AN ECONOMETRIC ANALYSIS OF THE SUPPLY OF MAIZE IN LESOTHO

BY

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This study is dedicated to my mother and father and to the Government of Lesotho.

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Chapter 1

1.1 General

Lesotho is largely agrarian. More than 90 percent of the Basotho population lives in rural areas. Agriculture provides an important source of income for over 50 percent of the rural population and is the largest contributor to GDP. Apart from migrant labour in the Republic of South Africa (RSA) and limited work in administration and commerce in the few urban centres, there are few employment opportunities other than agriculture.

1.2 Problem Definition

Under production of maize coupled with a growing population has lead to great shortages of maize in Lesotho. The hunger and nutritional problems associated with the maize shortage problem prompted the Government of Lesotho to set out self-sufficiency goals, which if met would help solve the maize shortage problem. What follows in this chapter is some evidence advanced to further define this problem .

1.3 Production

Under current practices, small land holdings still predominate and there is a high level of under-development. Of the total estimated land area of 7,558,000 acres in the country, only 12.1 percent is actually cultivated with 2.5 percent fallow. Many crops are grown, and beans and wheat are the major exported crops. Maize, the staple food, is the most important single summer crop cultivated on about 240,455 acres.

The maize acreage represents about 65 percent of the total area under cultivation for summer crops (1976/77 Bureau of Statistics Reports). With average maize yields of about 4 bags (200 lb bags) per acre total production is inadequate to satisfy the needs of the fast growing population.

Yields of all crops except wheat and beans dropped below "normal levels" in 1974/5 - 1975/6 (see Table 1 for maize yields). Also, because of the October - November drought, maize production in 1978/79 dropped 25% below the previous year's production. Lesotho, which has been a net importer of maize for the past decade, already imports 40 - 50 percent of its total food requirements. In 1975/76 imports of maize and maize products increased by 14 percent from the 1974/75 maize import figure (see Figure 1).

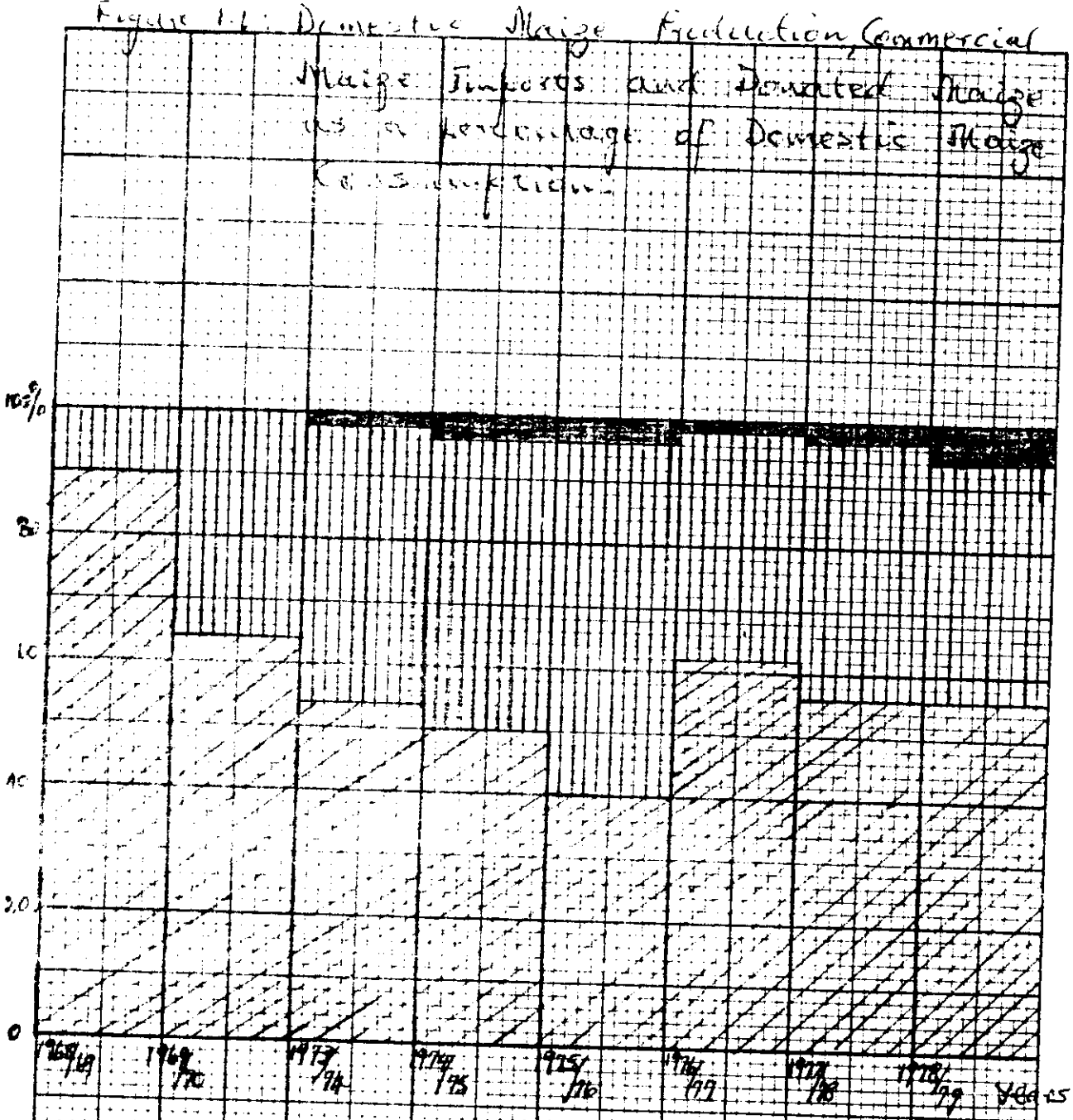
Table 1.1 Maize Yields From 1959/60 to 1978/79

Year	Area Harvested (ha)	Average Yield Kg/ha
1959/60		687
1961/60	148,492	815
1969/70	129,305	514
1973/74	129,700	945
1974/75	107,844	652
1975/76	84,827	579
1976/77	80,336	1,570
1977/78	101,683	1,410
1978/79	112,254	1,058

Source: 1960 and 1970 census of agriculture and 1968/69 estimates

Note: Data not available for missing years.

Figure 1.1: Domestic Maize Production, Commercial Maize Imports and Donated Maize as a Percentage of Domestic Maize Consumption



SOURCE: Same as for Table 1.1

LEGEND: ▨ % domestic maize production assuming 10% post-harvest losses (metric tons)

▥ % commercial maize imports (metric tons)

■ % donated maize (metric tons)

Note: Data not available for missing years

Low crop incomes in 1976, caused by an abrupt decline in planted and harvested acreage and excessive rainfall which reduced yields of maize and sorghum to the lowest in history, exacerbated the unfavourable grain import situation.

1.4 Lesotho's Dependence on Migrant Labor

The Lesotho economy depends very much on migrant labor to the Republic of South Africa. In 1978/79 it was estimated that about 70 percent of imports from RSA were paid for with the labor remmitances earned by Basotho migrant labor working in the RSA mines, factories and farms. The remaining deficit in the balance of trade was paid for by revenues from the Customs Union Agreement and foreign aid. Since the remmitances constitute over 80 percent of household incomes, the relevant demand and supply relationships are highly influenced by the RSA.

1.5 Planning Food Supplies

The period following Lesotho's 1966 independence witnessed periodic debates among government officials concerning the need to channel public funds into food crop production in order to attain self-sufficiency in maize, wheat, sorghum and beans through modernization of agriculture. Thus, in 1976 the government intervened in production by launching the Cooperative Crop Production Program (CCPP) which was followed in 1978 by the Basic Agricultural Services Program (BASP) -- an intergrated rural agricultural development effort.

1.6 Marketing Institutions

The Lesotho government, through statutory parastatal marketing institutions, has also intervened in the marketing and maintenance of some

control over agricultural produce prices. Unfortunately, these marketing institutions have not been able to maintain favourable agricultural terms of trade. Disincentives created by government involvement in this area emanate from the problem of having external trade with RSA. Local produce prices are set far below agricultural production costs. As a result, farmers produce just enough food to meet their family requirements. Maize producer prices have been undervalued as a result of the government pricing policy which is for the most part based on the South African pricing policy. To date, no agricultural taxes of any sort have been set in Lesotho.

1.7 Five Year Development Plan

The production of adequate food supplies to feed the growing population has been a major concern of successive national Five Year Development Plans because it has been realized that the adequacy of food is a constant threat to Lesotho's economic and political stability.

Lesotho's Second Five Year Plan developed in 1975 specified the following objectives, among others:

1. Increase of 38% in net agricultural output.
2. Rational use of resources to benefit the greatest number of Basotho through concentration of improvements on growth centres.
3. Expansion of employment opportunities within Lesotho through direct efforts at job creation and through the natural growth of the economy.

The plicy measures aimed at fulfilling the government's objectives in food production are given in the Third Five Year Plan developed in 1980. Briefly these include direct participation of government in food production

and marketing of food, livestock and fishery products through the relevant ministries in a well-coordinated and synchronized fashion.

1.8 Purpose Statement

In view of the great maize shortage that Lesotho is faced with, the intent of this paper is to (1) investigate the most important determinants of maize supply (2) make supply and demand projections of maize to 1985 and (3) to formulate alternatives which can be used by decision-makers in setting policy.

Chapter 2

Literature Review

The purpose of this chapter is to review the literature on selected supply studies made on maize in low-income countries. In Section 2.1 a review of supply studies is given.

2.1 Analysis of Supply

2.1.1 Study I

In 1978, Langley and Du Toit conducted a statistical analysis of the supply of maize in the Transvaal (Republic of South Africa). Maize supply in two of South Africa's most important maize growing regions was analyzed --the Eastern Transvaal Highland and the Western Transvaal. The influence of a number of factors on three aspects of maize supply (area planted (OM), total production (TP), and production per hectare (P/h) was estimated). The hypothesized relationships among the variables were expressed in separate estimation equations in which OM, TP,and P/h were endogenous variables in the time series. The model specifications used were:

$$OM = f(PM_{t-1};\ PK_t;\ PGS_{t-1};\ PGB_{t-1};\ PDB_{t-1};\ PSB_{t-1};\ R,T) \quad \ldots (1)$$

$$TP = f(OM;\ PM_{t-1};\ PK_t;\ PGS_{t-1};\ PGB_{t-1};\ PDB_{t-1};\ PSB_{t-1};\ R,T) \quad \ldots (2)$$

$$P/h = f(OM;\ PM_{t-1};\ PK_t;\ PGS_{t-1};\ PGB_{t-1};\ PDB_{t-1};\ PSB_{t-1};\ R,T) \quad \ldots (3)$$

Where:

OM	=	area planted to maize (ha)
TP	=	total production of maize (t)
P/h	=	production per hectare (kg)
PM_{t-1}	=	price index of maize, lagged one year
PK_{t-1}	=	current price index of short-term requisites (i.e. fertilizer and fuel)

PGS_{t-1}	=	price index of grain sorghum, lagged one year
PGB_{t-1}	=	price index of groundnuts, lagged one year
PSB_{t-1}	=	price index of sunflower seed, lagged one year
PDB_{t-1}	=	price index of dry beans, lagged one year
RSC	=	rainfall during the months September - October (mm)
RSN	=	rainfall during the months September - November (mm)
RSD	=	rainfall during the months September - December (mm)
RNM	=	rainfall during the months November - March (mm)
RDM	=	rainfall during the months December - March (mm)
RJM	=	rainfall during the months January - March (mm)
T	=	trend with 1946/47 = 1; 1947/48 = 2, etc.

The statistical technique used to analyze the data expressed in logarithmic form, was the OLS regression. All variables had signs of the estimated coefficients that were in step with a priori expectation. The calculated t-values indicated that the co-efficients of variables included were all statistically significant. The highly significant f-value of 14.7 and the high adjusted coefficient of determination of 0.7012 indicated that the data verified the model. However, a potential autocorrelation problem was indicated by the inconclusive Durbin-Watson statistic of 1.472.

