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An Economic and Policy Analysis of Soil-Water Problems and Conservation Programs in the Kingdom of Lesotho

by
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Kingdom of Lesotho

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LESOTHO AGRICULTURAL SECTOR ANALYSIS PROJECT

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and

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Kingdom of Lesotho
Maseru, Lesotho

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TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. METHODOLOGY FOR THE EVALUATION OF SOIL AND WATER CONSERVATION PROGRAMS	6
Conceptual Framework and Physical Criteria	6
Watershed Management Approach	6
Vegetative Control Concept	7
Land Use Capability	9
Necessary Conditions for Determining Effectiveness	9
The Conceptional Economics of Project Evaluation	11
The Opportunity Cost Concept	11
The With and Without Principle	12
Separability and Marginality: The Problem of Sub-Optimization	12
Discounting: The Present Value of the Future	13
Indirect Costs and Benefits, or Shadow Prices	14
Non-pecuniary Costs and Benefits	15
Cost Effectiveness Analysis	16
The Principle of Sufficient Information	17
Option Demands and Soil Conservation in Lesotho	19
Summary and Conclusions	22
III. THE NATURAL RESOURCE BASE OF LESOTHO	23
Overview	23
Physiographic Regions	23
Geology	27
Agricultural Land Resources	29
Soils	29
Land Capability Classes	35
Land Use	39
Evaluation and Management	39
Climate	42
Temperature	42
Precipitation	42
Runoff	46
Erosion and Sedimentation	48
Summary and Conclusions	52
IV. PRE-INDEPENDENCE CONSERVATION PROGRAMS	54
British Conservation Works: Phase I (1935-1950)	54
British Conservation Works: Phase II (1950-1966)	66
Pilot Projects	67
Another Policy Shift (1960)	76
Evaluation	76
Summary and Conclusions	80

Page

V. POST-INDEPENDENCE CONSERVATION PROGRAMS..... 82

Thaba Bosiu Rural Development Project (1973-1977)..... 83
Overview..... 83
Project Objectives..... 83
Budget..... 86
Accomplishments..... 92
Evaluation..... 101
Senqu River Agricultural Extension Project (1974-1977)... 102
Overview..... 102
Project Objectives..... 105
Budget..... 107
Accomplishments..... 108
Evaluation..... 112
Leribe/Khomokhoana Projects (1970-1980)..... 115
Overview..... 115
Project Objectives..... 118
Budget..... 119
Accomplishments..... 119
Evaluation..... 121
Thaba Tseka Mountain Development Project (1975-1978)..... 123
Overview..... 123
Project Objectives..... 126
Budget..... 128
Accomplishments..... 128
Evaluation..... 131
Land and Water Resource Development Project (1975-1983).. 133
Overview..... 133
Project Objectives..... 135
Budget..... 138
Accomplishments..... 138
Evaluation..... 148
Summary and Conclusions..... 151

VI. ASSESSMENT OF PAST PROGRAMS AND FUTURE OPTIONS..... 152

Statement of the Problem..... 152
Recommendations..... 155
A New Look at Future Policy Options..... 160
Summary and Conclusions..... 167

VII. APPENDICES..... 175

A. Discounting and Benefit/Cost Analyses..... 175
B. A Model of the Economic Evaluation of Soil..... 182
Conservations Projects in India
C. The Land Tenure System of Lesotho..... 189

I. INTRODUCTION

Publicly funded soil and water conservation projects constitute the single most expensive and of longest duration set of agricultural development related programs in Lesotho (formerly Basutoland). Commencing with a major British countrywide effort in the mid-thirties, these projects have been continually pursued up to the present. Much has been written about the individual components of these soil and water conservation programs, ranging in time from the Pim report in 1935 to the AID-funded LSCE contract report in 1978. 1/ 2/ Up to now, however, an overall research review and analysis of the program from an economic efficiency and human welfare point of view has not been available. It is the purpose of this report to remove this deficiency in the written record. Our primary objective is to provide in a single report as complete an information base as possible for Lesotho policy makers faced with choosing among available alternative approaches for their future soil and water conservation efforts.

The accelerating adverse impacts of man's activities on the erodable soils of Lesotho and surrounding areas have been going on for as long as these areas have been in tribal use. According to Leslie Brown, an ecologist, reporting on this phenomena for southern Africa as a whole:

> The destructive activity had begun with the native tribes that inhabited parts of the area before the early white settlers came. But it was greatly accelerated by these settlers, and it still continues. The effects of mankind on the natural conditions of the area are still incalculable, but will in the long run probably be more damaging than beneficial. 3/

1/ Pim, A.W., Financial and Economic Position of Basutoland, Report of the Commission Appointed by the Secretary of State for Dominion Affairs, London, 1935.

2/ Seckler, D.W., Nobe, K.C., et. al., A Reconnaissance-Level Evaluation of Soil Conservation Programs and Methods in the Kingdom of Lesotho, Report of the Colorado State University Evaluation Team (Contract No. AID/afr-C-1387), Department of Economics, Colorado State University, Fort Collins, Colorado, July 1978.

3/ Brown, Leslie, Africa: A Natural History, "A Rural Paradise: the Basotholand and Natal Highlands and the High Veld." (New York: Random House), 1965, p. 222.

While white settlers were not directly engaged in agricultural production activities in "Basutoland," their practices were nonetheless introduced by missionaries and other visitors. These impacts soon began to alter the traditional agricultural practices of the Basotho. As a result, the rate of erosion began to accelerate, in close association with the adoption of cultivated agricultural practices and intensification of cattle grazing.

Diaries, journal entries and technical writings by missionaries and other early visitors to Basutoland show that almost all of the visible signs of soil erosion, such as donga formation and exposure of bare rock surfaces in areas underlain by the Cave Sandstones, occurred after the mid-1800's. Stockley in his Report on the Geology of Basutoland, based on field surveys carried out during the 1938-40 period, gives a brief statement of early conditions in a section titled "Agricultural Features and Soil Erosion." 1/ He states in part:

> In Basutoland soil erosion may be identified with the underlying rock formation. On the Cave Sandstone sheet erosion is prevalent. The thin soil cover is being swept off the steeper slopes of the massive sandstone. Most of the older European inhabitants remember when these slopes were covered with grass, but with continual over-grazing and formation of innumerable cattle tracks accelerated the denudation. The steeper slopes are well on the way to being completely denuded. The next stage will be the extension from the steeper slopes to the flatter peripheries of the elevated plateaus... Transition beds and Red Beds are responsible for the majority of the donga erosion, which so profoundly affects the lowland regions ... The districts of Quthing, Mohale's Hoek, Mafeteng and Maseru, where the Red Beds are best developed, exhibit soil erosion par excellence. The argillaceous horizons of the transition beds and Red Beds are easily eroded and human activities have accelerated the process. Haphazard road making, cattle tracks, footpaths, uncontrolled cultivation, and overgrazing are some of the agencies promoting the development of deep dongas. 2/

Stockley, A.W. Pim, G. Fitzgerald-Lee and other writers of the early settlement and erosion pattern of Basutoland all quote the technical writings of the Rev. S.S. Dornan, an early missionary of the French

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1/ Stockley, G.M., Report on the Geology of Basutoland, published by the Authority of the Basutoland Government, Maseru, 1947, pp. 90-93.

2/ Ibid., p. 92.

Protestant Mission who worked in and observed the local conditions around the turn of the century. One such quote from a paper published in 1908 and cited in Stockley's work is particularly revealing:

> Recent and superficial deposits cover the low grounds, and consist of stratified clay, sands and gravels... The rivers in the course of ages have cut their way through them, and as they are loose and easily removed, the amount swept away by every storm is considerable... The dongas everywhere intersect the country... The destruction of the wood and bush of the country, together with the increase of cattle that eat off the grass, has powerfully assisted the formation of the dongas. They not only reduce the area of arable land, but also drain off the water and disfigure the country. If nothing is done to check their formation, they will render the water problem a very serious one at no distant future. When the first missionaries came to Basutoland about 75 years ago multitudes of these dongas did not exist. A deep donga 40 years ago was a small stream, that one could step across: now it is a trench 15 feet deep and 20 feet wide. 1/

In spite of ample visible signs of erosion damage dating back at least to 1850, and subsequent severe erosion periods that correlate with severe drought years followed by years of extremely heavy rainfall, the British government made no serious remedial attempts until the early part of the twentieth century. Hailey reports that the first evidence of official attention to the soil erosion problem dates from 1902; it included some crop management advice but, according to Dornan, focused primarily on tree planting recommendations. 2/ 3/ Although the Department of Agriculture in Basutoland was established in 1910, its work prior to the mid-1930's was directed primarily to providing veterinary services. Its limited soil and water conservation activities were concerned primarily with tree planting and limited donga control efforts, rather than with reducing the rate of runoff and sheet erosion on crop and rangeland.

It is apparent from reading the literature reporting on this period that these early educational oriented efforts were sporadic and largely unsuccessful.

1/ Dornan, S.S., an article unidentified by title, published in Geological Magazine, 1908.

2/ Hailey, Lord, Native Administration in the British African Territories, "Part V. The High Commission Territories: Basutoland, the Bechuanaland Protectorate and Swaziland," London, 1953.

3/ Dornan, op. cit.

According to Fitzgerald, the British government only began to get really concerned with the Basutoland dependence on its agricultural resource base in the early 1930's, at which time accelerated soil erosion was already clearly evident. 1/ He stated in part:

> Twenty years ago it became obvious that in such a small agricultural territory as Basutoland, with no industrial population, all suitable land should be used to the full if the population was to support itself. Soil erosion had by this time assumed threatening proportions, especially in the lowlands: deep, wide gullies scarred most of the landscape and the crop yields diminished in the eroded soil. Yet the population was increasing (the present rate is 25 percent, every ten years), and with it the cattle, sheep and goats, and the hillsides over which these animals roamed were becoming bare and brown. 2/

Following the severe drought in 1932-33 and the devastating rate of donga formation during the next year of very heavy rainfall, the Secretary of State for Dominion Affairs appointed a Commission "to inquire into the position of Basutoland from the financial and economic points of view and to report thereon." A three-man team, under the direction of A.W. Pim, arrived in-country in 1934 and in 1935 published what has been referred to hereafter as the Pim Report. 3/ Immediately thereafter, the British government initiated a major soil conservation program which continued in one form or another until Lesotho achieved independence in 1966. A series of area-based rural development projects with major soil and water conservation components have been funded by various international donors and placed in operation during the post-independence period. 4/

This research report consists of seven major sections: I. Introduction; II. Methodology for Evaluation of Soil and Water Conservation Programs; III. The Natural Resource Base of Lesotho; IV. Pre-Independence

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1/ Fitzgerald-Lee, G., "Basutoland's Success with Soil Conservation, New Commonwealth, 1951, pp. 520-523.

2/ Ibid., p. 521.

3/ Pim, A.W., op. cit.

4/ See in particular, Section V of the Seckler/Nobe report, op. cit. for an analysis of the following major projects: Thaba Bosiu Rural Development Project, Senqu River Agricultural Extension Project, Leribe/Khomokhoana Soil Conservation Projects, Thaba Tseka Mountain Development Project, and the Land and Water Resource Development Project.

