4.1 Scenario 1: Deregulation of RSA maize marketing system

The maize pricing system followed in Lesotho is termed import parity pricing. The Lesotho maize producer price is set equal to the SA Maize Board's selling price plus transport and handling costs to Lesotho. The government of Lesotho sets both the maize producer price and the mill-gate price of maize meal. In the past government has set the wholesale and the retail maize prices. However, most traders did not adhere to these regulated prices and government has since stopped setting them. Deregulation of RSA maize marketing is expected to lead to the abolition of the SA Maize Board levy which will in turn lead to lower

Table 4.1: Comparing results of deregulation of RSA maize marketing system with the base solution.

Particulars	Base solution	Scenario 1
L=E-Θσ (Rmillion)	26,585	28,355
Area cropped:	Ha	
Own maize	95 523	87 787
FSSP maize	3 521	532
Total maize	99 044	88 319
Sorghum	13 313	13 313
Wheat	5 982	9 763
Total grain	118 339	111 395
Pulses	26 720	26 720
Fallow	61 435	68 379
Total area	206 494	206 494
Production:	Tons	
Own maize	67 202	61 758
FSSP maize	4 578	691
Total maize	71 780	62 449
Sorghum	11 917	11 917
Wheat	3 985	6 531
Total grain	87 682	80 897
Pulses	11 757	11 757
Imports:	Tons	
Maize	13 578	22 809
Wheat	25 694	23 148
Sorghum	0	0
Sales out of rural areas:	Tons	
Pulses	1 919	1 919
Sales between rural households:	Tons	
Pulses	3 192	3 192
FSSP costs (Rmillion)	2,2	0,332
FSSP interest (Rmillion)	0,4	0,066
Migrants:		
In Lesotho	32 512	32 512
In SA	96 816	96 816
Remittances (Rmillion)	374,5	374,5

maize import prices to Lesotho. It is expected that maize import prices will fall by about 20 percent. Lesotho is a member of SACU and as such is considered a local market by the SA Maize Board. To simulate the impact of the deregulation of the SA maize marketing system, maize import prices were reduced by 20 percent, *ceteris paribus*. It is assumed that the three commercial mills given the rights to import maize will pass on the reduced prices to consumers.

Household welfare of producers ($L=E-\Theta\sigma$) is estimated to increase by 7 percent as most of the households are deficit maize producers (Table 4.1). Total area allocated to maize production decreases by 11 percent and maize production decreases by 13 percent. Area allocated to FSSP maize production and FSSP maize production decrease by 85 percent. Maize imports increase by 68 percent as a result of the decrease in maize production. Maize self-sufficiency decrease by 11 percent. Area allocated to wheat production increases by 63 percent while wheat production increases by 64 percent. Wheat imports decrease by 10 percent. Sorghum and pulse production remain unchanged. Fallow land increases by 11 percent while FSSP production costs decrease by 85 percent and interest payments decrease by 84 percent.

4.2 Scenario 2: A 10 percent reduction in wage workers employed in RSA

Recently, there have been labour retrenchments in RSA mines. A large proportion of Basotho males work in the mines and it can be expected that reduced off-farm employment will affect rural households' welfare in Lesotho. It is assumed that retrenchments will affect less educated and unskilled labour. Results of the offer wage models indicate that men from

Table 4.2: Results of a 10 percent reduction in wage workers employed in RSA.

Particulars	Base solution	Scenario 2
$L=E-\Theta\sigma$ (Rmillion)	26,585	20,940
Area cropped:	Ha	
Own maize	95 523	97 398
FSSP maize	3 521	3 521
Total maize	99 044	100 919
Sorghum	13 313	13 592
Wheat	5 982	6 685
Total grain	118 339	121 196
Pulses	26 720	26 720
Fallow	61 435	58 578
Total area	206 494	206 494
Production:	Tons	
Own maize	67 202	68 515
Fssp maize	4 578	4 578
Total maize	71 780	73 093
Sorghum	11 917	12 098
Wheat	3 985	4 442
Total grain	87 682	89 633
Pulses	11 757	11 757
Imports:	Tons	
Maize	13 578	13 578
Wheat	25 694	25 694
Sorghum	0	0
Sales out of rural areas:	Tons	
Pulses	1 919	1 856
Sales between rural households:	Tons	
Pulses	3 192	3 297
FSSP costs (Rmillion)	2,2	2,2
FSSP interest (Rmillion)	0,4	0,4
Migrants:		
In Lesotho	32 512	32 512
In RSA	96 816	87 136
Remittances (Rmillion)	374,5	339,7

the Lowlands are relatively more educated than those from the Foothills and members of households participating in FSSP tend to be more educated than those not participating in FSSP (NONFSSP households). To simulate the effects of reduced employment in RSA, the number of wage employed men in RSA was reduced by 10 percent which results in an increase in on-farm labour available in Lesotho. This was achieved by reducing the number of wage employed workers from NONFSSP households in the Foothills by 9 680. In 1990 127000 Basotho were employed in RSA mines and this number dropped to 107 000 in 1991 (Bureau of Statistics, 1993) and as such the 10 percent reduction in off-farm employment in RSA is not unreasonable.

A 10 percent reduction in wage workers employed in RSA is simulated to result in households' welfare decreasing by 21 percent as shown in Table 4.2. However, households affected by unemployment are estimated to suffer welfare losses of around 62 percent. This shows that rising unemployment in RSA mines has a significant effect on rural households in Lesotho. Area allocated to maize production and maize production increase by 2 percent. Maize self-sufficiency remains unchanged. Area allocated to sorghum increases by 2 percent and sorghum production increases by 1,5 percent. Area allocated to wheat production increases by 12 percent and wheat production increases by 11,5 percent. Maize and wheat imports remain unchanged and this indicates that increased labour consumption requirements are met by allocating additional area to all the grain crops. The additional pulse requirements are met by an increase in sales of pulses between rural households. Fallow land decreases by 5 percent and net remittances decrease by 9 percent.

4.3 Scenario 3: A 10 percent reduction in wage workers employed in Lesotho and RSA

NONFSSP wage employed workers in the Foothills working within Lesotho were reduced by 3 200 workers and those employed in RSA by 9 680 as it is anticipated that reduced off-farm employment will affect mainly them. Recent indications are that most companies located in neighbouring countries surrounding RSA are planning on relocating to RSA with RSA's return to democracy. The relocation is mainly because communications, financial services and electricity supply are more efficient in RSA. It can be assumed that some companies will relocate from Lesotho to RSA leading to reduced off-farm employment in Lesotho.

A 10 percent reduction in wage workers in both Lesotho and RSA leads to households' welfare decreasing by 23 percent (Table 4.3). Area allocated to maize increases by 2,5 percent while production increases by 2,4 percent. Area allocated to sorghum increases by 3 percent and sorghum production increases by 2 percent. Area allocated to wheat production increases by 16 percent and wheat production increases by 15 percent. Maize and wheat imports remain unchanged because as in scenario 2 the increased consumption requirements are met by additional area cropped to grains. Fallow land decreases by 6 percent while net remittances decrease by 10 percent. The percentage decrease in both households' welfare and net remittances between scenarios 2 and 3 are two and one respectively and this shows that a decrease of Basotho wage workers in RSA has a much higher effect on rural households than a corresponding decrease of wage workers within Lesotho. This is understandable because wages in RSA are much higher than in Lesotho.

Table 4.3: Results of a 10 percent reduction in wage workers employed in Lesotho and RSA.

Particulars	Base solution	Scenario 3
L=E-Θσ (Rmillion)	26,585	20,421
Area cropped:	Ha	
Own maize	95 523	98 028
FSSP maize	3 521	3 521
Total maize	99 044	101 549
Sorghum	13 313	13 685
Wheat	5 982	6 917
Total grain	118 339	122 151
Pulses	26 720	26 720
Fallow	61 435	57 623
Total area	206 494	206 494
Production:	Tons	
Own maize	67 202	68 955
FSSP maize	4 578	4 578
Total maize	71 780	73 533
Sorghum	11 917	12 159
Wheat	3 985	4 593
Total grain	87 682	90 285
Pulses	11 757	11 757
Imports:	Tons	
Maize	13 578	13 578
Wheat	25 694	25 694
Sorghum	0	0
Sales out of rural areas:	Tons	
Pulses	1 919	1 827
Sales between rural households:	Tons	
Pulses	3 192	3 298
FSSP costs (Rmillion)	2,2	2,2
FSSP interest (Rmillion)	0,4	0,4
Migrants:		
In Lesotho	32 512	28 750
In RSA	96 816	87 136
Remittances (Rmillion)	374,5	336,7

There is almost no fallow land left in the area operated by NONFSSP households. It can be expected that if off-farm employment increased by a higher percentage land would be limiting if there are no cash land rental transactions. In such a case the increased consumption requirements would be met by importing food from RSA even though there is fallow land operated by FSSP households in the same region. One other possibility is that any land shortage can be met by sharecropping which is a common practice in Lesotho.