Only the area annually planted to maize was influenced significantly by the various price variables. The elasticity of supply in the Eastern Transvaal with respect to changes in the price of maize and in the price of short-term requisites (i.e. fertilizer and fuel) amounted to 0.963 and 0.908, respectively. The long-run supply elasticity estimate was 10.467. None of the alternative crops (sorghum, groundnuts, dry beans and sunflower)

could be regarded as a significant competitor for maize in the Eastern Transvaal area. Area planted, rainfall, and technology seemed to be the most important factors which influenced the total production as well as the yield per hectare in both regions. The elasticity of supply with respect to the area planted for the Eastern Transvaal was 1.209; whereas for the Western Transvaal, the supply elasticity of production with respect to November-March rainfall was 0.926. The elasticity of supply (production) with respect to changes in the price of maize was not given for the Western Transvaal.

The results for the Western Transvaal indicated that groundnuts compete strongly with maize for the available cropping area. The elasticity of substitution with respect to area changes was -1.030. It was also found that under current cropping practices, sunflower probably represents an important substitute for maize in the Western Transvaal. The elasticity of sunflower substitution in production was 0.616.

However the reseachers may **be critisized for** having made serious misspecification errors in that virtually the same set of variables was used in each equation.

2.1.2 Study II

In 1973,J.M. Wolgin, employing a pooled cross-sectional time series model of micro-level data on inputs, outputs, and prices, undertook a study of farmer response to price in Kenyan smallholder agriculture.

Assuming that farmers are efficient in their allocation of scarce resources, the study set out to answer questions on: (1) What effect does risk have on farmer behavior? (2) Are farmers efficient in their allocation of scarce resources? (3) What are the bottlenecks that limit agricultural production? And (4) How responsive are farmers to changes in the price of maize?

Using a Nerlovian adjustment model, the regression equations estimated were of the following form:

$$QM = C + T_t + MP + Mq_{t-1}$$

Where:

QM	=	natural logarithm of the marketed output of maize
T	=	trend
t	=	time
MP	=	price of maize
Mq_{t-1}	=	the lagged natural logarithm of the marketable output of maize.

Separate regression equations were estimated for each of the nine districts in Kenya using the log-log transformation functions. The coefficients of the price of maize and trend variables were found to conflict with economic theory in some districts; whereas in other districts, they were compatible with a priori expectations. The elasticity of supply with respect to changes in the price of maize ranged from 0.0083255 to 0.10779; where it was positive, where the elasticity of supply was negative, it ranged from -0.031186 to -03863. These are all short-run elasticities.

Since the variance-covariance matrix for most of the districts yielded a normalized deviation of 0.552 from the mean expected income from maize, it was concluded that the results showed that the increase in the maize output price may increase risk by more than it increases expected returns. The conclusion was also corroborated by the evidence of negative supply elasticities with respect to changes in price in most districts. The great spatial and temporal variety of climatic conditions suggested that the seasonal variation made agricultural production very risky and this consequently rendered examination of farmer behavior inappropriate, without considering the importance of risk. It was concluded that farmers were risk-averse and tended to employ fewer resources in high-return/high-risk

crops than would be predicted by profit maximization theory. In addition, short-run elasticities of maize output with respect to output prices were found to be higher than expected, though some turned out to be negative.

The results showed small farmer responsiveness to changes in maize prices; but, their responsiveness was inhibited by the wide margin between the producer price and the consumer price.

2.1.3 Study III

In 1965, Mangahas, Recto, and W. Ruttan attempted to statistically estimate the supply and market surplus relations for rice and corn for major geographic regions of the Philippines using time series data.

Area, yield, and output response relations were estimated for the Philippines as a whole. Two types of linear models were used, simple models and distributed lag adjustment models. The basic output response function was:

$$Q_t = f(P_t, F, A_t, T_t)$$

Where:

Q_t	=	the output desired out of production in period t
P_t	=	the expected harvest price of the substitute crop
F_t	=	an index of expected prices of alternative crops
T_t	=	a measure of the expected standing of the technology of the subsistence crop relative to the technology of alternative crops.

The corn hectarage was significantly influenced: (1) by factor prices, as measured by the lagged wage rate in three regions; (2) by technology, as measured by the yield ratio in three regions; and (3) by trend in all nine regions.

The estimates of the short-run price elasticity of corn hectarage in the Philippines for the simple models was between 0.07 and 0.12 in some regions and negative in others. The estimated short-run elasticity of corn hectarage ranged from 0.20 to 0.05 for the various distributed lag models while the estimated long-run corn hectarage elasticities ranged from 0.04 to 0.11. The short-run price elasticity of marketed corn surplus ranged from 0.28 to 2.58 in most regions, but it was negative in others.

The marketed proportion of rice ranged from 0.37 to 0.65; whereas the marketed proportion of corn implied relatively high price elasticities of marketed surplus since relatively significant portions of corn are deducted for home consumption. Furthermore, the supply elasticity data indicate that Philippines rice and corn farmers are reasonably responsive to changes in the price of rice and corn relative to each other and to other commodities, even in the short-run.

2.2 Summary of Common Findings on the Analysis of Supply

In almost all supply studies, the estimated coefficients had the expected signs, and they were statistically significant. The R^2 was greater than 0.053 and DW value greater than 1.43. The elasticity of supply, with respect to changes in the price of maize, was from 0.19 to 0.963. Generally, all studies revealed that farmers are responsive to changes in the price of maize. Table 2.1 provides a quick look at the summary of common findings on the analysis of the supply of maize.

Table 2.1 Summary of Findings on the Supply of Maize

Researcher	Country	Time Period	Price Elasticities		R^2	DW
			Short-Run	Long-Run		
Langley & Du Toit	South Africa	1964-1978	.963	10.467	.8916	2.251
Wolgin	Kenya	1959-1969	.0083 - 0.1078	0.0408-	.8916	1.4364-
	Kenya	1959-1969	-0311 to -.0386	0.3905	.4702	2.7517
Mangahas, et al.	Philippines	1952-1963	0.28 - 2.58 and negative	***	***	***

*** Figure not given.

2.3 Plan of Subsequent Chapters

Chapter 3 describes the indeterminate situation of Lesotho which gave rise to the problem defined in Chapter 1. Chapter 4 attempts to combine economic theory, statistical techniques and knowledge of the market in studying maize supply-demand relationships in Lesotho. Chapter 5 provides an interpretation of the empirical results, and supply and demand projections. Chapter 6 covers the summary, conclusions, and recommended policy statements for decision makers.

Chapter 3

THE EXISTING SITUATION

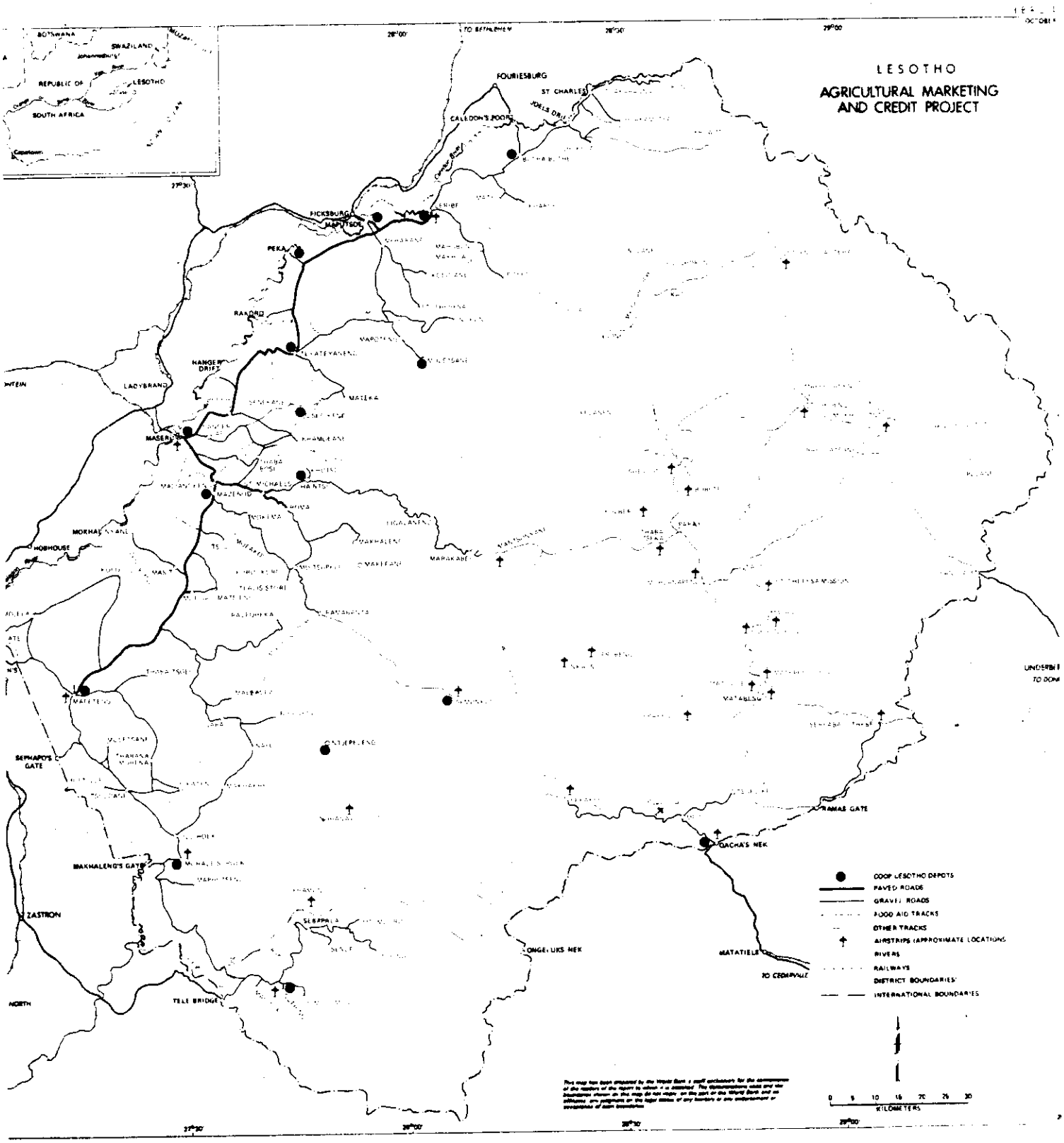
The intent of this chapter is to describe the existing situation of Lesotho which gave rise to the problem defined in Chapter 1. The positive description will be punctuated, where necessary, with normative statements on existing institutions, land tenure and the pricing systems.

3.1 Introduction

Lesotho is a small, mountainous country entirely surrounded by the territory of the Republic of South Africa (see map on page 15), with an area of 11,716 square miles and a population of about 1.2 million. The country is overcrowded and suffers from periodic drought accompanied by extreme soil erosion. Mohair and wool are the only major stable exports. Gross National Product in 1967/68 was R50,000,000; gross domestic product was R46,350,000; and per capita income was R56.

Lesotho's economy is characterized by a dualism typified by a coexistence of a large food-producing agricultural sector and a small diamond mining industry. The export-oriented primary product agriculture(i.e. wool and mohair industry) provides badly needed foreign exchange for domestic investment and capital formation. The Kingdom of Lesotho is one of the least "developed" countries of the world in terms of commercial activity. According to the international division of labor prevailing under pseudo-independence or "modern imperialistm", it is the American, British and South African workers who have access to the skills involved in cutting and exporting Lesotho diamonds rather than the Basotho officers and workers who dig the diamonds out of the ground.

Water is one of Lesotho's major natural resources, yet it has not been put to good large-scale productive use in irrigation ventures.


LESOTHO
AGRICULTURAL MARKETING
AND CREDIT PROJECT
BOTSWANA
SWAZILAND
REPUBLIC OF
LESOTHO
SOUTH AFRICA
FOURIESBURG
ST CHARLES
CALEDON'S POORT
FICKSBURG
MAFETENG
PEKA
RAMORD
HANGER'S DRIFT
LADYBRAND
MASERU
MAZENOD
MORHAS
HOBHOUSE
MAFETENG
SEPHAPO'S GATE
MAKHALENG'S GATE
ZASTRON
TELE BRIDGE
MARAKABEI
VATABLOU
RAMAS GATE
QACHA'S NEK
LONGELUKS NEK
MATATIELE
TO CEDRVALLE
COOP LESOTHO DEPOTS
PAVED ROADS
GRAVEL ROADS
FOOD AID TRACKS
OTHER TRACKS
AIRSTRIPS (APPROXIMATE LOCATIONS)
RIVERS
RAILWAYS
DISTRICT BOUNDARIES
INTERNATIONAL BOUNDARIES
KILOMETERS

Of the total estimated area of 11,716 square miles, 1,362 (about 11.6 percent of the total area) are considered arable with about 10,358 square miles non-arable. The non-arable land consists mainly of eroded land, bare rock, rivers, gullies and land which is under roads and village dwellings.