Conservation Programs; V. Post-Independence Conservation Programs; VI. Assessment of Past Programs and Future Options; and, VII. Appendices. In conducting this research, we relied heavily on available published reports about various projects and on in-country experience gained as team members on a recently completed AID-funded reconnaissance evaluation project directed to an overview of soil conservation programs and methods in Lesotho. Much of the material presented was included in the LSCE contract report; 1/ it is being summarized herein because of the limited distribution of that AID-funded contract report.

1/ Seckler/Nobe, op. cit.

II. METHODOLOGY FOR THE EVALUATION OF SOIL AND WATER CONSERVATION PROGRAMS

Any review and analysis effort brings with it an accepted set of concepts on which judgments are based. The approach taken in this research effort in Lesotho was to view conservation as a series of actions to provide for the protection, improvement and use of land and water resources according to principles that will assure the highest possible economic and social benefits over time. Several of the physical and economic concepts underlying this evaluation effort are presented below to help the reader gain an initial perspective of the processes involved.

Conceptual Framework and Physical Criteria

Conservation programs deal basically with management of physical resources and are designed to reach stated objectives. For example, in the case of soil conservation as addressed in this study, the objective may in part be stated as holding erosion losses below some pre-specified level; say, five tons of soil per acre per year. In designing such programs, several physical based concepts are particularly relevant. Among the more important of these are: (1) a watershed management approach; (2) vegetative control; and (3) land use capability. These concepts are discussed in turn, along with a review of data needs for evaluating the effectiveness of conservation efforts which requires the translation of physical parameters into economic evaluation procedures.

Watershed Management Approach

The watershed management approach to developing and evaluating conservation programs focuses on the watershed or catchment area as the natural unit for soil and water conservation activities. The approach implies that any conservation treatment should be considered in its relationship to the entire drainage area, both in how the watershed will impact the treatment and how the treatment will impact the watershed. The practical consequence of applying this concept is that no conservation practices are to be planned for any part of a watershed without consideration of what might be needed for the entire catchment. An example of problems encountered when this approach is not followed would be construction of terraces without consideration of nonterraced contributing areas or without consideration of disposal areas and downstream channel effects. The ranking of watershed areas against specific criteria will also assist the manager in the selection of those areas requiring intensive investigation, analysis of alternatives and treatment.

An intimately related concept is that the primary control of soil and water is exerted by vegetation, and that all efforts at management are

aimed at increasing vegetative control of erosion and runoff. Therefore, the watershed management approach favors land treatment practices rather than the more capital intensive structural methods commonly found in Lesotho.

Watershed management emphasizes the study of hydrologic principles as applied to the watershed ecosystem. The major concerns of watershed management may be divided into four categories: (1) surface runoff or water yield from the watersheds, (2) erosion and sedimentation, (3) quality of water, and (4) occurrence of groundwater. The reason for being so interested in water is that it acts as the mechanism for detaching and transporting the soil particles. Soil particles become sediment when they are detached and moved from their initial resting place. This process, which is called erosion, is accomplished for the most part by the impact of falling raindrops and the energy exerted by moving water and wind, especially water. A reduction in erosion rates (soil loss) is accomplished by protecting the soil with vegetation or other cover, and/or by reducing the velocity of moving water and wind by various land treatment measures.

In a developing country, such as Lesotho, the necessary data for watershed analysis is very limited. As a general principle, however, it is important to realize that the greater the distance a raindrop must travel, the less chance it has of becoming discharge from a watershed. Runoff from high mountain watersheds is used by riparian (streambank) vegetation, evaporated from stream surfaces, used for crop growth or goes into groundwater storage. Most sediment produced is deposited at some lower point in the watershed rather than reaching the stream outlet at the lower end of the drainage area. These conditions make the evaluation of runoff, sediment production, and the benefits of the conservation program very difficult to measure accurately.

Vegetative Control Concept

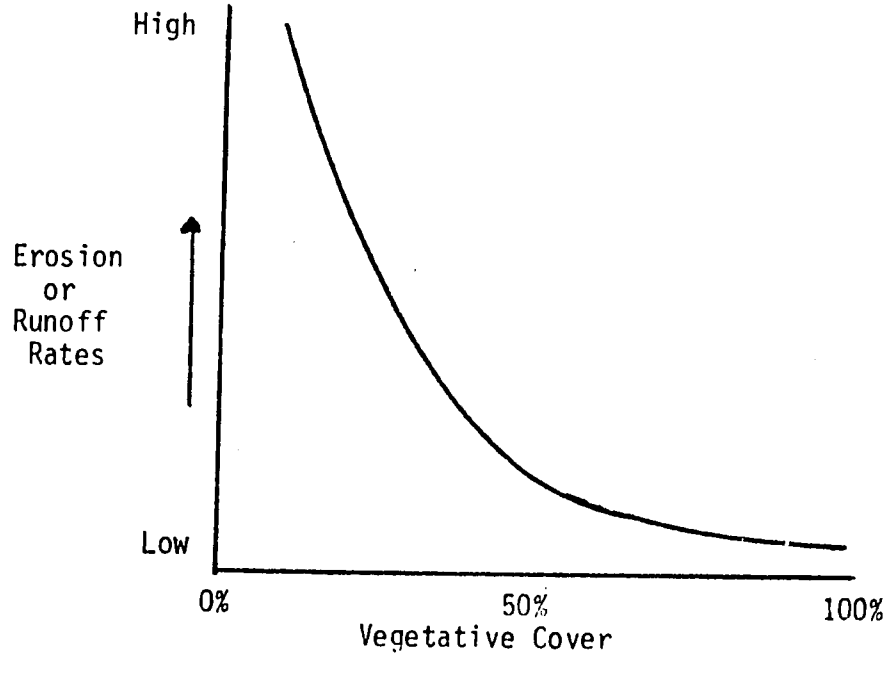
The vegetative control concept derives from the fact that man-caused increases in soil erosion and runoff result from an imbalance between vegetative cover and the soil-climate-landform conditions. The corollary to this fact is that the most effective treatment of accelerated erosion and runoff is the restoration of the proper balance between vegetation and site conditions. Vegetative control of runoff and erosion may be achieved either directly by improving the cover and conditions, or indirectly by effective management of crop residues on cultivated areas. Therefore, even where structural measures are employed, they should be considered as adjuncts to vegetative control methods.

Wischmeier and Smith (1965) found four factors important in rainfall erosion: climate, soil, topography and plant cover that interact

to cause total effect. 1/ To a limited degree, one can modify the micro topography with structures such as terraces, diversions or even land smoothing; but, these methods are expensive and have high maintenance costs. Fortunately, improving vegetative cover is relatively simple under Lesotho conditions, providing sufficient soil remains at the eroded site to provide an effective rooting depth and water holding capacity for plant growth. The general relationship that exists between vegetative cover and erosion or runoff is illustrated in Figure II-1.

It should be noted that some depletion of cover through grazing or cropping may result in very little change in erosion or runoff rates until a critical cover density is reached, after which they tend to increase at accelerating rates. The objective of good management then becomes one of managing the ground cover so that the critical point is not exceeded. An increase in vegetative cover and underground root mass (particularly fibrous roots) tends to increase infiltration rates rather rapidly. For example, under U.S. conditions, range sites in good condition have been found to absorb moisture five to six times faster than range sites in poor condition.

Figure II-1. General Relationship between Degree of Vegetative Cover and Erosion or Runoff



1/ Wischmeier, W.H. and Smith, D.D., Predicting Rainfall-Erosion Losses From Cropland East of the Rocky Mountains, USDA/ARS Agriculture Handbook No. 282, 1965.

Land Use Capability

Closely related to the vegetative control principle is the concept that every unit of land has a specific physical capability for use without permanent or reversable damage. Land use capability is an expression of the physical productivity conditions when using the land, without damage, for crops that require regular tillage, for grazing and other uses.

If land is used beyond its capability, natural relationships are unbalanced and accelerated erosion and runoff occur, along with the consequent loss of soil productivity and soil moisture storage capacity. Embodied within the concept of land capability is the possibility of adding conservation practices so that land with known physical limitations may be used for crop production without intolerable damages resulting. In some cases, the land use capability limitations may be so minor that only limited conservation practices or dense growing crops are required; or, they may be so severe as to require slope modifications by the use of diversions, terraces and grassed waterways to safely use the land for crop production. It should also be noted that the application of expensive structural measures does not necessarily change the capability of the land area. And, without continual maintenance of such structures, there is always the danger of structural failure and resulting damage. Unfortunately, damages from structural failures on protected lands are almost always more serious than those for unprotected lands, because the structures concentrate the water in a single place.

Necessary Conditions for Determining Effectiveness

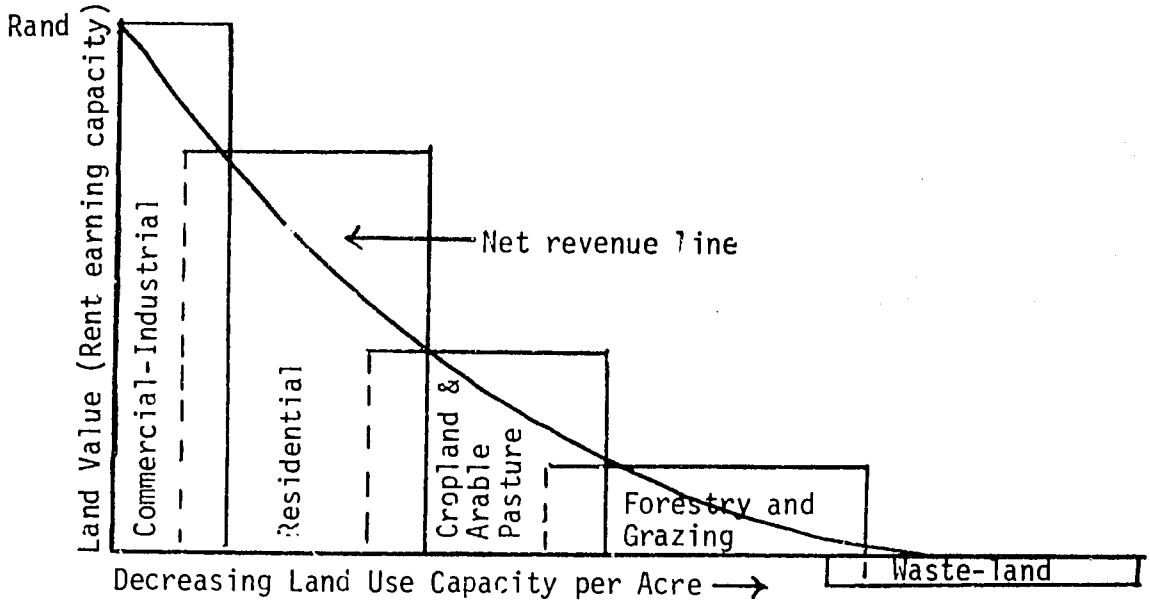
In theory, conservation is practiced to maintain or improve the quality of the land resource for both short-term and long-term use. Ideally, those practices are applied which allow achievement of long-term national public welfare goals while maintaining or enhancing the short-term productivity of the land for the resource user. Evaluation of conservation efforts must, therefore, consider the contribution of a program to long-term national goals and the short-term effects on resource users. Defined national goals for agricultural development serve as yardsticks, or the criteria, for measuring the effectiveness of individual programs in achieving these long-term goals. Short-term objectives of the individual villager's farming or grazing the land, which are largely profit oriented and which may in some cases be in direct conflict with long-term public welfare goals.