4.4 Scenario 4: Maize producer and consumer prices increased by 10 percent

Both consumer and producer prices affect producers as most households are deficit producers. Increases in maize prices can be caused by adverse weather conditions such as drought in both Lesotho and RSA. Maize producer and consumer prices were increased by 10 percent, *ceteris paribus*. Household welfare declines by 4 percent (Table 4.4). Area allocated to maize production increases by 8,14 percent and maize production increases by 7,9 percent. Maize production increases by a lower percentage because the increase in area cropped to maize occurs under own production (and not FSSP) where yields are lower. Maize imports decrease by 42 percent while maize self-sufficiency increases by 7 percent. Area allocated to sorghum, wheat and pulses does not change while fallow land decreases by 13 percent.

The 8 percent increase in maize production estimates a long run supply response elasticity for grains at 0,8 which is comparable to the long run response elasticity computed by Lyne (1989) in KwaZulu of 0,86. The estimate is not necessarily a true reflection of the predicted

Table 4.4: Results of maize producer and consumer prices increased by 10 percent.

Particulars	Base solution	Scenario 4
$L=E-\Theta\sigma$ (Rmillion)	26,585	25,598
Area cropped:	Ha	
Own maize	95 523	103 582
FSSP maize	3 521	3 521
Total maize	99 044	107 103
Sorghum	13 313	13 313
Wheat	5 982	5 982
Total grain	118 339	126 398
Pulses	26 720	26 720
Fallow	61 435	53 376
Total area	206 494	206 494
Production:	Tons	
Own maize	67 202	72 872
FSSP maize	4 578	4 578
Total maize	71 780	77 450
Sorghum	11 917	11 917
Wheat	3 985	3 985
Total grain	87 682	93 352
Pulses	11 757	11 757
Imports:	Tons	
Maize	13 578	7 908
Wheat	25 694	25 694
Sorghum	0	0
Sales out of rural areas:	Tons	
Pulses	1 919	1 919
Sales between rural households:	Tons	
Pulses	3 192	3 192
FSSP costs (Rmillion)	2,2	2,2
FSSP interest (Rmillion)	0,4	0,4
Migrants:		
In Lesotho	32 512	32 512
In RSA	96 816	96 816
Remittances (Rmillion)	374,5	374,5

supply elasticity as it relates to a single point on a stepped supply function. The arc elasticity of supply normally will vary along different segments of such a function. The latter behaviour is more realistic than the assumption of a constant elasticity which frequently is imposed in econometric estimation (Hazell and Norton, 1986). Because the programming model describes a situation of full adjustment, it is likely to estimates elasticities that are greater in value than corresponding econometric estimates. Hazell and Norton (1986) argue that this need not be the case. Shumway and Chang (1977) found econometrically estimated elasticities and programming model elasticities to be comparable in value.

4.5 Scenario 5: Maize producer prices increased

It is possible to have producer and consumer prices moving independently because of government intervention in maize pricing. Government has in some instances increased maize producer prices and held consumer prices constant. Maize producer prices were increased by 10 percent with maize consumer prices being held constant, *ceteris paribus*.

This scenario differs from scenarios 4 as both consumer and producer prices were increased in scenario 4 but only producer price in scenario 5. The latter scenario is relevant as households, being deficit producers are affected by both consumer and producer prices. The policy focus of the Lesotho government for a long time has been to achieve grain self-sufficiency although recently indications are that the focus is shifting to food security. High grain producer prices have been used as an incentive to achieve grain self-sufficiency. The import parity pricing practised in Lesotho has meant that maize producer prices in Lesotho are relatively higher than those in RSA. For example, the maize producer price in Lesotho was R508.16 per ton while in RSA it was R322.00 per ton in 1991/92 (Bureau of Statistics

and Ministry of Agriculture, 1994). The difference in the two prices is mostly made up of the SA Maize Board levy (margin).

Commercial mills within the country know that few quantities of local maize are delivered to them and as such agree to this practice. Furthermore government is a major shareholder in all the commercial mills. Data indicate that the three commercial mills purchase less than 10 percent of their requirements from Basotho farmers (Mokitimi, 1990).

Under this scenario, production of all crops does not change. Experiments with the model indicate that maize producer prices have to be increased by over 100 percent in order for households to produce maize for market purposes. This shows that most of the agricultural production in Lesotho will be for subsistence and that maize prices need to be increased substantially before farmers will produce a surplus. Approximately three percent of the households sampled in this study sold maize to their neighbours. Mudenda's (1989) findings in Zambia were that maize producer prices need to be increased by approximately 150 percent before farmers produced maize for the market. In trying to respond to higher maize producer prices households face constraints because of small farm sizes. This means that even if households respond to higher maize producer prices the incremental income constitutes a small proportion of the total household income. Thus off-farm employment is relatively more attractive than farming as earnings from off-farm employment are far greater than from farming. Income from farming usually comprises less than 10 percent of the de facto household income in Lesotho (Bureau of Statistics, 1988).

4.6 Scenario 6: Subsidy equivalent to 50 percent reduction in interest rate

At present the interest rate charged to farmers operating under FSSP is 20 percent per annum and a 50 percent subsidy will reduce it to 10 percent per annum. Currently the major source of agricultural credit in Lesotho is the Lesotho Agricultural Development Bank (LADB) which is a parastatal. In 1982 the share of agricultural credit in total credit extended was 0,7 percent as compared to 7,7 percent in 1986 (Mochebelele and Mokitimi, 1992). The increase in agricultural credit is mainly attributed to FSSP. A subsidy equivalent to 50 percent reduction in interest rate aimed at farmers operating under FSSP, leads to total household welfare increasing by 0,03 percent (Table 4.5). Area allocated to FSSP maize production increases by 20 percent and FSSP maize production increases by 18 percent. Total area allocated to maize production increase by one percent and total maize production increase by one percent. The increase in maize production results in maize imports falling by 6 percent. In addition the production of sorghum, wheat and pulses remain unchanged while Fallow land decrease by one percent. FSSP production costs increase by 18 percent while interest paid to FSSP decreases by 25 percent.

4.7 Scenario 7: Estimated cost of land rental transactions

The situation in Lesotho is that large areas of land lie fallow while there is excess demand for land. An estimate of 22 percent of arable land being left fallow shows the extent of the problem. This is despite increasing population pressure on arable land. Lawry (1993) has shown that emerging entrepreneurial farmers are interested in purchasing agricultural land but experience customary prohibitions to sales. To estimate the cost of land rental

Table 4.5: Results of a subsidy equivalent to 50 percent reduction in interest rate.

Particulars	Base solution	Scenario 6
$L=E-\Theta\sigma$ (Rmillion)	26,585	26,590
Area cropped:	Ha	
Own maize	95 523	95 523
FSSP maize	3 521	4 214
Total maize	99 044	99 737
Sorghum	13 313	13 313
Wheat	5 982	5 982
Total grain	118 339	119 032
Pulses	26 720	26 720
Fallow	61 435	60 742
Total area	206 494	206 494
Production:	Tons	
Own maize	67 202	67 202
FSSP maize	4 578	5 409
Total maize	71 780	72 611
Sorghum	11 917	11 917
Wheat	3 985	3 985
Total grain	87 682	88 513
Pulses	11 757	11 757
Imports:	Tons	
Maize	13 578	12 747
Wheat	25 694	25 694
Sorghum	0	0
Sales out of rural areas:	Tons	
Pulses	1 919	1 919
Sales between rural households:	Tons	
Pulses	3 192	3 192
FSSP costs (Rmillion)	2,2	2,6
FSSP interest (Rmillion)	0,4	0,3
Migrants:		
In Lesotho	32 512	32 512
In RSA	96 816	96 816
Remittances (Rmillion)	374,5	374,5

transactions several experiments were run with the model. Land transfers were introduced between household types in each region. Land transfers were costed in the objective function and the cost increased until there were no land transfers between households. Land transfers stopped when the cost reached R100 in the Lowlands. It is predicted that FSSP household would rent 0,3 ha of land from NONFSSP household. When land transfers were effected, there was no fallow land in NONFSSP households leading to increased crop production. In the Foothills FSSP household rent 0,2 ha of land and land transfers stopped when the cost was R150. Although the benefit from land rental is high, it is concluded that transaction costs exceed the rental value, precluding such a market. This shows that the cost of land rental transactions as measured by its shadow price is high.