The bulk of the population is found in the reasonably flat lowlands where about 39.9 percent of the total area is under cultivation, as opposed to 5.5 percent in the mountains. The ratio of arable to non-arable land is 1:2 in the lowlands and about 1:10 in the mountains.[1]

3.2 Rainfall

The main rains fall between November and March. Snow may fall in the mountains at any time of the year and may occassionally fall in the lowlands between March and August.

Typically, the rainy season begins in September or October. Lesotho falls within the Southern African area whose summer rainfall is characterized by alternative wet and dry spells. These cluster of wet years and dry years are approximately 9 - 10 years in duration.[2]

Average rainfall for the seven lowland stations is 735 mm. per year. In the first five years of the current wet spell (1970's) annual rainfall averaged 835 mm., 16.1 percent above normal. Rainfall differences between wet and dry years are concentrated in four months as shown below. These are exactly the critical months affecting production. The run-off is rapid. Hailstorms are not infrequent and often kill crops and livestock.

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1 B.M. Khaketla: Lesotho 1970: An African coup under the microscope.

2 Jerry Eckert and Joseph N. Mohapi (1979) The Future Environment for Agricultural Planning, 1980-2000 A.D. Discussion paper no.9. LASA Project, Ministry of Agriculture, Lesotho.

	Nov	Dec	Jan	Feb	Total (year)
Wet average	98.9	113.9	128.4	116.4	820.6
Dry average	64.7	81.3	105.9	94.3	667.8
Difference	34.2	32.6	22.5	22.1	152.8

Note: Averages for 1945/46 to 1978/79[3]

Rainfall is seasonally variable and in the lowlands, rainfall is not adequately distributed in the summer growing period to produce high and consistent yields of food crops like maize and cash crops.

3.3 Soil erosion

Soil erosion is one of the problems facing Lesotho. An estimated 50 percent of the nation's arable land is affected by erosion and an estimated 1 percent or more of the nation's topsoil is washed away each year through sheet and gully erosion.

Several international programs such as the Catholic Relief Services (CRS), the World Food Program (WFP), etc. have had to supply maize and other food aid packages to feed people who were working on soil conservation works, dam building and road building in places where soil erosion was severe.

3.4 Cropping Patterns and Crop Production

In Lesotho, cropping patterns vary from season to season and from region to region. There are two main planting seasons: (a) the period from April to December in which winter crops are grown; and (b) the period from September to June in which summer crops are grown. The summer crop------maize, sorghum and beans --- taken together constitute the largest portion of all crops planted in the country. Maize and sorghum are planted throughout the country.

Maize constitutes by far the most important crop grown in Lesotho because it is the staple food of the Basotho people. The percentage of

[3] Op. cit.

maize acreages varies from zone to zone being highest in the lowlands (61.6) and lowest in the mountains (30.4).

Considerable emphasis is placed by farmers on the cultivation of winter wheat for selling, but mainly as a relief crop designed to provide grains for household use during the "hunger season" between mid-October and January (i.e. the period when farm level stored grain is exhaused).

There are peak crop harvesting periods in Lesotho, namely, the period between November and January when most lowland wheat and peas are harvested and the summer crop harvesting period between May and July when sorghum, beans, and maize are harvested.

In all regions of Lesotho, assorted varieties of white and yellow maize are grown, both for human consumption as well as for livestock feed supplement. Maize is usually intercropped/mixed cropped with beans, pumpkins and water-melons or it may be grown in single stands.

Because of the old production methods used, maize yields per acre are low (average four, 200 lb.bags/acre) relative to 15 - 25 bags per acre maize yields reported by the Maseru based National Agricultural Research Station. On the now defunct rural agricultural development projects per acre maize yields of 6 - 8 bags were also reported (e.g. Thaba-Bosiu Rural Development Project). The output of maize per person has been declining in recent years. The protein content of maize is low. This causes protein famine.

Incomplete ploughing and weeding account for low maize productivity because of the solar energy-nutrient-moisture competition that ensues between the maize-bean crop and weeds.

Typically, a farmer possesses at least two fragmented fields of 2 acre average size each. In most cases, one field is on the relatively fertile soil whereas the other is located on the relatively less fertile area. In consequence, all problems of fragmentation such as extensive farming, traveling long distances between fields, low labor productivity, disincentives on land improvement, etc., confront Basotho farmers. Thus the introduction of one or two modern techniques or inputs is seldom successful. Hence the substantially higher equipment cost associated with tractorization and with improved land preparation is not likely to be justified without complimentary changes in seed variety, fertilization, irrigation, credit, research, marketing and favourable maize prices, land reform, extension and education, etc., all of which require governmental institution building. Consequently, the underlying technology provides but modest returns to human effort. This, of course, is reflected in the low levels of maize output per person and the resultant high maize and maize product imports. Further, disincentive in production arises from low maize prices which generally range between 8 and 10 cents per pound.

The fact that a high proportion of the population resides within the farming sector means that the possibilities for earning money income are rather severely constrained. Thus, the effective domestic market demand is low. Limited farm incomes caused by low maize gross margins per acre mean limited expenditures on production inputs as well as on consumer goods and services. This, in turn, implies that despite its large size, the agricultural sector makes only modest purchases from other sectors and they in consequence tend to remain small.

Capital equipment is limited to simple tools powered by men and/or animals. Because of inadequate employment opportunities, some 120,000 - 150,000 able bodied Basotho men migrate into the Republic of South Africa

to seek jobs in mines, factories and farms. Thus, farm work in Lesotho is left in the hands of women, children and old men who lack the requisite physical ability and technical know-how to exploit Lesotho's agricultural potential. Technical knowledge and work competencies are therefore transmitted by observation and learning by doing since it appears the extension-research services are very limited and ineffective.

Old age, sickness, crop failure and animal diseases represent the principal causes of loss of income. These risks are compounded by lack of scientific knowledge among the women.

Sharecropping of fields for a share of the final produce reduces the possible loss to the field owner by shifting part of the risk to the sharecropping partner. This practice is really an extension of respectable traditinal communal farming systems (matsema) which are fast disappearing.

Lesotho needs modernization of its agriculture which will lead to creating progressive rural structures if it is to meet its food needs. Up to this present research studies undertaken are extremely fragmented. The result is that there is a lack of coordination and integration. It is of great importance that Lesotho sets its research priorities straight. To date, Lesotho research stations have concentrated on investigations of professional interest instead of dealing with the problems of the small farmers.

In addition to carrying information from scientists to the small-holder farmers, it is equally important to carry information about farm conditions back to the scientists. This will ensure that the large body of knowledge that farmers themselves accumulated from experience is transmitted and used in agricultural research studies by the researchers. Research done in isolation will almost always be unsuccessful.

In order to facilitate communication between the research institutions and the farming communities, it is imperative that a close, dynamic interactive relationship exist between an effective agro-technical extension

service program and research activities. They must deal with location specific adaptive research that investigates bio-chemical and mechanical innovations.

3.5 Credit

Crop farmers provide a strengthening effect to Lesotho's economic structure by forming capital for investment in agriculture to improve the maize shortage situation and for investment in the non-agricultural sector. The average income per head of the rural population according to 1966/67 official estimates was about R61.00. Contrary to accepted orthodox theory that farmers in low income countries save little money, Basotho crop farmers despite their low incomes, have fairly high propensity to save because urban temptations towards luxury consumption are weak due to inadequate communications and because people save to safeguard themselves against future hazardous periods caused by drought and crop failures. They also save in order to be able to defray medical, school and funeral expenses.[4]

Credit Unions play a leading role in the cooperative movement. In general, Credit Unions grant loans which may be invested productively in agriculture or used to take care of children, school fees, medical expenses, funeral expenses and other family or farm expenses. Credit Unions are rurally based financial institutions. Thus, their membership consists of maize farmers and other crop farmers.

The Credit Unions are currently faced with loan repayment problems which are actually created by the low level of farm incomes and their fluctuations. Inefficient management, organizational and administrative weaknesses have caused a foreclosure of a significant number of primary Credit Union Cooperative societies.

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[4]Marco Onado and Antonio Porteri (1974), The Banking System and the Formation of Savings in Lesotho

Farmers prefer saving their money in Credit Unions as opposed to commercial banks because the Union's village offices are within the reach of any farmer and because they can borrow the book value of their deposits. This amount is equivalent to a credit line which can be drawn on at any time and which reconstitutes itself automatically as soon as the member-farmer repays his loan.

The Lesotho Credit Union Scheme for Agriculture (LECUSA) is a secondary cooperative movement in Lesotho whose function is to provide improved maize hybrid seeds, pesticides, fungicides and other agricultural inputs in order to improve crop productivity.

Using operational funds obtained from foreign-aid organizations like the Catholoc Relief Service and OXFAM, LECUSA is essentially an agricultural mechanization project which aims at educating and demonstrating the significance of yield increasing technological innovations like fertilizers and selected seeds.

The Agricultural Development Fund (ADF), too, is another agricultural credit institution which distributes foreign aid funds, mostly British Oxfarm. It is really a revolving fund dealing almost exclusively with farmers' associations rather than with individuals. No medium and long-term loans are granted and short-term loans are given for the purpose of seeds, fertilizers and insecticides and for paying hired tractor and/or animal services in land preparation. The problems of Credit Unions, LECUSA and ADF are identical.

Any unused Credit Union funds and LECUSA savings are deposited with the commercial banks. The two international banks - Standard Bank, Ltd. and Barclays Bank International, Ltd. - that operate in Lesotho have historically been interested in attracting local deposits rather than in lending in Lesotho. If they disburse any loans at all, the only recipients of such loans are middle and higher classes of the population.[5]

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[5] Ibid

Indeed, the financial capital generated by the natural wealth of Lesotho is not used to develop local factories, schools, agriculture and other structures for capital formation and for generating more wealth, but it is siphoned off by these subsidiary banking branches to Europe, the West and some of it to Swiss Banks. Therefore, Lesotho's finance capital is not used to maintain, let alone expand, the local economy.[6]

The problem of higher risks for the small-holder is often aggravated by the fact that he cannot obtain credit on equivalent terms with the larger farmer; his costs of borrowing are often higher and so his expected profits are lower.

It is apparent to the author that to try to understand why most of the wealth now being produced is not being retained within Lesotho for the benefit of Basotho, one needs to know why so much of its present wealth goes to Europeans, Jews and Indians, who reside for the most part outside of Lesotho.

The commercial banks always allege that Basotho farmers cannot gain access to bank loans because they have no "securities" or collateral. The author has also observed that commercial banks seem to deal only with those who can prove to the bankers that whatever happens, the bank will recover its money and make a profit.

A second category of financial institutions that milk the small-holder Basotho farmers are the building societies and insurance companies that transfer their accumulated monthly policy payments into investment in South Africa. Thus, they continue to dispossess Lesotho of its wealth.

3.6 Education and rural-urban migration

Lesotho has the highest literacy rate in Africa due to the presence of

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[6] Ibid

missionaries for over a century. This educational achievement co-exists with chronic economic stagnation which for the most part originates from the low farm earnings caused by low crops and livestock yields. As a result, there continues to be a high rural-urban migration caused by low crops and livestock yields.

In view of these problems, it is necessary that the government curbs this rural-urban migration. Avenues include introduction of rural small-scale industries such as wood works, pottery, weaving, brick making, house construction, road construction, etc., that have been proved to be low capital-intensive labor-intensive engagements. An economic policy that restrains rural-urban migration will reduce pressure on urban housing, minimize urban unemployment, etc. The movement of labor towards the cities can be restrained through an industrial location policy which emphasizes location of new industries in rural areas rather than in towns. Rural-urban labor migration is also responsible for low maize production as explained above.

Dependence of Lesotho on the generosity of friendly nations to meet part of her maize and food requirements is not a permanent solution. However, since food aid constitutes a relatively neglegible part of the total domestic maize requirements, food aid does not depress maize prices. A new strategy should be to improve the traditional agriculture on the basis of a full understanding of how the present system of farming works and what its limitations are. In the foreseeable future, the country will continue to depend on a relatively literate and poor farming population. The techniques recommended should therefore not necessitate a complete break-away from the old traditional farming practices as farmers may find it difficult to adopt them.

