Economic Analysis of Maize Production in the Maseru District, Lesotho: The Case of the Masianokeng Resource Center

Mampiti Matete[1]
The National University of Lesotho
Roma,Lesotho
Maletsema Mokitimi
Catholic Relief Services, Maseru, Lesotho

ABSTRACT:

Maize is a staple food and an important source of starch for many households in Lesotho. But, for many years, its domestic supply has failed to meet demand. In order to increase its supply, the Lesotho government has provided many incentives to maize producers, ranging from price support to input subsidies. Despite these efforts, maize supply continues to fall short of demand. Using the Maseru district as a case study, this study determined the economic efficiency of maize production in Lesotho, based on regression and budgetary analytical tools. The study further identified problems that hinder increased maize production in Lesotho. The regression analysis results indicated that, while farmers were economically efficient in using labor, they under-utilized land and fertilizer inputs. Budgetary analysis results indicated that farmers earned a net income of M272.93 per hectare. The study also observed that, lack of capital, unavailability of some inputs and high input costs, hindered maize production in Lesotho. From the overall results of the study, it is evident that maize production in Lesotho can be profitable and that domestic supply can be increased if farmers could use all the production inputs efficiently and if credit facilities and inputs can be made available.

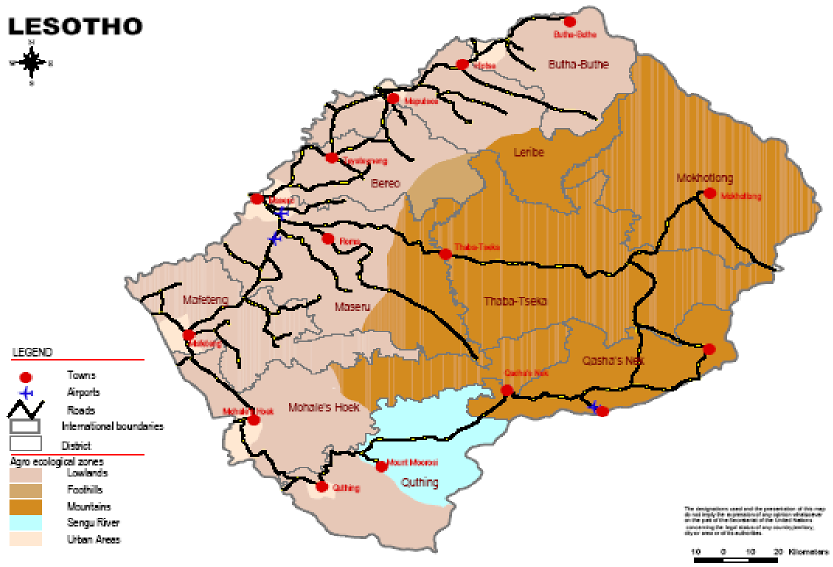
Introduction

Like in many developing countries, agriculture is important in Lesotho. Although its share in total GDP has declined considerably over the years (from 22% in the early 80s to 17% in 2003), the sector continues to play a pivotal role in the economy of the country. It generates employment and provides livelihoods to the rural population of the country, which constitutes 80% of the population of Lesotho. Fifty five percent of this population relies on agriculture directly for their livelihood (Ministry of Agriculture and Food Security (MAFS), 2003a).

Agriculture in Lesotho is mainly subsistence-based though plans to commercialise it are now advanced. Production is organised according to the four agro-ecological zones of the country: the Lowlands, Senqu River Valley (SRV), Foothills, and Mountains (see Figure 1 below).

Figure 1: Agro-ecological Zones of Lesotho

[1] *Corresponding author - Email: mateteme@yahoo.co.uk or me.matete@nul.ls*
Tel: +266-22340601
Fax: +266-22340000



LESOTHO
Butha-Buthe
Leribe
Bereo
Mokhotlong
Thaba-Tseka
Mafeteng
Maseru
Qasha's Nek
Mohale's Hoek
Quthing
Butha-Buthe
Mokhotlong
Thaba-Tseka
Roma
Qacha's Nek
Mohale's Hoek
Mount Moorosi
Quthing
LEGEND
Towns
Airports
Roads
International boundaries
District
Agro ecological zones
Lowlands
Foothills
Mountains
Sengu River
Urban Areas
10 0 10 20 Kilometers

The lowlands (1, 388 to 1, 800m above sea level) form a narrow belt (20 – 50 km wide) along the western border of the country and accounts for 80 percent of the productive arable land. Though relatively small, the zone has the highest population density estimated at 71 persons per km^2 (FAO, 2001). The SRV, at similar elevation, is a major grassland area supporting populations of livestock in mixed farming systems. The Foothills rise from 1, 800 to 2, 000m above sea level and form a narrow strip running from the north-east to south-west of the country, adjacent to the lower mountain range. This region makes up eight percent of the country. The Mountains (2, 000 to 3, 482m above sea level) account for 61% of the land area and are primarily used for summer grazing. They also form a unique African alpine and sub-alpine habitat of the Drakensburg range.

