# THE AGRO-ECONOMIC DEVELOPMENT OF THE LOWLAND REGION

BY

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The writer alone is responsible for the views expressed in this study.

CONVERSION FACTORS:

1,00 Rand (R) = 1,40 USS
1 acre = 0,47 morgen = 0,4 hectare (ha)
1 morgen = 2,1 acre = 1,17 hectare
1 inch = 25,4 millimetres (mm.)
1 kilogram (kg.) = 2,2 lb.
1 ton (metric) = 1 000 kg. = 2 204,6 lb.
1 bag of grains or pulses = 200 lb.
1 ton = 11 bags.
1 pocket (potato) = 15 kg.
1 ton - 67 pockets.
1 bag/acre = 2,1 bags/morgen = 0,22 ton/ha

TABLE OF CONTENTS.


| | | PAGE. |
|---|---|---|
| CHAPTER 1. | INTRODUCTION AND SUMMARY. | 1 |
| | Introduction. | 1 |
| | Summary. | 2 |
| CHAPTER 2. | BACKGROUND INFORMATION. | 5 |
| | Physical Background. | 5 |
| | Population and Labour Force | 6 |
| | Water and Mineral Resources | 7 |
| | The Economy | 8 |
| | Lesotho and RSA | 17 |
| | Conclusions | 18 |
| CHAPTER 3. | THE LOWLAND | 20 |
| | General | 20 |
| | The Village Economy | 20 |
| | Crop Area | 24 |
| | Yields. | 26 |
| | Cultivation Practices | 27 |
| | The Economics of Dry Land Crops | 29 |
| | Cultivation Services | 31 |
| | Agricultural Credit and Marketing | 33 |
| | Improvement of Present Dry Land Crops | 34 |
| | Irrigation | 36 |
| | Diversification of Crop Production. | 37 |
| CHAPTER 4 | THE VILLAGE MODEL | 39 |
| | Introduction | 39 |
| | Labour Resources | 39 |
| | Land Resources | 42 |

PAGE

| | | |
|---|---|---|
| | The Enterprises examined in the Model | 43 |
| | Improvement of Livestock Production | 45 |
| | Other Assumptions | 46 |
| | Present Income and Employment | 47 |
| | The Methodology of Examining the various Development Possibilities. | 48 |
| | Selection of the Planning Method | 49 |
| | Linear Programming | 50 |
| CHAPTER 5. | IMPROVEMENT OF DRY LAND FARMING | 55 |
| | Introduction and Summary of Results | 55 |
| | Solution Analysis | 57 |
| | Conclusions. | 63 |
| CHAPTER 6. | DRY LAND CROPS AND IRRIGATION - A | 65 |
| | Introduction and Summary of Results | 65 |
| | Solution Analysis | 68 |
| | Conclusions. | 73 |
| CHAPTER 7. | DRY LAND CROPS AND IRRIGATION - B | 75 |
| | Introduction and Summary of Results | 75 |
| | Solution Analysis | 80 |
| | Conclusions. | 86 |
| CHAPTER 8. | ALTERNATIVE DEVELOPMENT POSSIBILITIES.- COMPARISON AND DISCUSSION | 88 |
| | Comparison. | 88 |
| | Discussion | 90 |
| | The "Village Model" and Production Reality | 91 |
| | Conclusions. | 93 |

| | | PAGE. |
|---|---|---|
| CHAPTER 9. | LESSONS FROM THE PAST. | 95 |
| | Introduction. | 95 |
| | Cooperatives. | 95 |
| | Mechanized Farming | 98 |
| | Credit Institutions. | 105 |
| | Thaba Phatsoa Irrigation Scheme | 107 |
| | Progressive Farmers | 109 |
| | Taung Reclamation Scheme | 110 |
| | Conclusions. | 111 |
| CHAPTER 10. | ORGANISATION PATTERNS | 115 |
| | Introduction | 115 |
| | Supply and Marketing | 116 |
| | Crop Insurance | 117 |
| | Credit | 118 |
| | Mechanization Services | 119 |
| | Irrigation Schemes | 121 |
| | Land Tenure | 123 |
| | Conclusions | 124 |
| CHAPTER 11. | AGRICULTURE AND ECONOMIC DEVELOPMENT | 126 |
| | Agriculture and Economic Development | 126 |
| | The Balance of Economic Development | 127 |
| | Under employment | 129 |
| | The Application to Lesotho | 130 |
| | Conclusion | 133 |
| CHAPTER 12. | Conclusions. | 134 |
| | Introduction | 134 |
| | Conclusions | 136 |

APPENDIXES - A POPULATION
B GDP PER HEAD IN DEVELOPING AFRICAN COUNTRIES
C LAND (PROCEDURE) ACT
D COMPUTER'S OPTIMAL SOLUTION REPORT
E COMPUTER'S POSTOPTIMAL REPORT (LPANALYSIS)

BIBLIOGRAPHY.

LIST OF TABLES.


| | | PAGE. |
|---|---|---|
| TABLE 2.1 - | RESOURCES AND THEIR USE IN 1967/68 | 9 |
| TABLE 3.1 - | INPUT, OUTPUT AND NET RETURN PER ACRE (IN R) | 30 |
| TABLE 4.1 - | GROSS MARGIN, LABOUR REQUIREMENT YIELDS AND PRICES FOR THE CROPS INCLUDED. | 44 |
| TABLE 5.1 - | DRY LAND FARMING MATRIX | 56 |
| TABLE 5.2 - | POST OPTIMAL REPORT | 58 |
| TABLE 6.1 - | DRY LAND CROPS AND IRRIGATION A MATRIX | 66 |
| TABLE 6.2 - | SHADOW PRICES AND THEIR RANGE | 68 |
| TABLE 6.3 - | SENSITIVITY TO VARIATIONS IN THE PRODUCT PRICE | 70 |
| TABLE 6.4 - | THE SENSITIVITY TO YIELD VARIATIONS | 72 |
| TABLE 7.1 - | DRY LAND CROPS AND IRRIGATION B MATRIX | 77-78 |
| TABLE 7.2 - | SHADOW PRICES IN THE 3rd RUN AND THEIR RANGE | 81 |
| TABLE 7.3 - | THE SENSITIVITY TO VARIATIONS IN PRICES AND YIELDS. | 82 |
| TABLE 8.1 - | A COMPARISON OF THE PLANS. | 88 |

MAP.

# CHAPTER - 1.

## INTRODUCTION AND SUMMARY.

### 1. INTRODUCTION:

"Of all emerging countries, few have a greater need for economic development than Basutoland."[1)]
Lesotho achieved its political independence without being near economic independence.

The National Income per capita is among the lowest in Africa. Most of the able workers find their employment in the Republic of South Africa (R.S.A.), the main economic sector (AGRICULTURE) is dominated by backwardness. The land is over populated and subject to severe erosion. About 50% of the regular government budget is currently supported by the British Government and approximately 25% of the population currently receives food aid from various sources.

The fact that there are no known mineral resources (besides some diamonds) or any other natural resources (other than water) makes the picture even gloomier. As a result it is not at all clear how the country will cope with the problem of increasing employment opportunities for the growing population and improving their living conditions. Halpern went as far as arguing that "even with the best will in the world, the permanent solution of Basutoland's unemployment problems is beyond the powers of its present or any future administration."[2)]

Modern theories of economic development have recognized the active role of agriculture in the development process.[3)]

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1. WALLMAN S. 1969, p. 1.
2. HALPERN J. 1965, p. 177.
3. THORBECKE E. p. 3.

Some investigations into the development possibilities of Lesotho pointed at the agricultural sector as having the greatest development potential,[1] in the short run.

The purpose of this study is to explore the possibilities of agricultural development through the intensification of crop production in the lowland of Lesotho.

The methodology used went through the following steps:

a) A representative "village model" based on studies of lowland conditions was formulated.

b) The alternative ways of intensifying crop production in the lowlands were studied.

c) Linear programming was used in comparing the alternative ways by planning the "village model" with the objective of profit maximization.

d) The planning results were analysed and conclusions were drawn.

e) Organization patterns which are required for their implementation were recommended.

## 2. SUMMARY:

Chapters 2 and 3 present a brief background on the economy and the lowland region respectively.
Chapter 4 presents the "village model".
Chapters 5,6 and 7 examine the following ways to increase crop production:

a) Improvement of dry land farming.

b) Improvement of dry land farming and irrigation based on the existing crops.

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1. See for example - THE DEVELOPMENT OF THE BASUTOLAND ECONOMY. (1965)

c) Improvement of dry land farming and irrigation based on vegetables.

Chapter 8 compares and analyses the solutions obtained in chapters 5,6 and 7.
Irrigation with vegetables as the main crop appears to be the best solution. Where irrigation cannot be established the improvement of dry land farming is the obvious solution.

Chapter 9 presents a brief review of past experience in Lesotho in the fields of mechanization, credit, extension and co-operatives. Organization patterns which are required for the implementation of the recommendations presented in chapter 8 are recommended in Chapter 10.
Chapter 11 presents a brief review of contemporary economic theories dealing with the role of agriculture in economic development.

The conclusions of the study are presented in chapter 12. The most important ones are:

a) The necessity to introduce irrigation on a large scale.

b) Vegetables should be the main crop on the irrigated land.

c) The development through improvement of dry land farming and through irrigation should be balanced in order to avoid an increase in unemployment.

d) Labour migration to R.S.A. is expected to continue in the foreseeable future. Agricultural production should therefore be organized in a pattern which will enable labour migration without a reduction in land productivity.

e) The extension of mechanisation and credit services should be done mainly through private entrepreneurs.

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## CHAPTER - 2.

## BACKGROUND INFORMATION.

As mentioned in chapter 1 the study deals with the agro-economic development of the lowland region.
However, any development programme must be related to an appreciation of the economy as a whole.

### 1. PHYSICAL BACKGROUND:

a) AREA: The country is 11 700 square miles in area, land locked and entirely surrounded by the Republic of South Africa.[1] It is generally divided into 3 ecological regions:[2]

Lowland[3] - elevation 5 000 - 6 000 ft., 26,6%[4] of the total surface. This isthe most suitable area for arable agriculture.

Foothill - elevation 6 000 - 7 500 ft., 15,6% of the land surface. This region is partly suitable to arable agriculture and partly to animal husbandry.

Mountain - elevation 7 500 - 11 000 ft., 57,8% of the land surface. This is a traditional grazing area, although due to population pressure on land, there has been an extension of arable agriculture into this area.

b) CLIMATE: The average annual rainfall is 30 inches falling mainly in the period October to April. The amount of rainfall decreases from east to west. There are substantial annual variations in the amount of rain-

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1. To be abbreviated through this study R.S.A. or referred to as the Republic.
2. See map.
3. The lowland region may be further divided into the lowland and the Orange River Valley.
4. SOURCE: P. SMIT - LESOTHO: A GEOGRAPHICAL STUDY.

fall and periodic droughts are a common phenomenon. The average number of days with temperatures lower than $0^{o}$ increases from 50 in the west to 90 in the east.[1] Frost may occur during 6 months (April to September).

2. POPULATION AND LABOUR FORCE:

The de jure population (including absentees) estimate for 1971 is 1 052 000 persons,[2] of whom about 50% live in the lowlands Most of them are rural and African. The non-africans who numbered less than 2 500 persons 3) in 1966 are occupied mainly in the goverment, trade and various missions. The annual rate of pupulation increase is estimated at 2,5%[4].

There are no accurate statistics about the labour force. The estimate for 1969 was 430 000 persons (270 000 males, 160 000 females) of whom 120 000 males and 20 000 females were working in the Republic. The percentage distribution of the labour force in 1969 according to the source of employment was estimated to be as follows:[5]

| | |
|---|---|
| Employment in agriculture[6] | 48% |
| Paid employment in Lesotho | 7% |
| Employment in R.S.A. | 45% |
| | 100% |

Projections made towards the preparation of the five year development plan estimated the annual increase of the labour force at 8 000 persons.[7] In the same paper the rate of underemployment in 1966 was estimated at 50% and this rate was projected to grow

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1. P. SMIT, op. cit.
2. SOURCE: Lesotho First Five Year Development Plan 1970/71 - 1974/5 (abbreviated through this study LFDP)
3. 1966 Population Census Report, table 2.

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4. LFDP, p. 1. 5. I b i d , p. 11.
6. Mainly in Government, trade, etc.
7. Preparatory Paper Towards The Five Year Development Plan (Mimeographed).

to 60% in 1975.

Qualitively - "Basuto miners have earned for themselves a unique reputation for hard work, reliability and such skills as they are permitted to exercise, especially in shaft sinking.[1)]

3. WATER AND MINERAL RESOURCES:

WATER RESOURCES:

This is one of the most important resources of Lesotho. Although the exact potential has not yet been determined, there are indications that it is considerable.
The three main possibilities for economic exploitation of the water are:

a) Irrigation
b) Sale of water to R.S.A.
c) Production of hydro-electric power.

As regards irrigation, experience in Lesotho has been limited. However, the results from the 2 irrigation schemes at Thaba-Patsoa and Leshoeles are promising. Approximately 35% of the arable soils are considered suitable for irrigation. The suitability of the claypan soils which consist about 55% of the arable soils has not been determined as yet.

The selling of water to R.S.A. has been under consideration for sometime. A study of the total water resources and requireme of Lesotho has been carried out recently by the U.N.D.P.[2)] An interim report on this study recommended a project for selling

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1. HALPERN J. Op. cit. p. 237.
2. UNITED NATIONS DEVELOPMENT PROGRAMME.

150 million gallons of water per day to the Republic.[1)]

The plan for producing hydro-electric power for sale to the Republic has been postponed for the time being, because R.S.A. has shown little interest in obtaining power from outside the country.

MINERAL RESOURCES:

Diamonds are the only mineral which may be exploited economically. However, of the large number of Kimberlite pipes which have been discovered the diamond content in many of them is too small. A U.N.D.P. project has been started recently with the objective of using modern methods for the exploration of diamond deposits.

4. THE ECONOMY:

The National Income for the year 1967/8[2)] was estimated at R48.0 million which is R55.7 per capita.[3)] However, this figure may be biased downwards since it included

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1. L.F.D.P. p. 28.
2. The last year for which National Accounts have been published.
3. SOURCE: NATIONAL ACCOUNTS 1967/8/.
   See comparison with other Countries in appendix B.

the remittances of migrant workers rather than their full wages.[1)]

The composition of the G.D.P. in 1967/8 by sectors was as follows:

| | |
|---|---|
| Agriculture | 39,0% |
| Mining and quarries | 2,0% |
| Manufacturing and construction | 2,4% |
| Services (including Govt.) | 56,6% |
| | 100,0% |

It can be seen that agriculture is the largest productive sector, the secondary sectors (manufacturing and sonstruction) are insignificant and the services proportion is large.

Table 2.1 presents an analysis of the resources and their use in the year 1967/8.

TABLE 2.1 - RESOURCES AND THEIR USE IN 1967/8[2)]

| RESOURCES | MILLION R | EXPENDITURE | MILLION R |
|---|---|---|---|
| G.D.P. (factor cost) | 46,4 | Private consumption | 51,9 |
| Net income from abroad[3)] | 4,3 | Government " | 9,4 |
| Indirect taxes less subsidies | 2,4 | Total " | 61,3 |
| G.N.P. (market prices) | 53,1 | Gross investment[4)] | 5,8 |
| Transfers [5)] | 14,0 | Total expenditure | 67,1 |
| Total resources | 67,1 | | |

1. According to estimates made by the Africa Institute, the total earning of Basuto migrant workers in the Republic in the year 1965/6 amounted to R43,1 million. The gross domestic product for the same year was estimated by the same source at R34,3 million (see Van der Merwe E.J. Lesotho: National Accounts 1954/5 to 1965/6)/
2. Based on National Accounts 1967/8 and LFDP.
3. Mainly migrant workers' remittances.
4. Including stock changes.
5. Grant in Aid etc..

It can be seen from the table that the G.N.P. resources were not sufficient to cover the total consumption. Lesotho depends on external assistance not only for financing its investment but also for supporting its existing population.[1)]

The annual deficit in the goverment's recurrent budget which has in recent years, been within the range of R6,0 million (about 50% of the budget) has been financed by a grant in aid from the British Government. However, with the revision of the Customs Agreement with R.S.A., Botswana and Swaziland, Lesotho's share in the customs revenue is expected to grow from R1,7 million in 1967/8 to R5,9 million in 1971/2 and the deficit in the government's budget is expected to be reduced to R1,0 million.[2)]

b) AGRICULTURE:

It has been estimated that agriculture provides the primary means of livelihood for about 85% of the population.[3)]
The fundamental problems of agriculture are the extremely low-land productivity and the high rate of soil erosion.

CROP PRODUCTION: Crop production accounts for approximately 20% of the G.N.P.[4)] Most of it is concentrated in the low-land. According to the agricultural census of 1969/70 the cultivated area was distributed in the various regions as follows:[5)]

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1. The situation in the previous years was similar.
2. STANDARD BANK REVIEW, July 1971.
3. THE DEVELOPMENT OF THE BASUTOLAND ECONOMY, p. 15.
4. Based on LFDP./
5. Wherever figures from the agricultural census 1969/70 are quoted, they should be regarded as preliminary ones.

| | THOUSAND ACRES | % |
|---|---|---|
| Lowland | 518,9 | 57,1 |
| Foothill | 228,7 | 25,1 |
| Mountain | 162,2 | 17,8 |
| TOTAL | 909,8 | 100,0 |

The number of farm households was 174 thousand and the average size of a farm was 4,9 acres of arable land. The main crops are maize, sorghum and wheat. Other important crops are beans and peas:

| | THOUSAND ACRES | % |
|---|---|---|
| Maize | 318,4 | 35,1 |
| Sorghum | 204,0 | 22,4 |
| Wheat | 262,9 | 28,9 |
| Beans | 40,4 | 4,4 |
| Peas | 30,1 | 3,3 |
| Other crops | 2,5 | 0,3 |
| Fallow | 50,5 | 5,6 |
| TOTAL | 909,8 | 100,0 |

Most of the production is for own consumption.[1)]

The yields are extremely low. The yields recorded in the agricultural census of 1969/70 as compared with the yields measured in the agricultural census of 1960 were as follows:

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1. In the agricultural census of1969/70, 96% of the farmers mentioned that they were producing mainly for home consumption.

| CROP | YIELD IN BAGS/ACRE 1969/70 | YIELD IN BAGS/ACRE 1960[1] | AVERAGE AMOUNT OF RAINFALL (inches) |
|---|---|---|---|
| Maize | 2,3 | 3,7 | |
| Sorghum | 3,1 | 3,8 | 1969 - 21,92 |
| Wheat | 2,4 | 3,8 | 1960 - 33,06 |
| Beans | 1,0 | 1,6 | |
| Peas | 1,6 | 3,3 | |

One of the possible explanations for the much lower yields in 1969/70 is that the amount of rainfall in this year was lower than the average. However, this cannot explain all the decrease and it may be assumed that in the last decade the yields may at best have remained the same and possibly may have decreased.

As a result of the low yields Lesotho is a net importer of cereals, mainly maize and wheat. The average annual import of maize is estimated at 300 000 bags while the annual value of imported wheat and its products is approximately R800 000.[2]

Lesotho was not an importer of grains in the past. In 1837 Basutos had grain stored for 4-8years; in 1844 white farmers flocked to them to buy grain. During 1872 (after losing most of their fertile land) Basutos exported 100 000 bags of grain.

Later on, as shifting cultivation became impossible owing to the pressure of population there was a "downward trend in production". In 1903, during a drought, Basutoland began im-

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1. Source - AGRICULTURAL CENSUS 1960. There is no reliable information about yields in the years between the censas.
   1 Bag = 200lbs.
2. LFDP, p. 54.

porting grain from overseas.[1)]

LIVESTOCK PRODUCTION:

Most of Lesotho's area is suitable for grazing rather than for crop production. Livestock production accounts for about 15% of the G.N.P. Annual exports of wool mohair and other animal products amounted to R2,6 million in 1968, which was 77,4% of the value of exports in this year.[2)] Lesotho is the worlds fourth producer of mohair (after U.S.A., Turkey and R.S.A.)[3)]

The total grazing area is estimated at 5 million acres. Livestock population is about 2 000 000 sheep, 900 000 goats and 400 000 cattle.[4)] The carrying capacity of the existing pastures is approx. 500 000 large livestock units[5)] while the existing number of large livestock units is more than twice this figure. The result is soil erosion and low quality of the animals and their products.

The main obstacles to the improvement of livestock production are:[6)]

1) Overstocking.
2) Basuto's preference of quantity to the quality of their livestock.
3) Uncontrolled breeding which makes improvement difficult.
4) Parasite infestation mainly in small stock.

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1. THE OXFORD HISTORY OF SOUTH-AFRICA, pp. 69-70.
2. LFDP, p. 17.
3. BARCLAYS OVERSEAS SURVEYS, 1971.
4. Source: F.A.O. - AGRICULTURAL PLANNING AND MARKETING, p. 2.
5. 1 Large livestock unit = 1 unit of cattle or 5 sheep or 5 goa 10 acres are required for one large livestock unit.
6. LFDP, pp. 10,11. A further analysis of the obstacles is beyond the scope of this study.

C. INDUSTRY:

Manufacturing industry in Lesotho is very small. It employed 550 workers in 1967 and its contribution to the G.D.P. was approx. 0,7%.[1] Since then the newly established L.N.D.C.[2] has initiated projects at an investment of R8,0 million, employing 3 000 people.[3] Despite this investment the manufacturing industry's contribution to the economy is very small and will remain small in the foreseeable future. The prospects for industrial development are not favourable. The lack of raw materials, distance from principal markets, lack of local entrepreneurs and the shortage of people with technical qualifications, do not make the industrialization of Lesotho an easy task.

D. MIGRANT LABOUR:

It is estimated that almost 50% of the labour force is employed outside the country at any given time.[4] This phenomenon has positive and negative aspects. Migrant workers' contribution to the economy is certainly much higher than what it appears to be according to the national accounts.[5] They generate a local demand for non-agricultural products which may encourage local industries and strengthen the saving potential for financing investment. Perhaps the most important advantage of the labour migration is that it relieves the pressure on land and enables planning the development of the economy without being under severe pressure of the unemployed. Another

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1. Op. Cit. p. 115.
2. LESOTHO NATIONAL DEVELOPMENT CORPORATION ESTABLISHED IN 1967.
3. STANDARD BANK REVIEW, JULY 1971.
4. LFDP, p. 12. In the population census of 1966 it was found that approx. 111 000 persons were employed outside Lesotho at the time of the census.
5. Op. Cit. p. 66.

indirect benefit is that Basuto are getting used to working for money and to the exchange of money for goods. This may have an impact on the crop pattern towards more cash crops (beans, peas and wheat) and less subsistence crops (maize and sorghum).[1)]

There is also the aspect of training in modern production processes. In a survey of tractor owners which was conducted in a lowland area it was found that most of them gained their experience, from work in South-African farms.