Physical data collected for evaluation needs to be compatible with the data requirements of the economic evaluations, so there should always be close coordination between the physical data collected and the economic and sociologic studies being conducted. Costs must be identified in such a way as to permit the allocation of administrative, planning and installation costs for each practice applied to achieve some measure of

protection to the land. Cost effectiveness should be indicated by the relative budget and manpower requirements to achieve adequate levels of protection for various land capability classes in specific uses, and in the alleviation of special problems such as gully stabilization.

One example of an economic concept of land use that can usually be correlated with the physical concept of land use capability is the concept of land use-capacity. It refers to the relative ability of a given unit of land to yield an economic return in one or more uses equal to or above the internal production costs associated with it. In principle, these various net returns associated with alternative uses provide an "index" of use capacity and helps to explain why land tends to be allocated to its "highest and best use."1/ The interrelations of land use with net earning capacity, or economic rent, are shown in Figure II-2. While any physical factor of importance to the relative capacity of land to earn economic rent may be important in a specific case, such as transportation rates or site location in relation to urban centers, in Lesotho there tends to be a strong correlation between land use capability classes and economic land use capacity.

Figure II-2. The Concept of Economic Land Use Capability



Source: Adapted from Barlowe, Land Resource Economics, p. 14.

1/ Barlowe, Raleigh, Land Resource Economics, (Prentice-Hall, Inc.: Englewood Cliffs, New Jersey, 1958), pp. 12-16.

One final point to consider is that in many instances, under Lesotho conditions, there is a mixture of land use. As a result, the interaction of these uses complicates the application of the physical concepts outlined above. Further, because a combination of conservation measures will likely be involved, unit data for these practices, e.g., length of terrace, number of acres protected in each land use, etc. are needed but seldom recorded in Lesotho. Without such information, however, it was not possible to fully apply the economic concepts of project evaluation discussed below.

The Conceptual Economics of Project Evaluation

Evaluation of conservation programs requires the adaptation of certain fundamental principles of economics to the evaluation of public projects. Therefore, in order to fully understand project evaluation in this context, it is helpful first to understand what economics is and what these fundamental concepts are.

Economics is not a field of study; it is a way of thinking. If one insists on assigning economics a field, then it is what Lord Robbins has eloquently described as "the pure logic of choice." More specifically, Robbins defines economics as "that science which analyzes human behavior in terms of a relationship between ends and scarce means which have alternative uses." 1/ This definition specifies the three essential ingredients of an economic problem.

First, there must be a plurality of ends, or objectives. If there was only one objective in mind, no choice would have to be made. One would simply devote all available means to that one objective up to an efficiency limit; e.g., where marginal costs are equal to marginal benefits.

Second, the means must be scarce. If this condition did not hold, again no choice would be necessary since one could satisfy all objectives simultaneously.

Third, there must be alternative uses of the available means. If means were not applicable to the attainment of different objectives, or if they could not be allocated from one objective to another, no choice situation would exist. One would simply devote whatever means one had to the objectives for which they were appropriate.

The Opportunity Cost Concept

Very simple examples can be used to illustrate the three ingredients of an economic problem for, indeed, they are universal. Imagine a man in the evening torn between the desire to read a novel and a stroll in

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1/ Robbins, Lionel, Essay on the Nature and Significance of Economic Science, London, 1952.

the park. Here is a plurality of ends. His means are limited--in this case by the constraints of space and time. He cannot be in two different places at the same time, nor can he do two different things at once. Finally, the resources of place and time have alternative uses. They can equally serve either the novel or the stroll, but not both.

In this economic mini-problem, one can see at work perhaps the single most important concept in economics. This is the concept of opportunity cost. This fellow could receive a certain amount of pleasure from reading the novel; he would receive a certain amount of pleasure from walking in the park. He cannot do both. Therefore, he must sacrifice the pleasure of one activity to obtain the pleasure of the other. The pleasure lost, or forsaken, of the rejected alternative becomes the cost of the alternative selected. In essence, all costs are lost potential benefits. This is the meaning of "opportunity cost" and the key to economic thinking.

The With and Without Principle

Whenever one contemplates doing something, both the alternatives of doing nothing and the alternative of doing something else must be considered. Thus, in the evaluation of any project, one must consider the anticipated welfare of society as a whole in three alternative states: (a) the state of society with the project; (b) the state of society without the project; and, (c) the state of society without this particular project, but with some other project obtainable with the same expenditure of means. It is only if (a) is superior to both (b) and (c) that one can say that project (a) is desirable in an economic context.

The with and without principle is obviously but another name for the fundamental principle of opportunity costs. That is, if the net benefits of the project are not greater than the net benefits of each alternative to the project, that project represents, by definition, a loss. Project evaluation is little more than a process of unraveling this basic idea in all its various implications.

Separability and Marginality: The Problem of Sub-Optimization

Projects often have favorable benefit-cost ratios but are sub-optimal in that quantitative changes in project magnitudes would improve the ratio. Sub-optimization represents a loss of opportunity for an even better project of a different size or composition and should be carefully guarded against.

In order to prevent sub-optimization, the project analysis should reduce the project to its smallest possible segments and then the differences in costs and benefits occasioned by the addition of one unit more of these segments carefully appraised. This is the concept of the marginal costs and benefits of projects. The object is to make

the marginal benefit-cost ratio of each project sector equal to one, and the marginal benefit-cost ratio between each project sector also equal to one. It is only if these two conditions are satisfied that the total benefit-cost ratio of a project is optimized.

Discounting: The Present Value of the Future

A future Rand is worth less, today, than a present Rand. If the Rand represents a benefit, the value of the benefit is less; if it represents a cost, the cost is less in the future than in the present. Of all the concepts of benefit-cost analysis, this is one of the most difficult. Yet, it is certainly one of the most indispensible concepts in the analysis. For this reason, the reader is referred to Appendix A which explains both the concept and the mechanics of discounting. But a few words are also in order here.

The discount rate is but another name for the rate of interest society should charge itself for the opportunity cost of time. Time is the most irretrievable loss of all. As time goes on, opportunities are inevitably lost. Therefore, one wishes to use time as efficiently as one can. That is the ultimate objective of discounting.

The appropriate rate of discount is that rate which represents the rate of return on alternative investments of equal degrees of risk. The discount charge against a particular project thus represents the opportunity cost of giving up the total net returns, over time, accruing to an alternative project. Unfortunately, as endless dialogue among economists has shown, it is impossible to compute the true social rate of discount. Ideally a central economic organization should set the discount rate to be used in all evaluations. In the absence of this information, an approximation may be made following this working rule: the discount rate should be slightly below, but change with, the interest rate charged in the private sector on prime tax-free bonds in private markets. The reason it should be slightly below is to reflect the fact that loans to governments are safer than those to even the most substantial businesses. It should vary with the interest rate to reflect the changing opportunity costs of investment opportunities in the private sector over time.

For Lesotho, under present conditions, it appears that the appropriate discount rate is at or near ten percent. The reason is that the private rate of interest on prime loans is about 12 percent. Our opinion, for what it is worth on this score, is that once this principle is established, it really does not matter whether the rate is, say, eight percent or 12 percent. The reason is simply that, compared to other uncertainties in project evaluation, this range of variance is highly tolerable.

Regardless of the exact rate of discount used, it performs two indispensible functions: (1) As noted before, it provides the opportunity

cost of other projects and thus the third leg of the "with" and "without" comparisons mentioned above. (2) It makes projects with different time distributions of costs and benefits comparable. Without discounting it would be almost impossible, for example, to compare a short-payoff project such as improved agricultural practices with long-term payoff projects such as forest plantations. With discounting, the two kinds of projects are placed on the same footing, as it were, and the comparison becomes elementary.

Indirect Costs and Benefits, or Shadow Prices

Most projects involve both direct and indirect costs and benefits. Direct costs and benefits are project inputs or outputs directly purchasable with, or sellable for, money. The price of these inputs and outputs can usually be taken as representing the true values of the costs and benefits and used in the computation. However, this is not always the case, for the following reasons: (a) sometimes market prices do not reflect the true opportunity costs of inputs and outputs from a social point of view; and, (b) some inputs or outputs do not have market prices at all. In both of these cases the economist must attempt to impute what the true market price would be if the market were working perfectly. In other words, he must attempt to find true opportunity values for these commodities--or their "shadow prices."

An example of a project product (see "a" above) that may not carry a market price is a soil conservation project. The project may simply be delivered to the farmers for nothing or at a nominal charge. How does one then evaluate the benefits of a conservation project? In essence, one uses the with and without principle--what is the state of society with the conservation project as contrasted to its state without the project? The answer to this question, in part, depends on the productivity of the project in growing additional amounts of crops. The difference in crop production caused by the project is its marginal benefit. By estimating this amount, it is possible to infer what a farmer should be willing to pay for the project. That amount then becomes the marginal value, or shadow price, of the conservation supplied.

Relative to (b), some commodities carry a price, but the market price gives an incorrect reading of true opportunity costs. A particularly interesting example, highly relevant to conditions in Lesotho, is the comparative shadow prices of capital and labor. For example, most soil and water conservation work--construction of small check dams, bunds, ditches and the like--can be done either with bulldozers or with hand labor. Bulldozers are often in short supply in Lesotho, and have alternative uses in projects for which labor substitution is not so easy. Thus, if many bulldozers were to be used in conservation work, more would have to be imported. This investment would draw down the supply for foreign exchange and possibly create greater opportunity costs as imports of even more productive machines were

curbed. On the other hand, some labor may be at least seasonally under-employed, or unemployed altogether. The opportunity cost of employing any unemployed resource is zero. In the evaluation of capital versus labor-intensive means of performing conservation work, it is appropriate to charge nothing for the cost of labor if, without the project, labor would have been unemployed.

Thus, while it is perhaps appropriate to use market prices for the use of bulldozers, it is not appropriate to use market wage-rates for the use of unemployed labor in the evaluation of public projects. Use of less than market wages for labor will, of course, bias public projects toward labor-intensive projects. On the other hand, during the agricultural seasons there appears to be a severe labor shortage in Lesotho. 1/ In this case, the marginal product of labor in agriculture may be higher than in conservation work and the shadow wage of conservation labor would be higher than the market wage. This situation would, of course, bias projects toward more capital-intensive means. The optimal solution to this problem can be quite difficult indeed.