The main productive sub-sectors are crops and livestock and they each contribute 40 - 60% and 30% - 40%, respectively to agricultural GDP (MAFS, 2003a). The rest is contributed by the services sub-sector. The main staple crops are maize, sorghum, wheat, peas and beans. Maize is the most important staple crop and provides approximately 40 % of the daily diet of Basotho[2] (Massey and Pomela, 1990). It is predominantly grown in the Lowlands of Lesotho and the leading districts in maize production are Leribe, Maseru and Berea. More than 50% of planted area in Lesotho is always under maize. Between 1994/95 and 2000/01, an average of 65% of total area planted was under maize, 14% under sorghum, 12% under wheat and 5% and 4% under beans and peas, respectively. However, between 2001/02 and 2003/04, the area under maize comprised 70% of the total area planted, while the area under sorghum increased marginally by 1%. The area under wheat and peas decreased to 8% and 2%, respectively while that under beans remained constant at 5% as a percentage of the total planted area[3].

Although maize is an important staple food in Lesotho, its production has not kept pace with demand. Lesotho only produces about 30% of its maize requirements and the rest is imported. The area under maize has been declining in absolute terms since the late 80s from 189, 900 ha to only 145, 986 ha in 2002 (Department of Planning and Policy Analysis (DPPA) and Bureau of Statistics (BOS), 2002). Maize yields have also been on the decline since the early 80s until the early 90s when there was a general increase in yields until 2000 when they started to decline again, mainly due to unfavorable climatic conditions (DPPA and BOS, 2002). The decline in area allocated to maize and the general poor performance of the sector can be ascribed to a multiplicity of factors, including encroachment of urban residences into arable land, unfavorable climatic conditions, lack of credit (compounded by retrenchments of mine workers, who used to subsidise agriculture from the mines in South Africa), and degraded arable land (Lesotho government, 2005; MAFS, 2003a).

---

[2] *Lesotho people*

[3] *Derived from data produced by the DPPA in the MOAFS and the BOS, Ministry of Finance and Development Planning (MOFDP).*

The government of Lesotho has made several attempts to improve productivity of agriculture in general with special attention to maize, given its significance in the diet of Basotho. Attempts range from research in improved technologies, agricultural support in the form of input and output subsidies and agricultural extension services (Lesotho government, 2005; MOAFS, 2003a and b). Despite these efforts, the area allocated to maize and maize yields continue to decline unabated and the question that arises is, should Lesotho farmers continue to be encouraged to produce maize? But more important, is maize production an economically efficient activity in Lesotho? That is, are maize producing farmers able to make profits, and do they utilize their resources efficiently? If the answer to these questions is no, what problems hinder efficiency in maize production? The answer to these questions should provide useful information to decision makers, especially now that the country is emphasizing food security as an important ingredient towards achieving some of the millennium development goals (MDGs).

Although maize is the most important grain crop in Lesotho, economic analysis thereof has not received much attention. A few existing studies focused on the profitability of the crop under different cropping systems and in different villages and districts (Massey and Pomela, 1990; FAO, 1989; Holland and Tsiu, 1983). The districts of Maseru (Massey and Pomela, 1990; Holland and Tsiu, 1983) and Berea (FAO, 1989) are the only ones that have received attention to date. Economic efficiency in maize production has not received any attention and yet it plays a big role in the realization of profits. This study is aimed at bridging this gap in the literature by, not only estimating the profitability of maize in the case study area, but by also determining the economic efficiency of production thereof.

Using the Maseru district as a case study, this study analyzed the economics of maize production in Lesotho by determining whether farmers produce at optimal and profitable levels. The study further analyzed socioeconomic factors affecting maize production in Lesotho. This paper is organized in five sections. The next section discusses the concept of efficiency, followed by data and analytical tools used in the study in section three. Section four examines results and section five concludes the study and draws recommendations and policy implications from the study results.