The migrant labour system has also many negative aspects. The quality of labour which is left for carrying out the agricultural activities is inadequate. While many of the migrant workers seem to plan their absence so that they will be at home in the critical months (ploughing and harvesting)[2)] the work in the mines seems to cause neglect and lack of interest in agriculture.

Many of the migrant workers are married and thus from the social aspect their having to stay away from their families "undermines the structure of family life in Lesotho."[3)]

The fact that such a great part of its labour force is employed in the Republic, puts the economy in a vulnerable position. The projections as regards the future prospects of

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1. Indeed, a comparison of the various crops area 1960-1969/70 shows that the area of cash crops has increased and the area of subsistence crops has decreased:

| | 1960 | 1969/70 | change |
|---|---|---|---|
| cash crops (wheat, beans, peas) acres (000) | 224,4 | 333,4 | +48,6 % |
| /subsistence crops (maize, sorghum) acres (000) | 572,6 | 523,4 | -8,6 % |

2. There are 3 types of contracts for workers in the gold mines: 120, 180 and 270 shifts. Besides, the worker can extend his contract (up to two years).

3. LFDP, p. 13.

Basuto employment in the Republic are not clear.

On the demand side there are claims that mechanization of work in the mines and a possible decline in gold production will reduce the demand for miners. On the supply side there are projections about growing unemployment among the unskilled African workers in the African reserves in the Republic.[1] Therefore restriction on labour migration to the R.S.A. in the not too far future is not unexpected.

The greater the importance of migrant labour to the economy, the greater will be the effect of a change in R.S.A. policy on the economy.

E. THE FIRST FIVE YEAR DEVELOPMENT PLAN 1970/71 - 1974/75:

"The plan's main objectives are to increase agricultural productivity, to improve and further expand the country's economic and social infra structure and to balance the government's budget."[2]

1. The annual rate of growth of the G.D.P. is projected to be 5%, of which 3,1% is to be contributed by the agricultural sector. With a population growth rate of 2,5% this means an increase of 2,5% in G.D.P. per capita.

2. Total capital expenditure is estimated at R60 million of which R28,8 million will be government investment. R16,7 million is to be spent on the improvement and expansion of the economic and social infrastructure.

3. The government budget will be balanced towards the end of the period.

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1. RAND DAILY MAIL, 29th AUGUST, 1971.
2. LFDP, p. 44.

One of the main weak points of the plan is as regards the assumed increase in crop production. It has been shown that in the past decade the productivity per unit area has at best remained unchanged and possibly declined. Still the plan assumes an increase of 62,5% in the yield per acre of maize and sorghum and 50% increase inthe yield per acre of wheat, beans and peas, which are to be achieved by a more intensive use of fertilizer. On the basis of past experience in Lesotho this assumption seems to be extremely optimistic.

## 5. LESOTHO AND R.S.A.:

Lesotho is a part of the South african monetary area. It uses the Rand as its currency, has no central bank and no influence in monetary policy. According to the customs agreement with R.S.A., Botswana and Swaziland, each of the three countries (Botswana, Lesotho and Swaziland) will get its share in the customs revenue according to the following formula: The value of the goods imported to the country plus the value of exisable goods produced and consumed in the country, plus the excise and sales duties paid during the financial year.

The total value arrived at as a percentage of the value of those items for all the customs area and multiplied by 1,42 will give the country's share in the revenue in a financial year.

The other important points of the agreement are:

a) Uniform customs tariff and sales duties in all the participating countries.

b) No quantitive restriction or duties on goods imported from a member country.

c) Provisions for the protection of new industries:

1. through additional duties (for a limited period).

2. by declaring an industry as important to the economy of a member country. In such a case the customs duties on imported competing goods will not be reduced without the country's consent. R.S.A. will also be sympathetic to proposals to increase customs duties on such goods.

d) Free transit in the customs area.

Economically, the importance of Lesotho to the Republic is small. Its G.D.P. is less than ½% of that of the Republic.[1] The only demand from R.S.A. on its resources is for unskilled labour and possibly water.

On the other hand, Lesotho is economically dependent on R.S.A. which purchases its export of labour and goods.

A full economic cooperation with R.S.A. is of great benefit to Lesotho. There is a free flow of most goods across the border and most major agricultural products of Lesotho can be disposed of through the South African marketing boards.

The big South African market makes it possible to diversify Lesotho's agricultural production towards more labour intensive crops (like Vegetables). Until now Lesotho has not taken full advantage of those possibilities.

## 6. CONCLUSIONS:

The main problems in planning the economic growth of Lesotho are:

a) to achieve a growth rate of the economy which will enable a steady increase in the standard of living of a growing population.

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1. LEISTNER, G.M.E., 1966, p. 2.

b) to create employment opportunities for the increased labour force and for a reduction in the dependency on labour opportunities in the Republic.

"Industrialization is the magic word for all underdeveloped countries waging war against poverty and unemployment."[1] However, even if the increase in production of manufacturing industries will be as high as 10% per year their contribution to the G.D.P. in 1975 will be only 5%.[2]

The main possibilities of increasing production and labour opportunities in the next decade is through the development of the agricultural sector. Lesotho has the land, water and man power resources which are required for this as well as the market (R.S.A.) for the increased production. There are indications that lack of capital will not be an effective constraint.

Crop production is the main branch of the agricultural sector. Most of the crop production is concentrated in the lowland of Lesotho and its increase is connected with the agro-economic development of the lowland.

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1. Preparatory paper towards the five year development plan.
2. I b i d .

# CHAPTER - 3.

# THE LOWLAND .

## 1. GENERAL:

The lowland region is located along the Caledon river and along the Orange river.[1] The arable area is 521,5 thousand acres which are cultivated by nearly 90 000 farmers. The average holding is 5,8 acres.[2]

The amount of rainfall as measured in some lowland stations is as following (mm.):

| STATION | AVERAGE | MAX. | MIN. | NO. OF YEARS. |
|---|---|---|---|---|
| Maseru | 637,5 | 1119,4 | 428,5 | 49 |
| Mohales Hoek | 715,8 | 1142,2 | 458,2 | 55 |
| Mafeteng | 755,7 | 1056,4 | 515,1 | 47 |
| Quthing | 791,7 | 1197,6 | 443,0 | 45 |
| Leribe | 845,0 | 1343,2 | 563,1 | 53 |
| Butha Buthe | 818,6 | 1153,2 | 545,1 | 33 |

Source: LFDP, p. 254. 25,4mm = 1 inch.

It can be seen that even in dry years the amount of rainfall is high enough to ensure reasonable yields from dry land crops.[3]

## 2. THE VILLAGE ECONOMY:

Rural Basuto live in permanent villages divided into households. The basic household group consists of a man, his wife and children, and averages 5 persons. Most of the

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1. The Orange River valley is sometimes regarded as a separate region.
2. Based on preliminary results for the agric. census of 1969/7 The arable land in the Oranje River Valley is 74,2 thousan acres and the number of land holders approx. 17 000. The average size of a farm in the lowlands exc. Orange River valley is 6,2 acres.
3. See Sec. 3:8.

households have more than one hut for living, cooking,, storage, etc.. The house yard is generally fenced and used for growing vegetables or maize for consumption as green mealies. Fruit trees (peaches, apricots etc.) are grown in most of the house yards mainly for home consumption.

The primary level of government administration is through hereditary chiefs and headmen. They collect taxes (R3,50 per hea for men aged 18 years or more) issue official certificates (marriage, birth, etc.) and give letters of recommendation.

Land tenure; one of the chiefs' most important rights is to allocate land. Land in Lesotho does not belong to individuals but is held in trust for the nation by the Paramount Chief (now the Ki who delegates the authority to distribute the land to the chiefs.[1]

The chief, with the advise of an elected land Allocation Committee allocates house sites and agricultural land to individuals for a life time use (no payment is involved).

The right to use land is not inheritable. However, in the case of death, it is generally reallocated to the next of kin or another person within the close family, making inheritance exist de facto. The right to fence the land is limited to the house site Naturally the farmers feel more security of tenure as regards this piece of land and concentrate their investment in land there (fruit trees, organic manure etc.). The other fields are not to be fenced. The chief also controls land resources which are reserve for communal use: grazing lands, wood lots etc. He sets a schedule for use of grazing land, allocates trees for cutting in

1. ASHTON, H. 1967, p. 144.

the communal wood lots etc.

Formerly, when there was plenty of land every one was allowed to have as much as he needed.[1] Later, as population pressure on land increased each qualified adult was entitled to 3 fields: one for wheat, one for maize and one for sorghum.[2] However, at present many Basutos have less than 3 fields and some have no field at all.[3] The land holder may not be deprived of his land without good reason - such as the possesion of surplus lands, failure to cultivate his land for two successive years, etc..[4]

Ashton regarded the rights of tenure in Lesotho as giving satisfactory and secure title and as "admirably designed to meet the needs of the community."[5] However, the increasing pressure on land which has led to the rise of a landless class, has also increased the feeling of insecurity of tenure among those with arable land rights.[6] The Land (Procedure) Act 1967[7] was legislated for the purpose of increasing the security of tenure.

Crop production: crop production is mostly for subsistence purposes. The main source of cash income is work outside the farm (mines, etc.) and the sale of livestock.

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1. I b i d , p. 145.
2. I b i d , p. 146.
3. In the 1960 Agricultural Census 10% of the rural households the lowland did not have land and the average number of fields per household having fields was 2,4. The average si of a field was 3,0 acres.
4. I b i d , p. 147. 5. I b i d .
6. MOROJELE, 1963, Part 3, p. 34.
7. See Appendix C.

Animal husbandry: many of the lowland farmers own livestock, mainly cattle, sheep and goats. Some also own pigs, horses and donkeys or mules. The stock holdings are small and feeding is a problem. Because of the lack of grazing in the lowland, stock holders are supposed to send their stock to cattle posts in the mountains at the end of the ploughing season in December. However, this is too much trouble for small stock holders and is also risky (theft, etc.). As a result, many owners keep their stock locally all the year round herded by small boys. They graze on crop residuals, weeds, etc. and are a constant bother in fields under crops. As a result of the insufficient grazing area, lowland cattle are thin and fetch low prices.

Labour migration: most of the men in the lowland must have worked in the mines at one time or another. The timing of the migration to the mines is well coordinated with the field work. During the period January to May (after the planting of maize and sorghum and the harvesting of wheat) and in September, after the harvesting of maize and sorghum, most of N.R.C. recruits are from the lowland.[1] Not every man can work in the mines. Recruits must pass medical examinations and there is a minimum age limit of 18 years.[2] The minimum starting wage is R0,40 per shift and an increase of 3c per shift is granted every 3 months.

Employment, underemployment: men capable of working in the mines have always had the opportunity of doing so, since the demand for Basuto there has exceeded the supply. Therefore, there is no reason to assume that unemployment exists in this category of workers. All the other categories of the labour

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1. Information from N.R.C. Maseru.

2. Although theoretically there is no upper age limit, in practice according to N.R.C. figures, more than 90% of the miners are below 50 years of age.

force suffer from underemployment.

This is reflected by the low wages existing in the area: The rate for daily work is R0,20 per day (6-7 hrs.) Monthly employees are paid R5,00 - R6,00 per month plus housing and food. When they have their wife living with them, she works as well for no additional payment.

The writer met a youth (17 years) who was paid R2,00 per month plus housing and food. Tractor operators are paid R6,00 - R14,00 plus housing and food.

That the employment situation is not improving but rather deteriorating can be demonstrated by the following example: one of the share-croppers used to hire a maize sheller for shelling the maize. This year he found a cheaper solution - he employs women whose only payment are the cobs of the shelled maize. This example shows that the increase in population pressure may under certain circumstances cause an under employment of the limited capital already invested in agriculture.

3. CROP AREA:

The trends in crop production can be seen from a comparison of the crop area in the last 3 agricultural censuses (in thousands acres).[1)]

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1. Source: 1949/50 - AGRICULTURAL SURVEY;
1960/61 - AGRICULTURAL CENSUS 1969/70 - Preliminary results from the agricultural census.

| | 1949/50 | | 1960/61 | | 1969/70 | |
|---|---|---|---|---|---|---|
| | Acres | % | Acres | % | Acres | % |
| Maize | 314,4 | 65,2 | 255,4 | 57,0 | 185,6 | 36,9 |
| Sorghum | 106,8 | 22,2 | 115,8 | 25,9 | 126,5 | 25,1 |
| Wheat | 50,9 | 10,6 | 51,3 | 11,5 | 153,7 | 30,5 |
| Beans | 4,9 | 1,0 | 10,4 | 2,3 | 27,4 | 5,4 |
| Peas | 3,4 | 0,7 | 12,1 | 2,7 | 9,6 | 1,9 |
| Other crops | 1,3 | 0,3 | 2,8 | 0,6 | 0,8 | 0,2 |
| Total crop area | 481,7 | 100,0 | 447,8 | 100,0 | 503,6 | 100,0 |

By classifying the crops as "subsistence" crops (maize and sorghum) and "cash" crops (wheat, beans and peas) the dominant trend becomes even clearer:

| | SUBSISTENCE | | CASH | | TOTAL |
|---|---|---|---|---|---|
| | 000 Acres | Index | 000 Acres | Index | 000 Acres |
| 1949/50 | 421 | 100 | 59 | 100 | 480 |
| 1960/61 | 371 | 88 | 74 | 125 | 445 |
| 1969/70 | 312 | 74 | 191 | 324 | 503 |

There has been a consistent decline in the last two decades in the area of subsistence crops and a considerable increase in the area under cash crops. Of the subsistence crops, the decline is in maize, while there has been a slight increase in the sorghum area.

The increase in cash crops is mainly in wheat (area tripled since 1960) and beans (area doubled since 1960) while the peas area has been reduced.

The main reason for the increase in the area of wheat and beans and the reduction in the area of maize may be due to the fact that the former crops are more profitable[1] on the

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1. See Sec. 3:6.

average and have a ready market. Basuto farmers may have become more commercially minded and may have started realizing the benefit of selecting the crops which are to be grown according to the principle of profit maximization rather than producing directly for subsistence.

Some of the decrease in the maize area and the increase in the sorghum area may be due to the drought conditions in the preceeding years. Sorghum is known to be drought resistant and the farmers may therefore have increased its area.

Another explanation of the fact that the sorghum area has not decreased may be its use in the production of the local beer (joala). Special varieties are used for this and they are not readily available from the Republic.

4. YIELDS:

The yield as recorded in the lowland in the last 3 agricultural censes was as follows (in bags of 200 lbs.)[1)]

| CROP | 1949/50 | 1960/61 | 1969/70 |
|---|---|---|---|
| Maize | 4,9 | 2,9 | 2,3 |
| Sorghum | 3,8 | 3,3 | 2,8 |
| Wheat | 2,2 | 3,1 | 2,5 |
| Beans | 1,6 | 1,0 | 0,9 |
| Peas | 2,4 | 3,1 | 1,8 |
| Average Rainfall (inches) | 24,07 | 33,06 | 21,92 |

These yield estimates are based on crop sampling and should therefore be regarded as biased upwards.[2)]

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1. Based on agricultural census of 1949/50, 1960/1, 1970/69.
2. See explanation in 1960 Agricultural Census, Part 4, p.67.

The yield estimates from the 1949/50 agricultural census were particularly biased upwards.[1] However, even the 1960/61 yields were regarded as overestimates by the Department of Agriculture. It estimated the average yield of the major crops as being 2,5 bags (200lbs) per acre in 1965.[2] The Dept. of Agriculture was sure that "if land is prepared at the right time, seeds sown promptly and a reasonable standard of weed control practised, the addition of 200 lbs. per acre of super - phosphate at planting time, will double the yield".[3]

## 5. CULTIVATION PRACTICES:

The main method of cultivation is by using oxen. However, the number of tractors is increasing[4] and mechanical cultivation is taking over rapidly.

In a survey which was done in a certain area in the lowland, the results as regards transformation from animal to mechanical cultivation in recent years, were as following:

| YEAR | 1968 | 1969 | 1970 | 1971. |
|---|---|---|---|---|
| Fields ploughed by animal % | 33 | 34 | 26 | 20 |
| Fields ploughed by tractor % | 67 | 66 | 74 | 80 |
| TOTAL | 100 | 100 | 100 | 100 |

However the area in which this survey was conducted is regarded as one of the more market oriented parts of the lowland and this transformation may be much slower in other parts.

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1. 1960 AGRICULTURAL CENSUS, Part 4, p. 75.
2. THE DEVELOPMENT OF THE BASUTOLAND ECONOMY, p. 16.
3. I b i d .
4. The number of tractors Increased from 1968 to 1969 by approx. 20%.

The main advantage of mechanical cultivation as against animal cultivation is in the ploughing of the land and particularly ploughing for summer crops.

During the dry winter the soil is so hard and dry that animal ploughing has to wait for the rain before it can start. Even then, towards the end of the winter, grazing sources are so scarce that oxen are generally too weak and incapable of ploughing deeply enough.

However, other operations such as harrowing, planting of summer crops, inter-row cultivation and transportation can be done effectively by oxen. Many people keep cattle as a status symbol, for bohadi[1)] etc. and would continue keeping them even if the cultivation function ceased to exist. Therefore from the cultivation cost point of view, the cost of maintaining the oxen should be regarded in such cases as a fixed cost and the opportunity cost of using them for cultivation will be low. The same can be said about animal drawn implements which have a low sale value.

For these reasons, animal operations are much cheaper than the equivalent tractor operations and when the quality is regarded as similar they are preferred by the farmers. The combination tractor for ploughing, animal for the rest is therefore popular among farmers.

This can be seen from the following results obtained in a survey:

CULTIVATION OPERATIONS IN 1971 (%):

| | |
|---|---|
| Tractor only | 27 |
| Animal only | 20 |

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1. Bohadi - payment in livestock for a bride.

| | |
|---|---|
| Combination tractor + animal | 53 |
| TOTAL | 100 |

Use of Fertilizer: in the LFDP the present annual use of fertilizer was estimated to be 100 000 pockets (of 100 lbs.)[1)]

The recommended amount of fertilizer is 2 pockets per acre or 1 700 000 pockets for all the cultivated land.

The amount used is therefore approx. 6% of the recommended amount.

Harvesting: harvesting is done by hand in most cases. Given the high rate of unemployment the mechanization of harvesting would not be economically justified. The only exception is in the case of wheat. Firstly, its harvesting takes place in the rainy season and a delay may cause the sprouting of the wheat grains. Secondly, by mechanizing the harvesting, the harvesting is finished quickly and it may be possible to plant beans after an early planted wheat and by doing so increase production and net income per acre.[2)]

## 6. THE ECONOMICS OF DRY LAND CROPS:

Table 3:1 presents an estimate of the input per acre (excl. labour) the estimated output and the net return (for land labour and management) per acre.

TABLE 3.1 - INPUT, OUTPUT AND NET RETURN PER ACRE (in R):

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1. LFDP, p. 60.
2. Such a possibility was not included in the village model since its feasibility has not been proved.

| I T E M | MAIZE | SORGHUM | WHEAT | BEANS | PEAS |
|---|---|---|---|---|---|
| INPUT | | | | | |
| Seed | 0,60 | 0,30 | 2,50 | 2,40 | 2,40 |
| Insecticide | 0,50 | 0,50 | 0,10 | 0,10 | 0,10 |
| Ploughing | 1,50 | 1,50 | 1,50 | 1,50 | 1,50 |
| Harrowing | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 |
| Planting | 1,00 | 1,00 | -[1] | 1,00 | 1,00 |
| Inter row cultivation | 0,50 | 0,50 | - | - | - |
| Total input (excl. Labour) | 4,35 | 4,05 | 4,35 | 5,25 | 5,25 |
| OUTPUT | | | | | |
| (gross return) | 8,75 | 9,45 | 12,50 | 16,50 | 13,50 |
| Net return[2] | 4,40 | 5,40 | 8,15 | 11,25 | 8,25 |
| Yield (bags of 200lbs) | 2,5 | 2,7 | 2,5 | 1,5 | 1,5 |
| Price per bag (R)[3] | 3,50 | 3,50 | 5,00 | 11,00 | 9,00 |

The calculations presented in the table represent the input level used by the average farmer. Cultivation is assumed to be done by animal and no fertilizer is assumed to be used. The output level represents the expected output in an average year.

The net return will depend on the gross income and on the cost of production. Because the cost of production depends only to a small extent on the yield it is not expected to vary very much from year to year. The yield depends very much on the amount of rainfall. Therefore great variations between years may be expected in the average gross and net return.[4]

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1. Planting by hand broadcasting.
2. For land labour and management.
3. Farm gate price.
4. However in a good year prices are generally lower and in a bad year higher than the average. Therefore the variations in the value of the output will not be as great as the variati in the yields.

From the calculations beans and peas seem to be the most profitable crops followed by wheat and sorghum. Maize seems to be the least profitable one. This may be the main explanation for the decrease in the maize area and the increase in the area of wheat and beans. As for peas, this is a more risky crop than wheat.[1] This explains why its area hasn't been extended as was the case with the other cash crops.

The calculations may have been biased in the case of the subsistence crops (maize and sorghum) because of the use of the farm gate selling price for estimating the value of the output When a farmer grows a crop for home consumption the relevant price for him is the farm gate buying price.[2]

Assuming that the buying price is 20% higher than the selling price, the net return per acre of maize will be R6,15 and per acre of sorghum R7,30. This reduces the difference in profitability betweenthese crops and wheat.

Taking the distribution of the arable land as it was found in the agricultural census 1970 and the net return per acre as calculated in table 3:1, the present average net return per acre is estimated at R6,20.

7. CULTIVATION SERVICES:

Given the small size of the farms[3] it is uneconomical for most farmers to own their cultivation means, therefore they have to hire them.

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1. Which is grown in the same season.
2. This is relevant only for the quantity which is required for home consumption.
3. The average size is 5,8 acres.

The main source of cultivation services are private contractors giving the service in return for payment which is done in two main ways:

a) Payment per operation (e.g. ploughing, planting etc.) The payment may be done in cash or in kind.

b) Share cropping[1]. The share cropper does the cultivation by using his own equipment or by hiring it. He generally supplies the seed and fertilizer (if fertilizer is used). In return for this he gets a certain share of the yield. Thus the share cropper gives the farmer credit (in kind) undertakes most of the risk, and in many cases does most of the management. In the agricultural census of 1960 more than 18% of the land holders reported share cropping.[2] The share cropping arrangement seems to be suitable to the Lesotho conditions and unlike in other countries, is a positive phenomenon.

Mechanised cultivation: There were 497 registered tractors in Lesotho at the end of 1969. Most of the tractors are privately owned. In a survey of tractor owners it was found that many of the tractors were old (average age 5,5 years) and about 50% were bought second hand. The government operates a tractor hire service LEMA which included 18 tractors at the end of 1970.

12 Tractors are operated by LECUSA units.[3] There are a few cooperative societies which own tractors.

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1. See a more detailed discussion in sec. 9:3 c.
2. 1960 Agricultural Census part 5, table 17. Since a land holder may have share cropped on more than one field, the percentage of arable land share cropped may be higher.
3. See Sec. 9:3 a.