Another example of indirect costs is in the areas of flood or erosion control. Both phenomena damage assets in the form of land and structures. The value of an asset is the present value of the stream of net benefits over its expected life. Thus, the benefits of flood and erosion control projects are equal to this value, or the value of replacing the assets sufficient to generate this income stream, whichever is less. Again one can see the with and without principle at work. Without the project, society would suffer a certain future loss of income. With the project, this loss would be reduced. Accordingly, the benefit of the project is the present net value of the differences in these two situations.

Non-pecuniary Costs and Benefits

The discussion of the benefits of flood control above leads directly to some of the more difficult areas of project evaluation. To this point, the discussion has been occupied with the evaluation of pecuniary costs and benefits--those pertaining to money. But, certainly, some projects entail costs and benefits in other, non-pecuniary, dimensions. For example, flood control projects reduce the loss of life and limb and help prevent the spread of disease.

How are these non-pecuniary benefit and cost items to be included in the analysis? Is one to reduce the value of a human life to statement in terms of Rand? There is but one reply to this question. Benefit-cost analysis can carry one only so far; it can carry one through the values legitimately expressable in pecuniary terms, and no further.

1/ Refer to Section III of the Seckler/Nobe report, op. cit., for a comprehensive discussion of the farm labor constraint in Lesotho.

Thus, there is a clear limit to the use of benefit-cost analysis in project evaluation. But the end of benefit-cost analysis does not correspond to the end of economic analysis (although that, too, reaches an end). Rather, one can profitably continue the analysis, even of non-pecuniary values, by placing the particular technique of benefit-cost analysis within a wider framework of "cost-effectiveness analysis."

Cost Effectiveness Analysis

Use of this technique does not depend upon quantitative estimation of benefits in terms of pecuniary values. Rather, it takes certain objectives as given and attempts to find the most efficient, least cost means of meeting those objectives. This type of analysis grew out of studies in the U.S. Department of Defense where it is rather obvious that one cannot estimate the benefits of winning a war to find out if it is worth it or not. (Of course, we are speaking here of wars of national defense, as opposed to colonial wars, which were straightforward business propositions). Rather it is assumed that one wants to win the war; it is recognized that there are many alternative means of doing so; that the opportunity costs of these means to non-defense sectors of the economy are high; and, one should at least try to win efficiently--if for no other reason than that the more efficient one is, the more resources can be allocated to realizing the objective.

Thus, a nation develops a certain budget for national defense. Once that budget is fixed, cost-effectiveness is used to determine the most efficient means to the objective. Of course, there is a certain degree of interaction between the performance of the analysis and the size of the available budget but that is a matter that cannot be gone into here. The point is that similar, cost-effective considerations apply to such things as the life and health benefits of flood control projects. Given that one wishes to achieve these benefits, is flood control the most effective means? Should funds be spent on flood control, or on increasing food production, medical services, early warning systems, lifeboats or conservation education programs?

Lastly, it must be acknowledged that some public decisions are of such a nature to basically escape the methods of economic evaluation altogether. One thinks immediately, in this connection, of the great works of art upon which civilizations have expended so much of their resources and through which, in the dust of history, they are remembered. An economic advisor to Shah Jahan, had he dared to undertake an evaluation of the Taj Mahal "project," would have been a fool in more ways than one. Even in contemporary times, in the economics of fundamental scientific research and development, decisions are much more of an art than a science. The preservation of certain unique natural wonders, from endangered species to natural environments through irreplaceable properties of the soil, is as much a moral obligation between generations as a matter of calculated advantage. While one should use all the calculations one can, rarely is life so

simple that important decisions can be made on the basis of a mere number. Rational choice is not a division of numerology.

The Principle of Sufficient Information

The process of project evaluation is itself an economic process. It involves the use of scarce resources of scientific talent that could usefully be employed elsewhere; hence, has an opportunity cost. It is also true that even in moderately complex evaluations there is no natural limit to the amount of information that could be gathered in making an evaluation. How then does one determine the marginal value of additional information? How can one guard against the distinct possibility that the marginal benefit-cost ratio of additional research is not below a level of one? Of course, there is no formula to determine the optimal amount of research. It is a matter of mature scientific judgment, continuously checked by the critical review of others. But there are certain conceptual guidelines that are helpful in deciding on a rational cutoff point.

The object of project evaluation is to reach a decision. One wishes to know how a project should be structured optimally and, then, once this optimal structure is attained, whether to go ahead with the project or not. It follows that information which contributes to this objective is valuable and information which does not contribute to this objective is worthless.

There is a means of testing the locus of this shift in the value of information. It depends upon the magnitude of the benefit-cost ratio one has to work with. Quite often, on the basis of very low informational inputs, one or the other of the three following situations arises.

(a) The benefit-cost ratio is so high that it is most unlikely that further information will reduce it to less than one.

(b) The benefit-cost ratio is so low that it is unlikely that further information will raise it to more than one.

(c) The benefit-cost ratio is at or near one, but given the normal randomness surrounding the parameters--the inherent errors of estimation--one cannot say with sufficient certainty whether it is really above or below.

One of these situations will typically arise quite early in the evaluation process. The analyst can obtain from the considered judgments of various experts sufficient information to attain the preliminary, or *pro forma* benefit-cost ratio necessary to achieve these estimations. Once the *pro forma* ratio is attained, a *presumption* for or against various project alternatives is established. For example, one may

conjecture that: (a) is a good project; that (b) is a bad project; and (c) should not be undertaken because of the vagaries of life. Then one attempts to refute these hypotheses.

The most powerful tool in the refutation phase is sensitivity analysis. In this technique, the analyst may make arbitrary assumptions that various estimates of benefits and cost parameters are off by a factor of, say, plus or minus 20 percent. He then tests the sensitivity of the ratios to these errors, and to various combinations of these errors. Or conversely, he may find by how much the estimates must be off to reduce the ratio of good projects to less than one, or increase the ratio of bad projects to more than one.

By means of sensitivity analysis, one obtains the shadow price of information. If reasonable errors of estimation could reverse the presumption about a project, then further information is valuable--if not, not. This statement is true except for projects such as (c) where the project is so sensitive to errors that the presumption will vary from positive to negative with purely random information. In this case, the ultra-sensitivity of the project is itself generally sufficient to make a negative decision. Thus, the principle of sufficient information holds that one only needs enough information to decide for or against a project. If further information could not reverse the decision, then that information is irrelevant and scarce resources expended to obtain it have been wasted.

Several highly practical consequences flow from this principle. These are: (a) The economist should establish the pro forma benefit-cost ratio of the project as soon as possible, on the basis of as little information as he can tolerate. It is only after the pro forma ratio is established that he can determine the marginal value of more information. (b) Certain information can only be established--even in principle--within a large range of error. For example, projections of crop yields with and without a conservation project may be in error by several hundred percent. To be valid, the project must be able to stand this kind of uncertainty, as demonstrated through sensitivity analysis. (c) Sufficiency of information can be sometimes attained at a low level of information input. Direct costs and benefits are the easiest to evaluate; indirect costs and benefits are extremely difficult; non-pecuniary costs and benefits, the worst of all. One should perform evaluations in this order of increasing difficulty, always on the lookout for sufficient information to make a decision and thus end the evaluation.

It is surprising how often this procedure economizes decision time. In general, projects that have poor direct benefit-cost ratios are poor projects. The reason is that there are usually other project alternatives with favorable direct ratios, which accomplish the same objectives as those with poor direct ratios. In principle, it is difficult to make a silk purse out of a sow's ear; or vice versa.

Option Demands and Soil Conservation in Lesotho

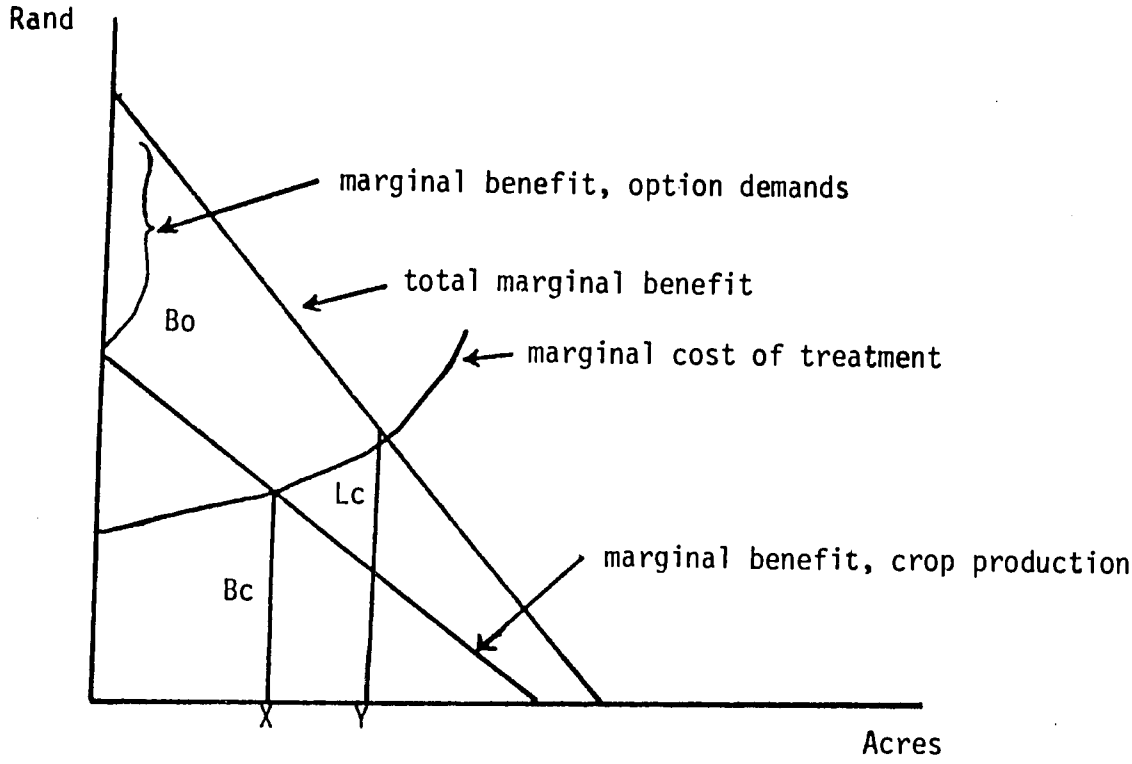
The option demand for soil conservation is the amount one would be willing to pay for the option to use the soil at some future date even if one has no immediate use for it. Of course this amount depends upon consideration of many variables. For example, soil loss is not a completely irreversible effect, such as the loss of a unique natural environment might be. The benefits obtainable from destruction of a unique environment are not obtainable from any other source whereas the benefits obtainable from the soil are always obtainable, in principle, from, say, food importation. This observation is not of course a declaration that food importation is a perfect substitute for soil conservation. It does, however, show that food importation is an alternative which must be considered on the margin.

The question is hardly ever one of letting all the soil erode away and importing all the food for a nation. It is a question of whether it might not perhaps be feasible to permit some soil to erode and replace the corresponding low level of food loss with some food imports, rather than spend enormous amounts trying to protect it all. Marginal considerations become particularly important in a cost-effectiveness analysis. For example, given the objective of conserving soil as an option for the future, it would be more effective to let some soil erode, if the unit costs of conservation are high for that soil, and spreading the limited capital and labor resources out over preservation of less costly, and possibly more valuable, soil.