THE CONCEPT OF EFFICIENCY

Efficiency can be simply defined as the goal of getting the most out of a productive performance (Sloman, 1991). The concept of efficiency is associated with observations that different farms produce different quantities of output from a given set of inputs and that different farms with the same set of prices of variable inputs earn different profits (Osburn and Scheneeberger, 1983). Production efficiency comprises technical and economic efficiency. In its simplest form, technical efficiency implies that given the same quantity of measured inputs, one farm or a group of farms produce a greater quantity of output than the other. Thus, if one has information on what inputs are used in a particular production process as well as on output levels, a simple ratio of output to input produces a measure of technical efficiency (Bucket, 1981).

The production function describes the technical or physical relationship between output and one or more variable inputs (Varian, 1992). It presupposes technical efficiency and states the maximum output obtainable from every possible input combination. But, the selection of the best input combination for the production of a particular output level depends on both input and output prices and this is the basis for economic efficiency determination (Bressler et al., 1975). Thus, economic efficiency is concerned with cost and value and it includes three aspects of efficiency: cost, allocative and innovation efficiency. Cost efficiency means that, for any given level of output, a farm uses the best available techniques and produces at the lowest possible cost. Allocative efficiency implies that a farm is producing the right quantity of goods and innovation technology states that a farm is capable of introducing innovations over a period of time which either reduce the farm's costs or increase performance of existing products (Burningham et al., 1991).

Economic efficiency in the use of a particular input is attained when the marginal value product (MVP) of the input is equal to the marginal cost (MC) of that input (Heady and Dillon, 1961). Conventionally, this means comparing the MVP of an input with its MC. That is, comparing the price of the input in a competitive market to its marginal value product.

DATA AND ANALYTICAL TOOLS

Type of data and collection method

Data was collected from a cross-section of farms on farm sizes, production costs and revenue as well as socio-economic characteristics of the farmers. A multi-stage sampling procedure was used to collect the data. First, the Maseru district was divided into seven resource centers from which one resource centre, namely Masianokeng, was selected to represent the other centers. The selected resource centre was then sub-divided into villages. From these, six villages were selected for the purpose of sampling. A list of 300 farmers in the six villages was obtained from the District Agricultural Office. From this list, a total of forty (40) farmers was selected using the simple random sampling method. To analyse the data, budgetary and regression analyses were used.

Analytical tools

As a prelude to the data analysis, frequency distribution and cross tabulations were used to highlight the socio-economic characteristics of the respondents, which can also help in explaining the regression analysis' (see Section 3.3.2) results. To address the specific objectives of the study, two analytical tools were employed: budgetary and regression analyses.

Budgetary analysis

Budgetary analysis was used to determine if farmers in the case study area were producing at a profitable level. The analysis involves estimation of total revenue and costs for the same production period. The difference between the two estimates gives a measure of net profit (Mbata, 1991). Mathematically, this relation is represented as:

$$\textit{Profit}\ (\Pi) = \textit{Total revenue (TR)} - \textit{Total costs (TC)} \qquad (1)$$

Where:

TR = quantity produced multiplied by price per unit for the particular production period

TC = Total fixed plus variable costs

Farm budgetary technique can, therefore, be used to calculate returns to the factors of production as a measure of resource use efficiency (Mbata and Amandi, 1993).

Regression analysis

Regression analysis, through estimation of production frontiers, has been predominantly used in the literature to estimate production efficiency in agriculture. Examples include, analysis of technical efficiency of paddy farmers in India (Battese and Coelli, 1995); analysis of technical, economic and allocative efficiency for a sample of New England dairy farms (Bravo-Ureta and Rieger, 1991); analysis of technical efficiency of Korean rice producers (Kwon and Lee, 2004); analysis of technical, allocative and economic efficiencies in swine production in Hawaii (Sharma et al., 1999). These studies used time series data to analyse efficiency of farms. Because of lack of time series data, especially on inputs data, this study employed cross-sectional data of farmers within the Maseru District.

In this study, the production function analysis was used to determine if farmers were allocating their production resources or factors efficiently or if they were producing efficiently. A production function describes the relationship between production factors and quantities of output. It specifies the maximum amount of output that can be produced from a given amount of inputs. The regression analysis was used to estimate the marginal value product (MVP) which was then compared with the marginal cost (MC) to ascertain whether the farmers maximized profit or were economically efficient in their use of production factors.