## 8. AGRICULTURAL CREDIT AND MARKETING:[1]

### A) CREDIT:

The variations in rainfall and therefore in the farmers' net return from farming make the extension of credit to individuals an extremely risky undertaking. Therefore there is in fact no source of agricultural credit for individual small farmers.

Commercial banks do not give credit to individual farmers because they cannot present proper securities. The Agricultural Development Fund (A.D.F.)[2] which has had bad experience with loans to individual farmers, gives preference to farmers' societies. Besides its funds are limited and are sufficient for giving credit to about 5 000 acres of crops in one year (out of 850 000 acres of crops). The credit unions[3] do not play a significant role in extending agricultural credit.[4] The Farmers' Marketing Cooperative Union of Lesotho (FMCUL) which deals with agricultural supplies gives some credit to Cooperative Societies which have saving accounts with FMCUL but this amounts to a relatively small sum.

The main source of agricultural credit is credit in kind extended to farmers by the share croppers. The share cropper gives the farmer services and materials for which he is paid a few months later, in kind. While credit institutions find it difficult toget their money back (A.D.F. repayment percentage is 71%) the sharecoppers

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1. The information presented here is not specific to the lowland but represents the situation in Lesotho.
2. See more details on A.D.F. in sec. 9:4 a.
3. See more details in sec. 9.
4. AGRICULTURAL CREDIT – REPORT TO THE GOVERNMENT OF LESOTHO, p. 2.

do not have such difficulties since they have close contacts with the farmers.

B) MARKETING:

Most of the marketing of grains and pulses is in the hands of private traders.

Maize - Lesotho is a net importer of maize. The annual import averages 300 000 bags of 200 lbs.[1)]

Wheat - Lesotho is a net importer of wheat (about 7 000 tons annually). Due to the subsidy system in the Republic it is more profitable for Lesotho to sell wheat to the Republic and import processed products rather than to process its own wheat.

From the individual farmer's view point, the most remunerative way to sell wheat is by selling it to an agent of the R.S.A.'s Wheat Control Board.

Beans and Peas - a great part of the pulses is exported by the traders to the Republic. While the demand for pulses in the Republic is growing it is not unlimited and a great increase in the quantity produced may create surpluses and a reduction of the producers' return.[2)]

9. IMPROVEMENT OF PRESENT DRY LAND CROPS:

Judging by the lowland rainfall data, the annual amount of rainfall is seldom below 400mm. (16 inches) and the average rainfall about 710mm. (28 inches). Experience in maize production in the Highveld region in the Republic[3)]

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1. MARKET PROSPECT FOR AGRICULTURAL PRODUCTS, p. 2.
2. I b i d , pp. 9-10.
3. Soil, Rainfall and Maize Yields in the Highveld Region - Farming in R.S.A.

indicates that with good crop husbandry the yield potential of maize grown on sandy-loam soils should be 21 bags/acre in an average year and 7 bags/acre in a very dry year (16 inches).

The potential yield of maize grown on clay soils is accordingly 11 bags/acre in an average year and 4 bags/acre in a very dry year.[1] In 1965 the Dept. of Agriculture was already convinced that with good crop husbandry and normal rains, yields could be double (i.e. from 2,5 to 5,0 bags/acre).[2]

The information presented above reinforces this conclusion.[3]

The main improvements required in crop husbandry are:

a) Conservation farming - cultivation methods ensuring maximum water conservation.

b) Good seed

c) Use of fertilizer

d) Weed control

e) Proper timing

The Food and Agricultural Organization of the U.N. has started a pilot project in the lowland which aims at finding the best ways of increasing production in this region. The project has introduced new cultivation methods such as the use of chisel plough instead of the present mould board ploughing, the use of drills with press wheels etc. and the results have been promising.

However, the main reason for the low yields in the past was

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1. Bags of 200 lbs. The utilization of the potential was assumed to be 80%. Soil depth is assumed to be 42 inches or more for sandy-loam soils, 22,5 inches or more for clay soils.

2. The Development of the Basutoland Economy, pp. 16-17.

3. It is assumed here that a ratio between potential yields and existing yields similar to the one found for maize exist also in the case of the other crops.

not the lack of knowledge as regards how the yields could be increased. The main difficulty was in finding a way of making farmers accept the new methods. This difficulty still exists but the indications are that farmers have become more profit motivated[1] and this makes the chances of success better than they were in the past.

10. IRRIGATION:

Most of the irrigable land is in the lowland region. The area which is already known to be suitable (mostly alluvial soils) is nearly 16 thousand acres. This is a sufficient area for starting to tackle the problem of irrigation in a country in which the irrigated area has been less than one hundred acres[2] until now.[3]

However, the economic suitability of land for irrigation depends very much on the crops which are to be grown and the increase in income which can be expected. Higher investment in establishing irrigation will be justified for high income crops rather than for crops like wheat or maize.

The following average yields have been obtained on irrigated plots in Lesotho (in 200 lbs. bags per acre).[4]

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1. See Sec. 3:3.
2. Excluding experimental farms.
3. As a comparison, in the Republic there are at present more than 48 300 acres (23 000 morgen) under irrigation in the Bantu areas. This is 37% of the irrigable land in those areas ( AGREKON VOL. 9. NO. 1, p. 36.)
4. See Sec. 9:5.

| | MASERU EXPERIMENTAL FARM | THABA PHATSOA[1] |
|---|---|---|
| Maize | 60 Bags | 30 Bags |
| Wheat | 16 " | 15 " |
| Peas | 10 " | 10 " |
| Beans | 13 " | 11 " |
| Potato | 600 pockets (15 kgs) | 370 pockets |

11. DIVERSIFICATION OF CROP PRODUCTION:

The introduction of new crops to the lowland is essential for 3 main reasons:

a) The intensification of agricultural production through the introduction of labour intensive crops is one of the main ways to reduce existing underemployment and to absorb the increase in the labour force.

b) It may reduce the seasonal underemployment.

c) The improvement of dry land crop production and the introduction of irrigation, if based on the present crops may create surpluses.

A report submitted to the government of Lesotho in 1969 by the chief of the Horticultural Research Institute in Pretoria[2] dismissed as unfeasible the possibility of establishing a deciduous fruit industry in Lesotho. The main reasons given were the marginal climatic conditions and the over-supplied market in R.S.A. and elsewhere.[3]

However, this does not rule out the growing of fruit trees for local consumption. In fact many of the rural house yards have fruit trees which are grown mainly for home consumption.

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1. See Sec. 9:5.
2. E. STRYDOM - Report on the Investigation into the Potentialities of Fruit and Vegetables Production in Lesotho.
3. I b i d , p. 16.

In the same report the expert stated that "no technical reasons could be found why commercial vegetable production on irrigable land should not be a successful venture."[1] He also suggested that after the establishment of a commercial vegetable industry, consideration should be given to the establishment of a processing plant for canning and quick freezing.

12. CONCLUSIONS:

There are 3 main ways for increasing agricultural production in the lowland:

a) Improvement of dry land crop production.

b) Introduction of irrigation based on the present dry land crops.

c) Irrigation based on labour intensive crop like vegetables.

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1. I b i d , p. 12.

# CHAPTER - 4.

# THE VILLAGE MODEL.

## 1. INTRODUCTION:

The information presented in the former chapters, and the results of recent surveys[1] which were conducted in the lowland were used for the formulation of a representative "village model". This model is similar to many of the villages in the lowland.

The three main alternative ways for agro-economic development (see Sec. 3:11) were tested in this model by planning it with the objective of maximizing its net income. The results were then analysed, compared and conclusions drawn.

The justification for this approach lies in the great similarity between the various parts of the lowland as regards present crop pattern, land tenure, climate, elevation, importance of migrant labour, nearness to the Republic, etc.. This similarity makes the conclusions arrived at, as a result of planning the "village model", applicable to a great part of the lowland region. (see conclusions in Chapter 8.)

## 2. LABOUR RESOURCES:

The village model was assumed to consist of 100 farm households[2] averaging 5 persons per household. The annual number of potential working days per household was calculated

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1969/

1. AGRICULTURAL CENSUS 1970, FAO Surveys.
2. The size of the village model was selected with consideration to the size of a average village in the lowland.

to be 580 days[1] of which only 400 days, assumed as available for crop production and for work in the mines, were included in the planning of the model.

There is at present a limited amount of employment outside the farm (other than in agriculture) in government, various trades, factories, transportation, etc.. This kind of employment was assumed to continue at the same rate in the future. The number of days involved was deducted from the days available for planning the model.

The same was done to days involved in livestock production for reasons explained in Sec. 4:5.

Finally, allowance was made for the extremely high number of days involved in obtaining water supply from springs, collecting fuel material and cooking.[2]

Since the number of farm households was assumed to be 100, the total number of days available for planning is 40 000. The labour available was assumed to be spread evenly through the 4, three month periods:

| | | |
|---|---|---|
| January - March | 10 000 | days |
| April - June | 10 000 | " |
| July - September | 10 000 | " |
| October - December | 10 000 | " |

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1. Based on preliminary results form a survey. In LFDP the labour force of a population of 1 038 000 was estimated at 430 000 persons or 0,44 per population head. Assuming 280 working days per person and an average household size of 5 persons a similar number of potential working days per household is obtained.

2. WALLMAN, S. Op Cit. pp. 46-47.

Two questions may arise:

a) What about the expected increase in labour power due to natural increase of the population?

b) Why was the work in the mines not excluded from the planning the way it was done with employment outside the farm, livestock, etc.?

As regards (a) it is explained is Sec. 7:2 that labour is hardly an effective constraint. The conclusions which follow are given in the same section and in sec. 8:3.

As regards (b) there is a clear distinction between employment outside agriculture in Lesotho and work in the mines in the Republic.

While an increase of work opportunities outside the agricultural sector such as in industry, trade, etc. can be regarded as a positive development, increase in the work in the mines is not so (in the long run).

Besides the fact that it puts the employment and earning pattern of the country in a vulnerable position, it also has a bad social effect (see Sec. 2:4 d.). Therefore, while work in the mines plays an important economic role at present, a reduction in its importance through an increase in local labour opportunities should be regarded as a positive development.

Putting it in direct "competition" with crops was aimed at finding out under which conditions the development of crop production may cause a reduction in the supply of labour to the mines.

It was assumed that if work opportunities in agriculture, assuring a net income per day equal or greater than the net income from work in the mines existed, most Basuto would prefer

agricultural work in Lesotho. This assumption is based on discussions with Basuto farmers.

The minimum net income per day required from any enterprise was assumed to be 20c. This price may be regarded as representing the opportunity cost of leisure rather than the possibility of alternative employment (see information about wages in Sec. 3:2.).

3. LAND RESOURCES:

The average area of a farm household was assumed to be 6 acres[1)] or 600 acres for the village model. $^1/_3$ of this area (200 acres) was assumed to be suitable for irrigation.

This proportion which is equal to the proportion of arable soils in Lesotho which are considered as physically suitable for irrigation[2)] is somewhat higher than the proportion of the arable area which is regarded as economically suitable for irrigation in the lowland.

However, the present estimate of economically irrigatable land is biased downwards. Firstly it is based on the assumption that the irrigated crops will be mostly the present dryland crops, for which only limited investment in irrigation facilities may be economically justified.

Secondly, it rules out the possibilities of irrigating the claypan soils which form about 55% of the arable land.

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1. Based on results of the Agricultural Census of 1969/70.
2. LFDP, p. 69.

However, the experience of the Chinese mission in growing irrigated vegetables on such soils shows that such a conclusion may be premature.

4. THE ENTERPRISES EXAMINED IN THE MODEL:

The crops included are either crops which have been grown in Lesotho on a wide scale or crops of which there is a good reason to assume that they could be grown there on a sizable area. Minor crops were disregarded here since their inclusion would have prevented the model from having a wide application.[1)]

The sources of information were as following:

Dry land Crops - results from Agricultural censuses 1960, 1969/70, Reports from the experimental station in Maseru, information from Ministry of Agriculture experts, calculations from the Republic[2)]

Irrigated dry-land crops - in addition to the sources mentioned for dry land crops - preliminary results from the irrigation schemes at Thaba-Patsoa and Leshoeles.

Vegetables - mainly information from Ministry of Agriculture experts and the Chinese mission in Maseru.

Dairy - discussion with experts from the Ministry of Agriculture, preliminary calculations made recently[3)] and literature[4)].

Work in the mines - information received from N.R.C.[5)] officials

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1. Sorghum was excluded because its coefficients are similar to those of Maize. Maize represents also sorghum in the model.
2. Calculation obtained from the Dept. of Agricultural Economics Pretoria.
3. Irrigated Dairying in Lesotho Lowlands (Mimeographed)
4. MORRISON, F.B., FEEDS AND FEEDING ABRIDGED, 9th Edition.
5. Mine Labour Organisation.

in Maseru and Leribe. Work in the mines was limited to 20 000 days. This was based on an assumption about the age distribution of the village populations and that this work was limited defacto to males of the age group 18-45 years.

A great deal of personal judgement was used mainly in estimating the yields and labour requirement. The price estimates for the various crops were based mainly on projections made in a recent study.[1)]

Table 4:1 summarizes the important coefficients of the crops included as they are expected to be with the improved farming practices.

TABLE 4:1. - GROSS MARGIN, LABOUR REQUIREMENT YIELDS AND PRICES FOR THE CROPS INCLUDED IN THE VILLAGE MODEL.[2]

| C R O P | OUTPUT[3)] R | INPUT R | GROSS MARGIN R | YIELD | PRICE R | LABOUR REQUIREMENT DAY |
|---|---|---|---|---|---|---|
| DRY LAND: | | | | | | |
| Wheat | 35,60 | 24,50 | 11,10 | 6 Bags | 5,70Bag | 2 |
| Maize | 38,30 | 25,90 | 12,40 | 9 " | 3,50 " | 16 |
| Beans | 38,40 | 21,10 | 17,30 | 3,5 " | 10,50 " | 20 |
| Peas | 36,60 | 21,10 | 15,50 | 3,5 " | 10,00 " | 14 |
| Potato | 130,00 | 95,30 | 34,70 | 200Pocket | 0,65Pocket | 39 |
| IRRIGATION: | | | | | | |
| Wheat | 95,75 | 52,15 | 43,60 | 15 Bags | 6,15Bag | 5 |
| Maize | 106,50 | 48,70 | 57,80 | 25 " | 3,50 " | 21 |
| Beans | 110,00 | 30,90 | 79,10 | 10 " | 10,50 " | 28 |
| Peas | 115,50 | 30,40 | 85,10 | 11 " | 10,00 " | 22 |
| Potato | 325,00 | 177,00 | 148,00 | 500Pocket | 0,65 " | 49 |
| Cabbage | 180,00 | 123,20 | 56,80 | 6 Ton | 30,00Ton | 52 |
| Onion | 245,00 | 81,90 | 163,10 | 7 " | 35,00 " | 47 |
| Carrot | 210,00 | 67,30 | 142,70 | 7 " | 30,00 " | 63 |
| Tomato | 560,00 | 287,30 | 272,70 | 8 " | 70,00 " | 100 |

1. Market \prospects for Agricultural Products (Mimeographed)
2. Output, Input, Gross margin, Yield and Labour requirement are per acre.
3. Output includes crop residues (straw, stover)

## 5. IMPROVEMENT OF LIVESTOCK PRODUCTION:

The problem of improving livestock production was excluded from the model.

A very small part of the lowland is considered as grazing land. Having the alternative of crop production, the opportunity cost per unit of feed grown on area suitable for crop production can be expected to be very high. Therefore it will be economically justified to limit livestock production in the lowland to the more intensive forms such as dairy. Feeding cattle may then be based on concentrates, crop residues, hay and if irrigation is established, irrigated fodder.

However, experience in intensive dairy production in Lesotho is very limited and any calculation made, involves strong assumptions as regards the nature of the expected production functions. Preliminary calculations done recently point out that intensive milk production may not be profitable.[1)] There is also the problem of the producers' (farmers) attitude. Most producers seem to prefer quantity of cattle to quality and changing their attitude may be a slow process, mainly when the reward is low.

Because of this uncertainty as regards livestock production, and since the problem of agro-economic development through crop production could be examined independently of livestock production, the latter was excluded from the model.

However, the activities examined in the 3rd stage (see Chapter 7) included a dairy activity. This was done in order

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1. Irrigated Dairying in Lesotho Lowland.

to get a "hint" about the competitiveness of dairy with regards to the other crops which were included in the model.

6. OTHER ASSUMPTIONS:

A) CREDIT:

no credit constraints were assumed.

B) MARKETING:

the market for the various products was assumed to be South-Africa (see discussion in Sec. 3:7). Wherever it was suspected that a crop (enterprise) may come into the optimal plan at a level in which the product may have marketing difficulties, a maximum area constraint was imposed on it.

C) PROFIT MAXIMIZATION:

in selecting profit maximization as the objective function (see explanation in Sec. 4:9) we assume in fact that this is indeed the producers' main production motive. In other words, the assumption is that their behaviour is economically rational. This assumption which is based on the writer's contacts with Basuto farmers, is widely recognized by development economists. Mellor, states that "Empirical evidence largely confirms the hypothesis that peasant farmers do act in an economically rational manner..... Much of the contrary evidence appears to rise from misconceptions about the objectives of peasant farmers and about the environment within which their decisions are made."[1)]

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1. MELLOR, J.W., TOWARDS A THEORY OF AGRICULTURAL DEVELOPMENT IN AGRICULTURAL DEVELOPMENT AND ECONOMIC GROUTH, p. 37.

Schultz, argues that farmers in poor countries allocate their factors of production in an efficient way. They have generally used all the profitable opportunities to invest in the agricultural factors at their disposal.[1)]

7. PRESENT INCOME AND EMPLOYMENT:

The assessment of the present situation as regards income and employment in the village model, is limited to crop production and work in the mines and based on the following assumptions:

a) The crop area is as following:[2)]

| | |
|---|---|
| Maize (and sorghum) | 340 |
| Wheat | 170 |
| Beans | 30 |
| Peas | 10 |
| Fallow | 50 |
| Total | 600 |

b) The input per acre is assumed to be as in Table 3:1. The value of output and the net income are based on the figures presented in this table plus the value of crop residues - R1,00/acre per wheat, beans or peas and R2,00/acre for maize and sorghum.[3)]

c) The labour input per acre for the various crops, was assumed to be as following (days/acre):

| | | | |
|---|---|---|---|
| Maize | 16 | Beans | 20 |
| Wheat | 10 | Peas | 14. |

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1. SCHULTZ, T.W., 1965, p. 44.
2. Based on the results from the agricultural census 1969/70.
3. The average gross margin for maize and sorghum was assumed to be R6,90/acre (including the value of crop residues)

d) Work in the mines - 20 000 days.

The present income and employment for the village model before development is assumed to be as following (round figures):

| ENTERPRISE | NET INCOME (R) | EMPLOYMENT (DAYS) |
|---|---|---|
| Maize | 2 350 | 4 760 |
| Wheat | 1 550 | 1 700 |
| Beans | 370 | 600 |
| Peas | 90 | 140 |
| Total crops | 4 360 | 7 200 |
| Work in the mines | 14 000 | 20 000 |
| Total | 18 360 | 27 200 |

The income and employment per acre and per farm, are assumed to be as following:

| | | FARM | ACRE |
|---|---|---|---|
| Total income | (R) | 184 | - |
| Total employment | (days) | 272 | - |
| Income from farming | (R) | 44 | 7,30 |
| Employment from farming | (days) | 72 | 12 |

## 8. THE METHODOLEGY OF EXAMINING THE VARIOUS DEVELOPMENT POSSIBILITIES:

Present situation - the assessment of the present situation was based on results from the agricultural census of 1969/70 and various surveys which were held in 1970/1971.

The village model was then planned with the objective of maximizing the gross margin in three stages:

a) Improvement of dry land farming (see Chapter 5)

b) Improvement of dry land farming and irrigation A - the irrigation crops being the samedry land crops (see Chapter 6).

c) Improvement of dry land farming and irrigation B - the irrigated crops being the same as in b) plus selected vegetables and dairy enterprise (see Chapter 7). The results from the various stages were then analysed, compared to the present situation and to each other and conclusions were drawn (see Chapter 8).

## 9. SELECTION OF THE PLANNING METHOD:

The selection of a planning method depends mainly on the complexity of the problem. For complex problems it is desirable to use mathematical models to arrive at the optimal solution. Such models provide an objective solution[1] and enable coping with the most complicated planning problems through the use of electronic computer.

On the other hand the use of the usual trial and error methods (such as budgeting) involve labourious computations and it is difficult to know whether the solution arrived at is indeed the optimal one. It may even depend on the planners' preference.

Linear programming was chosen for planning the "village model" because it is a mathematical method[2] which has

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1. The solution depends on the subjective assumptions about the constraints, input-output coefficients, prices etc.. However, such assumptions are required for any planning method and after making them, the solution can be regarded as an objective one.

2. A discussion of other mathematical models which may have been suitable, is regarded as being outside the scope of this study.

been used intensively for solving similar problems and has proved itself suitable.[1] It also has a written programme for most of the computers.

## 4. LINEAR PROGRAMMING:[2]

Linear programming (LP) is a mathematical model for determining the most desirable course of action for optimum results. It was developed in 1947 by Dantzig as a technique for planning the US Air Force activities. The method developed by him was an iterative procedure called the simplex method which is still the main method used for solving LP problems.

LP has become an important tool of economics, operations research and management science. It has been used in many countries for solving agricultural and industrial problems. In the Republic, LP has been used for planning agricultural production on farms.[3]

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1. "Programme planning" is another objective method for "desk calculations" which may have been suitable for a problem ofthe "village model" size.

2. A comprehensive discussion is regarded as being outside the scope of this study. There are numerous publications dealing with LP. Some of them are:
   DANTZIG, G.B., LINEAR PROGRAMMING AND EXTENSIONS. Princeton Univ. Press. 1963.
   HEADY, E.O. & W. CHANDLER, "LINEAR PROGRAMMING METHODS" Iowa State College Press, Ames 1958.
   GASS, S.I., LINEAR PROGRAMMING, METHODS AND APPLICATIONS. McGraw-Hill, New York, 1958.
   DORFMAN, R., P.A. SAMUELSON AND R.M. SOLOW, LINEAR PROGRAMMING AND ECONOMIC ANALYSIS, McGraw-Hill, New York, 1958.

3. See for example: BURGER J.D. & OTHERS. KORTTERMYN BEPLANNING VAN 'n GEMENDGE BOERDERY IN DIE DISTRIK VAN STELLENBOSCH MET BEHULP VAN LINIêre PROGRAMMERING. Dept. van Landbou-Ekonomie, Universiteit van Stellenbosch, (1968).

Every LP problem has 3 components:

a) A number of alternative production activities (or processes).

b) Constraints on the selection of these activities.

c) An objective (maximize income, minimize cost, etc.)