Most conservation programs, however, have a joint product in that they are at least intended to improve the immediate productivity of the soil and, simultaneously, create an option value for the future. The nature of this joint demand (or joint benefit) effect is shown in Figure II-3. Assume that there is a soil conservation "project." This project may be for a particular area or for the nation as a whole. On the basis of land classification studies, agronomic projections, and economic analysis, it is, in principle, possible to find the marginal benefit of the conservation program for each acre of soil, in terms of its effect on net crop production. Similarly, it is possible to find the marginal cost of treatment of each acre of soil.

If these acres are arranged in order of decreasing marginal crop productivity from left to right, then the demand curve for the conservation program in terms of crop productivity can be shown, as in Figure II-3. Assume, for purposes of convenience here, that the highest benefit acres are also the least marginal cost of treatment acres, and that these acres can be arranged in order of increasing marginal costs of treatment, again as shown in Figure II-3. Then the intersection of the marginal benefit and the marginal cost curves determines the optimum degree of treatment from the point of view of crop production alone--"x" acres.

Figure II-3. Benefits and Costs of Soil Conservation - joint product



In addition to the benefits of crop production, however, there are significant option benefits to the conservation program. The value of these option benefits are added to the crop production benefit curve, again as shown in Figure II-3. Certainly, the value of conserving the most productive soil is greater than that of preserving the worst as an option for the future--the difference between the two curves will therefore diminish from left to right. It is shown that the joint benefit of both production and option will lead to optimal treatment of more acres -"y," than with just production benefits alone -"x." This condition is the economic equivalent to the conservationists' argument that soil conservation must be considered in terms of its long run benefits in addition to short run productivity. Of course they are right. The economic analysis both substantiates this position and makes it more quantifiable.

It is also clear that, in terms of benefit-cost analysis, the addition of option demand may make a conservation project which is barely justifiable in terms of productivity and option value. The total value of the option in this hypothetical example is represented by the area "Bo" between the two marginal benefit curves. Since in Figure II-3 this area is nearly as great as the area under the marginal benefit of crop production curve "Bc," the ratio of benefits to costs in this hypothetical case would nearly be doubled by the addition of option value to the

analysis. Thus, both the number of acres treated and the benefit-cost ratio of treatment will be increased when the value of the option demand is recognized.

One can see the principle of sufficient information at work in this example. If the benefit-cost ratio of the project in terms of crop production alone were one or more, and if it were subjectively known that whatever the value of option demand is, it is at least mildly positive, this might be sufficient grounds for recommending the project, even without knowing the actual value of the option. On the other hand, if the benefit-cost ratio of the project is substantially less than one on the basis of direct, or crop production, benefits, then one would have to investigate the value of the option demand rather thoroughly. In the former case, the option benefits are a "free good;" in the latter, they may be a very expensive good indeed.

The Figure II-3 example also illustrates the importance of separability. Whenever a project has a joint product, as in this case, the optimum position for each product <u>together</u> will be less than it would be for each product <u>alone</u>. Thus, the optimum amount of treatment for crop production alone is "x", not "y" and, thus, the amount "Lc" will be lost from that perspective--although it is "worth losing" overall.

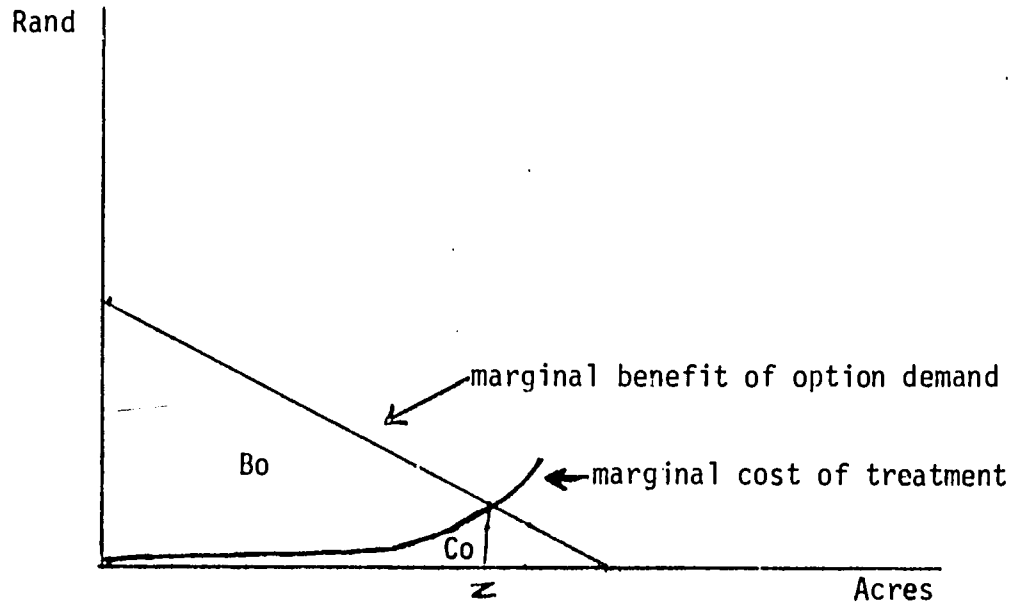
Now, let us assume that the two objectives are separable. For example, let us assume that one can have two different soil conservation projects. The first project is that shown in Figure II-3 which has high marginal costs and high marginal benefits for both crop production and for option values. In the second hypothetical project, we are willing to give up crop production benefits altogether and concentrate only on option values. Typically the second project will have lower marginal costs as well as lower marginal benefits, as shown in Figure II-4. Now, of course, the optimal amount of acres to be treated is "z" (in Figure II-4)--considerably higher than either "x" or "y" before (in Figure II-3).

If one is forced to choose between the two alternative projects, one would compute the benefit-cost ratios of each and choose accordingly. Since the <u>ratio</u> of benefits ("Bo" to costs "Co") in Figure II-4 is greater than the <u>ratio</u> of Figure II-3, then II-4 would be preferred. But the latter project requires very little resources. Therefore, if there is a fixed conservation budget one could take <u>all</u> of the second project and <u>part</u> of the first project as well. Thus, one could work back and forth between these separable projects, insofar as they are separable, and obtain a higher benefit-cost ratio of these two projects taken together, than obtainable by either one of the projects alone in trying to serve two inseparable objectives.

In Lesotho, the value of the land is low from a current crop production standpoint; yet, the option value is very high because of the contingency that the miners may return. Therefore, it is highly probable

that the most cost-effective approach is to separate conservation projects between those designed primarily to serve option values and those designed primarily to serve current crop production values. As shown, this separation would likely result in the most cost-effective service to both objectives.

Figure II-4. Benefits and Costs of Soil Conservation - Option Values only



Summary and Conclusions

The analysis provided in Appendix B, A Model for the Economic Evaluation of Soil Conservation Projects in India, shows the kind of data needed to estimate the economic value of conservation, in terms of direct crop production increases and net returns. But this is only the first of several critical steps in the evaluation process. To direct crop and/ or livestock benefits from conservation must be added the option values to be gained. But without available data relating conservation to yields and costs to benefits, as in Lesotho, very little can be accomplished in terms of quantitative evaluations. Planning for future agricultural research programs in Lesotho should ensure that the necessary data will be forthcoming.

III. THE NATURAL RESOURCE BASE OF LESOTHO

The nature and magnitude of the soil erosion problem in Lesotho is a function of its natural resource base and the agricultural uses to which it has been put. In particular, the erosiveness of the soil, topographic features and the amount and timing of rainfall are critical variables. For a complete discussion of the physical infrastructure of Lesotho, the reader is referred to Section II of the LSCE report. 1/ In addition, however, we felt that a brief summary of this section here would add to the reader's understanding of the review and analysis of Lesotho's soil and water conservation program that follows in subsequent sections of this report.

Overview

Lesotho is a landlocked, upland kingdom which was granted independence on October 4, 1966. A mountainous country, it covers an area of about 11,700 square miles or approximately 7.5 million acres. Elevations range from about 5,000 feet in the western lowlands to 11,500 feet in the central and eastern highlands. The country is bounded on the north and west by the Orange Free State Province, on the south by the Cape Province, and on the east and southeast by the Natal Province and Transkei, respectively.

Physiographic Regions

The country has four major physiographic regions. (See Map No. III-1.) The Lowlands range from 4,600 to 6,000 feet and consist of a narrow strip running northeast to southwest along the Orange Free State Provincial border. The Foothills lie in a strip running northeast to southwest, having an average elevation of about 6,500 feet, adjacent to the Lower Mountain Sub-region. The Higher Mountain Sub-region, which is part of the Drakensburg Range, rises to 11,400 feet. The Orange River Valley is an alluvial area stretching from the southwest part of the country up into the Drakensburg Mountains.

The most definitive available analysis of land resources of Lesotho is contained in a 1968 report by Bawden and Carroll. 2/ Based on their analysis, the total land area, by physiographic regions, and its relative suitability for agricultural use are given in Tables III-1 and III-2, respectively.

1/ Seckler and Nobe, op. cit., pp. II-1 to II-55.

2/ Bawden, M.G. and Carroll, D.M., The Land Resources of Lesotho, (England: Directorate of Overseas Surveys), 1968.