Several functional forms were fitted but, on the basis of the usual criteria (economic, statistical and econometric), the linear function emerged as the lead equation. The econometric approach was based on the Schwarz Criterion (SC) and Akaike Information Criterion (AIC), both of with are known for their strength in determining the right model (Judge et al., 1988). In Lesotho, maize is predominantly produced for subsistence and commonly influenced by the following factors: land, labour, fertilizer, seeds and operating costs which mainly comprise machinery (tractor) hire. The implicit functional form of maize production in the study area can, therefore, be expressed as:

$$Y = f(X_1, X_2, \ldots X_5) \qquad (2)$$

Where:

$Y = value$ of maize output (M)[4]

$X_1 = land$ in hectares
$X_2 = labour$ in mandays
$X_3 = amount$ of fertilizer (Kg)
$X_4 = amount$ of seed (Kg)
$X_5 = operating$ costs (M)

Assuming a linear production function, the explicit production function was then presented as:

$$y = b_0 + \sum_{i}^{5} b_i X_i + e_t \qquad i = 1, 2, \ldots, 5, \quad e = (0, \sigma^2) \qquad (3)$$

[4] *M stands for Maloti which is Lesotho currency pegged to the South African Rand on one to one basis*

Where b_i are parameters, which measure the rate at which input variables are transformed into output and e_t is the stochastic random error term.

RESULTS AND DISCUSSION

Descriptive statistical analysis revealed that the majority of the farmers (53%) in the case study area were above 50 years of ages. Forty two percent of the farmers were between the ages of 30 and 50 years, while only 5% of the farmers were below the age of 30. More than 50% of the farmers had no formal education while 43% had primary education only. Their farms ranged between 1 and 5 hectares with the majority of them owning between 1 – 3 ha of land. A large percentage of the farmers relied on family labour alone (38%) while 45% relied on both hired and family labour. Only 18% of the farmers relied solely on hired labour. Approximately half of the farmers used improved seeds in their production activities while the other half relied on seeds from past harvests. In addition, only 53% of the farmers used fertilizer (for details see Mokitimi, 1997). The budgetary and regression analyses results are reported in Sections 3.1 and 3.2 below.

Budgetary analysis

Budgetary analysis was used to assess profitability of the farmers under study. The analysis involves estimation of total revenue and costs. The difference between the two gives the measure of net profit or loss. The total revenue included the revenue obtained from the sale of maize output and the imputed value for output not sold but consumed or given to relatives.

The total costs consisted of both cash and non-cash expenses. The cash expenses included the cost of fertilizer, seed, labour, oxen and tractor hire. The non-cash expenses included the cost of unpaid labour (family labour) estimated from the opportunity cost of labour in the case study area. The value of land was also imputed using the annual rental rate in the case study area and interest on capital was also included. The results of the budgetary analysis are shown in Table 1.

Table 1: Average costs and revenue of maize farmers in the study area (Maloti in 1997 prices)

Item	Quantity	Unit cost (M)	Cost/value (M/ha)	
Revenue				
Maize (Kg/ha)	1080	1.00	1080.00	
Total revenue/ha				**1080.00**
Variable costs				
Labour (Mandays)	53	7.00	371.00	
Seed (Kg/ha)	5.75	10.00	57.50	
Fertilizer (Kg/ha)	60	0.96	57.60	

Tractor hire	24.00	
Oxen hire	10.00	
Total variable costs	**520.10**	
Capital costs[5]		
Imputed value for farmers' land/ha	200.00	
Interest on capital (interest rate = 17%)	86.97	
Total capital costs	**286.97**	
Total costs	**807.17**	
Net farm income		**272.93**

Source: Field Survey, 1997.

The results show that a typical farmer in the case study area makes a profit of M272.93 per hectare from maize production. This study confirms that of Holland and Tsiu (1983) which states that maize production in Lesotho is profitable, although the profit calculated in this study is much lower than the one derived by Holland and Tsiu (1983) for the villages of Siloe, Nyakosoba and Molumong in the Maseru District which was M500.

Regression Analysis

The regression analysis was used to determine efficiency in resource allocation by farmers in the study area. The results are presented in Table 2.

Table 2: Regression analysis results

Variable	Estimated coefficient	Standard error	T-ratio
Land	476.02**	125.5	3.79
Labour	7.88*	5.03	1.55
Fertilizer	2.80**	1.33	2.18
Seed	-8.38	18.04	-0.46
Operating costs	1.31	1.33	0.99
Constant	-117.01	237.90	-0.49

R^2 = 0.62

[5] *Depreciation on farm equipment and machinery was not calculated because interviewed farmers in the study area did do not own tractors and tractor drawn implements. Notwithstanding, they owned animal drawn implements albeit their costs were difficult to obtain.*

** = *Significant at 5%*

* = *Significant at 10%*

From Table 2, the R^2 value indicates that about 62% of variation in the value of output is explained by the variation in the independent variables included in the model. Since output in equation (3) is measured in monetary terms, the estimated coefficients are interpreted as marginal value products.