As an example in the "village model" the objective is maximization of the gross margin, and the alternative production activities are the various crops, work in the mines etc., defined in the matrix by the column vectors. The constraints are the limited quantities available of the fixed production factors (labour, land etc.) rotation constraints and other constraints. The efficiency of LP in comparison to other planning methods, increases with the number of the constraints.

A great advantage of LP is the obtainment as a byproduct of the opportunity prices (shadow prices) of the constraints. This information enables the indentification of bottlenecks in the production process, etc..

Mathematically LP is the finding of a minimum or a maximum to a linear function subject to linear constraints. The objective function can be presented as following:

$$F = \sum_{j=1}^{n} Cj\ Xj \longrightarrow \text{Max. (or min.)}$$

$$j = 1, 2, \ldots . n$$

Where: Cj = income (gross margin) per unit of activity (crop etc.)

Xj = number of units (acres, etc.) of activity j which are included in the optimal plan ($Xj \geq 0$).

The constraints are defined by a set of linear inequalities of the form:

$$bi \geq \sum_{j=1}^{n} aij\ Xj$$

Where: bi = constraint i (i = 1,2,..m)
aij = quantity of constraint i which is required for each unit (acre etc.) of activity (crop, etc.) j.

As an example we can demonstrate the LP formulation of a simplified version of the improvement of dry land farming model (see Chapter 5). With 4 activities and 4 constraints, the gross margin and the other coefficients are assumed to be as in Table 5:1.

| ACTIVITIES | GROSS MARGIN ( R ) | CONSTRAINTS | CONSTRAINT LEVEL |
|---|---|---|---|
| X1 = Wheat | 10,7 | b1 = Land | 600 acres |
| X2 = Maize | 9,2 | b2 = Labour | 40 000 days |
| X3 = Beans | 13,3 | b3 = Max. Beans | 120 acres |
| X4 = Peas | 12,7 | b4 = Max. Peas | 120 acres |

Xj is measured in acres. The gross margin is per acre.

The relations between the activities and the constraints are shown in the following matrix.

| ACTIVITIES | | X1 | X2 | X3 | X4 |
|---|---|---|---|---|---|
| GROSS MARGIN | | 10,7 | 9,2 | 13,3 | 12,7 |
| CONSTRAINTS | | | | | |
| b1 | 600 | 1 | 1 | 1 | 1 |
| b2 | 40 000 | 2 | 16 | 20 | 14 |
| b3 | 120 | | | 1 | |
| b4 | 120 | | | | 1 |

The objective function will be:

$$F = 10,7\ X_1 + 9,2\ X_2 + 13,3\ X_3 + 12,7\ X_4 \longrightarrow \text{Max.}$$

The linear functions describing the relations between the activities and the constraints will be:

$$b_1 = 600 \geq 1X_1 + 1X_2 + 1X_3 + 1X_4$$
$$b_2 = 40\ 000 \geq 2X_1 + 16X_2 + 20X_3 + 14X_4$$
$$b_3 = 120 \geq 0X_1 + 0X_2 + 1X_3 + 0X_4$$
$$b_4 = 120 \geq 0X_1 + 0X_2 + 0X_3 + 1X_4$$

The constraints are the frame in which production can take place, and the problem is how much to produce from each crop. In order to maximize the profit. The LP solution will give the values of $X_1, X_2, X_3, X_4$, which will maximize F, subject to the constraints $b_1, b_2, b_3, b4$, [1)]

The LP model is based on the following main economic assumptions as regards production processes:

a) Constant returns to scale. If one acre of maize requires 16 days, 100 acres of maize will require 1 600 days etc. However, it is possible by proper formulation to also include cases of increasing or decreasing returns to scale.

b) Technological independence between the activities. The selection of one does not necessitate the selection of the other and does not affect its coefficients. Here again it is possible to include cases of technological dependency by a proper formulation of the model.

c) Divisibility and additivity of the activities and the production factors. The optimal solution may include 0,01 acres of wheat or 6,2 cows. However, ...

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1. This simplified model can be easily solved by desk calculations.

in most cases the rounding of the factions will not significantly change the optimal solution.

# CHAPTER - 5.

## IMPROVEMENT OF DRY LAND FARMING.

### 1. INTRODUCTION AND SUMMARY OF RESULTS:

The crops included at this stage were the dry land crops already grown in the area but with improved agrotechnique (fertilizer, seeds, mechanization, etc.) as explained in Chapter 3. Work in the mines was introduced in units of 300 days.[1)]

The activities introduced at this stage and the constraints set are summarized in Table 5:1.

The optimal plan obtained was as follows:

| ENTERPRISE | SOLUTION LEVEL | NET INCOME (=gross margin) (R)[2)] | EMPLOYMENT (DAYS)[2)] |
|---|---|---|---|
| Wheat | 360 acre | 3 996 | 3 720 |
| Beans | 120 " | 1 860 | 2 400 |
| Peas | 120 " | 2 076 | 1 680 |
| Total crops | 600 " | 7 932 | 4 800 |
| Work in mines | 20 000 days | 14 000 | 20 000 |
| Total | | 21 932 | 24 800 |

1. This was done for convenience only and has no effect on the planning results.

2. The net income and the employment per enterprise which was included in the optimal plan is obtained by multiplying the solution level by the gross margin and labour requirement per unit (acre, etc.) as presented in Table 4:1. As an example, the net income from wheat is R11,10 x 360 acres = R 3 996.

The income and employment per acre and per farm were as following:

| | | FARM | ACRE |
|---|---|---|---|
| Total income | (R) | 219 | - |
| Total employment | (days) | 248 | - |
| Income from farming | (R) | 79 | 13,20 |
| Employment from farming | (days) | 48 | 8 |

TABLE 5:1 - DRY LAND FARMING MATRIX.

| ACTIVITIES | | | WORK IN MINES | WHEAT | MAIZE | BEANS | PEAS |
|---|---|---|---|---|---|---|---|
| GROSS MARGIN (R)[1] | | | 150,0[2] | 10,7 | 9,2 | 13,3 | 12,7 |
| CONSTRAINTS: | | | | | | | |
| Land | Acres | 600 | | 1 | 1 | 1 | 1 |
| Labour | days | 40 000 | 300 | 2 | 16 | 20 | 14 |
| Labour-,Jan.-Mar. | " | 10 000 | 75 | | 4 | 14 | |
| " ,Apr.-Jun. | " | 10 000 | 75 | 1 | 5 | 4 | 3 |
| " ,Jul.-Sept. | " | 10 000 | 75 | | | | 2 |
| " ,Oct.-Dec. | " | 10 000 | 75 | 1 | 7 | 2 | 9 |
| Max. work in mine | " | 20 000 | 300 | | | | |
| Max. Beans | Acres | 120 | | | | 1 | |
| Max. Peas | " | 120 | | | | | 1 |

It can be seen from the matrix that the possibility of double cropping was excluded. It is not clear at present whether

1. After the deduction of labour cost at 20c per day consistment with the assumption that minimum net income of 20c per day is required from any enterprise included in the optimal plan (see Sec. 4:2.). However, in calculating the total net income accruing from an enterprise the gross margin before the deduction of any labour costs should be used (see Table 4:1).
2. The net income per day was assumed to be 70c (50c after the deduction of 20c - See Foot note 1.)

it is feasible to plant more than one crop per year without irrigation.

2. SOLUTION ANALYSIS:

An analysis of the effect on the optimal solution (or plan) of changes in input-output coefficients, cost coefficients or constraints is no less important than the optimal solution itself.

Such sensitivity analysis may be important for the following main reasons:[1)]

a) Stability of the optimum solution under changes in the parameters may be critical. A slight variation of a parameter in one direction may result in large unfavourable variations in the optimal solution, while a large variation in it in another direction may result in only a small difference. Sometimes it may be desirable to move away from a "sensitive" optimal solution towards a more "stabilized" one.

b) "Values of the input-output coefficients, objective function coefficients and/or constraint constants may be to some extent controllable, and in this case we want to know the effects which would result from changing these values."[2)]

c) The values of the above mentioned coefficients are sometimes only approximate estimates. It is important to know for which ranges of these values the solution is still optimal.

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1. DANTZIG, 1963, pp. 265 - 267.
2. I b i d .

The (computer's) optimal solution report, may be accompanied (on request) by post-optimal analysis reports which include the sensitivity analysis.
Table 5:2 is based on such repots.

TABLE 5:2 - POST OPTIMAL ANALYSIS:

| VARIABLE | SOLUTION LEVEL | SHADOW PRICES | | RANGE | |
|---|---|---|---|---|---|
| | | INCREASE | DECREASE | UPPER BOUND | LOWER BOUND |
| Maize | 0 acres | - 1,50 | - | 360 | 0 |
| Wheat | 360 " | - 2,00 | - 1,50 | 480 | 0 |
| Beans | 120 " | 2,60 | - 2,60 | 480 | 0 |
| Peas | 120 " | 2,00 | - 2,00 | 480 | 0 |
| Work in mines | 20 000 days | 0,50 | - 0,50 | 33 300 | 0 |
| Land | 600 acres | 10,70 | -10,70 | 3 920 | 240 |

Table 5:2 gives a sensitivity analysis for selected variables. The term variable here denotes an activity (enterprise) or a constraint. The solution level of a variable shows how much of it is used in the optimal solution.

The "shadow price" (or marginal opportunity cost)[1] of a variable shows by how much the optimal plan's profit (or cost when the objective is to minimize the cost) will change if the solution level of the variable will be changed (increased or decreased)[2] by one unit (acre, day etc.). The range gives the bounds within which the shadow price is valid. As an example, the solution level of wheat is 360 acres.

1. Sometimes called the value of marginal product, imputed price.
2. Subject to $X_j \geq o$ (see Sec. 4:9.). The solution level of a variable cannot be negative.

Increasing the wheat area (up to 480 acres) will reduce the plan's profit by R2,00 for each acre of increase. Reducing the wheat area (down to 0 acres) will reduce the plan's profit by R1,50 per acre.

The variables can be divided into 3 groups:

a) Variables at their upper level (UL)-any increase in the solution level will increase the plan's profit. Any decrease in the solution level will decrease the plan's profit.

b) Variables which were not included in the optimal plan(LL). The inclusion of such variables will reduce the plan's profit.

c) Variables at an intermediate level (B). If the variable is an enterprise (crop, etc.) any change in its level will reduce the plan's profit. If the variable is a constraint (max. seasonal labour, etc.) it was not an effective one. Its removal wouldn't have effected the optimal plan.

The shadow price of an activity (enterprise) which was not included in the optimal plan shows also by how much the profit (gross margin) per unit (acre) has to increase if the activity is to be included in the optimal solution. As an example, if the gross margin per acre of maize will be R1,50 (or more) higher than it was assumed to be, the crop will be included inthe optimal plan.

Similarly, the shadow price (decrease) of an activity which was included in the optimal plan shows by how much the profit per unit has to decrease in order to exclude the activity from the optimal plan (or to reduce its solution level to the lower bound).

We are now in a position to analyse the solution obtained.

MAIZE - the crop was not included in the optimal plan. However, its shadow price is R1,50 per acre. This means that had the yield estimate been higher by 0.4 bags (approx. 5%) or alternatively, if the product price would have been higher by 5%[1] or if the cost of production would have been lower by R1,50 per acre the crop would have been included in the plan. The crop area would have been 360 acres and it would have replaced the wheat.

The price estimate per one bag (200 lbs) of maize was the farm gate selling price. However, many farmers grow most if not all the maize for home consumption and store the total harvest ~~of~~ at home. For them, the opportunity price of maize is the buying price. This price fluctuates during the year and is approximately 20% higher than the selling price. At a selling price of R3,50 per bag (see table 4:1) the buying price will be R4,20 per bag and the gross-margin per acre will be higher by R6,30.[2]

As the shadow price of one acre of maize was-R1,50, we can conclude that had the maize enterprise been split into two enterprises - maize for consumption and maize for sale, maize for consumption would have been included in the optimal plan.

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1. The cost per bag was assumed to be R3,50 (see Table 4:1). In order to get an increase of R1,50 per acre the yield has to increase by $\frac{1,50}{3,50} = 0,43$ bags (approx.) which ~~are~~ is an increase of $\frac{0,43}{9} \times 100 = 4,8\%$ in the assumed yield. Alternatively, the gross margin could be increased by an increase in the price per bag of $\frac{1,50}{9} = Ro,17$, etc. It is assumed that the change in production costs as a result of changes in the yield per acre is negligible.

2. Since the yield was assumed to be 9 bags/acre.

The estimated annual consumption of maize and sorghum is 2,5 bags per person.[1] The annual requirement of the whole village (500 persons) would have been 1 250 bags for which about 140 acres are required. The optimal plan would have been modified as following:

| CROP | OPTIMAL PLAN | MODIFIED OPTIMAL PLAN |
|---|---|---|
| Maize (acres) | 0 | 140 |
| Wheat " | 360 | 220 |
| Beans " | 120 | 120 |
| Peas " | 120 | 120 |

WHEAT - The shadow price for wheat is-R1,50 in the case of decrease (down to 0). That means that other things being equal, had the yield estimate or the product price estimate been lower by 4,4%, or the cost of production been higher by R1,50 per acre, the crop would not have been included in the optimal plan (and would have been replaced by maize). On the other hand if the gross margin per acre would have increased by R2,00 because of reduction in production costs, an increase in the yields, a higher product price or any combination of these factors, the crop area in the plan would have increased to 480 acres (replacing peas).

BEANS - the beans area was limited to 25% of the area (rotation constraint) which is 120 acres. The crop entered up to this limit. The shadow price was (±) R2,60 per acre for an increase or a decrease in the area and the analysis can be carried out in a similar way to the analysis of the shadow prices already done for maize and wheat. A reduction of about 7,1% in the yield of beans per acre or in the price of beans would have caused a replacement of the crop (by wheat).

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1. VAN DER MERWE, E.J. : LESOTHO - NATIONAL ACCOUNTS , pp. 63-64

PEAS - a rotation constraint was set at the same level as for beans. The crop entered at a maximum level of 120 acres. Had the price or the yield been lower by about 5,7%, or if production costs per acre would have been higher by more than R2,00 the crop would have been replaced by wheat.

WORK IN THE MINES - was included up to its upper limit of 20 000 days.

LABOUR CONSTRAINT - was not effective. Of the 40 000 days available, only 24 800 days were used of which 20 000 days were work in mines and 4 800 in crop production.

This means that the removal of this constraint would not have affected the optimal plan. At such a stage of under-employment, the main criterion for selecting a crop is its gross margin, per acre.

SEASONAL LABOUR CONSTRAINTS - these constraints were not effective either.

Employment according to season was as following:

| | REQUIRED | AVAILABLE | UNDER EMPLOYED |
|---|---|---|---|
| January - March | 6 680 | 10 000 | 3 320 |
| April - June | 6 200 | 10 000 | 3 800 |
| July - Septembeer | 5 240 | 10 000 | 4 760 |
| October - December | 6 680 | 10 000 | 3 320 |
| TOTAL | 24 800 | 40 000 | 15 200 |

/

It can be seen that with a combination of crops similar to the one in this plan the highest underemployment is in the period July - September.[1] Crops having a great deal of their labour requirement in this period will have the advantage of a low opportunity cost of labour.

3. CONCLUSIONS:

It can be seen from the solution analysis that the difference in profitability between the various crops and mainly between wheat and maize is not sighificant. As the information on which the calculations were based may have been subjected to a relatively high margin of error it would be unreasonable at present to recommend any specific combination of these crops,[2] for the improved dry land farming methods. There are additional producers' considerations which could not be incorporated in this model but may affect the decision as regards crop combination:

WHEAT - The crop requires a minimum number of days, management is easy, there are ensured markets and prices and the risk of failure is small.

MAIZE - The labour requirement for maize is much highter than for wheat (see Table 4:1.). While labour costs were calculated at 20c per day, the actual opportunity cost of labour may

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1. From observations in the lowland area this is indeed the period with the least demand for labour.
2. However, it was shown in Sec. 3:3 that there has been a change in the recent years. The area under wheat and beans has increased in recent years while the maize area has decreased.

be either higher or lower than this. This may change the relative profitablility of the crops (these considerations are relevant also to beans and peas).

BEANS - This is a relatively short term crop which may, in years with good rainfall, be planted after early harvested winter wheat.

PEAS - The crop is more sensitive than the others and the risk involved is higher.

# CHAPTER - 6.

## DRY LAND CROPS AND IRRIGATION - A.

### 1. INTRODUCTION AND SUMMARY OF RESULTS:

The land area in this stage was assumed to be divided into 400 acres of dry land and 200 acres with irrigation facilities (see Sec. 4:3.).

The dry land crops included were the same crops which were included in the former stage (Chapter 5.). The irrigated crops were the dry land crops under irrigation.

The enterprises included and the constraints imposed are summarized in Table 5:2.

The optimal plan was:

| ENTERPRISE | SOLUTION LEVEL | NET INCOME (= gross margin - R) | EMPLOYMENT (DAYS) |
|---|---|---|---|
| Dry land crops | | | |
| Wheat | 240 acres | 2 664 | 480 |
| Beans | 80 " | 1 240 | 1 600 |
| Peas | 80 " | 1 384 | 1 120 |
| TOTAL | 400 acres | 5 288 | 3 200 |
| IRRIGATED CROPS: | | | |
| Maize | 160 acres | 9 248 | 3 360 |
| Beans | 40 " | 3 164 | 1 120 |
| Peas (after beans) | 40 " | 3 404 | 880 |
| TOTAL | 240 acres | 15 816 | 5 360 |
| Total crops | 640 | 21 104 | 8 560 |
| Work in Mines | 20000 days | 14 000 | 20 000 |
| TOTAL | | 35 104 | 28 560 |

TABLE 6:1 - DRY LAND CROPS AND IRRIGATION A MATRIX:

| ENTERPRISE | WORK IN MINES | WHEAT | MAIZE | BEANS | PEAS | IRR. WHEAT | IRR. MAIZE | IRR. BEANS | IR PE |
|---|---|---|---|---|---|---|---|---|---|
| Gross margin(R) | 150,0 | 10,7 | 9,2 | 13,3 | 12,7 | 42,6 | 53,6 | 73,5 | 80 |
| CONSTRAINTS: | | | | | | | | | |
| Dry land | 400 | 1 | 1 | 1 | 1 | | | | |
| Irr. land Jan. | 200 | | | | | 1 | 1 | 1 | |
| " " Feb. | 200 | | | | | | 1 | 1 | |
| " " Mar. | 200 | | | | | | 1 | 1 | |
| " " Apr. | 200 | | | | | | 1 | | |
| " " May. | 200 | | | | | 1 | | | |
| " " Jun. | 200 | | | | | 1 | | | |
| " " Jul. | 200 | | | | | 1 | | | |
| " " Aug. | 200 | | | | | 1 | | | |
| " " Sep. | 200 | | | | | 1 | | | |
| " " Oct. | 200 | | | | | 1 | 1 | | |
| " " Nov. | 200 | | | | | 1 | 1 | | |
| " " Dec. | 200 | | | | | 1 | 1 | 1 | |
| Labour | 40 000 | 300 | 2 | 16 | 2o | 14 | 5 | 21 | 28 | 2 |
| Labour Jan.-Mar. | 10 000 | 75 | | 4 | 14 | | 1 | 7 | 19 | |
| Labour Apr.-Jun. | 10 000 | 75 | | 5 | 4 | 3 | 1 | 6 | 6 | |
| Labour Jul.-Sep. | 10 000 | 75 | | | | 2 | 1 | | | |
| Labour Oct.-Dec. | 10 000 | 75 | 1 | 7 | 2 | 9 | 2 | 8 | 3 | 1 |
| Max. Work mine | 20 000 | 300 | | | | | | | | |
| Max. Beans | 80 | | | | 1 | | | | | |
| Max. Peas | 80 | | | | | 1 | | | | |
| Max. Irrigated Beans | 40 | | | | | | | | 1 | |
| Max. Irrigated Peas | 40 | | | | | | | | | |

The average gross margin per acre of dry land was R13,20 as before (see Sec. 5:1.). The average gross margin per acre of irrigated land was R79,10, from which we have to deduct the annual equivalent of the investment and maintainance cost per acre of irrigated land. This cost will vary from area to area according to the topography, elevation to which the water has to be pumped, source of energy and the necessity of having a storage dam. Irrigation experts in the Ministry of Agriculture in Maseru estimated this cost as being R45,00 per annum per acre of a typical irrigable land.[1)]

Taking this estimate, the gross margin per irrigated acre after deducting the cost imvolved in establishing and maintaining irrigation system will be R79,10-R45,00 = R34,10 say R34,00. The total income of the village model after deducting irrigation costs (establishment and maintainance) will be R35 104 - R9 000 = R26 104.

The income and employment per farm and per acre are as follows:

| | | FARM | ACRE |
|---|---|---|---|
| Total income[2)] | (R) | 261 | - |
| " employment | (days) | 286 | - |
| Income from farming | (R) | 121 | 20 |
| Employment from " | (days) | 86 | 14 |

1. Based on calculations made recently for a new irrigation scheme.
2. Income and employment from farming and work in the mines.

## 2. SOLUTION ANALYSIS:

The shadow prices of the main variables are shown in Table 6:2.

TABLE 6:2 - SHADOW PRICES AND THEIR RANGE:

| VARIABLE | SOLUTION LEVEL | SHADOW PRICE (R) INCREASE | SHADOW PRICE (R) DECREASE | RANGE UPPER BOUND | RANGE LOWER BOUND |
|---|---|---|---|---|---|
| Maize | 0 acres | - 1,50 | - | 240 | 0 |
| Wheat | 240 " | - 2,00 | - 1,50 | 320 | 0 |
| Beans | 80 " | 2,60 | - 2,60 | 320 | 0 |
| Peas | 80 " | 2,00 | - 2,00 | 320 | 0 |
| Irrigated Maize | 160 " | -100,60 | -11,00 | 200 | 0 |
| Irrigated Wheat | 0 " | -11,00 | - | 160 | 0 |
| Irrigated Beans | 40 " | 19,90 | -73,50 | 200 | 0 |
| Irrigated Peas | 40 " | 27,10 | -80,70 | 200 | 0 |
| Work in mines | 20 000 days | 0,50 | - 0,50 | 27 360 | 0 |
| Dry land | 400 acres | 10,70 | -10,70 | 2 240 | 0 |

The analysis done in Chapter 5 for dry land crops is valid also for the dry-land crops in this run.

As for the irrigated crops:

WHEAT - was not included in the optimal plan. The gross margin has to increase by R11,00 or the value of output has to increase by 11%, / if the crop is to be included.

MAIZE - included at a level of 160 acres. A decrease of R11,00 per acre in the gross margin or 10% in the value of product per acre and the crop will be replaced.

PEAS AND BEANS - a great advantage is the relatively short period in which they occupy the land, which makes it possible to plant 2 crops per year.

WORK IN THE MINES - was included up to its upper limit.

LABOUR CONSTRAINTS - annual and seasonal were not effective.

The shadow prices can be used for checking the sensitivity of the solution to variation in the product price.