CHAPTER 5

POLICY IMPLICATIONS

This chapter discusses the implications of the empirical results and suggests policy measures aimed at improving crop production and the welfare of rural farm households in Lesotho.

From the mid 1970s Lesotho has received a disproportionate volume of aid most of which was disbursed on astonishingly generous terms (Wellings, 1983). Ferguson (1985) points out that Lesotho receives relatively more aid per capita than most African countries. The purpose of the aid is to alleviate poverty, increase economic output and reduce dependence on South Africa (Ferguson, 1985). The observation by Low (1986:2) that in most southern African countries rural infrastructure has been constructed, marketing organisations established, credit facilities made available, extension services strengthened and new crop and livestock production technology has been developed, extended and utilized and yet agricultural production has been declining aptly describes the situation in Lesotho. Agricultural production in Lesotho has shown declining trends despite government and foreign aid donors' intervention. Most aid agencies, e.g. the World Bank, USAID, FAO, UNDP, and CIDA, have been providing foreign aid to Lesotho with the aim of increasing agricultural production. Recently numerous Non-Governmental Organisations (NGOs) have sprung up in Lesotho with the same aim as the aid agencies. It seems the rationale for the proliferation of NGOs is that government cannot administer foreign aid effectively. Although the history of NGOs is not that long, results have been disappointing because instead of showing positive trends agricultural production is still declining. The decline in agricultural

production is exacerbated by the rapid increase in population so that Lesotho is increasingly importing food from RSA and receiving food aid. Between 1979/80 and 1989/90 commercial grain imports increased by 7 percent annually while food aid (mainly wheat and maize) increased by 3 percent annually.

Given the geographical position of Lesotho viz-a-vis RSA, it makes sense for Lesotho to trade with RSA. At present over 90 percent of Lesotho's imports are from RSA. It is expected that policy changes in RSA will have an impact on Lesotho. The deregulation of the RSA maize marketing system is expected to lead to lower maize import prices which results in increased household welfare as the majority of households are net consumers of maize. It also results in a reduction in maize production in Lesotho and increased wheat production and fallow land. There is an increase in maize imports and a decrease in maize self-sufficiency but more households' affordability to purchase maize increases. This shows that although food self-sufficiency has worsened, food security has improved. The deregulation of the RSA maize marketing system is expected to be beneficial to Lesotho and as such the government of Lesotho should examine ways and means of passing the benefits on to the people of Lesotho. Issues to be examined include the role of government in maize pricing, and which institutions are given the right to import maize.

Presently maize imports are restricted with the three commercial mills being only importers of maize. It has been argued that this practice results in high maize consumer prices (Olson, 1985). Perhaps the importation of maize should be opened to everybody as is the case in RSA where the SA Maize Board is no longer the sole buyer and seller of maize. Alternatively the three commercial mills should sell both processed maize products and maize

grain. In this way consumers will have a choice between processed and unprocessed maize. It has been postulated that rural Basotho prefer unsifted maize meal (Olson, 1985). If consumers are given the choice of purchasing maize grain they can mill/grind it at hammermills which are numerous and located in the main trading stations around the country. Hammermills charge a minimal fee for grinding maize. The option of letting consumers purchase maize grain is also beneficial because grain stores for longer periods than maize meal.

Reduced maize import prices lead to a decrease in maize production and increased fallow land. Studies have shown that maize production in Lesotho is relatively less profitable and Lesotho has a comparative advantage in fruits and vegetables because of its climate and sheltered river valleys (Kingdom of Lesotho, 1992). The Ministry of Agriculture, through its Extension Department, has been advising farmers to grow fruits and vegetables instead of maize. Farmers have continued to grow maize despite the advice. Subsistence farmers' objective is to provide their families with adequate food. Subsistence farmers first allocate resources to assuring necessary food supplies, and only then are remaining resources used to generate cash income (Hazell and Norton, 1986). It seems farmers grow maize in order to subsist and it is only after they have met their maize consumption requirements that they can start growing fruits and vegetables which are considered cash crops. It may be beneficial to Lesotho to diversify to vegetable production. This is pertinent as the government of Lesotho is moving from a policy of food self-sufficiency to food security. Wheat production does not increase by a higher percentage because of greater risk bearing. Wheat production decreased by almost 50 percent between 1965 and 1990 (Bureau of Statistics and Ministry of Agriculture, 1994). The decrease in wheat production may partly

be explained by the communal land tenure system in which arable land is not fenced and people let animals graze on other peoples' wheat fields.

Crop farming in Lesotho is increasingly becoming mono-crop farming. The proportion of area allocated to maize production has been increasing with the proportion allocated to other crops decreasing. Between 1970 and 1991 the proportion of area allocated to maize increased by over 20 percent (Bureau of Statistics and Ministry of Agriculture, 1992). Mono-crop farming is prevalent despite advice from the Extension Department of the Ministry of Agriculture which indicates that the northern part of the country is suitable for maize production while the southern part is suitable for drought resistant crops such as wheat and sorghum. This is because the southern part of the country is drier and more prone to drought. Statistics indicate that the southern part of the country used to produce most of the country's wheat requirements but nowadays most of the wheat is from the Mountains. The southern part of the country has turned to growing maize.

The history of labour migration from Lesotho to RSA dates back to the last century when gold was discovered in the Witwatersrand and diamonds in Kimberley. The impact of labour migration on agricultural production has to date never been exhaustively examined. The few studies which have been undertaken have examined labour migration from political, anthropological and historical perspectives. The few studies dealing with the impact of labour migration on agricultural production have presented opposing views. One is that labour migration has a negative impact on agriculture because able-bodied males migrate and leave agriculture to women and children. The opposing view is that labour migration has a positive impact on agricultural production because migrants are able to purchase superior

inputs like fertilisers and seeds. Tuoane (1989) applied a Cobb-Douglas profit function to test whether there was any difference in agricultural productivity of non-migrant and migrant farm households. Her results indicated that there was no difference in agricultural productivity between the two types of farm households.

The other striking feature about Lesotho is that most migrants in the 1970s spent most of their earnings on purchasing cattle. Between 1974 and 1982 imports of cattle increased by approximately 1 500 percent and this dramatic increase is attributed to the increase in mine wages which occurred in the early 1970s (Swallow, Mokitimi and Brokken, 1986). In 1984 imports of cattle were banned because the range could not sustain the increased number of animals. Recently it seems migrants spend most of their earnings on expensive houses, furniture, and funerals. Gordon (1990) has postulated that migrants do not spend most of their earnings on agriculture because of the insecurity of the land tenure system. Lesotho is mainly an agricultural country and as such retrenched mine workers have to be absorbed by the agricultural sector. At present although a significant proportion of the people are employed in agriculture most of them are underemployed. Given the fact that there is a shortage of arable land in Lesotho and at the same time arable land is underutilised, land intensive farming methods need to be introduced. However, the topography of the country is such that soil erosion is rife and this means care should be taken not to increase soil erosion through these intensive methods.

A reduction in workers wage employed in RSA and Lesotho leads to minimal increases in maize, sorghum and wheat production. Households' welfare is mostly affected by the reduction in wage workers and the effect is most adverse when the reduction occurs in RSA

where most Basotho males work as migrants. This shows the dependency of most rural households on remittances from RSA. The decrease in off-farm wage employment leads to worsening food security for most households as they do not have the income to purchase food. Lesotho has for a long time depended on wage employment of its nationals in RSA mines. The RSA mining industry is facing difficulties so that the future of Basotho men continuing to be employed in the mines is bleak. The recent political changes in RSA will further reduce the chances of Basotho being employed in RSA.

Results indicate that most of the people employed in RSA are relatively uneducated but within Lesotho women tend to be more educated than men. For people working as migrants in RSA, education does not have a significant effect on off-farm wages but experience has a positive and significant effect. The implication is that there is a tendency for rural households not to educate males as it is believed that they can easily obtain jobs in RSA mines. Recent experiences of retrenchments in the mining industry has indicated that in future only men with more skills and education may find employment. These miners are being offered renewed and longer contracts to help stabilise the labour force with more experienced and skilled workers. This has reduced mining job opportunities for young Basotho entering the job market for the first time. Education of males should therefore not be neglected.