From the results, only four variables, namely, land, labour, fertilizer and operating costs, came out with expected signs. The positive signs associated with land, labour, fertilizer and operating costs variables imply a positive relationship between the value of output and the respective variables. Contrary to apriori expectation, seed variable showed a negative sign. This can be attributed to the fact that 50% of the farmers used low quality seeds (saved from past harvests).

Nevertheless, only three coefficients were statistically significant, namely, land, labor and fertilizer. The insignificant variables are seeds and operating costs. In the case of operating costs, the insignificancy could be a result of the fact that most farmers were using their own animal drawn equipment to carry out farming operations, while in the case of seeds, it could be a result of unreliable data from the farmers, especially because some farmers do not use bought seeds, but instead rely on past harvests for seeds.

To determine efficiency in resource allocation, the marginal value products (MVPs) of inputs with significant coefficients were compared to their marginal costs, measured as the unit price or cost of obtaining that input. An input is efficiently utilised if $MVP_{X_i} / P_{X_i} = 1$. On the contrary, an input is over utilised if $MVP_{X_u} / P_{X_i} \prec 1$ and underutilised if $MVP_{X_i} / P_{X_i} \succ 1$.

Where: P_{X_i} = Price of X_i i = 1, 2, and 3

The ratios of marginal value product (MVPs) to marginal costs (MCs) are reported in Table 3 below:

Table 3: Ratios of MVPs to MCs

Inputs	MVP	MC	MVP_{X1}/P_{X1}
Land (ha)	476.02	200.00	2.38
Labour (mandays)	7.80	7.00	1.11
Fertilizer (kg)	2.89	0.96	3.01

The results indicate that farmers were economically efficient in the use of labour, but underutilized land and fertilizer inputs. The underutilization of these two inputs can be attributed to a number of problems which were raised by farmers during the interviews:

Fertilizer – during the interviews farmers expressed the problem of high input cost and lack of capital. Because of these problems, it is possible that it was difficult for farmers to obtain adequate amounts of fertilizer. Lack of transport and high transportation costs were also posed as a problem. This could have discouraged farmers living a long distance from input stores from buying sufficient amounts of fertilizers. Also, it is possible that farmers underutilized fertilizer out of ignorance, given that most of the interviewed farmers are illiterate and that extension services are poor in the case study area.

Land – During the interviews farmers mentioned the shortage of tractors which prevented them from carrying out their farming operations in time and hence some portions of land were left un-cropped. Delaying of inputs was posed as another problem, and this could result in late or planting of few hectares of land. It is also possible that low maize prices offered to farmers discouraged farmers from planting large quantities of maize. A summary of these problems is provided in Table 4.

Table 4: Production problems encountered by maize farmers in the study area

Problem	Number of farmers	Percentage
Availability of inputs	10	25
Lack of capital	7	17.5
Shortage of tractors	7	17.5
Low maize prices	11	27.5
Lack of transport and high transport costs	5	12.5
TOTAL	**40**	**100**

Source: Field survey (1997)

CONCLUSIONS AND POLICY RECOMMENDATIONS

This study analyzed profitability and efficiency of maize production in Lesotho using the Masanokeng Resource Center in the Maseru District as a case study. Data were collected from 40 farmers in the study area. From the results, the following conclusions can be drawn on the case study area: (i) only land, labor and fertilizer inputs significantly influence maize production, (ii) maize production is profitable at M272.93/ha; (iii) farmers utilize labor efficiently while they underutilize fertilizer and land inputs. The small profits realized by the farmers and inefficiencies inherent in their production activities can be ascribed to their socio-economic characteristics. That is, most farmers in the case study area are elderly (51 – 60 years of age) and about 53 % of them are illiterate. In addition, the farmers face a number of logistical problems including lack of credit, availability of inputs, production equipment (especially tractors) and high transport costs.