TABLE 6:3 - THE SENSITIVITY TO VARIATIONS IN THE PRODUCT PRICE:

| ENTERPRISE | SOLUTION LEVEL* | PRODUCT PRICE R. | LOWER PRICE R. | HIGHER PRICE R. |
|---|---|---|---|---|
| Maize | LL | 3,50 | | 3,67 |
| Wheat | B | 5,70 | 5,45 | 6,03 |
| Beans | UL | 10,50 | 9,76 | - |
| Peas | UL | 10,00 | 9,43 | |
| Irrigated Maize | B | 3,50 | 3,06 | 7,50 |
| " Wheat | LL | 6,15 | - | 6,88 |
| " Beans | UL | 10,50 | 3,15 | - |
| " Peas | UL | 10,00 | 2,66 | - |

* LL - Lower level.[1] UL - Upper level.[2]
B - Intermediate level

Table 6:3 gives the following information:

a) Enterprises at their upper level - how low the product price has to drop in order to reduce the enterprise level in the optimal plan.

b) Enterprises not included in the optimal plan (LL) -

1. The LL in this model is 0, i.e. enterprises at their LL were not included in the optimal solution.
2. Enterprises at their UL are enterprises which their solution level was limited by a maximum constraint (i.e. max. peas, max. beans, etc.)

how high has the product price to rise if the enterprise is to be included in the optimal plan.

c) Enterprises included at an intermediate level - what is the range of prices within which the enterprise will remain at its present level.

The calculation of the lower and higher prices are based on the shadow prices.

As an example, we demonstrate the calculation for dry land wheat: The shadow price of wheat (increase) is - R2,00. This means that if the gross margin per one acre of wheat would have been raised by R2,00 the crop's optimal solution level would have increased to 320 acres. To do this by raising the product's price means an increase of 2,00 ÷ 6 = R0,33 per bag, or a total price of R5,70 + 0,33 = R6,03 per bag.

The shadow price of wheat in the case of a decrease in its area is - R1,50, therefor if the gross-margin per acre of wheat will decrease by R1,50 (or more) the wheat area will be reduced to the lower bound (0 acres, see Table 6:2). Doing it through a decrease in the wheat price means a reduction of R1,50 ÷ 6 = R0,25 per bag or a price of R5,70 - R0,25 = R5,45 per bag.

The solution level of wheat will remain unchanged for price fluctuations within the range R5,45 - R6,03 per bag. The price of maize has to rise from R3,50/bag to R3,67/bag if the crop is to be included in the optimal plan. Irrigated maize will remain at a level of 160 acres as long as the price per bag will be within the range R3,06 - R7,50.

This kind of analysis is relevant when there is an uncertainty as regards the projected prices. Many times the prices are considered as fixed and the main uncertainty is as regards the expected yields. In such cases the analysis of the sensitivity to yield variations can be carried out in a similar way.

TABLE 6:4 - THE SENSITIVITY TO YIELD VARIATIONS:

| ENTERPRISE | LEVEL | YIELD PER ACRE | LOWER YIELD | HIGHER YIELD |
|---|---|---|---|---|
| Maize | LL | 9 bags | - | 9,4 bags |
| Wheat | B | 6 " | 5,7 bags | 6,4 " |
| Beans | UL | 3,5 " | 3,2 " | - " |
| Peas | UL | 3,5 " | 3,3 " | - |
| Irrigated Maize | B | 25 " | 21,9 " | 53,6 " |
| " Wheat | LL | 15 " | - | 16,8 " |
| " Beans | UL | 10 " | 3,0 " | - |
| " Peas | UL | 11 " | 2,9 " | - " |

Table 6:4 shows the sensitivity of the crops to yield variations:

a) Crops at their upper level (UL) - how low has the yield to be in order to cause a reduction in the enterprise level.

b) Crops not included (LL) - how high should the yield rise if the enterprise is to be included (in the optimal plan).

c) Crops at an intermediate level (B) - within what range

of yields will the enterprise remain at its present level.

The calculations involved are similar to those demonstrated for testing the sensitivity to price variations. But while in the former case the change in the gross margin is achieved through changes in the product price (the yield is unchanged), it is achieved here through changes in the yield (the price remaining fixed).

As an example, in the case of dry land maize an increase of 1,5 ÷ 3,5 = 0,4 bags is required for bringing the crop into the optimal plan (a yield of 9,0 + 0,4 = 9,4 bags per acre).

For simplification it was assumed that variations in the yield do not affect the crop's parameters (cost per acre, labour requirement etc.), which is not always true (mainly when the variations are great). However, it is possible to calculate the sensitivity by also taking the expected change in the parameters into consideration.

It can be seen from table 6:4 that dry land wheat will remain at its present level for yield fluctuations within the range 5,7 - 6,4 bags. Irrigated beans will remain at its present level even if the yield will drop from 11 bags to 3 bags/acre.

It is important to remember that the analysis of the sensitivity to price and yield fluctuations, is based on the assumption that only one change occurs at a time while other things (the coefficients of all the variables) remain unchanged.

## 3. CONCLUSIONS:

The difference in profitability between irrigated maize and irrigated wheat is not big enough to justify the

preference of one crop to the other. Beans and peas have a clear advantage over maize and wheat.

The average income per acre of dry land crops is R13,20 (see Sec. 5,1) while the average income per acre of irrigated land is R79,10[1)].

The difference in labour requirement per acre between dry land crops and irrigated crops is approx. 9 days or R1,80 if the opportunity cost per day is assumed to be R0,20. Therefore, when the irrigated crops which are to be grown, are those included in this plan or similar, the maximum investment in irrigation should be such that the annual equivalent cost will be not higher than R79,10 - R13,20 - R1,80 = R64,10.

If the annual equivalent cost of establishing irrigation is assumed to be R45,00, a relatively small margin of R19,10 is left for risk, uncertainty etc. Given the risk involved in introducing irrigation to a new area, such a margin is not too high.

The introduction of irrigation based on those crops, while increasing employment will not solve the under employment problem and cannot therefore be regarded as an alternative to work in the mines.

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1. Before deducting the cost of establishing irrigation system.

# CHAPTER - 7.

## DRY LAND CROPS AND IRRIGATION - B.

### 1. INTRODUCTION AND SUMMARY OF RESULTS:

The division of the land area to dry land and irrigated land was the same as in stage 2 (Chapter 6.). The number of enterprises was increased as following:

Dry land crops - potato was added.
Irrigated crops - vegetables and dairy were added.

The vegetable kinds examined were of the main vegetables grown in the Republic which are expected to give good results in Lesotho.

Minor types of vegetables were not examined. While they may be important from an individual farmer or village point of view, they are not important in our case. The objective is to identify the characteristics of the main alternative agricultural development possibilities. Therefore only crops which can be grown on a large scale are relevant here. The additional constraints to those included in the former stages were: (see Table 7:1).

| | | | | |
|---|---|---|---|---|
| Dry land potato | - Maximum | 100 | acres | (rotation) |
| Potato and tomato | - " | 50 | " | " |
| Onion | - " | 50 | " | ( market) |
| Carrot A | - " | 50 | " | " |
| Carrot B | - " | 50 | " | " |
| Dairy | - " | 10 | cows | " |

The seasonal labour constraint was relaxed by introducing

the possibility of hiring labour in peak seasons. Alternatively this may represent additional efforts made by the farmers in such periods. This additional labour was assumed to cost 40c per day rather than 20c, assuming that hired workers will demand higher wages in the peak season or alternatively that a compensation higher than 20c/day will be required for inducing the farmers to work longer days ..

Table 7:1/.....

| ACTIVITIES | | WORK-MINES | WHEAT | MAIZE | BEANS | PEAS | POTATO | IRRIGATED WHEAT | IRRIGATED MAIZE | IRRIGATED BEANS | IRRIGATED PEAS | IRRIGATED POTATO-A | IRRIGATED POTATO-B | CABBAGE A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GROSS MARGIN (R) | | 210,0 | 10,7 | 9,2 | 13,3 | 12,7 | 26,9 | 42,6 | 53,6 | 73,5 | 80,7 | 138,2 | 138,2 | 46,4 |
| Dry land | 400 | | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| Irr. " 1 | 200 | | | | | | | 1 | 1 | 1 | | 1 | 1 | |
| " " 2 | 200 | | | | | | | | 1 | 1 | | 1 | 1 | |
| " " 3 | 200 | | | | | | | | 1 | 1 | | | 1 | |
| " " 4 | 200 | | | | | | | | 1 | | 1 | | 1 | |
| " " 5 | 200 | | | | | | | 1 | | | 1 | | | |
| " " 6 | 200 | | | | | | | 1 | | | 1 | | | |
| " " 7 | 200 | | | | | | | 1 | | | 1 | | | 1 |
| " " 8 | 200 | | | | | | | 1 | | | 1 | | | 1 |
| " " 9 | 200 | | | | | | | 1 | | | 1 | | | 1 |
| " " 10 | 200 | | | | | | | 1 | 1 | | 1 | 1 | | 1 |
| " " 11 | 200 | | | | | | | 1 | 1 | | 1 | 1 | | 1 |
| " " 12 | 200 | | | | | | | 1 | 1 | 1 | | 1 | 1 | 1 |
| Labour | 40 000 | 300 | 2 | 16 | 20 | 14 | 39 | 5 | 21 | 28 | 22 | 49 | 49 | 52 |
| Labour 1-3 | 20 000 | 75 | | 4 | 14 | | 13 | 1 | 7 | 19 | | 21 | 22 | |
| Labour 4-6 | 20 000 | 75 | 1 | 5 | 4 | 3 | | 1 | 6 | 6 | 3 | | 21 | |
| Labour 7-9 | 20 000 | 75 | | | | 2 | | 1 | | | 3 | | | 12 |
| Labour 10-12 | 20 000 | 75 | 1 | 7 | 2 | 9 | 26 | 2 | 8 | 3 | 16 | 28 | 6 | 40 |
| Max.Pot. & Tom. | 50 | | | | | | | | | | | 1 | 1 | |
| " Onion | 50 | | | | | | | | | | | | | |
| " W.Fodder | 0,001 | | | | | | | | | | | | | |
| " S. " | 0,001 | | | | | | | | | | | | | |
| " Beans | 80 | | | | 1 | | | | | | | | | |
| " Peas | 80 | | | | | 1 | | | | | | | | |
| " Potato | 100 | | | | | | 1 | | | | | | | |
| " Irr. Beans | 40 | | | | | | | | | 1 | | | | |
| " " Peas | 40 | | | | | | | | | | 1 | | | |
| " Carrot A | 50 | | | | | | | | | | | | | |
| " " B | 50 | | | | | | | | | | | | | |
| " Tomato | 20 | | | | | | | | | | | | | |
| " Dairy | 20 | | | | | | | | | | | | | |
| " Work mines | 20 000 | 300 | | | | | | | | | | | | |

TABLE 7:1 : DRY LAND CROPS AND IRRIGATION B MATRIX.

TABLE 7.1 : (CONTINUED)

| ACTIVITIES | CABBAGE B | CARROT A | CARROT B | ONION A | ONION B | TOMATO | WINTER FODDER | SUMMER FODDER | DAIRY | HIRE LABOUR 1-3 | HIRE LABOUR 4-6 | HIRE LABOUR 7-9 | HIRE LABOUR 10-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GROSS MARGIN (R) | 46,4 | 130,1 | 130,1 | 153,7 | 153,7 | 252,7 | -37,3 | -39,9 | 112,0 | -0,2 | -0,2 | -0,2 | -0,2 |
| Dry land | | | | | | | | | | | | | |
| Irr. " 1 | 1 | 1 | | | 1 | 1 | | 1 | | | | | |
| " " 2 | 1 | 1 | | | 1 | 1 | | 1 | | | | | |
| " " 3 | 1 | 1 | 1 | | | 1 | | 1 | | | | | |
| Irr. " 4 | 1 | | 1 | 1 | | | 1 | | | | | | |
| " " 5 | | | 1 | 1 | | | 1 | | | | | | |
| " " 6 | | | 1 | 1 | | | 1 | | | | | | |
| " " 7 | | | 1 | 1 | | | 1 | | | | | | |
| " " 8 | | | | 1 | | | 1 | | | | | | |
| " " 9 | | | | 1 | 1 | | 1 | | | | | | |
| " " 10 | | | | | 1 | | | 1 | | | | | |
| " " 11 | | 1 | | | 1 | 1 | | 1 | | | | | |
| " " 12 | 1 | 1 | | | 1 | 1 | | 1 | | | | | |
| Labour | 52 | 63 | 63 | 47 | 47 | 100 | 9 | 13 | 40 | | | | |
| " 1-3 | 30 | 33 | 14 | | 20 | 40 | | 11 | 10 | -1 | | | |
| Labour 4-6 | 20 | | 49 | 24 | | | 2 | | 10 | | -1 | | |
| Labour 7-9 | | | | 23 | 5 | | 7 | | 10 | | | -1 | |
| " 10-12 | 2 | 30 | | | 22 | 60 | | 2 | 10 | | | | -1 |
| Max. Pot.& Tom. | | | | | | 1 | | | | | | | |
| " Onion | | | | 1 | 1 | | | | | | | | |
| " W. Fodder | | | | | | | -1 | | 0,8 | | | | |
| " S. " | | | | | | | | -1 | 0,5 | | | | |
| Max. Beans | | | | | | | | | | | | | |
| " Peas | | | | | | | | | | | | | |
| " Potato | | | | | | | | | | | | | |
| " Irr. Beans | | | | | | | | | | | | | |
| " " Peas | | | | | | | | | | | | | |
| " Carrot A | | 1 | | | | | | | | | | | |
| " " B | | | 1 | | | | | | | | | | |
| " Tomato | | | | | | 1 | | | | | | | |
| " Dairy | | | | | | | | | 1 | | | | |
| " Work mines | | | | | | | | | | | | | |

The optimal solution was as following:

| ENTERPRISE | SOLUTION LEVEL | NET INCOME R | EMPLOYMENT (DAYS) |
|---|---|---|---|
| Dry land crops | | | |
| Wheat | 263 acres | 2 919 | 526 |
| Peas | 37 " | 574 | 518 |
| Potato | 100 " | 3 470 | 3 900 |
| TOTAL | 400 " | 6 963 | 4 944 |
| Irrigated crops | | | |
| Wheat | 20 acres | 872 | 100 |
| Maize | 40 " | 2 312 | 840 |
| Peas | 40 " | 3 404 | 880 |
| Beans | 40 " | 3 164 | 1 120 |
| Potato | 30 " | 4 440 | 1 470 |
| Carrots | 100 " | 14 270 | 6 300 |
| Onion | 50 " | 8 155 | 2 350 |
| Tomato | 20 " | 5 454 | 2 000 |
| TOTAL | 340[1] " | 42 071 | 15 060 |
| Work in mines | 20 000 days | 14 000 | 20 000 |
| TOTAL | | 63 034 | 40 004[2] |

The total net income from farming, after deducting the cost involved in establishing and maintainance of the irrigation system (see Sec. 6:1.) is R49 034 - R9 000 = R40 034

---

1. 340 Acres of crop area on 200 acres of irrigated land.
2. The additional 4 days are due to the rounding of the solution levels.

and the total net income R54 034.

The income[1)] and employment per farm and per acre are as follows:

| | | FARM | ACRE |
|---|---|---|---|
| Total income | (R) | 540 | - |
| Total employment | (days | 400 | - |
| Income from farming | (R) | 400 | 67 |
| Employment from " | (days) | 200 | 33 |

2. SOLUTION ANALYSIS:

As in the former chapters we can use the shadow prices of the variables (see Table 7:2) and their sensitivity to variations in prices and yields (Table 7:3) for analysing the optimal solution.

Dry land crops:

The introduction of potato changed the optimal combination of dry land crops. Potato came up to its upper limit (100 acres). However, a reduction by more than 5,7% in the value of output will be sufficient for reducing the crop area by 14%. While grown on a small scale in Lesotho, the information available about the profitability of potato is insufficient and errors in the calculation of more than 5,7% are probable.

MAIZE - was not included but an increase of more than 4,3% in the value of output per acre will be sufficient for its inclusion in the optimal solution.

---

1. After deducting the cost of establishing irrigation.

BEANS - an increase of 3% in the value of the output will be sufficient for its inclusion.

PEAS - a decrease of 1,2% in the value of product per acre will be sufficient for the replacement of the crop.

TABLE 7:2 - SHADOW PRICES IN THE 3rd RUN AND THEIR RANGE:

| VARIABLE | SOLUTION LEVEL | SHADOW PRICE (R) INCREASE | SHADOW PRICE (R) DECREASE | RANGE UPPER BOUND | RANGE LOWER BOUND |
|---|---|---|---|---|---|
| Dry land crops: | | | | | |
| Maize | 0 acre | - 3,97 | - | 31,4 | 0 |
| Wheat | 263 " | - 0,4 | - 2,9 | 300,0 | 237,8 |
| Beans | 0 " | - 1,00 | - | 24,5 | 0 |
| Peas | 37 " | - 2,4 | - 0,4 | 80,0 | 0 |
| Potato | 100* " | 7,4 | - 7,4 | 111,9 | 86,0 |
| Irrigated Crops: | | | | | |
| Maize | 40 " | -38,0 | - 3,9 | 40,0 | 20,9 |
| Wheat | 20 " | - 3,9 | - 5,2 | 39,1 | 10,6 |
| Beans | 40* " | 22,1 | -22,1 | 40,0 | 22,0 |
| Peas | 40* " | 72,9 | -72,9 | 59,8 | 40,0 |
| Potato A | 30 " | - 7,8 | - 3,9 | 30,0 | 10,9 |
| Potato B | 0 " | - 3,9 | - | 19,1 | - |
| Cabbage A | 0 " | - 5,2 | - | 9,4 | - |
| Cabbage B | 0 " | - 7,8 | - | 0 | 0 |
| Carrot A | 50* " | 56,5 | -65,5 | 60,5 | 37,6 |
| Carrot B | 50* " | 117,1 | -117,1 | 59,4 | 38,9 |
| Onion A | 50* " | - | - 50,2 | 50,0 | 30,0 |
| Onion B | 0 " | -50,2 | - | 20,0 | 0 |
| Tomato | 20* " | 94,5 | -94,5 | 32,6 | 5,1 |
| Dairy | 0 " | - 5,3 | - | 0,01 | 0 |
| Work in mines | 20 000* " | 0,37 | - 0,37 | 20,440 | 19,480 |
| Dry land | 400* " | 10,4 | -10,4 | 620,1 | 174,3 |
| Labour | 40 000* " | 0,03 | - 0,03 | 40520 | 39560 |

* Variables at their upper limit.

TABLE 7:3 - THE SENSITIVITY TO VARIATIONS IN PRICES AND YIELDS:[1)]

| ENTERPRISE | SOIL LEVEL | PRODUCT PRICE (R) | | | YIELD PER ACRE | | |
|---|---|---|---|---|---|---|---|
| | | ASSUMED* | LOWER | HIGHER | ASSUMED* | LOWER | HIGHE |
| Dry Land: | | | | | | | |
| Maize | LL | 3,50 | - | 3,94 | 9 bags | - | 10,1 |
| Wheat | B | 5,70 | 5,22 | 5,77 | 6 " | 5,5 | 6,1 |
| Beans | LL | 10,50 | - | 10,79 | 3,5 " | - | 3,6 |
| Peas | B | 10,00 | 9,89 | 10,69 | 3,5 " | 3,4 | 3,7 |
| Potato | UL | 0,65 | 0,61 | - | 200pocket | 188 | - |
| Irrigated crops; | | | | | | | |
| Maize | B | 3,50 | 3,34 | 5,02 | 25 bags | 23,9 | 35,9 |
| Wheat | B | 6,15 | 5,80 | 6,40 | 15 " | 14,1 | 15,6 |
| Beans | UL | 10,50 | 8,30 | - | 10 " | 7,9 | - |
| Peas | UL | 10,00 | 3,40 | - | 11 " | 3,7 | - |
| Potato A | B | 0,65 | 0,64 | 0,67 | 500pocket | 506 | 512 |
| Potato A B | LBL | 0,65 | - | 0,66 | " " | - | 506 |
| Cabbage A | LL | 30,00 | - | 30,90 | 6 Ton | - | 6,2 |
| Cabage B | LL | 30,00 | - | 31,30 | " " | - | 6,2 |
| Carrot A | UL | 30,00 | 20,60 | - | 7 " | 4,8 | - |
| Carrot B | UL | 30,00 | 13,30 | - | " " | 3,1 | - |
| Onion A | UL | 35,00 | 27,80 | - | " " | 5,6 | - |
| Onion B | LL | 35,00 | - | 42,20 | " " | - | 8,4 |
| Tomato | UL | 70,00 | 58,20 | - | 8 " | 6,6 | - |

* See Table 4:1.

1. For simplification it was assumed that variations in the yield per acre do not change the cost of production per acre or the labour requirement.

Irrigated Crops:

Maize, wheat, beans and peas were included in the optimal plan. Of these crops, peas and beans are the most stable in the solution - relatively high changes in their gross margin per acre are required in order to justify their replacement by other crops.

As for vegetables the most stabilized ones were tomato and carrots. Other vegetables which were included in the optimal plan were:

Potato A - 30 acres, high sensitivity to variations in prices, yield, cost of production.

Onion A - 50 acres, small sensitivity to variations in the coefficients.

Potato B, cabbage A and B, although not included are highly sensitive to variations in prices yields etc. A relatively small change in their coefficients (yield, price, etc.) would have been sufficient for their inclusion in the optimal plan. A greater change in the coefficients would have been required in order to include onion B in the optimal plan.

Work in the mines: was included up to its upper limit. However, its shadow price was reduced from R0,50 to R 0,37 per day, which means that at this stage it competes to some extent with other enterprises on labour resources.

Labour - all the labour which was assumed available - 40 000 days was used. The opportunity cost of labour was R0.03[2] (this cost is relevant up to a level of 40 520 days). Therefore

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1. The area of potato and tomato was limited to 50 acres.
2. Which means a marginal net income of 0,40 + 0,03 = R0,43 (because the cost of seasonal labour is R0,40 (0,20+0,20).

an increase in the level of labour constraint wouldn't have increased the total profit (of the optimal plan) by much.

Seasonal labour constraints in the periods April - June and July - August were not effective. In January - March and October - December all the labour assumed available was used and additional days were hired.

The labour requirement according to the seasons was as following:

| | Days |
|---|---|
| January - March | 11 140 |
| April - June | 9 643 |
| July - September | 6 363 |
| October - November | 12 853 |

It can be seen that the conclusion arrived at in stage 1 (dry land crops Chapter 5.) as regards underemployment in the period July - September and the low opportunity price of labour which follows, is valid here also.

Dairy - was not included in the optimal as a result of a small marginal deficit (R5,30 per unit ). A slight change in the assumed feeding programme, through the reduction of the amount of summer fodder, would have brought the enterprise into the optimal plan.

It will now be demonstrated how the shadow prices can be used for gaining more insight into the reasons for inclusion or rejection of crops from the optimal solution.