The Lesotho Government places considerable emphasis on upgrading education at all levels. Education deficiencies do exist at all levels, especially at the professional and technical support levels.

Education is crucial in any type of society for the preservation of the lives of its members and the maintenance of the social structure, and, if properly directed, it can promote social change under certain circumstances. Lesotho education has to grow out of the Lesotho environment, the learning process being directly related to the pattern of work in the nation. Education provides and develops a scientific basis for technological development in agriculture and it can create an environment receptive to innovation, provide basic skills and new production practices that increase the productive capacity of the people.

3.7 Infrastructure

The lack of natural resources represents Lesotho's biggest obstacle to economic development. Though agriculture is the most important occupation, it does not provide full employment for the rural population. There are no market centres that provide an outlet for farm produce or that make farm inputs available. Roads are inadequate and irrigated farming is rare. However, the proposed network of improved roads that interlace the mountains will improve communications between the lowlands and the mountains. If the negotiations regarding the Highlands Water Scheme designed to harness the Senqu River for irrigation purposes and hydroelectric power generation become successful, the full implementation of the program will reduce Lesotho's dependence on rainfed agriculture which, up to now, has been characterized by variable crop productivity and intensify agriculture in general. Electrification of some of the agricultural activities will also become a possibility, and therefore, Lesotho could be self-sufficient in energy in the future. Among some possible multiplier effects, employment of the rural labor force and improvements in marketing facilities could be cited.

3.8 Farm Mechanization

The first problem associated with small-farm mechanization in Lesotho is their size and land fragmentation. Cooperative farming could be the answer. Another problem is purchasing power. To circumvent it will require that loans be granted to small farmers for the purchase of essential machinery. The mechanical knowledge of many farmers is also lacking, so practical training must be given before mechanization is introduced. At present, there is a lack of local repair services and an inadequate supply of spare parts. Fortunately, the Basic Agricultureal Services Program (BASP) has among its components a creation of a network of agricultural mechanization promotion centers and Mobile Machine Repair Services which are intended to deal with these problems.

3.9 Labour migration and its effect on agricultural output

In his examination of the question of whether Lesotho's agricultural production and agricultural development efforts are constrained by labor shortages, Wykstra concludes that "less than one-half the labor force of 516,000" is available fully for farming. Further, "almost 90 percent of all Lesotho males aged 15 - 59 are primarily employed in the RSA or in various non-farm activities."[7] Therefore, there is no permanent core of able-bodied male labor in Lesotho for agricultural production. Men available between contracts are usually not very involved in farming. Thus, decision making is accorded to females for approximately 70 percent of all Basotho farms.[8] Table 3.1 shows the decline of Lesotho's agricultural sector during the 1950 - 76 period. Over this period, the population increased by a half million people, but planted acreage decreased by some 200,000 arable acres and total crop production was half levels formerly reached. Evidence indicates a critical labor shortage at peak labor periods. Ploughing is untimely and weeding seldom done on complete fields. This causes declines in agricultural output.

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[7] R.A. Wykstra (September 1978), "Farm labor in Lesotho.: Scarcity or Surplus," LASA Discussion Paper No.5, Ministry of Agriculture

[8] Bureau of Statistics, 1970 Census of Agriculture.

TABLE 3.1 BASOTHO EMPLOYMENT IN THE REPUBLIC OF SOUTH AFRICA (RSA) MINES AND CROP PRODUCTION DATA, 1950 - 1976

	1950	1960	1970	1976
Gross Crop Production ('000) m.t., a/	322	248	190	133
RSA Mining Employment ('000)	34	51	87	120
Area planted ('000 acres)	738	797	856	556
Gross Yield Per Acre (200 lb. bags)	4.8	3.4	2.4	2.6

a/ Maize, sorghum, wheat, beans and peas.

Due to large male labor migration into RSA, management of agriculture is in the hands of females though some critical decisions like investment in land preparation and production expenses are made by the absent males through the postal system. Though employment in RSA provides invaluable foreign exchange earnings, it appears that unless domestic employment opportunities are opened, Lesotho's economic dependence on the Republic will continue.

3.10 Other Agricultural Inputs and Supplies and Farm Income

It is apparent from experience that the level of modern farm inputs such as fertilizer is low due to lack of knowledge, risk aversion and a host of other reasons. The commercial agri-support services are set up in such a way that large farm operators have better access to them than small farmers and in such a way that they are more accessible in prosperous farming areas. The Co-op Lesotho, Ltd., is a public agency which supplies fertilizers, hybrid and selected seeds, pesticides, feeding stuffs, etc., to small farmers. The problem with Co-op Lesotho is that its warehouses are situated in Lesotho's towns and as such it does not service villages well.

Some of its agricultural supplies and inputs are not in small enough packages that can usually be bought by small farmers.

The use of fertilizers is not widespread. The primary reason is lack of response to fertilizer by crop varieties, the high risks of drought during the growing season and inadequate credit or cash.

Farm production in Lesotho can be increased through improvement in and adoption of relevant farm techniques and management practices upon which the present Cooperative Crop Ppoduction Program (CCPP) and the Basic Agricultural Services Program (BASP) are based. However, even though these development projects do not presently deal with income distribution they need also to be concerned with income distribution impacts among farmers. For instance, in the phased out Thaba Bosiu Project regional sample surveys revealed that about one-third of the poorer farm household population received some one-eighteenth of all incomes whereas, at the upper extreme, some one-third of the farm households (FHH) due in part to on-farm income, received nearly two-thirds of all incomes (see Table 3.2)[9]

TABLE 3.2 HOUSEHOLD INCOME DISTRIBUTION AMONG A SAMPLE OF THABA BOSIU PROJECT'S FARMERS, 1975

Percent of FHH	Percent of Income
29	5.5
41	31.7
30	62.8

[9] Thaba Bosiu Project Report, MOA, Lesotho. 1975

A vast proportion of FHH earn a living on incomes closely approaching poverty levels. Poverty among small farmers is still one of the most serious problems confronting Lesotho.

Off-farm income in Lesotho has become an increasingly important part of rural household income. As can be noted in Table 3.3, off-farm incomes in Lesotho are relatively high percentages of rural household incomes. Off-farm income represents about 40% of total household income.[10]

As can be expected in countries of Lesotho's development status, there are great disparities in income distribution among crop and livestock farmers too. Livestock farmers have higher average incomes than crop farmers because of continuous income streams throughout the year and stability of income from season to season. Thus, it is safe to say that livestock farmers are in a slightly higher income bracket than crop farmers.

TABLE 3.3 HOUSEHOLD CHARACTERISTICS AND SOURCES OF INCOME (R1.00 = U.S. $ 1.15) 1979

	Household Income Levels-Rands)									
	0-199		200-599		600-999		1,000+		Average	
Percent Households	27		20		27		26			
Average Household Size	3.1		4.9		5.1		7.7		5.2	
Per Capita Income	21		83		168		226		151	
Average Household Income	66		408		859		1,739		783	
Sources of Income	R	%	R	%	R	%	R	%	R	%
Crops	26	39	66	16	30	3	75	4	47	6
Livestock	20	30	85	21	51	6	204	12	90	11
Total Agriculture	46	69	151	37	81	9	279	16	137	17
Lesotho Off-Farm	15	23	42	10	80	9	222	13	92	12
Migrant Labor (RSA)	5	8	215	53	698	81	1,238	71	554	74
Total Off-Farm	20	30	257	63	778	91	1,460	84	646	83

[10] Source: G.C. Wilken, Profiles of Basotho Farmers

Although the average per capita income has increased by 50 percent since 1960, this growth has been very unevenly distributed among regions within the country and within socio-economic groups.

A visible strategy for raising incomes of the lowest 40 percent of the population must necessarily focus on the agricultural sector. These designs must be based on the specific socio-economic characteristic of poverty groups.

Past development efforts emphasized community development on the grounds that it was a non-revolutionary approach of developing rural communities. But community development failed because it ignored to probe into questions of social conflict and social arrangement.

3.11 Nutrition

Dietary defficiencies are also common in Lesotho. Lactating mothers, children less than five years old and pregnant women show chronic cases of malnutrition. Chronic nutritional defficiencies prevail for some one-fourth of all children under age five and to a lesser extent, nutritional defficiency affects adult males. This also adversely affects work-time and labor productivity.

The root causes of malnutrition are found in economics, education, agriculture and health. The recently formed Nutrition Council of Lesotho takes a multi-disciplinary approach to the nutrition problem and it involves different institutions. The Council performs the functions of information collection and dissemination, provision of foods and services, financing and coordination. Significant problems, however, have been identified in the performance of these functions. These alleged problems encompass poor coordination, vague responsibility delineation, inadequate evaluation, personnel limitations and interministerial relationships. Unless these problems are tackled, the Council will remain ineffective.

Despite the fact that Basotho farming on average has minimum power requirements for an efficient agriculture, it does not follow that mechanization through the use of tractors is always economically feasible. Most of the new mechanical technology is capital-intensive. Even if tractorization could be feasible in some places, the use of tractors as traction power is discounted by the fact that the current level of productivity in Lesotho farming communities is too low even to support oxen. In an effort to reduce costs of operating crop enterprises, BASP will promote the training of efficient ox-teams in the lowlands where pasture is locally short. Whether this scheme will increase the labor efficiency of farmers employing animal power remains to be studied.

Substitution of capital for labor will remove the immediate labor bottleneck through mechanization. But the problem is that most Basotho farmers cannot effectively use a tractor because they lack the necessary training in the use of farm machinery. This emphasizes the need for research into appropriate agricultural technology which will fit into the soil and climatic requirements of Lesotho as well as agree with the level of knowledge of small farmers. Furthermore, some Basotho tractor-contractors operating in the rural areas are characterized by extreme over-investment in machinery and auxiliary equipment. Even though tractorization has the potential of increasing crop output through timely operations and deep ploughing, the problems enunciated above must not be forgotten.

The CCPP is a government run share-cropping mechanisation program which aims at demonstrating Lesotho's agricultural potential and thus achieve the food self-sufficiency goal through the use of modern farm inputs. It, however suffers from the weakness that the bulk of the farm machinery it utilizes is Canadian. It is quite possible that after two or so years, mechanical breakdowns will cause crop output to decline because of lack of spare parts and well-trained Basotho mechanics who can efficiently repair these machines.

Speeding agricultural work by substituting machines for human labor raises the immediate possibility of technological unemployment. This is a social cost which must not be forgotten. Eventually or perhaps within a decade, a substantial portion of Lesotho's rural population will not be needed in the fields. This in itself conflicts with the stated national goal of creating opportunities for employment of Basotho labor forces in domestic industry, particularly in agriculture.

3.12 Institutional Structures

The present institutional structure of Lesotho occurred as a result of colonization. The influence of Europe entered into school systems, legal systems, the agricultural system, the political, the financial and credit systems of Lesotho. The imperatives for institutional policy in agriculture development grow from the fact that Lesotho's traditional system of agricultural institutions lack the capacity to serve as a major investment for agricultural supplies and inputs, agri-support services, local verification trials, and adaptative research, dissemination of modern agricultural techniquest and production methods through the extension and education efforts, etc. This policy should be accompanied by a building up of a comprehensive system of institutions in which the powers of the private and public sectors complement and mutually support each other. Unless this policy is adopted not only will the gains in technical agriculture be nulified in a few years, but technical progress without institutional reconstruction will likely intensify pressures for a revolution.

Speedy institutionalization of land reforms, education, credit and finance, marketing and agri-support service structures is a precondition for Lesotho's economic growth. Coordination of all of these institutions at all levels will be vitally important. It is certainly unnecessary to be-labor the issue of farmer participation in the formative and implementation stages of such institutions. In addition, these institutions will have to be well planned, administered and efficiently organised.

Within the country Lesotho needs a further extension of regional power. The power of the regions, at present, is too limited and this is not favourable to economic construction. Where the situation and the work demands it, the districts should also make rules and regulations provided they do not conflict with the national policies. A consultative mode of operation with the districts is desireable and whenever the Central Planning and Development Office in conjunction with the Agricultural Headquarters do anything that will impact on small farmers, it is necessary that they consult with the districts which will in turn transmit the message to the villages.