Evidently, maize production can be a profitable agricultural enterprise in Lesotho, given favorable climatic conditions and agricultural policy reform that can eliminate logistical bottlenecks faced by farmers in the case study area. This would be significantly beneficial as it would ensure the highly "emphasized" food insecurity problem in the country, more so because maize is the most important staple food for Basotho. In the light of these, the following policy recommendations are made:

- to circumvent the farmers' illiteracy, the extension services in the study area should be strengthened to educate farmers on the use of modern farm inputs. Through extension services, farmers could be made aware of the use and allocation of resources, so that they can improve their profits;
- to solve the problems of lack of capital, unavailability of inputs and cost of the inputs, the government should ensure or facilitate that inputs and credit facilities are available to farmers. This way maize and other grain crops can be increased in Lesotho;

- that a similar study be extended to cover other aspects relating to maize production, not covered in this particular study, for example, response analysis of maize production in Lesotho.

REFERENCES

Battese, G. E. and Coelli, T. J. 1995. ***A Model for technical inefficiency effects in a stochastic frontier production function for panel data. Empirical Economics***, 20: 325-332.

Bravo-Ureta, B. E and Rieger, L. 1991. ***Dairy efficiency measurement using stochastic frontiers and neoclassical duality***. American Journal of Agricultural Economics, 73 (2): 421-428.

Bressler, J. R., Raymond, G. and King, R. A. 1975. ***Markets, Prices and Integrated Trade***. John Wiley and Sons Inc. New York.

Buckett, M. 1981. ***An Introduction to Farm Organisation and Management.*** Pergamom Press Oxford.

Burningham, D., Bennet, P. and Cave, M. 1991. ***Economics***. British Library, London.

Department of Planning and Polici Analysis (APPA) and Bureau of Statistic (BOS), 2002. ***Lesotho Agricultural Situation Report***, Ministries of Agriculture and Food Security; and Finance and Development Planning. Maseru, Lesotho.

FAO, 2001. ***Lesotho Demographic Survey***. Analytical Report, Vol. 1

Heady, E. O. and Dillon, J. I. 1961. ***Agricultural Production Functions***. Iowa State University Press, Ames Iowa.

Holland, D. and Tsiu, M. 1983. 1982/83 ***Cost and returns of field crops in Siloe, Molumong and Nyakosoba: Results from combination farmers***. Lesotho Agricultural Research Division Report. Ministry of Agriculture. Maseru, Lesotho.

Judge, G. G., Hill, R. C., Griffiths, W. E., Lütkepohl, H. and Lee T. 1988. ***Introduction to the theory and practice of econometrics*** (2nd Edn). John Wiley & Sons.

Kwon, O. S. and Lee, H. 2004. ***Productivity improvement in Korean rice farming: parametric and non-parametric analysis***. The Australian Journal of Agricultural and Resource Economics, 48 (2): 323-346.

Lesotho Government, 2005. ***Poverty Reduction Strategy*** 2004/05 – 2006/07. Ministry of Finance and Development Palling. Maseru, Lesotho

Massey, s. and Pomela, E. 1990. ***Lesotho crop production guidelines***. Lesotho Agricultural Research Division Report. Ministry of Agriculture. Maseru, Lesotho.

Mbata, J. N. and Amandi, C. J. 1993. ***The role of women in traditional agriculture:*** A case study of women in food crop production in Rivers State, Nigeria. Discovery and Innovation, 5: 81-87.

Mbata, J. N. 1991. ***An evaluation of institutional credit and its role in agricultural production in Rivers State, Nigeria***. African Review of Money, Finance and Banking. 1: 5-22.

Ministry of Agriculture and Food Security, 2003a. ***Agricultural Sector Strategy: Statement of Policy and strategy in the Agricultural sector***. Maseru, Lesotho

Ministry of Agriculture and Food Security, 2003b. ***Subsidies in the agricultural sector:*** policy statement and implementation framework. Maseru, Lesotho.

Mokitimi, M. 1997. ***Economic analysis of maize production in Maseru District, Lesotho***. Unpublished BSc dissertation. Faculty of Agriculture, National University of Lesotho.

Osburn, D. D. and Schneeberger, K. S. 1983. ***Modern Agricultural Management***: A system Approach to farming. Reston Publishing Co. Inc. London.

Sharma, K. R., Leong, P. S. and Zaleski, H. M. 1999. ***Technical, allocative and economic efficiencies in swine production in Hawaii***: a comparison of parametric and nonparametric approaches. Agricultural Economics, 20: 23-35.

Sloman, J. 1991. ***Economics***. Cambridge University Press,, Cambridge.

Varian, H. R. 1992. Microeconomic Analysis. 3rd Edn. W. W. Norton & Company, Inc. New York.