Cabbage B: The crop ~~The crops~~ uses the following limited resources:

| RESOURCE | OPPORTUNITY COST PER UNIT (R) | QUANTITY | TOTAL COST (R) |
|---|---|---|---|
| Irrigated land March | 8,066 | 1 | 8,066 |
| " " Dec. | 37,966 | 1 | 37,966 |
| Labour Jan - March | 0,20 | 30 | 6,000 |
| Labour Oct - Dec. | 0,20 | 2 | 0,400 |
| Labour (annual) | 0,033 | 52 | 1,716 |
| Total opportunity cost | | | 54,148 |
| Gross margin per acre | | | 46,4 |
| Marginal deficit | | | -7,748 |

The main reason for the high opportunity cost involved is the requirement of irrigated land in December. Irrigated land in this month has a high opportunity cost.

It can be seen from the analysis that if the cabbage can be planted later (e.g. in January) it will be included in the optimal plan.

An additional example is for a crop which was included-Tomato

| LIMITED RESOURCE | OPPORTUNITY COST PER UNIT (R) | QUANTITY | TOTAL COST (R) |
|---|---|---|---|
| Irrigated land - March | 8,066 | 1 | 8,066 |
| " " - November | 3,866 | 1 | 3,866 |
| " " - December | 37,966 | 1 | 37,966 |
| Labour annual | 0,033 | 100 | 3,300 |
| " Jan - March | 0,200 | 60 | 12,000 |
| " Oct - Nov. | 0,200 | 40 | 8,000 |
| Maximum potato & tomato | 84,933 | 1 | 84,933 |
| Total opportunity cost | | | 158,131 |
| Gross margin | | | 252,700 |
| Marginal surplus | | | 94,569 |

The results of the other crops can be analysed in a similar way in order to gain a better understanding of the optimal solution.

As demonstrated in the case of cabbage B, minor amendments may sometimes be sufficient for including an enterprise in the optimal solution (or for excluding it).

## 3. CONCLUSIONS:

The inclusion of potato / raised the net income per acre of dry land from R13,20 to R15,50 and the labour requirement from 8 to 12,4 days. This points out that the introduction of labour intensive dry land crops (like dry land vegetables ) may be an important component of any agricultural development programme. This approach has not received proper attention until now.

The inclusion of vegetables raised the average net income per acre of irrigated land from R79,10 (see Sec. 6:2) to R210,40. The difference in labour requirement per acre between dry land crops and irrigated crops in this run is 63 days or R12,60 per acre ifthe opportunity cost of labour is assumed to be R0,20. Therefore, for a combination of irrigated crops as in this optimal plan or similar, the maximum investment in establishing irrigation should be such that the annual equivalent cost will not be higher than $210,4^{-15,5} - 12,6 =$ R182,3.

Since the annual equivalent cost of establishing irrigation on an acre of typical land is estimated at R45,00 per acre, it can be concluded that when the irrigation is to be established for crops like those included in the optimal plan (vegetables, etc.) it may be economically justified to do it even in areas in which it requires a high investment.

As for the employment situation, the full employment which was reached in this plan includes full use of the work opportunities in the mines. The opportunity price of labour was low and it can be assumed that the amount of additional labour which could have been employed under the model's assumptions would have been limited. Had the level of the labour constraint been increased, a great part of the increased labour supply would have been underemployed.

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1. Before deducting the cost involved in establishing irrigation

# CHAPTER - 8.

## ALTERNATIVE DEVELOPMENT POSSIBILITIES - COMPARISON AND DISCUSSION.

### 1. COMPARISON:

The alternative plans presented and analysed in Chapter 5,6 and 7, are presented here in a comparative way.

The main characteristics of each of the optimal plans and of the assumed initial situation are summarized in Table 8:1.

TABLE 8:1 - A COMPARISON OF THE PLANS:

| I T E M | INITIAL STAGE | IMPROVED DRY LAND FARMING | DRY LAND CROPS & IRRIGATION-A | DRY LAND CROPS & IRRIGATION-B |
|---|---|---|---|---|
| Total net income per farm (R) | 184 | 219 | 261 | 540 |
| Total employment per farm (days) | 272 | 248 | 286 | 400 |
| Net income from farming per farm (R) | 44 | 79 | 121 | 400 |
| Employment from farming per farm (days) | 72 | 48 | 86 | 200 |
| Income from farming per acre (R) | 7 | 13 | 20 | 67 |
| Employment from farming per acre (days) | 12 | 8 | 14 | 33 |

It can be seen from table 8:1 that the improvement of dry land farming (stage 1, Chapter 5.) based on the present crops, may double the net income per acre. This approach however,

will not increase employment and may even cause a reduction in employment from crop production.

The introduction of irrigation on $^{1}/_{3}$ of the arable land based on crops like maize, wheat beans and peas (stage 2, Chapter 6) increased the net income per acre in comparison to the initial stage by nearly 3 times, income per farm by 42% employment per acre by 17% and employment per farm by 5%.

The actual increase in income and employment per acre and per farm will depend on the proportion of the total area on which irrigation will be introduced.

While the increase in the net income is considerable, the increase in employment is relatively small and under-employment remains high. Besides, the investment in establishing irrigation for those crops will be limited to places in which the cost of this investment is not too high, (pumping the water directly from the river, etc.).

The introduction of irrigation, with crops like vegetables, (stage 3 Chapter 7.) causes a radical change in income and employment. Net income from farming is increased by more than 9 times, and the total net income is nearly tripled. Employment per acre is raised by almost 3 times and the total employment by nearly 50%.

Here again, the actual increase (in income and employment) will depend on the proportion of the area which will be put under irrigation.

The "importance" of work in the mines as a source of income is reduced from stage 1 to stage 3 as following:

| | STAGE 1 | STAGE 2 | STAGE 3 |
|---|---|---|---|
| Work in the mines as percentage of total employment | 76 | 70 | 50 |

Still, even with the introduction of irrigation based on vegetables the possibility to work in the mines is essential for creating a full employment situation.

2. DISCUSSION:

A successful programme aimed at improvement of dry land farming in the lowland will cause an increase in agricultural production. However, the limits of agricultural development through the improvement of dry land farming should not be overlooked.

It can be seen from the analysis of the planning results, that such a programme will not ease the under-employment situation and may even make it worse. The introduction of labour intensive dry land crops (such as potato and other vegetables) will cause a further increase in income and employment.

The planning results show also that introducing irrigation based on labour intensive crops (such as vegetables ) will increase production and employment considerably.

Arable land resources in Lesotho are fully utilized and more than that. The projected increase in population and the poor prospects of quick industrialization (see Chapter 2) mean that the demand for land will increase and a great part of the increase in the labour force will have to be absorbed in agriculture.

The introduction of irrigation seems to be the only way

to increase the production potential of the existing land resources. It can be seen from sec. 7:1 that the expected net income from one acre under irrigation may be 10 times higher than the net income from one acre of dry land farming (improved.) The labour requirement for an irrigated acre may be 7 times higher than for one acre of dry land farming.

Through all the stages the highest rate of under-employment is in the period July - September, followed by the period April - June.

As already mentioned crops requiring a great part of their labour input in these periods will have the advantage of a low opportunity cost of labour. It may be well advised to examine the possibilities of introducing such crops into the lowlands.

Another conclusion which follows this seasonal under-employment pattern is as regards the mechanisation of the harvesting of crops such as maize, sorghum, beans etc.. This harvesting falls mainly within the period April - July. Therefore, unless the present way of harvesting involves high losses of yield, it may not be justified to mechanize their harvesting.

Work in the mines may be expected to continue being an important source of employment (and cash income) in the near future. Even if irrigation with labour intensive crops will be introduced in the same proportion of land as in the model, full employment or anything near that can be expected only by full use of the possibility to work in the mines.

## 3. THE "VILLAGE MODEL" AND PRODUCTION REALITY:

The planning of the "village model" as one unit gives

rise to criticism on the ground that in reality every village is composed of independent farm households. Each of them is an individual production unit which may have production constraints different to those of its neighbours. The optimal combination of enterprises may be different to that which will maximize the income of the other farms and the sum of individual optimal plans may not be equal to the optimal plan of the village planned as one unit.

However, it will be seen that the "village model" did not deviate sig-nificantly from reality.

Firstly, there is a great amount of cooperation in crop production among farmers. The sharecropping institution can also be regarded as a form of cooperation which enables overcoming the production constraints.

Secondly, the optimal combination of dry land crops in all the planning stages was not a stable one in the sense that small variations in the parameters would have changed it. Therefore it can be assumed that other combinations based on the same crops would have produced a similar net income.

Finally, in the case of irrigation it was taken forgranted that the resources (land, labour) are being pooled together (see Chapter 10).

Therefore, the optimal plans obtained by planning the "village model" are a good estimate of the optimal plan for

a "village model" which consists of independent producers.

4. CONCLUSIONS:

The introduction of irrigation on a wide scale should be given serious consideration. The scale will be determined by the availability of the resources (suitable land, capital, technicians etc.) and marketing possibilities.

The main crops grown under irrigation should be labour intensive crops (like vegetables). The economic justification in establishing irrigation for the traditional crops only, is limited to areas in which the investment in it is relatively low.

Irrigation is not an alternative way of development to that of the improvement of dry land farming. It is rather a complementary way. It has been mentioned already that only a part of the lowland is suitable for irrigation. The greater part is not. Therefore, a programme for the improvement of dry land farming can be launched simultaneously with irrigation projects.

In planning improved production patterns, the fact that work in the mines will cnntinue being an important factor, even in the long run, should be borne in mind.

These general conclusions are independent of the characteristics of the representative "village Model" (i.e. labour potential, farm size, proportion of land suitable for irrigation etc.).

The same general conclusions would have been arrived at if the irrigable area would have been assumed to be smaller.[1] In places in which no irrigation possibilities exist, improved dry land farming remains the only alternative way for increasing crop production.

The conclusions arrived at, may therefore, be regarded as applicable to practically all the lowland region.

The analysis has been carried out in a purely technical way up till now.

However, it can hardly be regarded as complete without analysing the organisational patterns which may be required for its implementation. This will be done in Chapter 10. Prior to this, it will be essential to review briefly, past experiece with development schemes and organisation patterns in Lesotho.

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1. But the average income and employment per acre and per farm would have been smaller.

# CHAPTER - 9.

## LESSONS FROM THE PAST.

### 1. INTRODUCTION:

The understanding of past experience can provide important guidance for planning future development.

This chapter provides a brief review of past experience in Lesotho in the fields of cooperatives, mechanisation, credit, irrigation and extension.

### 2. COOPERATIVES:

#### A) KOOPANO COOPERATIVE:[1)]

Koopano ea Tsebeliseno (Mutual aid Association) was established in 1964 by a Catholic priest. The cooperative was an organisation of village associations. Each village had a committee which was supposed to initiate projects, communicate information and carry out decisions of the Central and District committees.

The district committee was elected from among the village committees and a Central committee was elected from among the district committees. The Central committee was the governing body of the association.

Most of Koopano's capital was created by donations from donors such as Oxfam, World Neighbours, U.S. AID, Catholic Relief Services and others. A Board of Trustees was formed

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1. Most of this reveiw is based on a memorandum by a Peace Corps volunteer working at Koopano (1.9.1969.)

to supervise the donations and obtain additional ones. The relations between the Board of Trustees and the Central committee were not good.

In 1969 Koopano consisted of about 100 groups of farmers. Members paid annual registration of 10c and worked together in each others fields. The benefits from being a member were:

a) Employment in Home Industries Branch.

b) Tractor ploughing at low rates.

c) Purchase of goods and groceries at the consumer store.

Of the various branches of activity the most successful one was Home Industries. This branch developed into a workshop manufacturing hand-woven mohair rugs. About 30-35 members were working full time spinning and weaving while about 600 members worked accasionally (once every 6 - 8 weeks) preparing mohair at home for spinning. Most of the product was sold locally to tourists, expatriates etc. while export experiments have failed.

The mechanization services were based on 2 tractors donated by U.S. Aid. The tractors were badly maintained, repair costs were high and they were idle a great part of the time. The tractor charges were the lowest in Lesotho and were not sufficient for the creation of a replacement fund.

The consumer store sold soft goods and groceries. However the turnover of the store was too small and it has been working at a loss.

The administrative expenses of Koopano were high - R120 per month with little income to offset it and little or no

progress to show for them. As a result donors were no longer willing to contribute money to cover these expenses and they were increasingly met by the profits of the only successful branch - Home Industries.

By 1971[1] only the Home Industries section remained active. Koopano had no money to buy seeds and fertilizer for its members. The ADF[2] refused to extend credit since only 60% of a former loan had been repaid. Oxfam, one of the main donors refused to help since it has already poured R7 600 into it, in the past.

B) TSIQOANE AND LIHOAI COOPERATIVES:

Tsiqoane - The cooperative was established in 1955 for the purpose of helping its members to cultivate their land. It started with one tractor and later on bought another one. In the past the cooperative supplied its members with seeds and fertilizers but due to bad management it suffered losses and had to sell its last tractor last year (1970).

The cooperative still exists and has 42 members. The cultivation of the land is done by the government tractor hire service (LEMA).

The members pay cash for the cultivation and have to buy fertilizer and seeds on their own. They still have hopes of receiving help for buying a tractor abut for what purpose?

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1. See Rand Daily Mail 15.6.1971.
2. Agricultural Development Fund.

This particular area is overcrowded by privately owned tractors. The prices charged by the tractor owners are not higher than the cost which can be expected from a cooperative tractor, even with the best management. However, past experience shows that good management is scarce and therefore the cost of operations of a cooperatively owned tractor may even be higher.

Lihoai - This is a small cooperative - 7 members - which was established in 1969. Registration fees are R2,00 and any additional deposit is regarded as shares. At the end of 1970 the total savings amounted to about R50,00. Members had to buy the inputs (seed, fertilizer) on their own. There is some confusions as to the purpose of its existance. Some members claim that the main purpose was the buying of a tractor, But 3 members are, in fact, tractor owners of whom one is the biggest share cropper in the area cultivating the fields of some 70 farmers.....

3. MECHANIZED FARMING:

A) LESOTHO CREDIT UNION SCHEME FOR AGRICULTURE (LECUSA):

LECUSA was started as a pilot scheme in 1968 for the purpose of promoting mechanized farming. A set of tractor and implements was provided to 12 well established Credit Unions. The donors were OXFAM, CRS and the U.S. Embassy.

It was recognised that mechanised agricultural schemes had failed in the past mainly because of ineffective organisation, supervision and poor planning. It was hoped that the Credit

Unions had the necessary organization, trained leadership and dedicated members needed to make the scheme work. The scheme is assisted by the Extension Department of UBLS[1] and by Peace Corps volunteers.

The Board of Directors includes some of the donors, Government experts, representatives of Credit Unions etc..

According to the Board's decisions -

a) Economic rates for tractor hire must be charged.

b) Cash payment.

c) Only a full package of inputs including ploughing, seeds, fertilizer and insecticides can be undertaken by the farmers.

d) A part of the revenue is placed in a replacement fund for the purchase of a new tractor and equipment after four years.

The following information[2] about one of LECUSA units may throw some light on the problems which the scheme faces. The unit has been cultivating fields for 81 farmers (about 235 acres).

A farmer becomes a member by paying 50c for registration fees. A committee and a president are elected by the members. Payment is supposed to be arranged before the operation in the field takes place. However, credit was sometimes given to friends of the president and other influential members to such an extent that in one year credit amounting to

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1. University of Botswana Lesotho and Swaziland.
2. The information is based on private communications.

R1 400 was extended, of which only R900 was repaid.

The unit suffers from personal quarrels between members. The most sensitive problem is the order of cultivation (planting) of fields.

By the second half of 1971 the financial situation reached such a stage (due to non repaid credit) that the Board of Directors decided to take away the tractor and its equipment (temporarily).

Some of LECUSA'S weak points are:

a) Rigid regulations as regards the components of the package of inputs: It is determined by the Board of Directors and is standard and compulsory for all those using its mechanization services. This regulation limits the potential demand for LECUSA services since many farmers are interested in ploughing only, and have (or borrow) animals for planting. Others want a different type of fertilizer, etc..

b) Depreciation cost is based on a life time of 4 years, no matter how many hours the tractor has worked. However, the rigid package regulations (all or nothing) makes a full use of the tractor's potential a difficult task. Therefore depreciation charge per tractor hour (acre) is high.

c) Bad management of the local units.

d) Organisation pattern which encourages friction on a personal and political basis.

While the future of LECUSA is unclear at present, it can be concluded that this form of organisation is unlikely to succee

as a wide scale organisation of mechanised farming in Lesotho.

B) LEMA TRACTOR HIRE SERVICE:

Lema is the government mechanization service which took over the "Farmech" mechanization scheme[1] after the latter had suffered great losses due to bad management.

Despite the fact that its rates are similar to the rates charged by private tractor owners, Lema has been operating at a deficit. The tractors are not operating at their full capacity, the work is spread over too large an area which means that much time is spent on travelling, and the criterion for accepting work is not always the economic one.

Despite this the government plans to increase the number of tractors from 18 to 30.[2]

C) SHARE - CROPPING: (see also Sec. 3:7.)

Share-cropping agreement is a common way of cultivating land in Lesotho. According to the agricultural census 1960, 18% of the farmers were involved in share-cropping agreements.[3] The agricultural census of 1969/70 gives a somewhat lower percentage.[4]

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1. See in WALLMAN S, 1969.
2. LFDP, p. 67.
3. 1960 Agricultural Census, Part 5, p. 53.
4. 13,9%. However, the question as regards share cropping in the 1969/70 census questionaire, was not as straight forward as in the 1960 census.

There are 2 main types of share-croppers:[1)]

a) Share-croppers who own the means of cultivation.

b) Share-croppers who only finance the cultivation of the field.

There are many kinds of agreements as regards the actual sharing of the payment for the inputs and the sharing of the yields. Generally the farmer (land owner) gives the field and the share cropper gives the cultivation and planting. Seeds and fertilizer when used are in most cases provided by the sharecropper but their cost equivalent in grains is deducted before the sharing. Weeding, harvesting and threshing are generally shared by both farmer and share cropper. After threshing the share cropper generally deducts a part of the yield to cover the cost of seeds and fertilizer and the rest of the yield is shared equally with the farmer.

We shall now try to examine the sharecropper's return from one acre of wheat in an average year. It is assumed that no fertilizer is used and cultivation is done by animal:

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1. The two sides in the Sharecropping agreement are the farmer (landholder) and the supplier of cultivation means (sharecropper).

| | BAGS OF 200 lbs. | RAND[1] |
|---|---|---|
| Total yield | 2,5 | 12,50 |
| Less seeds | -0,5 | - 2,50 |
| Yield for sharing | 2,0 | 10,00 |
| Farmers share (farmer's net return) | 1,0 | 5,00 |
| Share cropper's part (share cropper's gross return) | 1,5 | 7,50 |
| Cultivation cost | -0,7 | -3,50 |
| Seeds | -0,5 | -2,50 |
| Share cropper's net return | 0,3 | 1,50 |

In a year with better yields both farmer and share cropper will enjoy a higher net return. However, in a bad year while the farmer always[2] (unless the crop was a complete failure) gets some return, the share cropper's gross return may not be sufficient to cover all his costs.

Cultivation through share cropping is done mainly by farmers working in the mines, woman farmers who have fields allocated to them but do not have the time or the means to cultivate them. From this point of view share cropping is suitable to the special conditions of Lesotho where many of the farmers work in the mines in the R.S.A.

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1. The farm gate market price is assumed to be R5,00. This price is lower than the price which was assumed in the "village model" Chapter 4, since grading is assumed to be lower and the wheat is assumed to be sold to traders rather than directly to an agent of the R.S.A. Wheat Control Board.

2. When the yield is very small the sharecroppers do not generally deduct the cost of seeds and fertilizer before sharing.

The main advantages of share cropping to the farmer are as follows:

1) Extension of credit

2) No risk

3) Better management

4) Freedom to work outside the farm (mines etc.)

These are advantages from the national economy stand point as well since production restraints are removed.

The share cropping system in Lesotho is similar to the farming-on-the-half system once popular in South Africa. In this system the white land owner entered into a partnership with Africans who owned ploughs and oxen. The Africans cultivated the land, sowed their own seed and reaped the crop, handing over half of the yield to the land owner.

The 1913 Land Act gave the system a blow from which it never recovered.[1)]

The sharing of the crop system, so often criticized, is at this stage of economic development preferable to a "cost plus" system, since it makes the share cropper interested in maximizing the fields' yields.

The transition from animal to tractor cultivation and the increased use of inputs seem to increase the number of fields which are cultivated through share cropping.

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1. WILSON F., FARMING 1866-1966, IN THE OXFORD HISTORY OF SOUTH AFRICA, pp. 127 - 130.

This cultivation technique requires more capital, therefore the attraction of the credit and insurance incorporated in share cropping, is greater than it was before.

It seems that the tractor owning share-croppers have not yet adjusted themselves to the new situation. The acreage cultivated by them is too small to cover the high fixed costs of tractor and implements and the other overheads involved. Their charges are often too low and they may find it difficult to finance the replacement of their equipment when the time for this comes.

On the other hand, if assisted, the share croppers may form the best means for extending mechanization and credit services to small farmers as well as spreading the use of fertilizers, improved seeds and water conservation techniques.

The share croppers are profit motivated private entrepreneurs, therefore it should be easier to make them accept new technologies which may increase their profit.

Each one of them could cultivate fields for 50-100 farmers, and it should be easier to spread new technologies to these farmers by communicating with one share cropper rather than by contacting each farmer separately.

4. CREDIT INSTITUTIONS:

A) AGRICULTURAL DEVELOPMENT FUND (ADF):

The ADF was established in 1962/63 with grants from Oxfam and other agencies. It has developed into a revolving

fund for the purpose of giving short term loans for buying seeds and fertilizer, to individual farmers.

The ADF has been under-staffed and its capital resources insufficient. High administrative costs and bad debts have depleted its capital. In the period 1963-68 excess expenditure amounted to R25 400 out of a total fund of R86 700 which was donated by various institutions. Credit extended during this period amounted to R77 213 given to 6 760 farmers. The average percentage repayment of loans during this period was 71%.[1)]

The future of the ADF is not clear. It is very likely that it will be incorporated in the Development Bank which is supposed to be established soon.

B) CREDIT UNIONS:

During the past few years a few Credit Unions have been formed on the lines of CUNA international.

Discussing village credit cooperative societies, Lewis stated that their advantage to commercial banks is that their cost of acquiring information about the borrower and keeping an eye on his movements, is lower since they have known him personally.[2)]

Lewis however fails to mention the great disadvantage of such societies. Because of personal acquaintance with the borrower or other ties (family or political) they tend to give loans to individuals whose credit worthiness has not been proved. Their other great disadvantage is the chronic lack of good management.

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1. ADF REPORTS.
2. W.A. LEWIS - THE THEORY OF ECONOMIC GROWTH p. 128.