Map III-1. Physiographic Regions of Lesotho

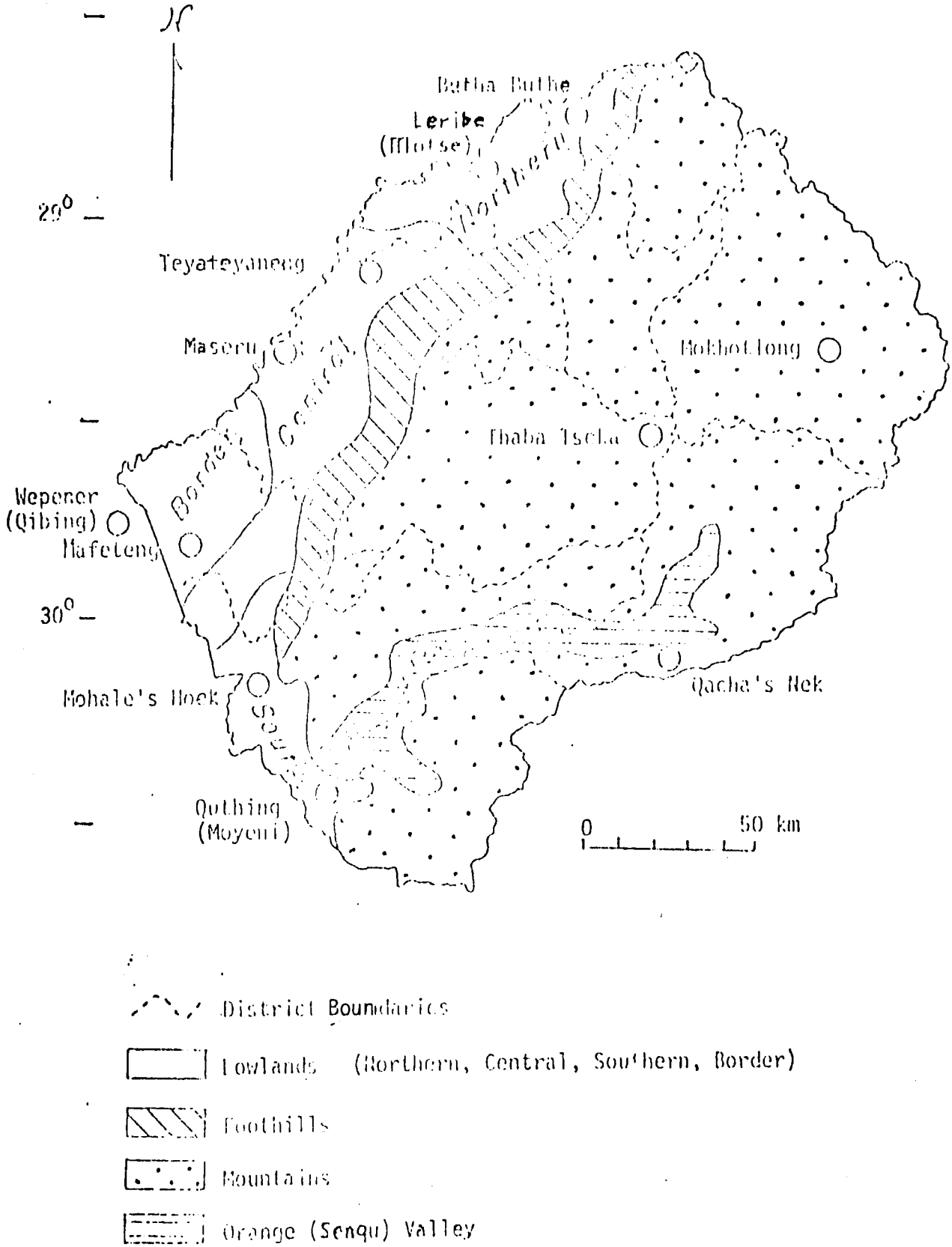


Table III-1. Land Area in Physiographic Regions in Lesotho

Region	Area Km^2	
Mountains		
High Plateau	3,043	
High Mountain Flats	445	
Higher Slopes	4,209	
Simple Slopes	2,712	
North-West Escarpment	842	
Compound Lower Slopes	6,861	
Mountain Spurs	984	
Mountain Valleys	886	
Mountains Total	19,982	65%
Foothills		
Sandstone Plateau	155	
Northern Basaltic Foothills	1,476	
Southern Basaltic Foothills	961	
Sandstone Foothills	31	
Lowlands Escarpment	1,948	
Foothills Total	4,571	15%
Lowlands		
Caledon Lowlands	736	
Phuthiatsana Lowlands	404	
Central Lowlands	575	
Makhaleng Lowlands	352	
Red Beds Plains	427	
Molteno Plains	262	
Dissected Molteno Plains	376	
Little Caledon Valley	57	
Southern Beaufort Plains	202	
Northern Beaufort Plains	31	
Dolerite Hills and Plains	140	
Orange Valley Flats	332	
Orange Gorge	1,772	
Orange Lowlands	370	
Lowlands Total	6,036	20%
GRAND TOTAL	30,589	100%

Source: Bawden and Carroll, 1968.

Table III-2. Acres of Land with Different Agricultural Potential by Physiographic Regions, in 1,000 acre units

Category	Higher Mountains	Mountain Zone	Foothills Zone	Caledon Lowlands	Orange Lowlands	Total	Percent of Total
	More than 9,000 ft.	6,500-9,000 ft.	5,900-6,500 ft.	Less than 5,900 ft.			
Land suitable for cultivation							
1. Land primarily suitable for semi-intensive cultivation				377	273	650	8.6
2. Land suitable for extensive cultivation				234	87	321	4.2
Land suitable for grazing							
3. Grazing land primarily suitable for small stock	1,902					1,902	25.2
4. Grazing land primarily suitable for large stock		2,612				2,612	34.5
Land suitable for both cultivation and grazing							
5. Land suitable for cultivation and grazing; poor access		462			82	514	7.2
6. Land suitable for cultivation and grazing; good access			610			610	8.1
Land unsuitable for agriculture				481	438	919	12.2
Total	1,902	3,074	610	1,092	880	7,558	100.0
Percent of total area	25.2	40.7	8.0	14.5	11.6	100.0	

Source: Bawden and Carroll, 1968.

Geology

Geologically and physiographically Lesotho is relatively uncomplicated (Table III-3). During the Jurassic period massive outpourings of basaltic lavas covered a succession of horizontal sedimentary formations laid down in earlier times. Basic magma intruded along planes of weakness in the sedimentary layers to form networks of dykes and sills. The basalts and sedimentary rocks exposed by subsequent erosion are associated with the major physiographic regions of Lesotho (Map II-1).

Table III-3. Geological Succession in Lesotho

Formation (thickness)	Lithology	Age
	Intrusive kimberlite pipes	Cretaceous?
	*Intrusive dykes and sills of dolerite, gabbro and basalt	Lower Jurassic
Drakensberg Beds (0-1500m)	*Basalt lava flows	Lower Jurassic
Cave Sandstone (0-240m)	Fine grained buff sandstone, very occassionally bedded	Lower Jurassic
Transition Beds (0-80m)	Fine grained red sandstone with some clay-shales and mudstones	Triassic
Red Beds (15-260m)	Buff red sandstones with thin clay-shales and mudstones	Triassic
Molteno Beds (15-150m)	Coarse-grained white sandstone and grits, with clay-shales and mudstones	Triassic
Upper Beaufort Beds	Buff sandstones, with purple and red clay-shales and mudstones	Triassic

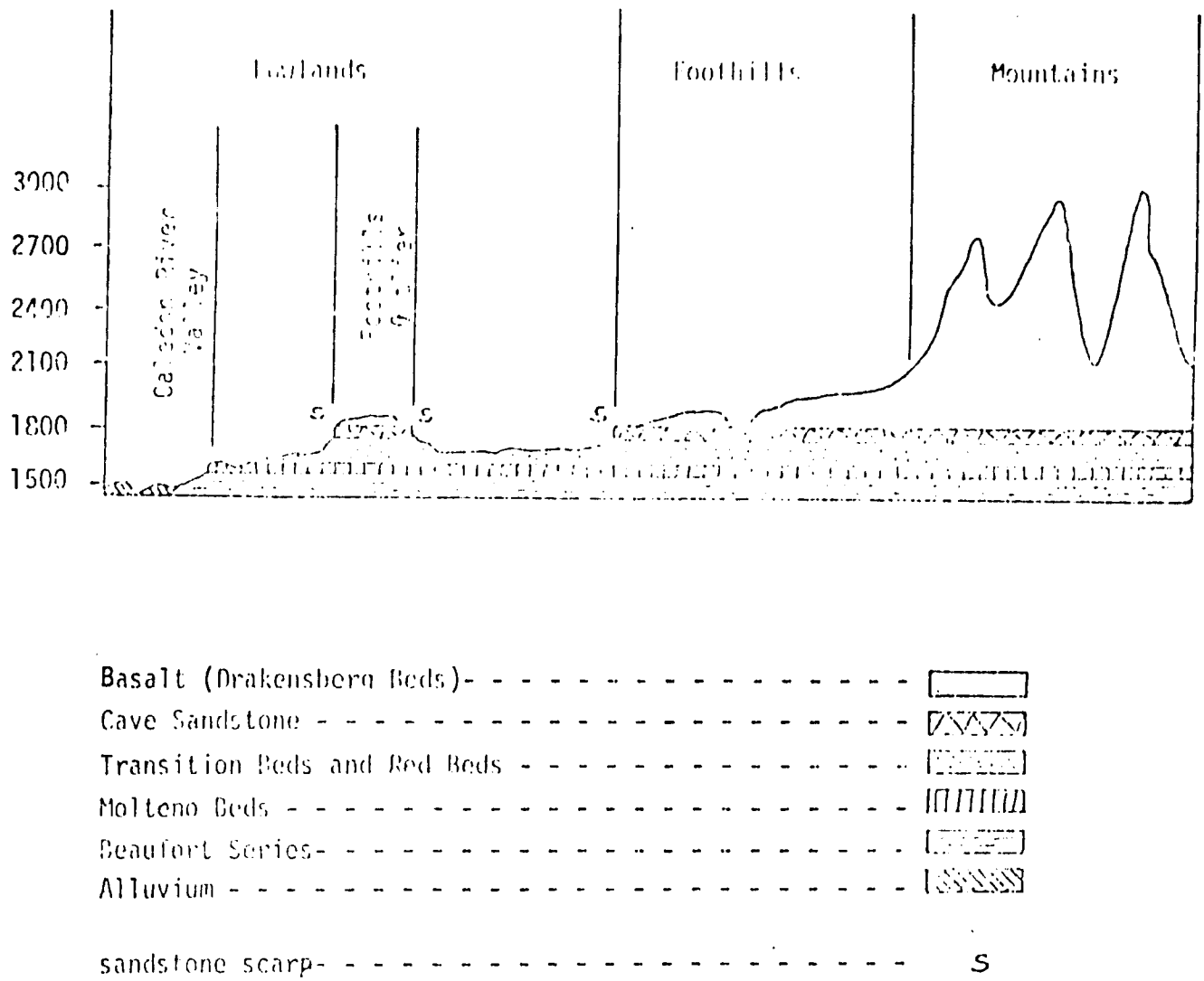
*Contemporaneous with one another

Source: Binnie & Partners 1972, "Inventory Report on Soils," in Water Resources Development of Lesotho, Vol. 3, p. 7; after Stockley, 1947, p. 10.

Basaltic masses form the Mountain Region that covers about 65 percent of the total national area (Table III-1). Below the Cave Sandstone scarp at about 1,800 m. lies the sedimentary Lowlands. The lowest of these, the Border Lowlands (1,450-1,500 m.) is the only region where Beaufort formation rocks are extensive (Fig. III-1). The Lowlands proper (actually high plains) range from 1,500 to 1,800 m. in elevation. In the Northern Lowlands, Red Beds and Transition Beds are important.

South of these, in the Central Lowlands, Molteno Beds predominate. The Southern Lowlands are a jumble of dissected foothill remnants separated by river valleys. Between the Mountain and Lowland Regions, at 1,800 to 2,400 m. lie the Foothills, actually deeply dissected lower basalt platforms in which stream erosion has exposed areas of Cave Sandstone, and basalt and sandstone outliers. Soils that have developed in place derive many of their characteristics from these underlying formations. The remaining agricultural soils are depositional, either aeolian (wind) or alluvial (water) in origin.

Figure III-1. Physiographic Section of Lesotho



Source: Binnie & Partners 1972, Vol. 3.

Agricultural Land Resources

For an agrarian nation, its land resource is one of its most fundamental assets. Not only the types of agriculture but also general levels of activity and prosperity depend upon the natural soil endowment, and upon the management which maintains and improves this endowment or, alternatively, degrades it.