As farming-systems researchers conduct surveys and establish trials in eastern and southern Africa, they increasingly find themselves dealing with women farmers (Low, 1986:171). This is the prevailing situation in Lesotho. This means most agricultural work is undertaken by women as men are away working in RSA mines. In most cases agricultural extension

services are geared towards men. It may be beneficial if greater extension efforts are also focused on women, given their higher level of education than men.

In recent years the textile industry has shown growth in terms of number of people employed and contribution to GNP. Given that Lesotho has a relatively skilled and abundant labour, the government of Lesotho should continue encouraging foreign investment in the country. The recent political changes in RSA have meant that some investors located in Lesotho may leave for RSA where investor services are better. Given that Lesotho has a small population with low purchasing power most of the investments have to be export orientated.

Results indicate that a *ceteris paribus* increase of 10 percent in maize producer and consumer prices, leads to maize production increasing by 8 percent. Maize self-sufficiency increases by 7 percent. This indicates that the supply response for maize is inelastic with respect to product prices.

An increase of 10 percent in maize producer prices with maize consumer prices held constant, *ceteris paribus*, does not have any effect on the production of all crops. Experiments with the model indicate that maize producer prices have to be increased by over 100 percent in order for households to produce maize for market purposes. This shows that most of the agricultural production in Lesotho will remain for subsistence even under relatively high maize prices. In most developing countries, such as Lesotho, it is usually assumed that farmers will respond to price signals. It is argued that farmers will respond to producer price signals of a staple such as maize if they are surplus producers. Most farmers in Lesotho are deficit producers (net consumers) and as such it can be expected that they will

respond differently to price signals. An increase in the price of maize will have little impact on output but will have a negative impact on large numbers of rural households. Evidence has shown that Basotho farmers respond significantly to pulse prices mainly because they are surplus producers of pulses (Tarbox, 1979).

The practice of setting high producer prices in order to promote self-sufficiency benefits those few households who are surplus producers while harming the majority of the population who are deficit producers. The high maize producer prices tend to push up the relatively higher informal (farm-gate) prices. Informal maize prices tend to be much higher than official prices (Ministry of Agriculture, 1992). Indications are that Basotho households are more responsive to maize consumer prices than maize producer prices and this shows that the majority are net consumers of maize. Expectations are that farmers respond to both consumer and producer prices of maize with surplus producers responding to producer price while deficit producers respond to consumer price.

Results indicate that Basotho are net consumers of maize. Most of the policies which have been implemented by the government of Lesotho have treated Basotho farmers as surplus producers of maize. For instance, the government of Lesotho usually sets high maize producer prices in an attempt to encourage increased maize production. It is argued that the high maize producer prices result in high maize consumer prices. Because a large proportion of the rural households are deficit maize producers, the high consumer prices hurt the most. It is thus argued that the government of Lesotho should, when designing policies, take into consideration that most rural households in Lesotho are net consumers of staple food such as maize.

An interest rate subsidy has almost no effect on household welfare and leads to an increase in FSSP maize production and this results in minimal increases in total maize production. This is despite the increased maize production costs because FSSP is a high cost production system which has resulted in a financial burden on the Lesotho treasury and donor funds. The yields realised by farmers involved in FSSP are lower than break-even yield of 1,4 tons/Ha so that most farmers are unable to pay back FSSP loans. The small farm sizes also makes it difficult for households to raise enough money to repay loans. This has resulted in high rates of loan defaulting so that in most instances government has to write off farmers' debts. This calls for a closer examination of FSSP especially now that foreign donors are withdrawing from Lesotho.

Some analysts have argued that there is fallow land in Lesotho because farmers practise crop rotation. Results from surveys undertaken in Lesotho in which respondents were asked to give reasons for fallow land indicate that most respondents mentioned lack of resources and drought. In the survey undertaken for this study not a single respondent mentioned crop rotation as a reason for fallow land. Lyne and Nieuwoudt (1991) have argued that arable land is underutilised in less developed regions of Southern Africa because the opportunity cost of non-use is zero. Where a land market exists participation is worthwhile, households would rather rent their land to tenants than leave it idle. Although sharecropping arrangements where a resource-poor land owner teams up with a land-poor household with resources are common, sharecropping has limitations. Lawry (1993) has shown why emerging enterpreunial farmers prefer outright cash land rental arrangements over sharecropping. In sharecropping equal labour contribution is usually the most common justification for equal division of output, without any attempt to consider contributions of

other inputs, e.g. seeds and fertilisers. Lawry (1993) observed that a large proportion of survey respondents said that dispute over the division of the harvest in relation to labour contribution had led to the discontinuance of sharecropping in the past. Lyne (1989) has shown the advantages of land rental which include improved efficiency and equity. Since land rental arrangements are voluntary, all participants benefit. Lessors gain income and lessees are able to access additional land without diverting working capital into land purchase. It is postulated that in order for the underutilised land to be farmed efficiently land rental arrangements should be encouraged.

Results indicate that although the benefit from land rental is high, transaction costs exceed the rental value resulting in the non-existence of a land rental market in Lesotho. One of the major recommendations of the Land Policy Review Commission (1987) was that land rental transactions should be formalised. The government of Lesotho has since passed the Agricultural Lease Regulations (1992) under which land holders can convert their holdings into leasehold tenure. Few households have applied for leases since 1992. It seems the major problem facing government is providing institutional support for a land rental market and so mechanisms to promote land rental in Lesotho should be pursued.

The reason for low crop production in Lesotho does not appear to be a price problem. Other policy issues expected to impact on crop production were not considered. These policy issues include farm size, land markets, market failure, lack of information, transaction costs, appropriate technology and institutional factors. It is recommended that these policy issues be studied further in order to have insights into the problems of crop production in Lesotho. In addition it seems one other major problem is the low yields realised. Research conducted

at the Research Division of the Ministry of Agriculture indicate that maize yields of between 3-4 tons/ha are possible in Lesotho under good management practices. Experts have argued that such yields are not being realised because farmers do not practice good farm management (du Toit, 1995). It is recommended that farmers' management practices be improved so as to improve crop productivity.

CHAPTER 6

CONCLUSIONS

Lesotho is a less developed country with agriculture as the major sector. Crop farming in Lesotho is declining despite government and foreign aid donors' intervention. The purpose of this study was to identify factors affecting crop production in Lesotho and to analyse different economic policies on resource allocation. The purpose of the study was achieved by using a mathematical programming model which aggregates enterprise levels for four representative households to form a sector model.

Results from a household-based programming model indicate that even though agriculture is the key sector in Lesotho, rural Basotho households are more responsive to consumer than producer prices. This is because the majority of rural households are net consumers, mainly because of the subsistence farming practised in the country. The practice of setting high producer prices in an attempt to encourage increased production, benefits a small proportion of households who are surplus producers while harming a large proportion of households who are deficit producers. The deregulation of the RSA maize marketing is simulated to result in lower maize import prices and subsequently increased welfare for Lesotho rural households. This is because Lesotho imports approximately 50 percent of her maize requirements from the RSA. The deregulation of the RSA maize marketing system results in maize self-sufficiency declining while food security improves. The recent political developments in RSA render the policy of food self-sufficiency uneconomic. The policy shift

from food self-sufficiency to food security calls for the reconsideration of the FSSP especially as one of the objectives of FSSP is to achieve grain self-sufficiency.

An increase in the unemployment rate is predicted to result in minimal increases in crop production and a decrease in household welfare. This is despite the increase in the population resident in Lesotho. Increased unemployment results in worsening food security as most households cannot purchase food. The decrease in household welfare is worse when unemployment occurs in RSA rather than within Lesotho. Most Basotho males work in RSA as migrant workers and the RSA mining industry is experiencing difficulties. Recent political developments in RSA may mean that the RSA government will give priority to RSA citizens and the employment of workers from Lesotho in RSA may stagnate or decline. In recent years there has been significant retrenchment of Basotho workers in the mining industry. This calls for the establishment of industries within Lesotho.