The relationship between Headquarters and the rural districts can be solidified by arousing the enthusiasm of the rural districts by allowing them to have an autonomy which permits them to run their own individual intergrated rural development programs under the unified national development plan.

Thus, there needs to be a flow of information from the grass roots without which the Agricultural Headquarters will lack the raw material out of which correct decisions and policies can be made. Only if people are consulted will they subsequently be in the right frame of mind to accept the decisions of the leading government officials once they are elaborated and work willingly and whole-heartedly toward their implementation. It also becomes important for civil servants not to regard themselves as qualitatively different from the masses and superior to the masses.

3.13 Storage at Farm Level

If the Lesotho government could ensure that all the maize produced in the country were also consumed by its citizens, Lesotho would probably be self-sufficient in the crop. But weevils, rodents, parasites, diseases and birds eat a significant proportion of its annual production each year. This percentage which at the moment cannot be figured appears to some people as a reasonably modest loss, but even so, the annual loss of at least an

estimated 500,000 bags makes all the difference between self-sufficiency in maize and having to import supplies from abroad.

The losses weigh heavily on small farmers who make up roughly 70 percent of Lesotho's population. Practically all the losses occur on these small farms. Many farmers have adopted the new maize variaties, but they have continued to use the old methods of storage. Storage facilities appropriate for the new maize have been little in evidence; one technology has outstripped another.

Farmers attempt to lay in supplies of maize to feed their families throughout the year and, if needed, to seed the following year's crop. But because of pests, most farmers find their plan goes astray. Losses on their maize usually means three hungry months each year for the family farm before the next harvest is ready. Therefore, there is a definite urgency for the national research station to conduct on-farm storage experiments that rely mainly on cheap locally available building material, local skills and knowledge in order to reduce on-farm grain losses.

The best way to reduce this loss will be to improve, maintain and fumigate traditional grain storages. Reduction of losses in storage will make more food available from a given amount produced, make more of it available at the time of greatest scarcity before the next production season or harvest. Promotion of production methods that increase output will be the second remedy. In the area of livestock production, external parasites are responsible for loss of body weight and sight, low quality hides, skins, wool and mohair, etc., and this reduce the potential revenue to be earned by the farmer and the Basotho nation.

3,14 Land Distribution

The size distribution of operational units is a structural characteristic that bears heavily on the course of the agricultural development. Illustrative data for Lesotho are set forth on Table 3.4. The disproportionally large share of the land cultivated by mainly the chiefs has aroused

great concern among Basotho people. This difference in size distribution not only indicates differences in the distribution of income in the traditional economy, but it has a profound effect on the pattern of agricultural modernization.

In Table 3.4, half Lesotho's fields are within the national average size field and the top 3 percent are seven times the mean field size of 2.0 acres.

TABLE 3.4 FARM SIZE DISTRIBUTION AS A PERCENTAGE OF THE TOTAL POPULATION IN AGRICULTURE, 1979

Size of holding	Percent
.01-3.99 acres	50
1.00-7.99 acres	34
8.00-14.99 acres	13
More than 15 acres	3

Source: Eugene Mathis, et. al., Agricultural Sector Assessments, Lesotho. 1979

The significance of the degree of skewness of field size goes beyond its direct effects on rural income distribution and its indirect effect on economic and political power. The size distribution of operational fields is the principal determinant of participation in commercial sales of maize and other farm crops, and the ability of a farmer to purchase modern inputs, to transform traditional technology.

3.15 Land Tenure and the Land Act

The problems enumerated above are enshrined in Lesotho's land tenure system. Lesotho is currently in the process of enacting a Land Act which

will prevent further field fragmentation, enable field owners to have a lease in order, among other things, to permit owners to pledge their land as collateral and encourage land improvement. However, if it does receive royal consent and approval the Land Act will still possess negative aspects. For example, it will breed a new group of landlords, entrench those Basotho who already possess extraordinary large fields and increase the number of landless Basotho. Indeed, it appears that the Land Act ignores the fact that the vast lands which have been extorted from the small holders have to be returned to them.

One would have expected the legalization of a land policy which realizes that customary land tenure arrangements need to be modernized by removing defects from the traditional system instead of strengthening them. Measures to modernize the present land tenure system which puts Basotho land in the trust of the chief for allocation to married couples must go in conjunction with measures to improve other agricultural institutions such as credit and infrastructure.

3.16 Marketing

As in all low-income countries, Basotho farmers in the past relied entirely on local merchants for the sale of their farm produce. Small farmers, cognizant of the great loss they incurred as a result of trading with the exploitive merchants to whom they sold agricultural produce, urged the government of Lesotho to intervene on their behalf and eliminate some of the usurous middlemen by introducing public marketing agencies. Thus, the Lesotho Government passed the Produce Marketing Corporation (PMC) Act in October, 1973. The full implementation of the Act took place on the 1st of June, 1974.

The operations of the Corporation fall clearly into two distinct areas:[11]

(1) Marketing of producers' dry crops, namely maize, sorghum, wheat, beans, peas, barley, oats, rye, including their products and any cereal

in unthreshed form.

(2) Marketing of vegetables and fruits, namely cabbage, carrots, tomatoes, onions, pumpkins, potatoes, seed potatoes, beetroot, green beans, spinach, turnips, radishes, cauliflower and applies, mangos, oranges, guavas, etc.

The PMC had among some of its purposes and functions the duty of: (a) advising the Minister of Agriculture in all matters related to the production, preparation, processing and marketing of agricultural products and the marketing of agricultural supplies; (b) regulating and controlling the marketing process for commodities and products as indicated by the Minister in pursuance of the Agricultural Marketing Act of 1967; (c) to buy commodities and products and to arrange for their sale; (d) secure the most favourable arrangements in respect of the country's economy for the purchase of commodities and products, their preparation, transport, storage, processing and sale; (e) introduce quality standards and grading systems to which price differentials shall be related; and (f) secure domestic supply in relation to demand so as to stabilize as far as possible producer and consumer prices throughout the year and between different crop years.

Because of limited finance and staff, the Corporation was unable to function actively immediately from its inception. Other quasi-autonomous public marketing agencies were instituted, at about the same year of the formation of PMC, to help livestock farmers earn the highest possible returns from their livestock enterprises. These agencies were the Livestock Marketing Corporation (LMC), the Lesotho Wool and Mohair Organization and the Agricultural Marketing Section established within the Ministry of Agriculture.

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[11] Percy, Produce Marketing Corporation Report for the Year Ending March 31, 1975, Lesotho.

PMC regulates the marketing of crop products with Lesotho Co-op Ltd., acting as its-sole buying and selling agent. In parts of the country where there are no Lesotho Co-op branches, licenced traders and individual dealers are granted the permission by the Agricultural Marketing Section to sell or to buy from farmers agricultural produce subject to the provision that such licensees agree to charge and offer, after deducting government set transportation charges, regulated prices. Similarly, even in the case of the LMC permission is granted to licenced local dealers and individuals to trade in livestock products. Where it is possible for the LMC and PMC to carry out business directly with farmers, the corporation's function purely in the capacity of agents for farmers. Hence, they don't take physical possession of or title to products they market, but merely make marketing arrangements on behalf of their principals -- the farmers.

The corporations may, if they deem it to be in the economic interest of farmers, organize local auctions with approved dealers from the Republic of South Africa. However, the bulk of agricultural produce handled by both PMC and LMC is exported to RSA merchants, abattoirs and auction warehouses. After deducting marketing costs from payments received (i.e. transport, levies, taxes, commissions and duties) a corporation remits the balance to rightful farmers. Farmers have complained about the disincentive effects of the intervention of PMC in the marketing of their crop products by stating that they receive their pay from the corporation after an elapse of an extremely long time. Village farmers too complain that the corporation system is unfair in that it does not allow them to dispose of their farm output at the readily accessible marketing outlets.

In essence, the Agricultural Marketing Section functions purely in a legislative capacity inaugurating marketing laws and orders. In their attempt to stabilize produce prices and search for profitable outlets, the PMC and LMC are frustrated by the serious pricing difficulty which arises from the fact that agricultural produce prices in Lesotho have to be based

on prices obtained in the Republic of South Africa (RSA). For this reason, Lesotho does not have a market intelligence system nor any marketing information network. Furthermore, Lesotho's marketing corporations do not have separate wings whose duty is to conduct market research. Thus, Basotho farmers are not sufficiently informed on the local and overseas markets. Information of this type, if available, would assist the farmers to adjust their production to the demands of those markets. Reliable, accurate and timely marketing information is essential for the efficient execution of any corporation's functions. Such information is needed daily and weekly to determine where and when to sell produce to the best advantage and to develop long-term production and marketing plans.

Though to some limited extent future product prices are announced in advance through the radio medium before the harvesting season sets in, it is clear that vital marketing information such as gluts at favoured markets is ignored.

The corporations expect individual deliveries of agricultural products from the farm level to their stores and shed. As it can be expected, numerous difficulties emerge. For instance, since ordinary farmers and those farmers who are members of marketing associations (e.g. District-Based Egg Cycles, Wool and Mohair Associations) are usually dependent on relatively old transportation methods, the quality of products suffers in transit, especially where infrastructure is inadequate. The problem becomes compounded during rainy days when dirt roads are just impassable.

The transport means provided by Lesotho Cooperatives and LMC fall far short of the volume to be shipped, mainly during the harvesting season. Storage is a major problem confronting Lesotho's marketing system. Fortunately, Lesotho Government has now embarked on an ambitous program of building national grain storages, elevators and silos, milling and processing facilities in order to overcome this problem, increase Lesotho's food

self-sufficiency, save badly needed foreign exchange and increase employment opportunities for Basotho .

The storage problem became acute in the year 1976/77 when the Government apportioned funds to PMC to purchase the bumper CCPP agricultural output and store it in Lesotho Cooperative stores. Several grain bags and bales of animal fodder got spoiled by rain. The situation was worsened by the fact that some grain bags which did not meet the moisture requirements for storage and fumigation against pests had to be sun-dried outside the stores. It is known that the main functions of storage are to balance supply and demand and to stabilize prices, but storage capacity problems made the realization of these functions difficult.

An inefficient and ineffective vegetable marketing system has caused Lesotho to be dependent on supplies from RSA, even at times when there is sufficient local production of vegetables. Lack of transportation, non-existent marketing information and absence of an indenpendent pricing system, weak import control regulations, unfavourable agricultural terms of trade and absence of cold storage facilities are factors responsible for the heightening of Lesotho's dependence on RSA vegetable imports.

Roadside stands that sell mainly fruits and vegetables imported from the Republic of South Africa predominate throughout Lesotho. Though some locally produced agricultural products like roasted green mealies may be sold at some roadside stands located close to and in towns, the bulk of what they sell is largely imported. The public sector provides the transportation system, storage and railhead warehouses and other facilities without which trade with South Africa would be impossible. Most of the goods and services consumed in the urban towns are either imported or produced in the rural agricultural sector. The urban sector and its foreign trade related segment in conjunction with the road and rail network, supplies the marketing and transportation services necessary for selling agricultural produce to RSA and to world markets.

Chapter 4

THEORETICAL FRAMEWORK

In this chapter an attempt will be made to combine economic theory, statistical techniques and knowledge of the market in studying maize supply-demand relationships in Lesotho.

The theoretical relationships existing among the numerous variables affecting maize supply and demand in the Lesotho economy will be discussed briefly. Then, the variables assumed important for inclusion in the models will be discussed. Lastly, a graphical presentation of the maize economy will be cast with a discussion of data problems in Lesotho.