Farmers, range managers, foresters, soil conservationists and land use planners need information about the productivity, erodibility and other problems of the land in order to manage it more efficiently. This information is usually obtained by either reconnaissance or detailed soil surveys. 1/ Detailed soil surveys are now being made by the Office of Soil Survey, Conservation Division, Ministry of Agriculture with the goal of providing soil surveys for all of Lesotho as quickly as budget and manpower constraints will permit. As of June 1977, soil surveys had been completed on 564,610 acres. An analysis of the cost per acre for soil surveys completed in the last four years shows that detailed soil surveys were being made for 0.32 Rand per acre. 2/

Soils

The erodibility of specific soils is very important in planning soil conservation practices. Table III-4 provides a ranking by K factor 3/ values and erodibility ratings for Lesotho soils which can be used to indicate potential problem soil series.

The Maseru, Sephula and Tsiki soils are duplex or claypan soils with sharply separated A and B horizons; all of these are highly erodible with the Maseru series being a particular problem. The A horizon in these series consists of friable to firm, permeable loamy textured sediments that rest abruptly on a very firm, relatively impermeable and generally clayey sediment layer. These lands account for the majority of the gullied lands of Lesotho, and where the A horizon has been eroded away in the claypan areas, it is nearly impossible to grow

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1/ Several reconnaissance soil surveys have been made in Lesotho. Included are Notes on the Soils of Lesotho by Carroll and Bascomb (1967), together with the associated Land Resources of Lesotno by Bawden and Carroll (1968), and the Binnie and Partners (1972) "Inventory Report on Soils," (Vol. 3), of their study report series, Water Resources Development of Lesotho.

2/ Personal communication with Paul Carroll, Conservation Division, MOA, Maseru, Lesotho, January 1978.

3/ K, the soil erodibility factor, is defined as the relative average soil loss under standard conditions. Originally on a 72.6 ft. 9-percent slope in tilled continuous fallow.

Table III-4. Ranking by K-factor Values and Erodibility Ratings for Lesotho Soils

Ranking	Soil Series	K-factor by Nomograph	Qualitative Expression of Erodibility	Erodibility Rating (Conservation Division, MOA)	Erodibility Rating (Handbook for Soil & Water Mgmt &Conservation)
1	Maseru	0.60	Very High	Easily	Severe
2	Tsiki	0.56	High	Easily	Mod. to Severe
3	Bosiu	0.55	High	Easily	Severe
4	Thoteng	0.49	High	Moderately	Moderate
5	Phechela	0.45	High	Moderately	Mod. to Severe
6	Thabana	0.42	High	Moderately	Moderate
7	Ntsi	0.42	High	Moderately	Moderate
8	Kolonyama	0.41	High	Moderately	Mod. to Severe
9	Ralebese	0.40	High	Resistant	Mod. to Severe
10	Theko	0.40	High	Moderately	Mod. to Severe
11	Sephula	0.39	Medium to High	Easily	Mod. to Severe
12	Rama	0.36	Medium to High	Easily	Mod. to Severe
13	Berea	0.32	Medium to High	Moderately	Moderate
14	Matela	0.32	Medium to High	Resistant	Mod. to Severe
15	Mats'aba	0.30	Medium to High	Resistant	Mod. to Severe
16	Leribe	0.28	Medium	Resistant	Moderate
17	Popa	0.28	Medium	Moderately	Moderate
18	Machache	0.27	Medium	Resistant	Moderate
19	Kuba	0.23	Medium	Resistant	Moderate
20	Khabos	0.22	Medium	Moderately	Mod. to Severe
21	Maliele	0.22	Medium	Moderately	Moderate
22	Matsana	0.21	Medium	Resistant	Moderate
23	Fusi	0.21	Medium	Moderately	Moderate
24	Caledon	0.18	Low to Medium	Moderately	Moderate
25	Sefonia	0.18	Low to Medium	Moderately	Moderate

Source: Guide to Engineering Uses of Soils in Lesotho, 1977. Ministry of Agriculture, Conservation Division.

any vegetation. For the Thaba Bosiu project area, the ten soil series with K factors of 40 or higher account for 51,373 acres (17.9%); a similar relationship would presumably be found for most of the Caledon Lowlands and their tributary areas.

Table III-5 provides the surface soil properties and available water holding capacity (cm) in 100 cm soil depth where this depth is commonly available. Based on the available soil survey reports, the more desirable soils for crop production are the Berea, Khabos, Leribe, Machache, Matela, Matsabe and Sofonia soil series, both because of their soil characteristics and the gentler slopes they commonly occupy. Most of these soils have available water holding capacities of 14-16 cm in a 100 cm soil profile.

Soil Groups

Soil analyses and surveys are absolutely essential for establishing an objective inventory and evaluation of the soil resource and, as such, are indispensible for sound agricultural planning. But, soil science has its own technical language that often is unintelligible to the uninitiated. Therefore, in this review, it seems appropriate to simplify the detailed and often technical description of soils and processes by grouping soils according to general characteristics. Such an approach was used in the Lesotho Conservation Cropping Guidelines (1977), in which soils were grouped according to general characteristics and crop suitability. These groups include the main agricultural soils from the lowlands and foothills regions where most farming takes place. The soil series, descriptions, and evaluations outlined below were adapted from these Guidelines. 1/

Leribe Soil Group (Leribe, Matela, Maliele series)

The Leribe soils are mainly undulating to rolling and are moderately deep to mostly deep. They occupy gently to moderately sloping, mostly convex, ridge tops and upper or middle sideslopes of low hills or gentle land rises. They are developed in two-layered sediments consisting of a loamy upper story and a generally clayey lower story, both derived in greater part from Red Bed sandstone and shales. The surface soil is typically dark reddish brown loam about 25 cm. (10") thick. The upper subsoil is reddish brown and dark brown sandy clay loam and clay loam about 50 cm. (20") thick. The underlying material is reddish brown clay loam that extends to variable depths below 150 cm. (59").

Matela soils lack the moderately fine textured lower subsoil layer of the Leribe series but are otherwise similar.

1/ More detailed characteristics of the various soil series are provided in Binnie & Partners (1972, v. 3) and in unpublished reports available from the Conservation Division, Ministry of Agriculture in Maseru.

Table III-5. Surface Soil Properties and Available Water Capacity in 100 cm Depth for Lesotho Soils

Soil Series & Mapping Symbol	USDA Class	Permeability cm/hr	Surface AWC cm/cm	Hydrologic Soil Group	Shrink/ Swell Potential	AWC in 100 cm Depth
Berea	L	7-12	0.12-0.16	B	Low	14.0
Bosiu (Bo)	SiL FSL	0.8-3.5	0.12-0.17	B	Low	15.5
Caledon	LFS	1.5-5.1	0.04-?	A	Low	6.0
Fusi (Fs)(Fu) (Mf)(Pr)(Ps)	GCL	10-20	0.15-0.17	B	Low	14.4
Khabos (Kh)	L	5-15	0.15-0.17	C	Low	14.8
Kolonyama (Ko)	SiL	0.5-1.5	0.16-0.18	C	Low	16.9
Kubu (Ku)	CL	5-15	0.15-0.17	B	Low	14.7
Leribe (Le)(Lf)	SL or L	3-6	0.16-0.17	B	Low	15.3
Maliele (Mg)	L	1.5-5.0	0.15-0.17	C	Low	15.9
Machache (Ma)	SiL	1.5-5.0	0.16-0.18	C	Low	14.7
Maseru (Me)	SiCL	0.8-1.6	0.17-0.18	D	Mod.	12.4
Maseru (Dark Variant)(Mk)	SiL	1.0-5.0	0.16-0.18	D	Mod.	16.3
Matela (Md)(Mh)(Bm)	SL	1.0-5.0	0.10-0.13	B	Low	12.2
Mats'aba (Mb)(Mt)	SiL	1.2-5.0	0.16-0.18	B	Low	13.9
Matsana (Mc)(Mf) (Ms)(Pr)(Ps)	GL	5.0-15.0	0.12-0.14	B	Low	12.4
Ntsi (Nt)(Bn)	LFS	5.0-15.0	0.06-0.09	D	Low	2.0 (27 cm)

Table III-5. Surface Soil Properties and Available Water Capacity in 100 cm Depth for Lesotho Soils (Continued)

Soil Series & Mapping Symbol	USDA Class	Permeability cm/hr	Surface AWC cm/cm	Hydrologic Soil Group	Shrink/ Swell Potential	AWC in 100 cm Depth
Pechela (Pe)(Ph)	C	0.15-0.40	0.08-0.15	D	High	11.5
Popa (Po)(Pp) (Pr)(Ps)	SiL	5-50	0.14-0.16	D	Low	5.4 (40 cm)
Ralebese (Rz)(Mt)	GFSL	8-10	0.07-0.10	B or C	Low	2.7 (40 cm)
Rama (Rm)	SL	0.2-2.0	0.12-0.15	C	Mod.	14.6
Sephula (Se)	SL	0.6-2.0	0.12-0.14	D	Low	9.7
Sofonia (So)	L	3.0-7.5	0.15-0.17	B	Low	16.0
Thabana (Ta)	C	0.2-0.6	0.10-0.14	D	Low	12.5
Theko (Th)	FSL	5-15	0.12-0.14	D	Low	10.9
Thoteng (To)	FS	15-50	0.06-0.08	A	Low	6.7
Tsiki (Ts)(Tt)	L	0.5-5.0	0.11-0.14	D	Low	14.3

Source: Guide to Engineering Uses of Soils in Lesotho, Conservation Division, Ministry of Agriculture, Maseru, 1977.

Maliele soils generally are darker colored to greater depth than are the Leribe soils and are confined to cool, south-facing slopes below sandstone escarpments.

Sofonia soils are derived from recent, stratified, loamy alluvium rather than from older, wind-deposited or locally-washed sandstone residuum and have higher organic matter content than Leribe soils.

Thabana Soil Group (Thabana and Khabos series)

The Thabana soils are deep, moderately well to somewhat poorly drained, gently to steeply sloping soils on concave side-slope positions of foothill regions or mountain valleys in basalt bedrock controlled landscapes. The surface soil is typically dark brown, heavy clay loam about 23 cm. (9") thick. The subsoil layer is about 70 cm. (28") thick and generally is fine or clayey textured. The underlying layer is brown, fine loamy material that commonly bears rock structure.

Khabos soils are similar to Thabana soils but occupy ancient, upper alluvial terraces, are somewhat better drained and have their lower layers developed in basaltic water-laid material rather than in weathered base rock material.

Mats'aba Soil Group (Mats'aba, Machache series)

The Mats'aba soils are undulating to rolling and are moderately deep. They occupy crests and gently- to strongly-sloping land rises in basalt bedrock-controlled terrain. The surface layer is typically dark reddish brown silt loam about 24 cm. (9") thick. The subsoil is dark reddish-brown and yellowish-red loam about 35 cm. (24") thick. The underlying material is strong brown sandy loam.