Given the risk involved in dry land farming under Lesotho conditions and the lack of securities it is not safe to give loans to individual farmers. In fact, in many cases the member of the credit union gets a loan which is equal to his own savings. However, while for these savings (shares) he gets a dividend of 3% - 4%, he has to pay 12% interest on the loan he gets. Given the possibility to save in the Post Office Saving Bank or in a saving account in a commercial bank, from which the money can be withdrawn when it is required and in which it is safer, the suitability of the credit unions to Lesotho conditions seems questionable.

## 5. THABA-PHATSOA IRRIGATION SCHEME:

The irrigation scheme at Thaba-Phatsoa was started in 1967 on a area of 85 acres. The water source was an irrigation dam with a capacity of 300 million gallons which was built originally for soil conservation purposes. The land on which the project was established and which was cultivated by many farmers, was consolidated. The farmers became participants in the scheme in accordance with the acreage which they contributed to it.

According to the agreement between farmers and the Ministry of Agriculture, the Ministry provides all managerial functions and production costs, in return for 50% of all the gross margin per acre. The remaining 50% are divided by the number of acres, each farmer getting his part in accordance with the number of acres which were contributed by him.

In the first year, the gross marginhad amounted to R80 per acre and the farmers' share was R40,00 per acre[1] No reports have been published about the following years but the manager of the

1. SOURCE: Memorandum, Thaba-Phatsoa Irrigation Project - Ministry of Agriculture, August 1969, (mimographed).

the scheme estimated the annual gross margin at R100 per acre.

While the participating farmers were expected to contribute labour they received no payment for their work (later they were paid 60c every 6th day i.e an average payment of 6c per day. The reason for this was the manager's wish to show "high gross margin."

No wonder then that the farmers were reluctant to contribute labour at no payment and workers had to be hired at a payment of 60c per day (minimum Government daily rate), mainly in the peak season.

This brought the idea of mechanising a certain operations in order to cut the labour cost.

While the farmers were supposed to form a cooperative or similar association after 4 years, they were no nearer to this now than at the time the project was established.

However, it is clear that while some of the farmers refused to participate at the beginning (and were forced to do so), they are aware of the increased income which resulted from the introduction of irrigation. At their request the project is to be extended to 150 acres.

Irrigation schemes run by the Government can be regarded as one of the possible organisation patterns. The Thaba-Phatsoa project could have supplied important information for the evaluation of such projects. It is regretable that records have not been kept there in an orderly manner.

The distribution of the gross margin as a return for land

only and the fact that the farmer did not get a fair compensation for his labour contribution, has caused an artificial labour shortage in an area which generally suffers from underemployment. It can be said that the project has been suffering from a lack of economic direction.

## 6. PROGRESSIVE FARMERS:

The "Progressive Farmers Scheme" started at the end of 1958. The scheme operated as following: an approved candidate was to work with a demonstrator from the Department of Agriculture for three years. Each demontrator was to work with a maximum of ten farmers. The demonstrator was supposed to help the progressive farmer to acquire tools and fertilizer. Credit was also made avaiable for the progressive farmers. Halpern, after avisiting Lesotho stated that "at present, the most promising developments in Basutoland are the progressive farmers' scheme and the growth of the cooperative movement". [1] The number of progressive farmers was 487 in 1960/61 and it had reached 798 by 1964. [2]

However, the Annual Report of the Ministry of Agriculture for the year 1964 is the last one in which the scheme is mentioned It has failed to achieve its target and has been abandoned.

Yudelman, mentions a similar experience with the introduction of new technologies through demonstrators to the African areas in Rhodesia.

The result of their work was examined by a committee which found that after 15 years, most of the farmers in the neighbour-

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1. HALPERN J. 1965 p. 186.
2. SOURCE: Annual Reports of the Ministry of Agriculture.

hood continued using their primitive methods despite the fact that the average yields in the demonstration plots were 5 times higher than those on ordinary farms.

Yudelman suggested 3 possible explanations:

a) the opportunity cost of leisure

b) the increase in risk involved in using the new technologies.

c) the high discounting rate of interest.[1)]

7. TAUNG RECLAMATION SCHEME:

This was an anti-erosion scheme planned for the Taung Ward in the Mohale's Hoek district. Soil errosion in this area has reached an extreme stage and the necessity of urgent action was widely recognized.

A plan was made to close temporarily overgrazed areas and stop the cultivations of unsuitable lands. At this stage animals were to be sent to cattle posts in the mountains. After that a proper land use plan was to be introduced into the area.

The implementation of the plan started in 1956. People were instructed to remove all the stock from the area and some of the lands were not to be cultivated. However, these regulations were not obeyed despite the setting up of a special court for dealing with cases of disobedience.

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1. YUDELMAN, M., 1964, Chapter 6.

The political disputes which followed the local elections in 1959, and the replacement of the Regent made the scheme a target for political disputes. The scheme was finally withdrawn by the Department of Agriculture in 1961.

The main reasons for the failure of the scheme were analysed by Wallman[1] as following:

a) The administrative responsibility for the scheme was not clear.

b) Staff was insufficient.

c) The regulations of the scheme were unpopular and the unpopularity was transferred to the people responsible for it.

d) Bad communication with the people. The BaTuang "regarded the scheme as belonging to somebody else --".

e) The chiefs did not cooperate fully.

f) The scheme became a focus for a political dispute.

g) There was not sufficient grazing land in the mountains, to replace the area which was closed.

h) Farmers whose fields were to be closed could not get other fields to replace them.

8. CONCLUSIONS:

Experience with cooperatives in Lesotho suggests that under present conditions they cannot be expected to play

1. Wallman S. 1969. ch.4.

a leading role in the agro-economic development of Lesotho.

Leistner, reporting on a visit to European institutions concerned with African development, states that most of those asked about the role of cooperatives were sceptical. None of the experts visited were aware of successful cooperation in the field of production. Production on a cooperative basis was considered unsuitable in the early stages of development because of the following main reasons:

a) lack of a clearly discernible link between individual effort and gain.

b) lack of technically and personally qualified leadership.

c) clash with tradition.

d) the contradiction between the ideal of all members having an equal say and the practical need for one competent decision maker.[1)]

These reasons in addition to political friction seem to be valid in Lesotho.

Experience with government hire services in other African developing countries has not been encouraging either. De Wilde, states that many schemes have been tried but "virtually all have failed to cover costs of operation and have had to be abandoned or continuously subsidized."[2)]

The weakness of the cooperative organization patterns and the government hire services on one hand and the existence of

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1. LEISTNER G.M.E., Aspect of European Research on Peasant Agriculture in Africa, Agrekon, Vol. 9. No.1. Jan. 1970. p

2. DE WILDE JC., 1967, p. 121.

fairly successful private entrepreneurs in the field of agriculture on the other hand suggests that promoting them may be a more promising approach to agricultural development.

The main weakness of credit schemes in Lesotho has been their inabilty to ensure the repayment of credit. The European experts visited by Leistner, considered the provision of credit as "utterly unsuitable as a first step in co-operation because unsophisticated peasants happily accept fertilizer, seed, implements etc. 'free' but will not readily repay this credit in cash after the harvest"[1]. Here again the extension of credit through private entrepreneurs, is a promising approach.

The failure of the progressive farmers scheme suggests that "programmes aimed solely at improving the economic efficiency of farmers are doomed to failure"[2]. The farmers may have been optimizing their production in respect to their constraints. Only a change in the constraints e.g. establishment of irrigation, easy approach to R.S.A. markets, ensured product prices, efficient cultivation services, availability of credit and farm inputs may accelerate the change of the stagnating production patterns. However, their removal is beyond the possibilities of any individual Basuto producer and can be achieved only through government initiative.

Finally, the experience from the Taung Reclamation Scheme demonstrated the importance in gaining the farmers confidence

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1. LEISTNER, I b i d ,
2. SCHULTZ, T.W. 1965 p. 45.

and cooperation as a precondition for the success of any agricultural development scheme in Lesotho.

# CHAPTER - 10.

## ORGANIZATION PATTERNS:

### 1. INTRODUCTION:

Mellor, classifying the inputs required for technological change, mentions the importance of institutions for servicing agricultural production, such as distribution of inputs, marketing and credit.[1] In planning the "village model" it was assumed that such services are available to the producers. Having reviewed the lesson from past experience in Lesotho in this field (see Chapter 9), this chapter will deal with possible organization patterns in the light of the development possibilities (see Chapter 8) in a very general manner. A more detailed examination of this problem is considered to be outside the scope of this study.

In examining the possible patterns, the scarcity of good technical personnel in the high and medium levels, must be borne in mind. The main difficulty is due to the fact that agricultural production is done by so many independent micro-producers. This means that the contacts of any central organisation (for supply, marketing, credit ) cannot be directly with the producer but has to be done through "mediator" such as cooperatives, private constractors . The organization pattern suggested

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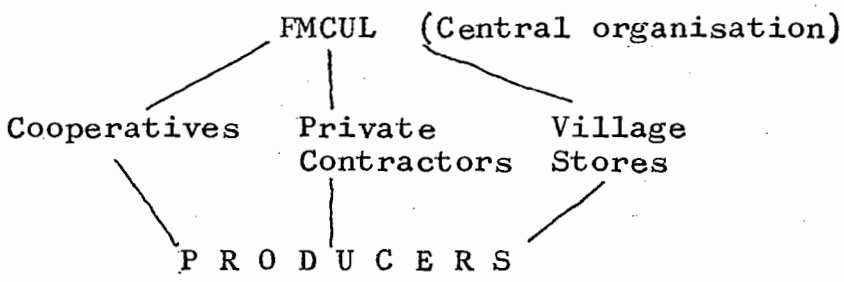
1. MELLOR J.W., Towards a theory of Agricultural Development in Agricultural Development and economic growth edited by Johnston B.F. and H.M. Southworth, p. 49.

for supply and marketing is shown schematically in the following diagram:




2. SUPPLY AND MARKETING:

The FMCUL has been functioning as a central supply organization and has also undertaken recently some marketing functions. It has been suggested that FMCUL will be freed of its restrictions which limit it to dealing with cooperatives only and will undertake marketing activities.[1)]

Classified according to their channel of communication with the central marketing and supply organisation (FMCUL) the producers may be divided into 3 groups:

a) producers organized in cooperatives.

b) producers operating through private contractors (Share-cropping).

c) producers operating on their own.

a) Producers organised in cooperatives - the communication will be between the management of the cooperative (on behalf of its members) and the FMCUL.

b) Producers operating through private contractors:

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1. Agricultural Planning and Marketing, p. 9.

The FMCUL will deal with the contractors who will buy the inputs required for the fields cultivated by them. They will sell to FMCUL, not only the part of the product which they get from the producers in return for their services but also the surpluses which the producers intend selling in the market.

c) Producers operating independently: These are producers who buy the input and pay for each item at purchasing time.

It is essential to have a store for the sale of inputs in every village.[1] Such a store should preferably be located either in an existing grocery shop in the village or in a private contractor's place depending on the situation. As to the buying of the product, the FMCUL may organize one buying day per year in every village, for each of the main crops.

Alternatively, the purchase may be done through the village supply store. Because of bad past experience it may be advisable for FMCUL not to manage savings accounts or extend credit. These functions should be undertaken by the commercial banks.

3. CROP INSURANCE:

The organization patterns suggested should embrace marketing supply and credit. However, no credit scheme can succeed under Lesotho conditions without its being backed by a compulsory insurance of the crops for which the credit is extended.

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1. The situation now is that there are FMCUL stores in the main district towns and farmers have to travel many miles in order to buy fertilizer and seeds.

In the case of a crop failure the lending agency is to be refunded from the insurance fund.

In order to reduce the cases of crop failure and therefore the insurance premium, the crop insurance and the credit, should be limited to fields - which:

a) were ploughed in the way recommended (water conservatio effect).

b) used recommended inputs (selected seeds, fertilizers, insecticides ).

c) were planted within the recommended period.

4. CREDIT:

The scheme recommended is one of supervised credit. The cooperatives and the agricultural contractors can generally offer securities which are acceptable to commercial banks and should therefore receive their credit from them. They will be obliged to deal only with the bank which extends the credit and to consult the bank before undertaking any major investment.

The securities given to the bank will include:

1. Crop insurance policy.
2. Returns from sales to FMCUL.
3. Liquid assets
4. Government guarantee.

It is expected that the banks will have agricultural credit

advisers or agricultrual economists who will keep the agricultrual clients under constant supervision and give them current advice.

In this way, commercial credit which has not been used in agriculture, will be mobilized for financing the expected technological changes in agricultrual production.

There is one group of producers for which no credit provisions have been suggested. These are producers operating independently (see Sec. 10:2). However, many of them are expected to have some savings which may enable them to buy the required inputs without provision of credit. As for the others, they are expected to join any of the other groups (cooperatives, private contractors) gradually.

## 5. MECHANIZATION SERVICES:

The 3 main sources of mechanization services in the lowland are:

a) Cooperatives.

b) Government (Lema - see Sec. 9:3.).

c) Private contractors ( share-croppers).

Past experience with cooperative mechanised services (see Sec. 9:3.) shows that extreme caution should be taken here. Good management must be ensured and the area which is to be cultivated should be large enough to justify the purchase of a tractor and equipment.

As regards government mechanized services - there is no

justification at all for these in the lowland. Experience has shown that they can be given at a lower cost[1] by profit motivated private entrepreneurs. Government limited resources may have a more efficient use in areas to which private enterprise is not attracted.

Experience in Lesotho has shown that private contractors may be the main source of mechanization services to agricultural producers. However, experience in other parts of Africa shows that their disadvantage lies in a miscalculation of the actual cost of production and the high cost of repairs.[2]

The situation in Lesotho is similar (see Sec. 9:3). It will be essential to train the contractors and their tractor operators, establish good repair services, extend credit for the purchase of equipment ..

The establishment of an insurance scheme makes it possible to transform the traditional sharecropping into a more modern system. The sharecropper can now agree to an alternative way of sharing - one in which he deducts in grain, the equivalent of the value of his services to the producer.

However, many producers such as miners, old men and women, who cannot look after their fields may still prefer the old system, i.e. sharing according to fixed proportions since it increases the sharecropper's interest in the production results of the field.

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1. Lower cost to the economy but not necessarily to the individual farmer since government mechanisation services are generally heavily subsidized.

2. DE WILDE, J.C., Op. cit. p. 120.

6. IRRIGATION SCHEMES: (See Sec. 9:5)

There are no final formulas as yet for the organization of irrigation schemes in Lesotho.

It is desirable to choose for this purpose full time farmers i.e. producers for whom farming is the main source of income. Since all the arable land has already been allocated to producers, not all of whom are suitable according to this criterion, some land exchange must take place.

An alternative may in some cases be that of operating all the irrigable land in a communal way to the benefit of all the village members. In such a case each producer will have dry land field(s) and also be a member of the irrigation scheme sharing duties and profits with other producers.

The two main organizations patterns for the irrigation schemes seem to be:

a) Government managed scheme (like Thaba-Phatsoa)

b) Cooperative.

In a government managed scheme all the irrigable lands are pooled. The government is to supply the investment capital and a manager, who is to work with a committee selected by the participants. The manager in consultation with the committee will decide on the production plan. The net income should be divided among the participants using two criteria:

1) The size of the land contributed to the scheme.

2) The amount of labour contributed.

The remaining surpluses may be accumulated in a reserve fund after an appropriate allocation to a depreciation fund. Such a scheme may later develop into a cooperative.

In the case of a cooperative, all is in fact, expected to be the same, except for the fact that the manager will be appointed by the cooperative members rather than by the government.

In both forms of organization, supply and marketing services are to be undertaken by the FMCUL, and credit through commercial banks. Mechanisation services may depend on a schemes's size: large schemes may prefer to own their tractors and equipment. In the case of small schemes, hiring may be justified.

MARKETING:

Vegetables are expected gradually to become the central crops in any irrigation scheme.

The marketing of vegetables may raise some problems. A great part of the vegetables are to be exported to the Republic where they will have severe competition from the more experienced S.A. growers. In order to succeed the standard of the product has to be high. Another problem is that of planning the production in such a way as to avoid excessive surpluses.

These marketing and planning functions are different to those required for grains and may therefore required a special department within FMCUL to deal with vegetables.

## 7. LAND TENURE[1)]

The land tenure system has been blamed for the lack of progress in agriculture in Lesotho. A series of expert missions have stressed the necessity of introducing changes which will give the farmers more security of tenure.

However, most experts were of the opinion that such changes should be consistent with the maintainance of the basic elements of the present system.[2)]

Ashton, regarded the defects of the system as not great enough to justify any upheaval; a tighter control of the chieftainship could according to him, be suited to the Basutos' present needs.[3)] To some extent this has already been done by the Land (procedure) Act of 1967 (see appendix C.).

Changes in land tenure which enable industrial development have already been introduced. The introduction of irrigation which involves long term investment, will certainly require amendments of the land tenure which will give more security of tenure to the participating farmers.

Without such provision the farmers' inducement to invest in the land will be low.

While changes in land tenure will also be desirable in

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1. A Detailed dicussion of reforms in land tenure is outside the scope of this study.
2. I B I D , 1968, Current Economic Position and Prospects of Lesotho, p.7.
3. ASHTON, H., 1967, p. XXX1.

the case of dry land farming, they are not as essential as in the case of irrigation, and the improvement of dry land farming can be implemented with the existing system.

## 7. CONCLUSIONS:

The organization patterns recommended are similar to those which exist at present and have proved successful.

Although past achievements of FMCUL have not been impressive it has a fair chance of success if its operations will be extended on a national scale and also include marketing. Cooperatives should be limited to cases in which a basis for successful cooperation exists and where good management is ensured. However, the cooperative movement does not seem capable at present of extending itself on a wide scale.

Private contractors (share croppers) have provided the producers with important services but their contribution has never been fully acknowledged. They have played an important role in the introduction of mechanization services to Lesotho.

Their "credit system" has been more successful than any other one in Lesotho. The share cropping arrangement enables farmers to work in the mines while their fields are cultivated by the sharecropper. It is suggested that this system will be modernized and extended.

While agricultural producers have been craving for credit, and commercial banks have been looking for clients, commercial

credit has not been available for agriculture. A way to mobilize commercial credit through a supervised credit scheme is suggested here.

Finally, experience with irrigation schemes in Lesotho has been limited. The organization suggested is based on past experience with irrigation schemes or similar fields.

# CHAPTER - 11.

## AGRICULTURE AND ECONOMIC DEVELOPMENT[1)]

### 1. AGRICULTURE AND ECONOMIC DEVELOPMENT:

The role of agriculture in economic development has long interested economists.

Typical to developing countries is the fact that most of their labour resources are engaged in agriculture. The main reason for this is the low level of efficiency in agriculture in these countries.[2)] A comparative analysis of the national aggregates (GNP, GDP) of many countries shows a relationship between a high stage of development and a small propottion of the labour occupied in agriculture.[3)] The reduction in the proportion of the labour force engaged in agriculture which accompanies economic development can be explained by the following two main facts:

a) the increase in agricultural productivity which has accompanied economic development.

b) as income per capita increases the proportion of income spent on food decreases (Engel's law).

" As the largest sector of the economy agriculture is the chief source of man power for industrial expansion, itiis the chief source of savings for non-agricultural investment."[4)]

It is clear therefore that an increase in agricultural

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1)The chapter presents a brief review of contemporary economic thinking on the role of agriculture in economic development. A more detailed discussion on this subject is considered as being outside the scope of this study and can be found in the reference books.
2) Mellor J.W. 1966. p.4. 3) Kuznets S., Six Lectures on Economic Growth.
4) Johnson B.F. and H.K. Southworth, Agricultural Development : Problems and Issues in "Agricultural Development and Economic Growth". p.4.

productivity which will enable mobilizing labour from agriculture to other sectors is a precondition for economic development.

It is agued that "economic development involves a major transformation of the economy from one which is dominatly agricultural to one containing a large and growing urban - industrial sector."[1)]

However, it would be a mistake to deduce from this that one of the primary requisites for a developing country is to reduce its agricultural population. Dovring, analysing data from advanced countries, shows that in their early stages of growth the absolute number of people engaged in agriculture increased (although their proportion in the labour force decreased). Only after a relatively long period of time there was a decling in the absolute number also. Dovring's conclusion is that "in most of the less developed countries today, there is no reason to expect a reduction of absolute numbers in the agricultural population within the near future."[2)]

## 2. THE BALANCE OF ECONOMIC DEVELOPMENT:

A debatable problem in planning economic development is that of keeping a balance between development of the agricultural sector and that of the industrial one. One of the main advocates of balanced economic growth is R. Nurkse. His basic argument is that because of the limited market in under-

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1. MELLOR J.W. "TOWARDS A THEORY OF AGRICULTURAL DEVELOPMENT" in "AGRICULTURAL DEVELOPMENT AND ECONOMIC GROWTH" p. 23

2. DOVRING F., THE SHARE OF AGRICULTURE IN A GROWING POPULATION, IN AGRICULTURE IN ECONOMIC DEVELOPMENT" edited by Eicher C. vand L. Witt, McGraw-Hill, 1964.

developed countries it is impossible to start economic development with a single industry. The only way of doing so is by investing in a wide range of industries at the same time in order to create simultaneously with the increased production capacity, an overall enlargement of the market.[1)]

Hirshman, while critizing the balanced growth approach on the grounds that underdeveloped countries do not have the resources required for carrying out such a policy[2)] suggests his approach of unbalanced growth. According to this approach a "deliberate unbalancing of the economy in accordance with a predesigned strategy, is the best way to achieve economic growth."[3)]

Given the scarcity of resources in developing countries, development planning involves the establishment of priorities between the economic sectors. The convenient solution of balanced agricultural and industrial development is not always feasible because it may require spreading the economic resources on a front which is too wide for their effective use.[4)]

Some economists (e.g. Kahn A.E., Viner J. )[5)] argue for giving priority to agricultural investment because of the importance in increasing food production or because of the higher

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1. NURKSE R. p. 1953.
2. HIRSHMAN A.O., 1965 p. 53.
3. HIGGINS B., 1968 p. 335.
4. NICHOLLS . W.H., 1964, p. 14.
5. I b i d.

marginal productivity of capital in agriculture. Others, however, while recognizing the importance of raising agricultural productivity conclude that it can be achieved only through a "big push" industrialization programme.[1] However, even the economists belonging to this second group (e.g. Singer H., Hirshman A. ) recognize the need to accompany the big push in industry by a big push in agriculture as well.[2]

3. UNDER-EMPLOYMENT:

The concept of under-employment (i.e. a situation in which the marginal product of labour is zero) is a debatable one among economists. Lewis, based his famous model of economic development with unlimited supplies of labour on the assumption that there are countries in which agriculture contains a large pool of unproductive labour. This labour can be drawn away to other sectors without any significant reduction in agricultural production.[3]

Fei and Ranis presented a model which is also based on the assumption of the existence of under employed labour resources within the agricultural sector.[4]

Empirical studies in a few developing countries have confirmed that under employment (or disguised unemployment) in agriculture does exist.[5]

However, many other economists question the existence of

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1. I b i d , pp. 15-16.
2. HIGGINS B. Op. Cit. p. 334.
3. LEWIS W.A.,Economic Development with Unlimited Supplies of Labour, reprinted in The Economics of Underdevelopment edited by Agarwala A.N. and S.P. Singh.Oxford Univ. 1963.
4. FEI, J.C.H. & RANIS.,1964 5. KAO C.H.C. & OTHERS 1964.
5. KAO C.H.C. and others, 1964.

under employment. Schultz, who earlier supported the validity of the disguised unemployment concept, rejected it in later publications.[1] As an empirical reinforcement he brought the example of the influenza epidemic in 1918-1919 in India in which the agricultural labour force was reduced by 9 percent. The area sown in 1919-1920 was 3,8 percent below the area sown in 1916-17.