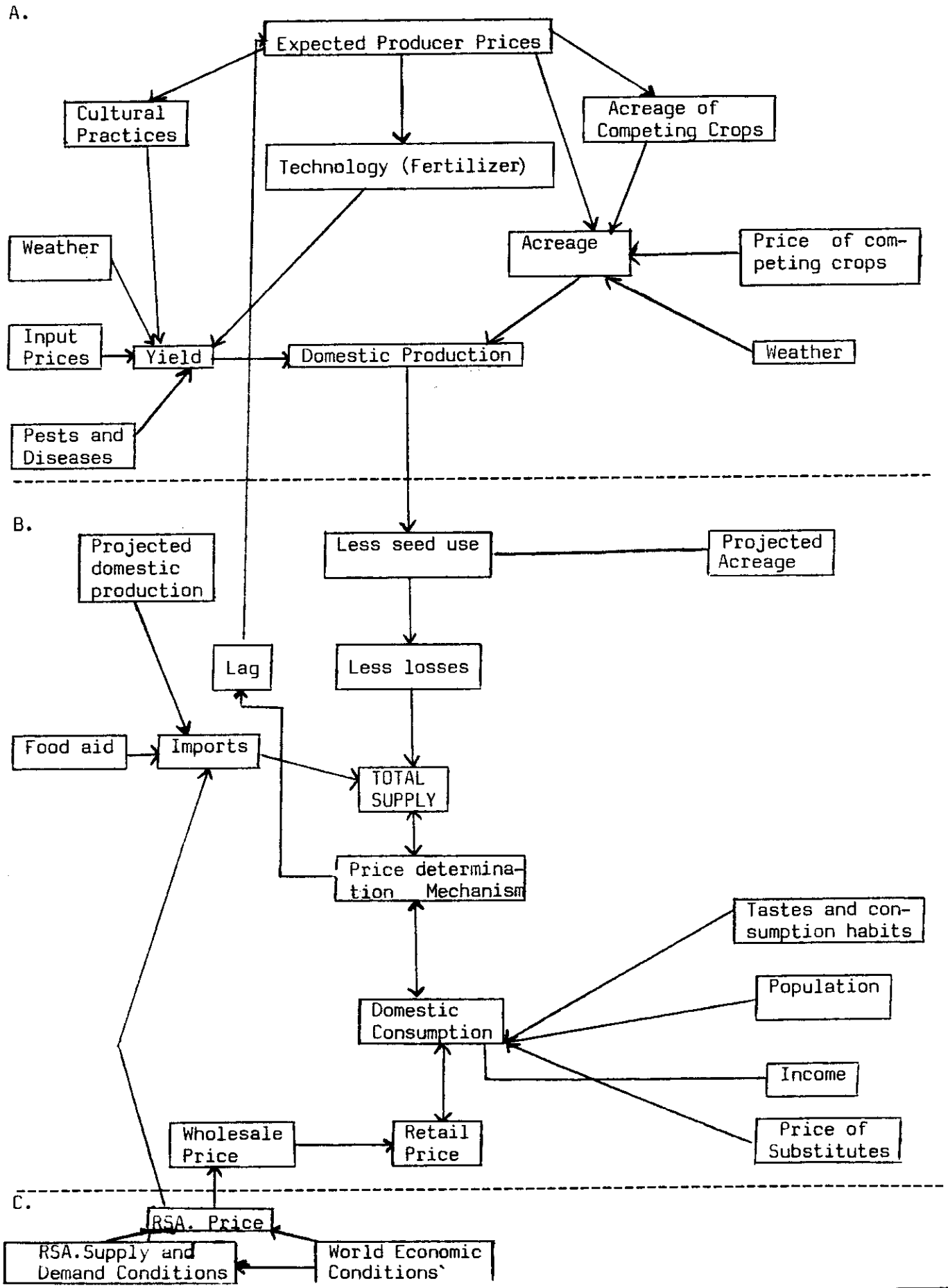
4.1 The Economic Model

The main economic relationships and variables involved in the Lesotho maize industry are shown in Figure 4.1. Part A of the figure shows the direction of forces affecting yield, acreage, and domestic production of maize, Part B shows net supply for domestic consumption after losses and retention of maize seed for the next season have been accounted for, and Part C shows that retail prices for maize in Lesotho are influenced by forces in the Republic of South Africa and world conditions.

The price determining mechanism in Lesotho is not clear. Generally, PMC receives information pertaining to direct production costs per acre from the Ministry of Agriculture. Inputs covered in direct production costs include seed, fertilizer, seedbed preparation costs such as ploughing, harrowing, planting, etc., and harvesting costs. Production costs used are those incurred by an average progressive farmer. To these costs is added a 10% mark-up in order to ensure that farmers make a reasonable profit from the sale of their crops. A figure arrived at in this manner in respect of each main crop then becomes the producer price for that crop.

FIGURE 4.1

Major Relationships in the Lesotho Maize Industry



A proposal was made to establish a stabilization fund wihin PMC in order to minimize annual price fluctuations. Because of the inadequacy of working capital PMC has never been able to maintain this fund. In consequence, producer prices fluctuate from year to year in relation to changes in input prices.

On the demand side, PMC does not involve itself in setting consumer prices because retail prices in Lesotho are based solely on South African prices. Another proposal has been made to hold both the Ministry of Agriculture and the Ministry of Commerce and Industry responsible for setting the producer as well as the consumer prices; but this mechanism is still in its formative stages. Hence there is currently no direct relationship between producer prices and consumer prices for agricultural products in Lesotho.

In view of the dynamic nature of supply, it is difficult to determine the exact price relationship to which farmers respond. However, prices of the more recent past are probably more influential as far as farmers' expectations are concerned. Thus the expected producer prices will tend to influence the farmers' choice of cultural practices, technology (fertizer) and the allocation of acreage among competing crops. The inclusion of the previous year's price is realistic in view of the fact that controlled marketing by PMC succeeds in eliminating extreme annual price fluctuations that were prevalent in the traditional marketing system.

The factors influencing yield are cultural practices, expected producer prices, weather, input prices, pests and diseases, and technology. The three variables affecting maize acreage are acreage of competing crops, expected price of maize and competing crops, and weather. Prices of variable inputs determine what amount thereof can be used in the production process. With a given price for maize an increase in the prices of inputs will tend to shift the supply curve to the left and vice versa. Changes in the prices of competitive crops would also result in shifts in the

supply of maize.

The area planted with maize serves as good indication of next year's production intentions or planned supply of farmers. The total annual production as well as the production per unit area can be regarded as the physical supply or domestic production. The total supply of maize includes domestic production less seed use and losses, plus imported maize quantity and food aid received from international agencies and other countries.

With respect to the demand side many factors can shift the demand curve for maize. Some of these factors are: prices of substitutes, buying power (income) and its distribution, population growth and consumption in terms of age, consumer preferences and consumption habits. The net supply, and domestic demand determine the retail price.

4.2. The Statistical Model

The statistical model functionally represents the economic relationships briefly discussed above. These relationships, when supported by economic theory provide a framework for the construction of a statistical model and the incorporation of appropriate variables.

Since the supply relationships are hypothesized not to be simulteneously determined with demand, Ordinary Least Squares (OLS) estimation of the parameters is appropriate. However, in the case of the demand relationships the OLS techniques is not appropriate. That is, since Lesotho imports about 20% of the RSA maize supply, the quantity of imports of maize in Lesotho affect RSA prices. Hence, it cannot be assumed that the retail price of maize in the demand equations is exogenous because of the fact that Lesotho's imports are a large percentage of RSA maize. Thus, the quantity of imports affects the retail price, and therefore, the current price of maize cannot be considered predetermined. Also, the price of maize in Lesotho is affected by how much is imported and hence further supports

the notion that price is endogenously determined. It is not, therefore, appropriate to use OLS to estimate the demand side. The use of a Simulteneous Estimation Technique is in order to obtain reliable estimates of the structural demand coefficients.

4.2.1 Supply

Theoretically the supply curve represents the relation between the price of a commodity and the quantity offered for sale at a particular point in time, while all other factors that could affect this relation are held constant. But when this ceteris paribus condition is relaxed supply shifters come into the picture. These factors include expansion of agricultural land, labour supply, formation of capital in agriculture as well as external financing, technological development, risk and uncertainty, the application of technical knowledge to agriculture, costs of production and prices of complementary and competitive products.

Simple supply responses to price are likely to be greater in the longer term than in the short term. However, even in the longer term the importance of supply response is likely to be reduced by the effects of the irreversibility of new technologies, inputs and institutions because farmers do not immediately respond to changes in these three factors. But farmers allow time to lapse before they can change their production decisions in relation to changes in technology, inputs and institutions. Short-run output responses almost always emanate from weather variability as well as from physical and biological hazards.

The factors that affect supply are, indeed, numerous. Most of these factors cannot be measured statistically, either because of paucity of data or because it is impossible, within the limitations of current state of arts, to quantify them. Thus, in this study, only those variables for which data are available have been included however, when necessary the

use of selected proxy variables was investigated.

In this analysis an attempt was made to specify the complete supply model in its simplest form. Hence, an estimate of the influece of a number of relevant factors on the following three aspects of the maize supply, namely area planted (acreage), total production and production per acre (yield) was hypothesized. These three variables were in turn regarded as dependent variables in the various alternatively specified supply functions. The following model specifications for the three separate relationships have been hypothesized.

Equations

(4.1) $A_t = C+\beta_1 PM_{t-1}+\beta_2 PF_t+\beta_3 PS_{t-1}+_{t-1}+\beta_4 PW_{t-1}+\beta_5 REMT_t+\beta_6 R_t+\beta_7 T+e_t$

(4.2) $Y_t = C+\beta_1 PM_{t-1}+\beta_2 PF_t+\beta_3 REMT_t+\beta_4 R_t+\beta_5 T+e_t$

(4.3) $AY^s_t = C+\beta_1 PM_{t-1}+\beta_2 PF_t+\beta_3 PS_{t-1}+\beta_4 R_t+\beta_5 T+e_t$

Where:

A_t = area planted to maize (ac)

Y_t = production per acre (kg)

AY^s_t = total production of maize in year t in thousand metric tons (excluding food aid and imports because they biased the results)

PM_{t-1} = last year official RSA producer price of maize in Rands/kg (i.e. proxy for Lesotho producer prices)

PF_t = current fertilizer price in Rands/kg

PS_{t-1} = the RSA producer prices as proxy producer prices of Lesotho sorghum (substitute in production) lagged one year in Rands/kg

PW_{t-1} = the ex-board producer price for wheat lagged one year (substitute in production) in Rands/kg

$REMT_t$ = migrant labour remittances per year in thousand rands

R_t = two-year moving average rainfall during the current year in millimetres

T = trend

e_t = error term

β_1 = estimated regression coefficients

C = constant term.

In view of the absence of complete time series data for yield and acreage, no separate relationships were statistically estimated for yield and acreage as would be indicated in Figure 4.1. Also, estimates of AY_t including food aid and imports were tried but it was felt that AY_t excluding food aid and imports would be preferable.

4.2.2 Demand

The concept of demand as encountered in economic theory involves the relationship between the price of a commodity or group of commodities and the quantity thereof demanded by purchasers. This relationship is valid under a strict set of static condition --- the so called ceteris paribus assumptions, according to which some factors are held constant.

When examining the effects of variables which cause the demand curve to shift, these ceteris paribus conditions have to be done away with. Some of these factors defy precise statistical measurements, for example, consumner tastes, preferences and psychological factors. Those demand shifters which are amenable to quantification include population, income, the relative price of the commodity, and the price of close substitutes in demand. The wholesale price does not affect the retail price because retailers who sell maize attach a mark-up on the wholesale price of maize. Per capita demand was to be obtained by computing average figures for "apparent consumption" calculated by using available statistics and estimates of the following: consumption = production + imports - exports - changes in national stocks - local non-food use. The relationship that is indicated among the prices could not be statistically estimated because of the simulteneity problem arising from the no longer predetermined price of maize and non-existence of relevant data. The complete model in its simplest form was hypothesized

to be of the following form:

Equations

(4.4) $D_t^I = C+\beta_1 PM_t+\beta_2 Y_t+\beta_3 TM_t+\beta_4 T+e_t$

(4.5) $AY_t^D = C+\beta_1 PM_t+\beta_2 Y_t+\beta_3 T+e_t$

(4.6) $AY_t^S = D^I+AY_t^D$

Where:

D^I = domestic import demand in thousand metric tons

AY_t^D = domestic demand in thousand metric tons

AY_t^S = market clearing identity in thousand metric tons

PM_t = import price variable in Rands/kg

Y_t = per capita real income in Rands

TM_t = tariff variable

e_t = error term

βi = estimated regression coefficients

C = constant term

T = trend

In order to be able to untangle the joint relationship between domestic import demand and domestic demand so as to obtain reliable estimates of the structural coefficients it is necessary to solve equations (4.4), (4.5) and (4.6) simulteneously. If the least squares approach is used to estimate the structural coefficients in these equations that contain current values of 2 endogenous variables, estimates that are statistically biased would be obtained.