Increased crop production in Lesotho could contribute to food security in the country by increasing household incomes and food supply. This may be accomplished by having appropriate producer incentives. The policy focus of the Lesotho government for a long time has been to achieve grain self-sufficiency although recently indications are that the focus is shifting to food security. High grain producer prices have been used as an incentive to achieve grain self-sufficiency. Increases in maize producer and consumer prices lead to maize production increasing by a smaller margin. Results indicate that the supply response for maize is inelastic with respect to product prices. An increase of producer prices with consumer prices held constant leads to no changes in crop production. Experiments with the model indicate that maize producer prices have to be increased by over 100 percent in order

for households to produce maize for market purposes. This shows that most of the agricultural production in Lesotho will be for subsistence and that maize prices need to be increased substantially before farmers will produce a surplus. Increasing maize prices by such magnitudes negatively affects a large proportion of the population who are deficit producers while benefitting few surplus producers. One option pursued by the government of Lesotho has been to subsidize some food commodities, for instance, maize. This has met some problems because of the open border between Lesotho and RSA. There is evidence that some illegal importation of maize grain is taking place. This is mainly undertaken by people who have realised that maize producer prices in Lesotho are higher than those in RSA. In addition Lesotho has adopted the IMF/World Bank Structural Adjustment Programme and one of the conditions is that government should curb expenditure. Curbing government expenditure means decreasing subsidies such as the one on maize.

Results indicate that increased subsidisation of the FSSP in the form of reduced interest rates, results in minimal increases in maize production although production costs increased by a bigger margin. FSSP is financed with aid money and its continuation is uncertain because aid donors are re-examining their role in developing countries. In addition since democratic elections were held in RSA most aid donors have moved from Lesotho to relocate in RSA. This means the amount of aid received by Lesotho will decrease. Prospects of FSSP being financed by the government of Lesotho are bleak because of the high loan defaulting by farmers participating in FSSP.

It has been postulated that one of the causes of low food production in Lesotho is land shortage but one peculiar aspect of Lesotho's agriculture is that arable land is underutilised

and grazing land overutilised. There is significant fallow land despite population pressure on arable land. Results indicate that land rental arrangements can lead to increased production but transaction costs exceed the rental value and this has resulted in the non-existence of a land rental market in Lesotho. This calls for the examination of factors that lead to the inefficient use of land in Lesotho and ways and means found to promote the efficient land use in the form of land rental arrangements. The high transactions costs on land transfers also need to be examined.

CHAPTER 7

SUMMARY

Lesotho is a less developed country with agriculture being the key sector and a major source of employment within the country. Approximately 85 percent of the population lives in rural areas. Crop farming is characterised by a high proportion of subsistence farming with over 80 percent of the production being kept for home consumption. Lesotho's agriculture has declined despite government intervention in the form of area-based development projects and massive international aid. Foreign aid has been used to establish marketing organisations, credit facilities, extension services, and roads. As a result of the low and declining agricultural production, Lesotho is increasingly relying on imports and foreign aid to feed its growing population.

Lesotho exports labour to RSA because of limited resources and lack of employment opportunities in the country. Approximately 40 percent of Lesotho's male labour force is at any point in time engaged in employment in RSA as migrants. Migrant workers' remittances account for approximately 50 percent of the GNP of Lesotho. Agriculture as the main source of income has decreased substantially while dependence on migrants' remittances and foreign aid has increased. Most households in Lesotho have some members working as migrants in RSA. Indications are that migrant cash remittances are a major source of cash income for rural households. Migrant remittances contributed 52,7 percent of total rural households' income followed by subsistence farming which contributed 16,1 percent. A large proportion of migrants originate from rural areas, given that most of the population

lives in rural areas. Paid employment for regular wage/salary earners is found mostly in government and to a lesser extent in the private sector and parastatals, with estimates of unemployment rates in Lesotho ranging from 23-45 percent.

Lesotho is experiencing rapid population growth. In the 1976-1986 inter-censal period population increased by 2,6 percent per annum with projections being that the population will reach 2 million by 1996. Approximately 70 percent of the population lives in the Foothills and Lowlands and this has resulted in great pressure on arable land. Even though there is increasing pressure on arable land, land under cultivation has been declining. Coupled with this is increasing fallow land. With increasing population pressure, landlessness has been increasing.

The average monthly cash income per household for the country was R236 in 1986/87 and indications are that the income distribution in Lesotho is highly skewed. Lorenz-curve analysis showed that the 50 percent of the population with the lowest total income account for 10,3 percent of the total incomes, while 10 percent with the highest income have 47 percent of the total income.

The major crops produced in Lesotho are maize, sorghum, wheat, beans and peas with grains being the most important crops in terms of area planted. The average area devoted to grain production was 75 percent of the total arable land in Lesotho for the years 1973/74-1988/89. Most crops in Lesotho are grown in summer but wheat and peas are grown in winter and summer with winter wheat and peas being grown in the Lowlands while summer wheat and peas are grown in the Mountain region. The major cash crops grown in Lesotho are

asparagus and beans. Under livestock, the sale of wool and mohair are the major sources of cash income.

Lesotho's crop farming has experienced continuous declines since 1978/79 but recovered in 1985/86 as a result of good rains. The overall index of food production (encompassing the five major crops) indicates that from 1973/74 to 1984/85 production on the average declined by about five percent per annum. Causes of the declining crop production include drought, low yields, low fertilizer applications, low and erratic rainfall, hail, frost and soil erosion. In addition, the level of money wages in RSA is recognised as a factor affecting agricultural production since suitable levels of subsistence can be reached by most households through mine remittances. It has been postulated that because of this, there exists little incentive to engage seriously in agriculture. Also mine employment means the able-bodied male labour force is not engaged in agriculture and so agriculture is left to women, children and older men.

The government of Lesotho, with assistance from donors, promotes agricultural production in the form of area-based development projects. The agricultural marketing system is being liberalised and this came about with the IMF/World Bank Structural Adjustment Programme which Lesotho adopted in 1988. Under this programme the private sector, including individuals, farmer co-operatives and associations, is allowed to participate in the marketing of agricultural products so as to promote competition. Under this programme Co-op Lesotho was dissolved although plans are underway to revive it.

The purpose of this study was to identify factors affecting crop production in Lesotho and to analyse different economic policies on resource allocation. The study was also meant to provide policy recommendations aimed at improving agricultural production in Lesotho and increasing the welfare of rural households.

The study applies household economics theory which recognises the fact that most farm households in developing countries are deficit producers and as such are engaged in both production and consumption, which is the situation in Lesotho. Household economics provides a theoretical and empirical analysis of how farm households respond to government interventions in the agricultural sector. These models are designed to capture several factors which determine households' resource allocations so that results of the analysis can be applied empirically to illuminate responses to policy interventions.

The purpose of the study was achieved by using a mathematical programming model to predict responses to several economic policies. The programming model aggregates enterprise levels for four representative household types to form a sector model. Data were obtained from a sample survey of 160 crop producing households located in the northern Lowlands and Foothills of Lesotho. Representative farm households from each region were selected using principal component and cluster analyses. The latter analyses identified two types of farm households in each region, namely, the ones participating in FSSP and those not participating. The representative household programming models were combined to form a sector (regional) model. Aggregate resource levels in each household type were computed as the product of the representative (mean) household resource levels and the estimated number of households in the group.

To account for differences in wage earning potentials, offer wage rates were estimated for all household members not wage employed. Offer wage models predicted that men have a higher wage earning potential than women. Men can either be allocated to on-farm work, low income off-farm employment within Lesotho or high income off-farm employment in RSA while women can either be allocated to on-farm work or low income off-farm employment within Lesotho. Results of the offer wage models indicate that people wage employed within Lesotho are relatively more educated than those wage employed as migrants in RSA.

Crop production in Lesotho is risky due to unstable crop yields. To account for risk, a linear approximation of the gain-confidence limit (E,L) criterion suggested by Baumol (1963) was used. Risk aversion coefficients were estimated independently for each representative household by simulating its observed enterprise mix. These estimates were then substituted into the aggregate model.

Several economic policies were simulated and results compared with the base solution. Most of the policies examined focus on maize prices because maize is the most important staple food in Lesotho and changes in its price are expected to affect rural households' resource allocation and welfare.

(i) Deregulation of RSA maize marketing system

To simulate the impact of the deregulation of the RSA maize marketing system, maize import prices were reduced by 20 percent, *ceteris paribus*. Household welfare of producers is

estimated to increase by 7 percent as most of the households are deficit maize producers. Area allocated to maize production and maize production decrease. There is also a decrease in area allocated to FSSP maize production, FSSP maize production and maize self-sufficiency. Maize imports increase as a result of the decrease in maize production. Area allocated to wheat and wheat production increase while wheat imports decrease. Sorghum and pulse production remain unchanged with fallow land increasing while FSSP production costs and interest payments decrease.