This shows according to Schultz that no part of the labour force was under employed at the time of the epidemic.[2] Other economists (e.g. Higgins) pointed out that under employment in agriculture is seasonal. During planting and harvesting time the entire labour force is employed, therefore any permanent withdrawal of workers from agriculture will cause a decline in agricultural production.[3]

4. THE APPLICATION TO LESOTHO:

Economic development models attempt to explain the expected stages of economic growth in countries with conditions similar to those assumed in the model (under-employment).

There is under-employment in the agricultural sector in Lesotho as can be seen from the following example:

In a lowland area, work on road improvement was done in the middle of the harvesting season (May, June, July). Payment

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1. I b i d , p. 139.
2. I b i d ,
3. HIGGINS B., Op. cit. p. 305.

to workers was given in food. The year was a good one for crop production and the yields were higher than the regular, therefore, more workers were required for the harvesting, threshing and winnowing the crop. Despite the fact that about 150-250 workers out of about 1 000 farm households were engaged daily 5 hours per day in road work, the harvesting of the crops was completed in time. This proves that in this particular area under employment exists even in the harvesting season (which is a peak season). A great number of workers could be removed to other work without causing a decline in production.

However, while under-employment does exist, the suggested models for explaining the economic development of labour surplus economy[1] are not suitable here. Firstly, a basic assumption in these models is that "any number of workers whatsoever can be absorbed into the industrial sector."[2] However, the industrial sector in Lesotho cannot at present absorb any significant number of additional workers, neither will it be capable of that in the foreseeable future.

The industrialization of Lesotho while important for future economic development is not the means for accelerating the rate of growth in the near future. Even if the rate of industrial development will be much higher than that of the other sectors of the economy, its contribution to the economy in the coming years will remain relatively low (see Sec. 2:6).

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1. LEWIS MODEL, FEI-RANIS MODEL
2. HIGGINS, OP. CIT., p. 309.

Secondly, the quality of the under-employed labour (mainly women old men, youths) is simply not of the calibre which is required for industrial development. However this type of labour can be used for the intensification of agricultural production.[1)]

The labour required for industrial development can be expected to come from the following two main sources:

a) The natural increase in the labour force.

b) A decrease in the number of Basuto wokers in the mines (in the long run).

However, in the short run industry may not be able to absorb even the annual increase in the labour force, and the number of Basutos working in the Republic may increase. It can be seen from this discussion that agricultural development and industrial development do not compete with each other as regards labour resources.

The development of the agricultural sector requires heavy investment (irrigation, machinery ).

However, agricultural and industrial development do not neccessarily compete with each other as regards investment capital either. While the investment in industry can be expected to be financed mainly by private foreign capital, in the first stages, investment in agriculture may be financed

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1. It is suitable for work such as weeding, transplanting, harvesting.

mainly by international sources (IBRD, UNDP, bilateral aid ).

At a later stage increased savings from the agricultural sector (as a result of the agricultural development) may be mobilized for financing investment in the other sectors of the economy.

As to the problem of balanced industrial growth, given the economic cooperation with R.S.A. the main argument for it i.e. the necessity of creating the market, does not take place. Instead there is the problem of competing with the highly developed industries in the Republic.

However, experience has shown that most of the newly established industries in Lesotho have been established with the aid of foreign capital and knowledge, and are therefore in a competitive position at an early stage.

## 5. CONCLUSION:

The main conclusion from the discussion in this chapter, is that the main potential of economic growth in Lesotho in the coming years lies in agriculture. Being the main economic sector, its high rate of growth is essential for the achievement of a high rate of growth in the economy as a whole. Given its present backwardness it should be possible to raise its production significantly.[1)]

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1. An increase in the average yield from 2,5 bags/acre to 5,0bags/acre (100%) may be achieved by introducing "simple inputs" such as fertilizers and improved seeds. An additional increase of 100% in the yields may be much more difficult to achieve, if possible at all. Therefore, had the average yield initially been 5,0 bags/acre for example the possibilities of increasing agricultural production would have been much more limited.

# CHAPTER - 12.

# CONLUSIONS .

## 1. INTRODUCTION:

"It is much easier for a poor country to acquire a modern steel mill than a modern agriculture"[1] This statement describes the situation in Lesotho.

While a modern hotel with a casino has proved itself successful within one year, most of the schemes for increasing agricultural production have failed.

The main reasons for the failure of agriculture development programmes in developing countries are, according to Schultz:

a) A misunderstanding of the economic constraints in traditional agriculture.

b) The mistaken idea of farmers being inefficient in the allocation of their resources.

c) The mistaken belief that farmers are not saving and investing enough and that they are using less than an optimum amount of credit.

d) The attempts to induce farmers to use inputs which are not productive enough to make their use profitable.[2]

Many failures of agricultural schemes in Lesotho can be attributed to similar reasons. More recent examples of projects which are still in the planning stage may demonstrate

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1. SCHULTZ, T.W., 1965, p. 41.
2. Op. cit, pp. 56 - 57.

the danger of repeating such mistakes:

a) In a draft plan for increasing crop production, the planners stated that they would discourage sharecropping. Had they bothered to understand the economics of sharecropping in Lesotho they would surely have changed their attitude and by doing this would have increased their chances of success.

b) Another agricultural development scheme puts an excessive emphasis on involving the farmers in field operations. For many farmers the income from work outside the farm (mines, etc.) is an essential complement to the income from farming. A farming system in which the farmers' involvement is minimized, will be more suitable for them.

A great deal of the planning and advisory work in agriculture is done by expatriates. Many of them tend to underestimate the capability of Basutos to adapt themselves to new enterprises and technologies. That this estimate is a subjective one, can be demonstrated by the following example:

The owner of a new factory in Lesotho hired a man (European from an African country) to train local workers. This man who had a very low opinion of Africans, told the author that it was very difficult to teach them and that at least "15 years" would be required for this purpose. Later, another man newly arrived in Africa was hired for the same purpose. This man was, in the owner's words "performing miracles" in the training of local workers. The man himself described them as highly adaptable and quick to learn.

A basic assumption through this study is that Basutos are capable of adapting to the new enterprises and technologies which are required for increasing agricultural production.[1)]

1. With the help of technical assistance from abroad.

Another basic assumption is that the economic development of Lesotho should be based on full economic cooperation with R.S.A. Such cooperation is very important for Lesotho's economic development and outweighs the disadvantage of an increased dependency on the Republic.

It was not the objective of this study to propose a detailed agro-economic development plan for the lowland. The purpose was rather to suggest new ideas which would stimulate new thinking among agricultural planners.

## 2. CONCLUSIONS:

Two main ways for increasing crop production in the lowland were examined:

a) Irrigation

b) Improvement of dry land farming.

It has been shown that given the availability of capital and technical resources, the introduction of irrigation would be limited mainly by the availability of water, suitable soils and economic considerations.

Given the high rate of underemployment and the necessity to create additional employment opportunities for the growing rural population, the establishment of irrigation should be given a 'big push'. The profitability of irrigation and its contribution towards increased employment will depend on the type of crops grown. The greatest increase in income and employment will be achieved if the irrigated crops are labour intensive and high income crops such as vegetables.

The introduction of irrigation should therefore be accompanied by the introduction of vegetables (and similar crops).

The improvement of dry land farming is the obvious way to increase crop production in places in which irrigation is not feasible. However, the methods recommended, while increasing land (and to some extent labour) productivity, will reduce the number of days required per unit area (acre), and may therefore incrase unemployment.[1)]

Therefore a balance between the development through the improvement of dry land farming and through irrigation should be established.[2)]

The solution to the village model with irrigation and vegetables (chapter 7) and the projected modest increase in employment opportunities in industry show that labour migration will continue to be an important source of employment and income for the rural poppulation in the foreseen future.

Agricultural production should therefore be organized in a pattern which will enable labour migration without a reduction in land productivity.

Cooperatives have not proved suitable to the conditions of Lesotho. The transformation of the existing sharecropping

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1. This effect may be countered to some extent by the introduction of labour intensive dry land crops (like potatoes,)

2. Irrigation can be introduced in a quicker step than the improvement of dry land farming since it is assumed that there is a supply of under-employed labour.

system into one based on private entrepreneurs is a more promising organization pattern for the extension of mechanization and credit services to producers. This is also a way to mobilize commerical credit for its use in agriculture.

## APPENDIX A - POPULATION:

### A. THE POPULATION OF LESOTHO.

1891 - 1975.

| YEAR | POPULATION (000)[1] DE FACTO[2] | POPULATION (000)[1] DE JURE[3] | DENSITY PER SQUARE MILE DE FACTO | DENSITY PER SQUARE MILE DE JURE |
|---|---|---|---|---|
| 1891 | 219 | | 19 | |
| 1904 | 349 | | 30 | |
| 1911 | 404 | | 34 | |
| 1921 | 499 | | 43 | |
| 1936 | 562 | | 48 | |
| 1946 | 564 | | 48 | |
| 1956 | 642 | | 55 | |
| 1966 | 852 | 968 | 73 | 83 |
| 1975 | 1015[5] | 1152[4] | 87 | 99 |

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1. SOURCE FOR THE YEAR 1891-1966: STATISTICAL BULLETIN 1966.
1. PRESENT
2. INCLUDING ABSENTEES
3. PROJECTION (SOURCE - LFDP)
5. BASED ON THE ASSUMPTION THAT THE PROPORTION DE-FACTO : DE JURE IN 1975 WILL BE AS IN 1966.

B. THE POPULATION DENSITY IN SELECTED AFRICAN COUNTRIES IN 1968.

( PERSONS PER SQUARE MILE)

| COUNTRY | DENSITY |
|---|---|
| SOUTH-AFRICA | 41 |
| LESOTHO | 87 |
| BOTSWANA | 3 |
| SWAZILAND | 60 |
| MALAWI | 95 |
| KENIA | 45 |
| TANZANIA | 35 |
| ZAMBIA | 14 |
| UGANDA | 89 |
| NIGERIA | 173 |

SOURCE: AREA - FAO PRODUCTION BOOK 1968.

POPULATION - A SURVEY OF ECONOMIC CONDITIONS IN AFRICA 1969. UN. 1970.

## APPENDIX B.

## GROSS DOMESTIC PRODUCT PER HEAD IN DEVELOPING AFRICAN COUNTRIES IN 1968.

( AT CURRENT MARKET PRICES IN US$)

| | US$ |
|---|---|
| **NORTH AFRICA** | |
| MOROCCO | 211 |
| ALGERIA | 263 |
| TUNISIA | 292 |
| LIBYA | 1 655 |
| UAR | 238 |
| SUDAN | 115 |
| **WEST AFRICA** | |
| MAURITANIA | 175 |
| SENEGAL | 223 |
| MALI | 91 |
| IVORY COAST | 317 |
| UPPER VOLTA | 52 |
| DAHOMEY | 93 |
| NIGER | 94 |
| GAMBIA | 151 |
| GUINEA | 89 |
| SIERRA LEONE | 177 |
| LIBERIA | 312 |
| GHANA | 288 |
| TOGO | 141 |
| NIGERIA | 66 |

| | US$ |
|---|---|
| **CENTRAL AFRICA** | |
| CAMEROON | 175 |
| CHAD | 73 |
| GABON | 526 |
| CONGO (B) | 215 |
| EQ. GUINEA | 234 |
| RWANDA | 44 |
| BURUNDI | 53 |
| **OTHER AFRICA** | |
| ANGOLA | 182 |
| BOTSWANA | 108 |
| LESOTHO | 75 |
| SWAZILAND | 201 |
| MOZAMBIQUE | 171 |
| **EAST AFRICA** | |
| ZAMBIA | 345 |
| RHODESIA | 251 |
| MALAWI | 69 |
| MADAGASCAR | 117 |
| TANZANIA | 74 |
| UGANDA | 96 |
| KENIA | 127 |
| SOMALIA | 63 |
| ETHIOPIA | 65 |

SOURCE: A SURVEY OF ECONOMIC CONDITIONS IN AFRICA 1969 - UN 1971.

APPENDIX C - LAND (PROCEDURE) ACT (Act 24 of 1967, 1.6.1967).

The purpose of the act is to make provision for the procedure of applications for allocation of lands, hearing of appeals, etc.. The main sections of the act are:

1. An advisory board to the chiefs for land allocation, is to be elected in a pitso.[1)]
2. Allocation of land:
   a) An application for the allocation of land should be done in writing to the chief, within whose jurisdiction the land is situated.
   b) Thie chief will fix a time for hearing, in which the applicant will have the right to support his application. Records of the proceedings are to be kept in writing.
   c) The chief will take into consideration advice given to him, on behalf of the Minister of Agriculture.
   d) The decision taken shall be in writing and explain the grounds upon which it is given.
   e) The chief may be fined or imprisoned for not consulting the advisory committee.
3. Revocation or derogation of the right to use land:
   a) The chief should give a written notice of his intention to restrict or revoke any interest or right over land. The notice will clearly set out the grounds for his decisio
   b) The person notified will be entitled to make any submission and representation, of which records will bekept.
   c) The person affected has the right to appeal before the autority which is the immediate superior to the chief.
4. Certificate of allocation and registry.
   A person to whom land was allocated will be given a certificate which has to be registered by him.

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1. Pitso - a meeting of the people.

APPENDIX D: COMPUTER'S OPTIMAL SOLUTION RE

| VARIABLE | TYPE | ENTRIES | SOLUTION ACTIVITY | UPPER BOUND | LOWER BOUND |
|---|---|---|---|---|---|
| PROFIT | B* | 0 | 58233.553 | ********** | ********** |
| WORKMINEUL | | 6 | 66.666 | 66.666 | 0.000 |
| HLBA | B* | 2 | 1139.950 | ********** | 0.000 |
| HLBB | LL | 2 | 0.000 | ********** | 0.000 |
| HLBC | LL | 2 | 0.000 | ********** | 0.000 |
| HLBD | B* | 2 | 2853.416 | ********** | 0.000 |
| WIT | B* | 5 | 263.316 | ********** | 0.000 |
| MAIZ | LL | 6 | 0.000 | ********** | 0.000 |
| BIN | LL | 7 | 0.000 | 120.000 | 0.000 |
| PEA | B* | 7 | 36.683 | 120.000 | 0.000 |
| IWIT | B* | 14 | 20.000 | ********** | 0.000 |
| IMAIZ | B* | 12 | 40.000 | ********** | 0.000 |
| IBIN | UL | 10 | 40.000 | 40.000 | 0.000 |
| IPEA | UL | 13 | 40.000 | 40.000 | 0.000 |
| POT | UL | 5 | 100.000 | 100.000 | 0.000 |
| IPOTA | B* | 10 | 29.999 | ********** | 0.000 |
| IPOTB | B* | 11 | 0.000 | ********** | 0.000 |
| CABA | LL | 10 | 0.000 | ********** | 0.000 |
| CABB | LL | 10 | 0.000 | ********** | 0.00 |
| CARA | UL | 9 | 50.000 | 50.000 | 0.00 |
| CARB | UL | 8 | 50.000 | 50.000 | 0.00 |
| ONIA | B* | 11 | 50.000 | ********** | 0.00 |
| ONIB | LL | 12 | 0.000 | ********** | 0.00 |
| TOM | UL | 10 | 20.000 | 20.000 | 0.00 |
| WFODD | LL | 11 | 0.000 | ********** | 0.00 |
| SFODD | LL | 11 | 0.000 | ********** | 0.00 |
| DARY | LL | 8 | 0.000 | 20.000 | 0.00 |
| RPOFIT | B* | 0 | 0.000 | ********** | 0.0 |
| LAND | UL | 0 | 400.000 | 400.000 | 0.0 |
| IRLNDJ | B* | 0 | 199.999 | 200.000 | 0.0 |
| IRLNDF | B* | 0 | 179.999 | 200.000 | 0.0 |
| IRLNDM | UL | 0 | 200.000 | 200.000 | 0.0 |
| IRLNDA | B* | 0 | 140.000 | 200.000 | 0.0 |

VARIABLES AT UPPER BOUND OR LOWER

| VARIABLE | SOLUTION ACTIVITY | UPPER BOUND | COST/UNIT INCREASE | INC A |
|---|---|---|---|---|
| TYPE | CURRENT COST | LOWER BOUND | COST/UNIT DECREASE | DE A |
| WORKMINE | 66.666 | 66.666 | -170.000 | |
| UL | 210.000 | 0.000 | 170.000 | |
| HLBB | 0.000 | ********** | 0.200 | 9 |
| LL | -0.200 | 0.000 | -0.200 | - |
| HLBC | 0.000 | ********** | 0.200 | |
| LL | -0.200 | 0.000 | -0.200 | -3 |
| MAIZ | 0.000 | ********** | 3.966 | |
| LL | 9.200 | 0.000 | -3.966 | |
| BIN | 0.000 | 120.000 | 1.000 | |
| LL | 13.300 | 0.000 | -1.000 | |
| IBIN | 40.000 | 40.000 | -22.133 | |
| UL | 73.500 | 0.000 | 22.133 | |
| IPEA | 40.000 | 40.000 | -72.899 | |
| UL | 80.700 | 0.000 | 72.899 | |
| POT | 100.000 | 100.000 | -7.366 | |
| UL | 26.900 | 0.000 | 7.366 | |
| CABA | 0.000 | ********** | 5.166 | |
| LL | 46.400 | 0.000 | -5.166 | |
| CABB | 0.000 | ********** | 7.766 | |
| LL | 46.400 | 0.000 | -7.766 | |
| CARA | 50.000 | 50.000 | -65.499 | |
| UL | 130.099 | 0.000 | 65.499 | |
| CARB | 50.000 | 50.000 | -117.133 | |
| UL | 130.100 | 0.000 | 117.133 | |
| ONIB | 0.000 | ********** | 50.233 | |
| LL | 153.700 | 0.000 | -50.233 | |
| TOM | 20.000 | 20.000 | -94.533 | |
| UL | 252.700 | 0.000 | 94.533 | |
| WFODD | 0.000 | ********** | 37.600 | |
| LL | -37.300 | 0.000 | -37.600 | |
| SFODD | 0.000 | ********** | 92.833 | |
| LL | -39.900 | 0.000 | -92.833 | |
| DARY | 0.000 | 20.000 | 5.333 | |

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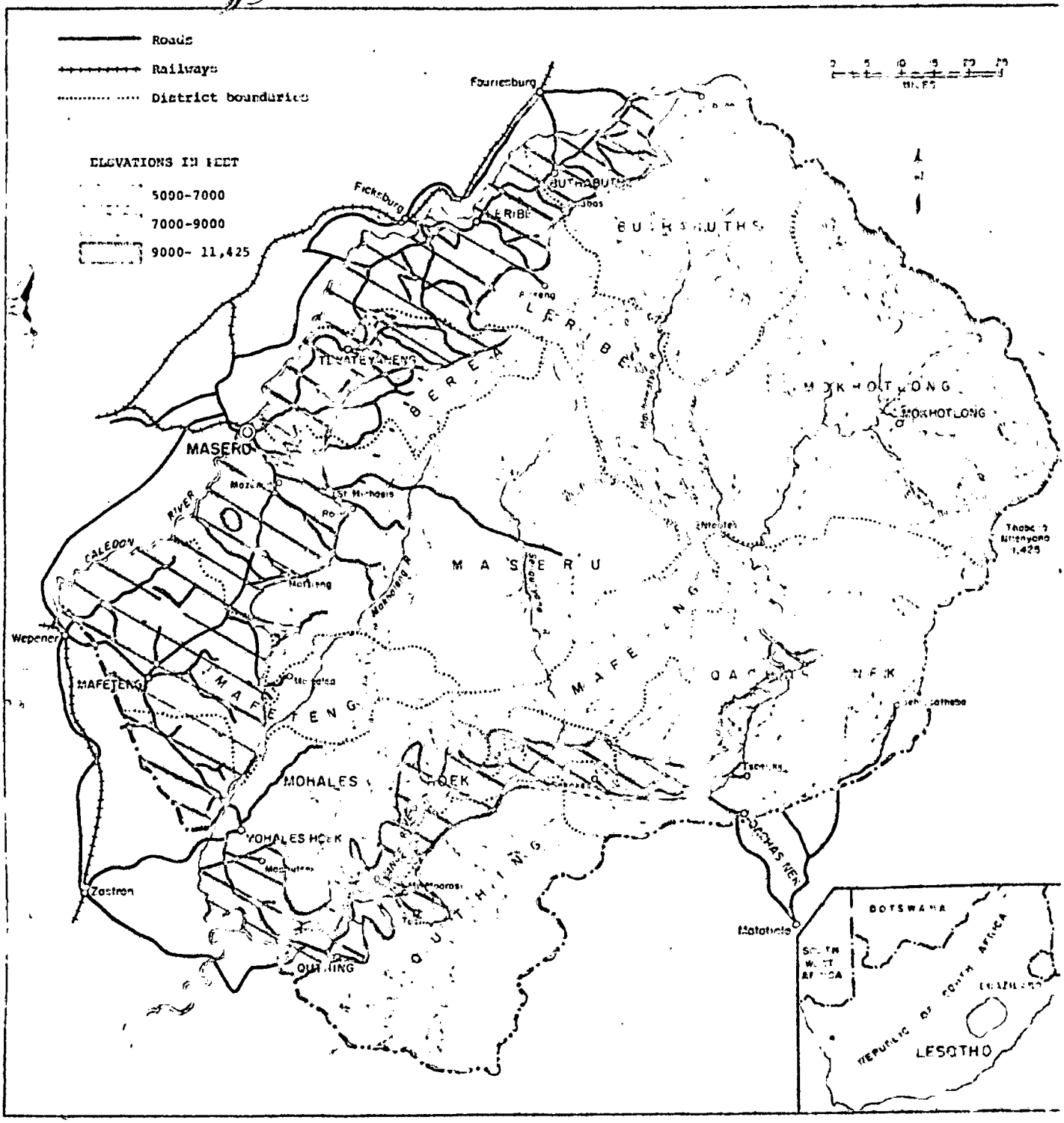
# LESOTHO


Roads
Railways
District boundaries
ELEVATIONS IN FEET
5000-7000
7000-9000
9000- 11,425
Fouriesburg
Ficksburg
LERIBE
BUTHA-BUTHE
BEREA
MOKHOTLONG
MASERU
MAFETENG
MOHALES HOEK
QACHAS NEK
Wepener
Zastron
Matatiele
BOTSWANA
REPUBLIC OF SOUTH AFRICA
LESOTHO