There are 7 variables in the system, 5 variables in equation (4.4) and 4 variables in equation (4.5). Since 7-5 equals the number of endogenous variables in the system minus one, it can be assumed that equation (4.4) is just identified. However, the domestic demand equation is

overidentified since 7-4 is greater than 3-1.

There is sufficient information in the just identified equation (4.4); but because equation (4.5) is over-identified there is too much information and the reduced form parameters will not yield unique estimates of the structural parameters. Also, a complete set of data does not permit estimation of the 2 behavioural demand equations, largely because of incomplete import data. Therefore, the results from estimating equation (4.5) would be biased if the OLS technique were used. For these reasons both the domestic and import demand equations were not estimated. The other reason is that empirical problems of estimating demand and import demand arose from the fact that there was inadequate information to use for estimating import prices which are needed to estimate domestic demand and because of the simulteneity problem.

4.3 A Note on Data and Methodology

Paucity of data limited this study. This study analyses eleven time-series observations extending from 1966 to 1976 only for the supply relationship. Theoretically, it becomes difficult to find significant regression coefficients because the number of variables estimated are large relative to the number of observations.

In addition, as the number of independent variables increases, the problem of multicollinearity arises. This problem increases the variance of the estimated coefficients. Generally, a solution to this problem would be to increase the number of observations or to drop variables but, getting additional data was not possible in this study.

Production figures used for the three competitive crops, maize, wheat and sorghum, reflect official estimates based on crop cutting measurements.

Several problems were encountered in the attempt to calculate satisfactory rainfall figures as an important variable in supply equations. Rainfall variables were calculated by taking a two-year moving average rainfall of officially reported average annual rainfall for Lesotho. Had monthly rainfall been available, the rainfall variable would have been sub-divided into rainfall during the ploughing/planting season, rainfall during the growing but before the maize tasseling stage, rainfall during the cob formation stage and rainfall before harvesting. These four rainfall variables would have indicated as to which rainfall has a positive influence on total maize production.

It had been hoped that inclusion of fertilizer prices in the estimated supply model would represent adoption of technology; but, data limitations were so great that technological impacts could not be considered. Prices of competing crops posed an additional problem. In the context of Lesotho agriculture, beans are regarded as a strong competing crop in maize production because beans are a cash crop. But because information at the investigator's disposal did not contain bean prices, beans could not be included as a competing crop in the basic model. Thus shifts in the supply of maize that could result from changes in the prices of all possible competing crops could not be studied.

A trend variable was used as a measure of technological change assuming that technological development took place at a more or less constant rate in the period under review. The effect of technology embodied in commercial fertilizers, commercial maize seed varieties, and improved cropping methods would legitimize the CCPP program.

As there are no consistent time-series of prices for agricultural commodities in Lesotho, the South African series have been used as relatively reliable proxies. Furthermore, the price indices for some years have been obtained by linking the one in Eckert's LASA report with the South African

series.

To account for the effect of the general price level, all prices were deflated by the consumer price index. Population was accounted for by deflating the quantity and income variables by population.

Under ceteris paribus conditions, it is assumed that a decrease in the producer price of maize will result in increased production of sorghum and/or wheat as farmers shift their resources from maize production to sorghum/ wheat production.

Lagged maize, wheat and sorghum prices have been used in the supply response because it is believed that farmers base their expectation of future maize prices on past maize prices since PMC announces crop prices prior to harvesting but after planting.

Footnote

For the raw data used to obtain the empirical results presented in the next chapter, see Appendices.

Chapter 5

Empirical Results

In this chapter an attempt is made to interpret the parameter estimates in terms of their compatibility with economic theory and knowledge of the maize industry in Lesotho. The correctness of signs and the magnitudes of the estimated parameters will be scrutinized in order to discover whether they are in step with a priori expectations. Evidential statements will be advanced to explain departures from what is expected. The statistical significance of the parameter estimates will also be given.

5.1 Interpretation of empirical results

5.1.1 Supply

Supply equations were estimated with ordinary least squares multiple regression. Logarithmic functions were preferred to linear forms because they appeared to fit the data better than the non-log forms. Many specifications of the total supply equation in which total supply included domestic production, maize commercial imports and food aid were estimated; but it was deemed best to report only the supply equations based only on domestic production.

Multicollinearity as evidenced by the high correlation among the exogenous variables in the correlation matrix presented itself in all estimated specifications. When necessary, the supply equations were estimated using the Cochran-Orcutt Interative technique to correct for serial correlation.

It was hypothesized that an increase in the migrant labour remittances had a negative influence on maize output in Lesotho. Hence migrant labour remittances were introduced into the estimated supply equations as a proxy variable for agricultural labour. Inclusion of labour remittances as a separate exogenous variable in the supply model introduced a degrees of freedom problem since available data on migrant labour remittances covered a time series of 10 annual observations only as opposed to the initial sixteen year annual data.

When remittances were included as an emplanatory variable in the model it had a positive impact on maize production. This result does not verify the hypothesis made in respect of the influence of labour migration on the production of maize in Lesotho. Labour migration pushed the magnitudes of all the estimates coefficients up. This effect implied that migration had to be included in the basic model. Even though labour remittances helped the estimated coefficients of some of the independent variables to become significant, labour remittances catapulted the elasticity of output supply extremely high. In the absence of better results from the several supply specifications tried, the labour remittances had to be retained in the final model.

The variables PM_{t-1}, PS_{t-1}, R_t, PW_{t-1}, REMT and T were defined in Chapter 4. The estimate of the model specification is:

<u>Equation 5.1</u>

$$AY_t^s = .792429 + \underset{(2.02134)}{5.54083\ PM_{t-1}} - \underset{(-3.26594)}{5.47611\ PS_{t-1}} - \underset{(-1.65490)}{1.11908\ R_t} + \underset{(2.89929)}{1.36288\ REMT_t} - \underset{(-2.65645)}{5.91547\ PW_{t-1}} - \underset{(-3.28535)}{.2848\ T}$$

$R^2 = 0.90$ DURBIN-WATSON STATISTIC = 2.6551

$F(6, 3) = 4.52177$

The numbers in parenthesis beneath the estimated coefficients are the t-values of the respective coefficients.

All variables bear signs that are compatible with a priori expectations except that the estimated coefficients for annual average rainfall (R_t) and migrant labour remittances ($REMT_t$) have signs that are contrary to those expected. Despite the fact that one would expect a positive relationship between rainfall and maize output the negative sign of the estimated rainfall coefficient was not a surprise in view of the fact that the rainfall data used was on an annual instead of a monthly basis. Technically, in the growth process of a maize plant there are certain critical stages at which excessive rainfall has a negative impact on the formation of a maize cob. By the same token, inadequate rainfall immediately after planting and at the tasseling stage can reduce yields and, hence, total maize production. The timing of rainfall within the season is critical. And since annual average rainfall figures cannot capture the critical intraseasonal effects, the estimated negative albeit insignificant influence of rainfall was obtained.

Even though the sign of labour remittances in equation 5.1 does not support the hypothesis that labour migration has a negative impact on maize output, the positive sign of labour remittances can be explained. The possibility does exist, however, that a one percent increase in remittances may cause maize production to increase by 1.36 percent because a relatively larger portion of the increased income originating from higher wages is invested in yield increasing inputs such as improved maize varieties and commercial fertilizers.

The explicit incorporation of these inputs into the supply equation was impossible because of data inavailability. In terms of the F-statistic, equation 5.1 is significant only at the 10 percent probability level.

The short-run elasticity of maize output with respect to changes in the price of maize is 5.54083 for equation 5.1. This means that for every one percent increase in the price of maize there will be a 5.5 percent increase in maize output. Since the price elasticity of maize output is significant, this suggests that there is a strong response in maize output to changes in the maize producer price.

The results show that wheat and sorghum compete with maize in production. The elasticity of substitution is 5.47611 for sorghum and 5.91547 for wheat. Thus, for every one percent increase in the price of sorghum there will be a 5.5 percent decline in maize output and for every one percent increase in the price of wheat there will be a 5.9 percent decrease in maize output. Over the past ten years there has been a decline in total domestic maize production.

All the estimated coefficients are statistically significant except that for annual average rainfall. The exogenous variables explain 90 percent of the variability in maize production. The Durbin-Watson statistic of 2.6551 indicates that serial correlation does not pose a serious problem.

5.2 Forecasted Domestic Production for 1985

A test of the supply equation was used to determine how well it predicted turning points. The supply model had three missed turning points out of 11 observations. Several assumptions had to be made in order to estimate 1985 maize production. On the basis of the fact that analysed data showed a 5 percent annual increase in the price of maize, it was assumed that prices for maize will increase at an annual rate of 5 percent. Eckert estimated that migrant labour remittances would decrease annually by 4.0 percent in the future as a result of reductions in the recruitment of Basotho mine labour. Thus, the same rate of decline in migrant labour remittances was adopted in supply projections. Since the 1980's will be characterized by a progressively decreasing rainfall as estimated by Dyer and Tyson's

studies of the rainfall circumstances in the Southern Africa area, it is estimated that rainfall will fall to a low of 650 m.m. average annual precipitation in 1985. Plugging the time variable of 25 (1985) into the linear relationship model, the estimated maize production for 1985 is about 49418 metric tons in the event of no change in yield increasing inputs and agricultural resources.

The historical domestic production levels ranged between 49000 and 122, 500 metric tons. The present production level (1979) is 49199 metric tons. In comparison with the present and the historical domestic maize production levels, the projected 1985 domestic production show that Lesotho is likely to be headed for a maize shortage in the absence of increased imports or food aid.

5.3 Projected Domestic Demand - 1985

All estimates are subject to errors and uncertainty. These errors and uncertainties may arise in respect of the estimates of present and past demand or in the method used for forescasting future demand or in future demand itself owing to economic causes which are chance occurances and are difficult to predict (e.g. sociological factors).

Again, in projecting domestic demand for maize many assumptions were made. It is assumed that the income elasticity will remain constant over time with changing incomes. Further, it is assumed that population growth will change at the same rate throughout the period 1977-1985; and that income will also increase at a constant annual rate.

In projecting demand, a projection method adopted by FAO was employed.[3/] This simple method uses an estimate of income elasticity and estimates of projected income and population growth. Implicit in this function is constant demand price. The following formula was used for long range projection.

$$D_t = D_o (1 + d)^t$$

Where:

D_t = projected consumption in time T

d = popo + ny

= annual rate of growth in the consumption of maize.

pop = rate of growth in population

n = income elasticity

y = annual rate of growth in income per capita

t = 1977-1985 = 8

D_o = consumption in base year (1977)

The income elasticity was assumed to be about 0.60. This estimated income elasticity was arrived at on the basis of demand results obtained by the investigator. The rate of population growth of 2.27 percent was borrowed from Eckert and Mohapi[1/] and the rate of real income growth per capita (-4.4%) was obtained from Eckert and Mohapi[2/]. The demand projection is

$$d = 2.27 + 0.60 (-4.4) = 0.37$$

$$D_{85} = 175099 (1 + 0.37)^8$$

$$= 245,138.6 \text{ metric tons}$$

A comparison of the supply and demand forecasts exposes a shortage of about 195.720 metric tons of maize which will have to be made up by imports, food aid, etc. If future domestic maize production continues to decline as the projections would seem to indicate, the dependence of Lesotho on commercial maize importations to meet local maize requirements will become a prevailing situation even in years to come. This will, indeed, spell an extremely weak economic situation for Lesotho.

1/ Eckert and Mohapi. "The Future Environment for Agric Planning, 1980-2000 A.D. LASA Discussion Paper No.9 June 1980.

2/ Op cot

3/ FAO, 1975. Projection of demand and supply

The projected supply of and demand for maize reveals a disturbing situation in which Lesotho will continue to use badly needed foreign exchange to defray costs associated with maize imports until the year 1985. In the absence of a drastic reorientation of the government's agricultural policy, the future of Lesotho's maize production is indeed gloomy.

Chapter 6

Summary, Conclusions, and Policy Implications

This chapter is comprised of three sections: Summary, Conclusions policy implications. The summary will review some of the major findings of this study.

6.1 Summary

The problem giving rise to this study was defined in Chapter 1. In Chapter 2, a review of some literature in some low-income countries was made with the view to eliciting some findings which are relevant to this study. The third chapter presented a normative and positive description of the Lesotho agricultural economy with specific reference to the maize industry. Institutional constraints that inhibit increases in maize production were dealt with and it was indicated that research into on-farm storage has to be conducted in order to reduce maize and other grain losses. In chapter four, a theoretical construct was presented by combining economic theory, statistical techniques and knowledge of the maize market in studying maize supply-demand relationships in Lesotho. In chapter five the empirical results were presented.