(ii) A 10 percent reduction in wage workers employed in RSA

To simulate the effects of reduced employment in RSA, the number of wage employed men in RSA was reduced by 10 percent and this results in an increase in on-farm labour available in Lesotho. This was achieved by reducing the number of wage employed workers from NONFSSP households in the Foothills by 9 680. A 10 percent reduction in wage workers employed in RSA is simulated to result in households' welfare decreasing. Households affected by unemployment are estimated to suffer significant welfare losses. This shows that rising unemployment in RSA mines has a significant effect on rural households in Lesotho. There are minimal increases in maize and sorghum production but maize self-sufficiency remains unchanged with area allocated to wheat production and wheat production increasing significantly. Maize and wheat imports remain unchanged and this indicates that increased labour consumption requirements are met by allocating additional area to all the grain crops. The additional pulse requirements are met by an increase in sales of pulses between rural households. Fallow land and net remittances decrease.

(iii) A 10 percent reduction in wage workers employed in Lesotho and RSA

A 10 percent reduction in wage workers in both Lesotho and RSA leads to households' welfare decreasing. Area allocated to maize, sorghum and wheat increases and their production also increases. Maize and wheat imports remain unchanged while fallow land and net remittances decrease. The percentage decrease in both households' welfare and net remittances between scenarios 2 and 3 are two and one respectively and this shows that a decrease of Basotho wage workers in RSA has a much higher effect on rural households than a corresponding decrease of wage workers within Lesotho. This is understandable because wages in RSA are much higher than in Lesotho.

(iv) Maize producer and consumer prices increased by 10 percent

Maize producer and consumer prices were increased by 10 percent, *ceteris paribus*. Household welfare declines by 4 percent. Area allocated to maize production and maize production increase by 8 percent. Maize imports decrease while maize self-sufficiency increases. Area allocated to sorghum, wheat and pulses does not change while there is a decrease in fallow land. The increase in maize production estimates a long run supply response elasticity for grains at 0,8.

(v) Maize producer prices increased

Maize producer prices were increased by 10 percent with maize consumer prices being held constant, *ceteris paribus*. Under this scenario production of all crops does not change.

Experiments with the model indicate that maize producer prices have to be increased by over 100 percent in order for households to produce maize for market purposes. This shows that most of the agricultural production in Lesotho will be for subsistence and that maize prices need to be increased substantially before farmers will produce a surplus.

(vi) Subsidy equivalent to 50 percent reduction in interest rate

A subsidy equivalent to 50 percent reduction in interest rate aimed at farmers operating under FSSP, leads to total household welfare increasing by a small percentage. Area allocated to FSSP maize production and FSSP maize production increases. Total area allocated to maize production and total maize production increases by only one percent. The increase in maize production results in maize imports falling. The production of sorghum, wheat and pulses remains unchanged, fallow land decreases by only one percent and FSSP production costs increase while interest paid to FSSP decreases.

(vii) Estimated costs of land rental transactions

To estimate the cost of land rental transactions several experiments were run with the model with land transfers being introduced between household types in each region. Land transfers were costed in the objective function and the cost increased until there were no land transfers between households. The results show that land transfers stopped when the cost reached R100 in the Lowlands. It is predicted that FSSP household would rent 0,3 ha of land from a NONFSSP household. When land transfers are effected there is no fallow land in NONFSSP households leading to increased crop production. In the Foothills, FSSP

household rent 0,2 ha of land and land transfers stopped when the cost is R150. Although the benefit from land rental is high, it is concluded that transaction costs exceed the rental value, precluding such a market. This shows that the cost of land rental as measured by its shadow price is high.

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APPENDIX A:CROP ENTERPRISE DATA

Table A.1.1: Lowlands own maize estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)a	Price (R/T)	Revenue (R)	Deviations (R/Ha)
1980/81	0,611	533,50	325,97	-57,48
1981/82	0,450	595,37	267,92	-115,53
1982/83	0,724	550,60	398,63	15,18
1983/84	0,586	525,45	307,91	-75,54
1984/85	0,619	564,85	349,64	-33,81
1985/86	0,677	543,04	367,64	-15,81
1986/87	0,641	534,15	342,39	-41,06
1987/88	0,823	575,23	473,41	89,96
1988/89	0,777	541,89	421,05	37,60
1989/90	1,093	526,00	579,92	196,47
Mean	0,700	549,00	383,45	0

Table A.1.2: Lowlands own maize estimated production costs - excluding labour - 1992.

Particulars	R/Ha
Tractor Ploughing	138,00
Seed (8,7 Kg - PNR 473)	43,50
Fertilizer (135 Kg - 3:2:1(32)+Zn)	136,35
Pesticides (0,3 Litre- Thiodan)	6,00
Total	323,85

Table A.1.3: Lowlands own maize estimated labour requirements by season

Season	Hours/Ha
Oct-Dec	124
Jan-March	289
April-June	241
July-Sept	0
Total	663

Table A.1.4: Lowlands FSSP maize estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)	Price (R/T)	Revenue (R)	Deviations (R/Ha)
1980/81	1,632	533,50	870,67	200,41
1981/82	0,700	595,37	416,76	-253,50
1982/83	0,650	550,60	357,89	-312,37
1983/84	0,425	525,45	223,32	-446,94
1984/85	1,645	564,85	929,18	258,92
1985/86	1,320	543,04	716,81	46,55
1986/87	1,495	534,15	798,55	128,29
1987/88	1,555	575,23	894,48	224,22
1988/89	1,230	541,89	666,52	-3,74
1989/90	1,575	526,00	828,45	158,19
Mean	1,223	549,00	670,26	0

Table A.1.5: Lowlands FSSP maize production costs - 1991/92 season

Task	R/Ha
Ploughing	116,14
Discing	59,30
Planting	74,13
Spraying	32,12
Transport	12,36
Fertilizer (185 Kg-3:2:1(32)+Zn)	147,22
LAN (125 Kg)	54,36
Seed (12,4 kg)	51,90
Herbicides (3 Litres)	39,33
Cutworm bait (69 ml)	13,57
Stalkborer chemical (119 ml)	23,78
Total	624,21

Table A.1.6: Lowlands FSSP maize estimated labour requirements by season.

Season	Hours/Ha
Oct-Dec	10
Jan-March	211
April-June	261
July-Sept	0
Total	482

Table A.1.7: Lowlands wheat estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)	Price (R/T)	Revenue (R)	Deviations (R/Ha)
1980/81	0,660	616,13	406,65	-21,87
1981/82	0,774	667,88	516,94	88,42
1982/83	0,588	650,58	382,54	-45,98
1983/84	0,650	605,68	393,69	-34,83
1984/85	0,635	611,11	388,05	-40,47
1985/86	0,730	531,86	388,26	-40,26
1986/87	0,710	548,59	389,50	-39,02
1987/88	0,845	554,77	468,78	40,26
1988/89	0,950	520,08	494,07	65,55
1989/90	0,835	546,98	456,73	28,21
Mean	0,740	585,37	428,52	0

Table A.1.8: Lowlands estimated wheat production costs - excluding labour - 1992.

Particulars	R/Ha
Tractor Ploughing	138,00
Seed (20 kg - Tugela)	60,00
Fertilizer (150 Kg - 3:2:1(25)+Zn))	150,50
Total	348,50

Table A.1.9: Lowlands wheat estimated labour requirements by season.

Season	Hours/Ha
Oct-Dec	300
Jan-March	0
April-June	200
July-Sept	160
Total	660

Table A.1.10: Lowlands sorghum estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)	Price (R/T)	Revenue (R)	Deviations (R/T)
1980/81	0,750	505,38	379,04	29,41
1981/82	0,630	621,75	391,70	42,07
1982/83	0,710	505,10	358,62	8,99
1983/84	0,525	524,20	275,21	-74,42
1984/85	0,655	553,45	362,51	12,88
1985/86	0,645	499,00	321,86	-27,77
1986/87	0,510	488,71	249,24	-100,39
1987/88	0,846	455,50	385,35	35,72
1988/89	1,110	419,25	463,37	113,74
1989/90	0,735	421,00	309,44	-40,10
Mean	0,710	499,33	349,63	0

Table A.1.11: Lowlands estimated sorghum production costs - excluding labour -1992.

Particulars	R/Ha
Tractor Ploughing	138,00
Seed (10 kg - DC 75)	29,00
Fertilizer (135 Kg - 3:2:1(32)+Zn)	136,35
Pesticides (0,3 Litre- Thiodan)	6,00
Total	309,85

Table A.1.12: Lowlands sorghum estimated labour requirements by Season

Season	Hours/Ha
Oct-Dec	150
Jan-March	200
April-June	300
July-Sept	0
Total	650

Table A.1.13: Lowlands beans estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)	Price (R/T)	Revenue (R)	Deviations (R/Ha)
1980/81	0,378	1326,60	501,45	-115,30
1981/82	0,399	1918,79	727,22	110,47
1982/83	0,388	1442,59	559,72	-57,03
1983/84	0,148	1505,23	222,77	-393,98
1984/85	0,319	1716,28	547,49	-69,26
1985/86	0,642	1601,87	1028,50	411,65
1986/87	0,272	1523,86	414,49	-202,26
1987/88	0,377	1444,31	544,50	-72,25
1988/89	0,539	1399,68	754,43	137,68
1989/90	0,702	1235,00	866,97	250,22
Mean	0,414	1511,42	616,75	0

Table A.1.14: Lowland estimated beans production costs - excluding labour - 1992.

Particulars	R/Ha
Tractor Ploughing	138,00
Seed (26 Kg - Small White Haricots)	59,80
Fertilizer (150 Kg - 3:2:1(32)+Zn)	151,50
Total	349,30

Table A.1.15: Lowlands beans estimated labour requirements by season

Season	Hours/Ha
Oct-Dec	140
Jan-March	190
April-June	300
July-Sept	0
Total	630

Table A.2.1: Foothills own maize estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)	Price (R/T)	Revenue (R)	Deviations (R/Ha)
1980/81	0,662	533,50	353,18	-85,06
1981/82	0,473	595,37	281,61	-156,63
1982/83	0,674	550,60	371,10	-67,14
1983/84	0,672	525,45	353,10	-85,14
1984/85	0,750	564,85	423,64	-14.60
1985/86	0,773	543,04	419,77	-18,47
1986/87	0,755	534,15	403,28	-34,96
1987/88	1,011	575,23	581,56	143,32
1988/89	0,966	541,89	523,47	85,23
1989/90	1,277	526,00	671,70	233,46
Mean	0,800	549,00	438,24	0

Table A.2.2: Foothills own maize estimated production costs -excluding labour - 1992

Particulars	R/Ha
Tractor Ploughing	231,00
Seed (8,2 Kg - PNR 473)	41,00
Fertilizer (107 Kg - 3:2:1(32)+Zn)	108,07
Pesticides (0,32 Litre- Thiodan)	6,40
Total	386,47

Table A.2.3: Foothills own maize estimated labour requirements by Season

Season	Hours/Ha
Oct-Dec	147
Jan-March	174
April-June	358
July-Sept	0
Total	679

Table A.2.4: Foothills FSSP maize estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)	Price (R/T)	Revenue (R)	Deviations (R/Ha)
1980/81	1,814	533,50	967,77	253,18
1981/82	0,725	595,37	431,64	-282,95
1982/83	0,663	550,60	365,05	-349,54
1983/84	0,394	525,45	207,04	-507,55
1984/85	1,736	564,85	980,58	265,99
1985/86	1,420	543,04	771,12	56,53
1986/87	1,578	534,15	842,89	128,30
1987/88	1,671	575,23	961,21	246,62
1988/89	1,365	541,89	739,68	25,09
1989/90	1,671	526,00	878,95	164,36
Mean	1,304	549,00	714,59	0

NB: Foothills FSSP maize productions costs are the same as those in the Lowlands.

Table A.2.5: Foothills FSSP maize estimated labour requirements by season.

Season	Hours/Ha
Oct-Dec	10
Jan-March	211
April-June	261
July-Sept	0
Total	482

Table A.2.6: Foothills wheat estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)	Price (R/T)	Revenue (R)	Deviations (R/Ha)
1980/81	0,720	616,13	443,62	-54,73
1981/82	0,850	667,88	567,70	69,35
1982/83	0,625	650,58	406,62	-91,73
1983/84	0,739	605,68	447,60	-50,75
1984/85	0,845	611,11	516,39	18,04
1985/86	0,864	531,86	459,53	-38,82
1986/87	0,950	548,59	521,16	22,81
1987/88	0,870	554,77	482,65	-15,70
1988/89	1,200	520,08	624,09	125,74
1989/90	0,940	546,98	514,16	15,81
Mean	0,860	585,37	498,35	0

Table A.2.7: Lowlands estimated wheat production costs - excluding labour - 1992.

Particulars	R/Ha
Tractor Ploughing	231,00
Seed (20 Kg - Tugela)	60,00
Fertilizer (150 Kg - 3:2:1(25)+Zn)	150,50
Total	441,50

Table A.2.8: Foothills wheat estimated labour requirements by season

Season	Hours/Ha
Oct-Dec	300
Jan-March	0
April-June	160
July-Sept	200
Total	660

Table A.2.9: Foothills sorghum estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)	Price (R/T)	Revenue (R)	Deviations (R/Ha)
1980/81	0,965	505,38	487,69	78,35
1981/82	0,714	621,75	443,93	34,59
1982/83	0,895	505,10	452,06	42,72
1983/84	0,610	524,20	319,76	-89,58
1984/85	0,760	553,45	420,62	11,28
1985/86	0,710	499,10	354,36	-54,98
1986/87	0,656	488,71	320,59	-88,75
1987/88	0,850	455,50	387,18	-22,16
1988/89	1,210	419,25	507,29	97,95
1989/90	0,950	421,00	399,95	-9,39
Mean	0,832	499,33	409,34	0

Table A.2.10: Foothills estimated sorghum production costs - excluding labour - 1992.

Particulars	R/Ha
Tractor Ploughing	231,00
Seed (10 kg - DC 75)	29,00
Fertilizer (135 Kg - 3:2:1(32)+Zn)	136,35
Pesticides (0,3 Litre- Thiodan)	6,00
Total	402,35

Table A.2.11: Foothills sorghum estimated labour requirements by Season

Season	Hours/Ha
Oct-Dec	150
Jan-March	200
April-June	300
July-Sept	0
Total	650

Table A.2.12: Foothills beans estimate of detrended yield, deflated producer price, revenue and deviations from the mean revenue (1992=100)

Year	Yield (T/H)	Price (R/T)	Revenue (R)	Deviations (R/Ha)
1980/81	0,501	1326,60	664,63	-36,97
1981/82	0,412	1918,79	790,54	88,947
1982/83	0,400	1442,59	577,72	-124,56
1983/84	0,252	1505,23	379,32	-322,28
1984/85	0,233	1716,28	399,89	-301,71
1985/86	0,998	1601,87	1598,66	897,06
1986/87	0,493	1523,86	751,26	40,66
1987/88	0,272	1444,31	392,85	-308,75
1988/89	0,395	1399,68	552,87	-148,73
1989/90	0,736	1235,00	908,96	207,36
Mean	0,469	1511,42	701,60	0

Table A.2.13: Foothills estimated bean production costs - excluding labour - 1992

Particulars	R/Ha
Tractor Ploughing	231,00
Seed (28 Kg - Small White Haricots)	64,40
Fertilizer (120 Kg - 3:2:1(32)+Zn)	121,20
Total	416,60

Table A.2.14: Foothills beans estimated labour requirements by season

Season	Hours/Ha
Oct-Dec	140
Jan-March	190
April-June	300
July-Sept	0
Total	630

Table A.3: Estimated mean retail, formal and informal prices -1992 (R/Kg)

Crop	Retail (Imported)	Informal(village level)	Formal (urban sales)
Maize	1,18	0,86	0,51
Wheat	1,25	0,90	0,70
Sorghum	1,20	0,80	0,60
Beans	3,06	2,40	1,27

APPENDIX B: SURVEY QUESTIONNAIRE

1 IDENTIFICATION

Village:_____ EA No:_____

District:_____ Zone:_____ Date: _____

2 HOUSEHOLD SIZE AND COMPOSITION

No.	Name of household member	Sex	Age	Relation to head	Occupation	Place of employment	Monthly income	Monthly remittances	Monthly Pension and disability payments	Level of education
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Sex: M=male
F=female