This study undertakes a statistical analysis of the supply of maize in Lesotho with the objectives of projecting supply and demand for this commodity in 1985. The second objective of the study was to provide information for policy decision making.

The influence of maize price, sorghum price, annual average rainfall, labour remittances, the wheat price and time on the total domestic production of maize was estimated by the OLS technique. All variables were transformed into their logarithmic form to facilitate a better fit of the data as well as to provide a ready interpretation of the elasticities. All supply variables, with the exception of rainfall and labour remittances,

had signs of the estimated coefficients that tallied with a priori expectations. The calculated t-values indicated that all coefficients but the coefficient of rainfall were statistically significant. The significant F statistic of 4.52 and the high coefficient of determination of 0.90 provided credibility to the results of the estimated model.

Sorghum and wheat were found to be significant competitors for maize in Lesotho. However, average two year moving annual rainfall seems to be unimportant in influencing the total domestic maize production. Non-availability of data precluded the estimation of yield and acreage to changes in the price of maize.

In comparison with supply studies conducted in South Africa, Kenya and the Philippines it is interesting to note that not all of the estimated coefficients in this study had signs that are similar to those found in the above three studies. These coefficients were also not all statistically significant whereas the estimated coefficients carried the expected signs and were statistically significant in the reviewed supply studies. The short-run elasticity of supply with respect to changes in the price of maize was from 0.19 to 0.963 in those studies whereas it is 5.54 in this study. However, in one South African Study a long-run supply elasticity estimate of 10.5 was obtained.

In compliance with the findings of the studies reviewed concerning the responsiveness of farmers to changes in the price of maize, this study also revealed that Basotho farmers are responsive to changes in the price of maize. The present study used a simple method to project future Lesotho maize consumption. Forecasts of quantities supplied and demanded in 1985

indicate that Lesotho is likely to face a maize shortage of about 195,720 metric tons of maize (or about 50% of its projected annual consumption) which will have to be made up by imports, food aid, etc.

6.2 Conclusion

There exists many variables that bear on the response to change in the prices of agricultural commodities, maize included. Unfortunately it was not possible to uncover the precise underlying form of the responses - aggregate response or response to relative price changes, acreage, or yield response or marketed surplus response. Since statistical testing was based on seemingly poor available data, the study has shed little light on maize production response in Lesotho.

The model specifications used were based on relatively few and not very reliable data. The price actually received by the producer, for example, may differ from that which was used in this study (i.e., not only in its level but also in its degree and direction of change).

The supply relationship tested produced statistically significant results with respect to the producer price for maize, sorghum and wheat, labour remittances and trend; but, the estimated rainfall coefficient was insignificant and carried a sign that is not compatible with expectations. The results show that price has a large influence on the output of maize in Lesotho. The results also lead to the conclusion that sorghum and wheat are important competitors in maize production and that annual average rainfall has an indeterminate effect on maize production because of aggregation of monthly rainfall.

It appears that maize produced by Basotho farmers is responsive to prices. Therefore, the conclusion may be made that Basotho farmers are responsive to economic incentives. Had data been available it would have been interesting to separate acreage from yield effects and also to discover

the significance of monthly rainfall in Lesotho's maize production.

The projected supply of and demand for maize reveals a disturbing situation in which Lesotho will continue to use badly needed foreign exchange to defray costs associated with maize imports until the year 1985. In the absence of a drastic reorientation of the government's agricultural policy, the future of Lesotho's maize production and the possibility of reaching self-sufficiency in maize during the 1980's is needed oblique.

6.3 Policy Implications

While the simplest thing to do would be to leave the market mechanism to determine the level of prices, intervention by State agencies becomes inevitable with a view to safequard the interests of the producers on the one hand and that of the consumers particularly of the vulnerable sections, on the other hand. The difficult question to address is: at what price level should this intervention take place? While recognizing the need for keeping the internal price structure in agriculture in line with the South African price pattern, there are obvious limitations in doing so. For one thing, cost structures between Lesotho and South Africa and within Lesotho itself differ. These differentials need to be taken into account when formulating an agricultural price policy.

To be taken into consideration also is the output substitution that exists between maize, wheat and sorghum when changes in the price of maize occur. This ties very well with the specification of the objective the price policy is supposed to help attain before the level of agricultural prices can be determined.

In the context of Lesotho, the first objective of price policy is to help attain self-sufficiency in food production. Therefore, the price policy has to be oriented towards providing adequate incentives for adoption of new technology and sometimes even for shifting of resources in favour of food crops. But, as the economy moves to a stage of near self-

sufficiency in food, the price policy instruments will have to be increasingly used for generating a "balanced structure of production." That is, the price policy must encourage a balanced investment of production resources in the agricultural sector and the non-agricultural sectors.

A price policy that ignores regional differences is bound to misfire. For the most part, the existing producer price levels for the marketable surplus of agricultural commodities in Lesotho have neglected consideration of many costs that farmers incur before they finally sell their produce to PMC/Co-op Lesotho and LMC depots. For instance, transportation costs of farmers are not usually reflected in the price. Therefore, whenever a policy disregards these facts of production it is not surprising that it meets with unexpected responses from farmers. Thus, the micro-and macro aspects of a price policy must be articulated.

In the area of adoption of new technology, output price may have only a marginal role to play in the Lesotho context in cereal production. But the level thereof will have to be stabilized in order to encourage gradual adoption of new technology. In addition to a policy for research in agriculture which would integrate the research effort with the overall economic and social objectives of growth in agriculture, what is needed is the institutionalization and decentralization of agricultural credit, land reforms, commercial agric-support services, and Planning.

Another area, in addition to price policy instruments, that may be exploited in order to attain optimality in land-use patterns in Lesotho as a whole is to use fiscal incentives for promoting growth of processing industries in regions enjoying comparative advantage in producing certain field crops. Since in most cases the small farmer is both a seller and a buyer of food crops, he gets doubly hurt in the phase of rising prices.

He is forced to dispose of his produce right after harvest when prices are generally depressed but he has to buy foodgrains in the "hungry" season when prices tend to be very high. Part of the solution to his problem is a research policy that aims at improving and maintaining effective on -farm storage facilities. In the final analysis, a price policy should ensure that the existent income disparities among farmers are not perpetuated but reduced. For this policy to be effective it must work hand in hand with a policy for land reforms. Reduction of income disparities among farmers may not be an easy task, but it is important that the distributional impacts of a price policy are not overlooked. To summarize, an agricultural policy that ensures that farmers are paid sufficiently to grow foodgrains will be popular. Farmers are basically interested in higher prices. In short, they want to see the terms of trade for agriculture held favourable. When the government administers the trade in cereals it must effectively shoulder the responsibility for an efficient price system.

Research Needs

1) Since there is such an assortment of crops grown in Lesotho (e.g., wheat, beans, peas, maize. sorghum, pumpkins, etc.), an indepth research must be made into how these crops substitute in production.

The objective will be to find justification for supporting output prices of some of these commodities and subsidizing resources that go into their production (e.g. fertilizer). It is also worthwhile to analyze the economics of import substitution in the agricultural sector, and to discover roughly at what price levels Lesotho should strive to attain food self-sufficiency.

ii) While there is clear evidence that allocation of land among competing alternative crops is significantly influenced by changes in the relative price structure, empirical evidence relating to allocation of other inputs such as fertilizer, labour and machine/animal power is lacking. Research in this area is imperative to identify those productive inputs that may be subsidized, if need arises.

iii) The lack of the availability of reliable demand figures and also the absence of reliable statistics on major vairables influencing supply response inhibited exposure of supply-demand relationships that actually exist within Lesotho. Hence, further research into the supply and demand not only of maize but of all agricultural commodities is needed in order to provide economic data that will enable the planning, formulation and implementation of streamlined national crop and livestock production programs as well as national crop and livestock processing ventures designed to reduce Lesotho's economic dependence on South Africa. What is urgently needed is an annual consumption survey of Basotho that is carried each year. Information collected and collated in such surveys could be invaluable in planning production and in formulating national plans. Such surveys should include, among other things, statistics on household expenditures, individual earnings and farm incomes, food consumption patterns and quantities.

iv) It is necessary that forecasts of future production and price tendencies be made and the information transmitted in plain words to farmers and other interested parties. In addition, a price policy that takes regional differences into consideration will have to rely on information obtained from the research into regional supply response estimates. Techniques used in regional supply response estimates may include Linear Programming, Input/output analysis, etc.

v) Research is needed to ascertain the extent, frequency and distribution of environmental hazards common to Lesotho. These should include drought, frost and hail and the calculation of costs of physical protective measures and insurance. In addition, the farmer's perception of risk and risk-avoidance strategies must be investigated.

vi) Creating employment opportunities for Basotho within agriculture and in the non-agricultural sector is one of the major objectives of the Lesotho government. To ensure that job openings are offered in agriculture a study needs to be undertaken on the phenomenon of the substitution of human labour for mechanical power (capital) in agricultural production.

vii) There must be systematic examination of impacts of both the distribution of income and the growth of income. The overwhelming need for data on income distribution is on the sectoral distribution of the poor, their occupational characteristics and educational levels, their ownership of productive assets, and their access to key production inputs.

APPENDIX 1

Appendix Table 1 Statistics Analyzed to Determine Demand Response

Year	Production Plus Import (m.t)[1]	Population in '000[1]	Price of Maize R/kg[2]	Price of Sorghum R/kg[3]	Real Per Capita National Income in Rands[3]	Consumer Price Index[3]	Trend
1967	137,992	978	.0359	.0355	55.52	88.8	1
1968	139,567	1,000	.0359	.0338	57.86	91.6	2
1969	132,225	1,023	.0367	.0334	58.27	93.3	3
1970	130,366	1,046	.0390	.0364	59.37	96.0	4
1971	110,071	1,070	.0397	.0353	59.55	101.3	5
1972	110,623	1,094	.0399	.0374	59.68	107.6	6
1973	135,388	1,119	.0410	.0364	64.60	114.7	7
1974	150,297	1,144	.0455	.0497	72.38	128.0	8
1975	150,946	1,170	.0490	.0 82	85.75	144.9	9
1976	142,520	1,197	.0523	.0690	97.25	184.0	10
1977	175,099	1,224	.0613	.0834	103.90	213.3	11

Sources: [1]Lesotho Statistical Bulletins

[2]Imputed from RSA Board, 1967/77 figures.

[3]Eckert, Jerry and Joseph N. Mohapi. "The Future Environment for Agricultural Planning, 1980-2000 A.D., LASA;" June 1980

APPENDIX 2

Appendix Table 2. Statistics Analyzed to Determine Supply Response

Year	Domestic Maize Production 1000 (m.t)[1]	Price of Maize R/kg[2]	Price of Sorghum R/kg[2]	Average Annual Rainfall m.m[3]	Migrant Labour Remittances in R'000[4]	Consumer Price Index[4]	Price of Wheat R/kg[2]	Trend
1966	109,000	.0355	.0337			85.4	.0590	1
1967	110,000	.0338	.0355	791	892.0	88.8	.0625	2
1968	108,743	0338	.0338	493	116.2	91.6	.0653	3
1969	101,893	.0334	.0334	565	123.0	93.3	.0640	4
1970	66,360	.0364	.0364	567	124.5	96.0	.0640	5
1971	74,000	.0353	.0353	624	132.7	101.3	.0659	6
1972	59,000	.0374	.0374	699	132.1	107.6	.0697	7
1973	70,000	.0364	.0364	590	161.1	114.7	.0703	8
1974	122,500	.0455	.0497	790	202.7	128.0	.0778	9
1975	70,292	.0570	.0582	841	361.1	144.9	.0979	10
1976	49,128	.0620	.0690	939	454.6	165.3	.1020	11

Sources: [1]Bureau of Statistics and PMC

[2]Estimated from 1980 Abstract of Agricultural Statistics, Division of Agricultural Marketing Research, Pretoria

[3]Annual Statistical Bulletins

[4]Eckert, Jerry and Joseph N. Mohapi. "The Future Environment for Agricultural Planning, 1980-2000 A.D., LASA; "LASA" June 1980.

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