Relation to head:
1=head
2=spouse of head
3=child of head
4=grandchild
5=spouse of child
6=parent of head/spouse
7=other relative
8=domestic employee
9=labourer

3. CROPPING

3.1 Own Fields

		Own (Ha)			own operated with FSSP (Ha)		Amount produced in bags*			Yield (Kg/ha)			No of bags retained	No of bags sold	Value of sales (R)	To whom sold #
Crop	Grown Y/N	Field1	Field2	Field3	Field1	Field2	F1	F2	F3	F1	F2	F3				
Maize																
Sorghum																
Wheat																
Beans																
Peas																
Fallow																
Asparagus																
Potatoes																
Vegetable																
Sunflower																
Fodder																
Maize/ Beans																
Sorghum/ Beans																

* Indicate whether 70kg, 90kg or makopokopo # Indicate whether Formal(F) or Informal(I)

3.2 Sharecropped Fields

		Own (Ha)	Not own (Ha)	Amount produced in bags*	Yield (Kg/ha)	Ouput sharing You Other	No of bags sold	Value of sales (R)	To whom sold#
Crop	Grown Y/N	Field1 Field2	Field1 Field2	F1 F2 F3	F1 F2 F3				
Maize									
Sorghum									
Wheat									
Beans									
Peas									
Maize/ Beans									
Sorghum/ Beans									
Others Specify									

* Indicate whether 70kg, 90kg or makopokopo # Indicate whether Formal(F) or Informal(I)

Which agricultural inputs did you contribute to the sharecropping arrangement?

Input Quantity

1_____ _____

2_____ _____

3_____ _____

Which agricultural inputs were contributed by the other party in the sharecropping arrangement?

Input	Quantity
1_____	_____
2_____	_____
3_____	_____

Do you have any problems which inhibit increased crop production?

Y	N

If yes, list the problems:

1._____

2._____

3._____

4._____

Do you have any problems in selling surplus crop production?

Y	N

If yes, list the problems:

1._____

2._____

3._____

4._____

What proportion of arable land was cropped last season?

All (100%)	_____
Most (75%)	_____
Half (50%)	_____
Some (25%)	_____
None	_____

Why is some arable land left uncropped?

1._____

2._____

3._____

Is land rented from other farmers?

Y	N

If yes what is the annual rental _____/ha

If no, what are the reasons for not renting land from other farmers?

Do not have enough resources
There is no land available for renting
Other farmers not willing to rent us land
Other reasons_____

_____

Is land leased out to other farmers?

Y	N

If yes, for how much is the land leased out for per year ____/ha

If no, what are the reasons for not leasing out land to other farmers?

There is no land available for leasing out to other farmers
Tenant won't pay enough for my land
Afraid of the tenant claiming ownership of my land
Tenants do not usually pay on time
Other reasons_____

_____

_____

Do you feel that you might be dispossessed of your land if you do not farm it yourself?

Y	N

Does the household use credit to obtain farm inputs?

Y	N

If yes, from which institutions is credit obtained?

1 _____

2 _____

3 _____

If no why does the household not use credit?

1 _____

2 _____

3 _____

4. LIVESTOCK

Livestock	Number in possession	Number sold last year	Value of sales (R)	Value of produce sold (milk wool mohair, eggs)* (R)
Cattle				
Sheep				
Goats				
Horses				
Donkeys				
Pigs				
Poultry				
others				

* For wool and mohair the value should include both 1st&2nd payments.

5. ALTERNATIVE SOURCES OF INCOME

SOURCE	ANNUAL INCOME
1 Handicrafts	_____
2 Beer making	_____
3 Family business (e.g cafes)	_____
4 Litokofela (stokvels)	_____
5 Rental of farm equipment	_____
6 Gifts from sons and daughters	_____
7 Others (specify)	_____
	_____
	_____

6. LABOUR USED IN CROP PRODUCTION

6.1 Maize: Field1

Name of H/hold member	Relation to head	Sex	Hours worked per day	Days worked per week	Weeks worked per year	Daily wage (R)	Wage in kind
PLOUGHING							
1							
2							
3							
4							
PLANTING							
1							
2							
3							
4							
WEEDING							
1							
2							
3							
4							
HARVESTING							
1							
2							
3							
4							

6.1 Maize: Field2

Name of H/hold member	Relation to head	Sex	Hours worked per day	Days worked per week	Weeks worked per year	Daily wage (R)	Wage in kind
PLOUGHING							
1							
2							
3							
4							
PLANTING							
1							
2							
3							
4							
WEEDING							
1							
2							
3							
4							
HARVESTING							
1							
2							
3							
4							

6.2 Sorghum

Name of H/hold member	Relation to head	Sex	Hours worked per day	Days worked per week	Weeks worked per year	Daily wage (R)	Wage in kind
PLOUGHING							
1							
2							
3							
4							
PLANTING							
1							
2							
3							
4							
WEEDING							
1							
2							
3							
4							
HARVESTING							
1							
2							
3							
4							

6.3 Wheat

Name of H/hold member	Relation to head	Sex	Hours worked per day	Days worked per week	Weeks worked per year	Daily wage (R)	Wage in kind
PLOUGHING							
1							
2							
3							
4							
PLANTING							
1							
2							
3							
4							
WEEDING							
1							
2							
3							
4							
HARVESTING							
1							
2							
3							
4							

6.4 Pulses (Specify)

Name of H/hold member	Relation to head	Sex	Hours worked per day	Days worked per week	Weeks worked per year	Daily wage (R)	Wage in kind
PLOUGHING							
1							
2							
3							
4							
PLANTING							
1							
2							
3							
4							
WEEDING							
1							
2							
3							
4							
HARVESTING							
1							
2							
3							
4							

6.5 Others (Specify)

Name of H/hold member	Relation to head	Sex	Hours worked per day	Days worked per week	Weeks worked per year	Daily wage (R)	Wage in kind
PLOUGHING							
1							
2							
3							
4							
PLANTING							
1							
2							
3							
4							
WEEDING							
1							
2							
3							
4							
HARVESTING							
1							
2							
3							
4							

Is there sufficient labour for crop production?

Y	N

Could labour be hired if needed?

Y	N

If not, why?

1 prefer to go to the mines in RSA _____
2 prefer to go to urban areas in Lesotho _____
3 cannot afford to pay labour _____
4 labour needs close supervision _____

In which crop production tasks do you need extra labour?

1 ploughing 2 planting
3 weeding 4 harvesting

7. INPUT USAGE

Inputs	UsageY/N	Qnty used/yr			Price paid(R)			Place obtained		
		F1	F2	F3	F1	F2	F3	F1	F2	F3
Crop	*****				**********			**********		
Improved seed										
Normal seed										
Fertilizer:LAN Mixes*										
Kraal manure										
Herbicide										
Pesticide										
FSSP input package										
Tractor ploughing		**********								
Animal ploughing		**********								
Tractor discing		**********								
Tractor planting		**********								
Animal planting		**********								
Animal cultivation		**********								
Weeding (L)										
Harvesting (L)										
Othercosts										

*Mixes = Composite fertilizers like 2:3:2, 3:2:1, etc. (L) = Labour

Do you have any problems with acquisition of agricultural inputs?

Y	N

If yes, list the problems:

1_____

2_____

3_____

4_____

8 HOUSEHOLD EXPENDITURE

How much did the household spent on the following items last month

Item	Amount
Food and beverages	_____
Clothing and footwear	_____
Furniture and household equipment	_____
Fuel for cooking	_____
Medical and health expenses	_____
Transport and communications	_____
Education (school fees/year)	_____
Others	_____
	_____

9. ASSETS

9.1 ANIMAL DRAWN

Item	Number owned	Cost price (R)	Age (years)
Plough			
Harrow			
Planter			
Cultivator			
Scotch cart			

9.2 TRACTOR DRAWN

Item	Number owned	Cost price (R)	Age (years)
Tractor			
Plough			
Harrow			
Planter			
Cultivator			
Trailer			

9.3 OTHER ASSETS

Item	Number owned	Cost price (R)	Age (years)
Combine harvester			
Motor car			
Van (bakkie)			
Hoe			
Knapsack sprayer			
Wheel barrow			
Others			

9.4 FINANCIAL ASSETS

Do you have bank accounts?

Y	N

If yes, what kinds — Amount

Savings account _____
Current account _____
Fixed deposits _____
others _____
_____