Machache soils have slightly finer textured subsoils and are deeper over slightly weathered parent material than are Mats'aba soils.

Berea Soils Group (Berea and Rama series)

The Berea soils are undulating to rolling and are moderately deep to deep. They occupy plane and concave, middle and lower slope positions on sandstone bedrock-controlled landscape. The surface layer is typically brown, mottled loam about 20 cm. (8") thick. The subsoil is dark yellowish brown and yellowish brown mottled loam about 130 cm. (52") thick. The underlying layer is consolidated Cave Sandstone bedrock.

Rama soils are similar to Berea soils but have firm, strongly-structured subsoils that indicate their intergrade toward Duplex (Sephula) soils.

Sephula Soil Group (Sephula and Maseru series)

Sephula soils are mainly undulating to gently rolling and are moderately deep to deep. They occupy gently to moderately sloping, mostly concave side slopes of minor drainageways and land rises or low hills. They are formed in somewhat poorly or poorly drained loamy over clayey sediments derived largely from Red Bed sandstones and shales. The surface layer is typically brown sandy loam or loam about 15 cm. (6") thick. The subsurface layer is typically brown, sandy loam or loam about 7 cm. (3") thick. The subsoil is generally yellowish and grayish, mottled sandy clay loam, clay loam, and/or clay about 73 cm. (31") thick. The underlying material is mottled, reddish brown clay that is more than 50 cm. (20") thick.

Maseru soils lack subsoil ironstone nodules that are diagnostic for Sephula soils and are more poorly drained than the latter.

The Sephula Group contains the distinctive and somewhat controversial "Duplex soils" in which a light-textured surface layer overlies a much heavier and usually much older substratum. In true Duplex soils, the transition between the two layers is abrupt. Drainage is severely impeded and heavy rainfall can quickly waterlog these soils. In addition, they seem particularly susceptible to gully (donga) erosion. Duplex soils are widespread in southern Africa and are generally considered a major problem in Lesotho. 1/ However, Binnie and Partners argue that they are not all that prevalent in Lesotho, being limited mostly to the Border Lowlands, and thus do not pose a major management problem except in that region. 2/ Unfortunately, however, a significant amount of the cropland is found in these lowlands.

Land Capability Classes

The chemical and physical analyses that are used to differentiate soil series do not by themselves necessarily indicate suitability for any particular use. Therefore, soils must further be evaluated for use purposes. Two of the most common uses are for civil engineering, as in foundation material for roads or buildings (e.g., Lesotho n.d.) and for agriculture. Suitability for agriculture commonly is indicated by Land Capability Classes.

Capability is an expression of the effect of physical features, including climate and slope, on the suitability of land for agriculture without permanent damage to the soil resource. Soils are grouped according to their possibilities and limitations, and to their response to similar

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1/ Carroll and Bascomb, op. cit., pp. 14-16.

2/ Binnie and Partners, op. cit., pp. 31-36.

land treatments. But, the classes do not take into account expensive modifications such as major slope modification (e.g., bench terraces) or irrigation. 1/ The following classes are included in the classification system:

Class I Land - There are very few soil limitations that limit their use for cropland.

Class II Land - There are moderate limitations in soils or slope that either reduce the choice of crops or require moderate conservation practices for safe use.

Class III Land - There are severe limitations in either soils, slope or climate that reduce the choice of crops or require intensive conservation practices for safe use.

Class IV Land - There are very severe limitations in soil and/or slope that reduce the choice of crops or require very intensive land treatment for safe use; (the land should be in grass most of the time).

Class V Land - There are physical limitations that are impractical to remove for cropland use. There is little or no erosion hazard when used for pasture, range or woodlot (to date none of this land has been mapped in detail in Lesotho).

Class VI Land - There are severe physical limitations in either soil or slope that preclude their safe use for cultivated crops and limit their safe use to pasture, range, woodlands, recreation and wildlife.

Class VII Land - There are very severe physical limitations in either soil or slope that preclude their safe use for cultivated crops and restrict their use largely to grazing, woodland and wildlife habitat.

Class VIII Land - There are physical limitations in landforms that preclude their use for commercial plant production. They are restricted to recreation, wildlife, water supply or esthetic use.

1/ The land capability system in use in Lesotho was previously developed and widely used by the Soil Conservation Service, U.S. Department of Agriculture.

The land slope is a basic feature in determining the land capability classification for a specific tract of land. The maximum land capability for specific slopes is as follows:

Maximum Land Capability Class	Slope Mapping Symbol	Percent Slope
I	A	0-3 %
II	B	3-6 %
III	C	6-12%
IV	D	12-20%
VI	E	20-35%
VII	F	> 35%

The other factors that reduce the land capability are erodibility of the soils, wetness, and soil limitations related to depth, texture or stoniness.

The only available estimates for land capability classes in Lesotho are for the Thaba Bosiu Project area, and for small areas included in the Ongeluksnek Range and Mount Moorosi Projects. Together these areas account for only 4.0 percent of the country. The 1960 Census of Agriculture for Lesotho, however, provides a valuable breakdown of fields by slopes and physiographic zones. Such data from the 1960 Census of Agriculture are summarized in Table III-6.

Table III-6. Cropland Acres in Lesotho by Three Slope Classes, 1960

Zone	0-19%	20-34%	> 35%	Total	Percent
Lowland	470,796	10,621	4,435	485,852	55.7
Foothills	136,270	10,724	1,931	148,925	17.1
Mountain	145,124	72,141	19,645	236,910	27.2
Total	752,190	93,486	26,011	871,687	100.0
Percent	86.3	10.7	3.0	100.0	

Source: Lesotho Census of Agriculture, 1960.

While this census information is now considered to be out of date, it still provides a valuable indication of the location and slope of cropland fields in 1960. But, because some of the fields farmed in 1960 have subsequently been abandoned due to erosion and related factors, the present day cropland probably has an even lower percentage of

excessive slopes. There is some indication, however, from the Thaba Bosiu and other soil surveys, that the slope measurements taken for the 1960 Census of Agriculture may have been on the high side.

To provide a basis for understanding the relative problems of the different elevation zones and physiographic regions, estimates of the land use capabilities for all lands in Lesotho are shown in Table III-7. The Class I, II and III lands most suitable for crop production are estimated to amount to about 680,000 acres, or 9.0 percent of the country. When the Class IV lands that are marginally suited for limited crop production are added to the above total, the acreage for cropland amounts to about one million acres or 13.2 percent of the country. It might be noted that the 1960 Census of Agriculture data quoted above would put an upper limit of perhaps 750,000 acres on the Class I through IV lands from slope limitations alone. On the other extreme, personnel in the Conservation Division, Ministry of Agriculture, have estimated that total arable lands amount to as much as 1.5 million acres. 1/

Table III-7. Estimated Land Capability Classification by Elevation Zones for Lesotho, (1,000 acre units)

Land Capability	Higher Mountains	Mountain Zone	Foothills Zone	Lowlands	Total	% of Total
	More than 9,000 ft.	6,500-9,000 ft.	5,900-6,500 ft.	Less than 5,900 ft.		
I				30	30	0.4
II		10	40	200	250	3.3
III		50	75	275	400	5.3
IV		80	100	140	320	4.4
Subtotal		140	215	645	1,000	13.2
VI	820	900	80	600	2,400	31.8
VII	120	400	100	80	700	9.3
VIII	950	1,600	180	530	3,260	43.1
Villages etc.	2	18	30	110	160	2.1
Water areas	10	16	5	7	38	0.5
Total	1,902	3,074	610	1,972	7,588	100.0
Percent	25.2	40.7	8.0	26.1	100.0	

Source: Extrapolated from Thaba Bosiu and other soil survey information obtained from the Conservation Division, MOA; Bawden and Carroll (1968); personal interviews with technicians; and, judgement decisions by Ivan F. Wymore of the LSCE Team. February 1978.

1/ Personal communication with H.W. Cooper, Director, Conservation Division, Ministry of Agriculture, Maseru, January 1978.

Recent estimates of actual cultivated land amount to 370,000 ha (914,000 acres). 1/ If 20 percent of the fields are idle in these same years, the total area in fields may amount to as much as 1.1 million acres. Since we estimate that only about 680,000 acres are suited for crop production, some 40 percent of the present cropland should be in grass or close growing crops most of the time in order to keep erosion within acceptable limits.

Land Use

Specific records of land use for all of Lesotho are generally not available. As shown in Table III-8, however, acreage in the 21 conservation projects amounts to 2,720,152 acres, or about 36.0 percent of the total land area of Lesotho. These projects show 591,971 acres of arable land (21.8%) and 2,128,181 acres (78.2%) of grazing and village lands.

By making some very broad assumptions, the generalized land use for all of Lesotho may be estimated as shown in Table III-9. These aggregated estimates are not intended to specifically indicate where the conservation efforts should be concentrated. But, the 1.1 million acres of cropland and the 3.0 million acres of rangeland with a high production potential would be the areas where the most progress could be made for a specific expenditure of time and capital. An ideal conservation program would, of course, include shifting of marginal cropland into pasture or range uses.

Evaluation and Management

The soil series discussed in a previous section are arranged generally in order of agricultural quality, from the Leribe series which contains some of the better soils in Lesotho to the Sephula and Maseru soils which are particularly difficult to manage. The correlations are only approximate since any soil group could include soils in Capability Classes I to VII. As a final step, therefore, soil groups are evaluated in terms of specific crops and treatments. Preliminary findings are shown in Table III-10. These ratings are still being refined and should be checked before decisions are made with respect to soil suitability and crops.

To recapitulate, soils are assigned to a Soil Series based upon chemical, structural, textural, and locational characteristics. Similar series are combined into Soil Groups. Evaluation for a general purpose (e.g., agriculture) results in Land Capability Classes, whereas Cropping Guidelines will relate Soil Groups to specific crops and management practices.

1/ Ibid.

Table III-8. Approximate Acreage and Land Use in Conservation Projects

	Name of Project	Arable Area	Grazing & Villages	Total Area
1.	Kolonyama	18,000	2,000	20,000
2.	Thaba-Phatsoa	1,339	8,502	9,841
3.	Matsieng-Morija	7,500	9,750	17,250
4.	Mount Moorosi	2,000	3,600	5,600
5.	Berca-Majara	28,000	24,600	52,600
6.	Bera-Martintsi	7,600	5,600	13,200
7.	Qhoqhoane	24,628	35,511	60,139
8.	Tsoaing	41,895	40,698	82,593
9.	Qalo	8,379	17,157	25,536
10.	Qholaqhoe	3,970	23,142	27,112
11.	Khomokhoana	23,500	13,500	37,000
12.	Senqu	164,214	1,428,746	1,592,960
13.	Thaba-Tseka	8,000	100,000	108,000
14.	Phuthiatsana	107,200	180,200	287,400
15.	Thaba-Bosiu	100,000	200,000	300,000
16.	Moroeroe	1,800	3,670	5.470
17.	Matelile	1,943	355	2,298
18.	Liphiring	1,603	1,397	3,000
19.	Likhakeng	600		600
20.	Tsakholo	39,800	18,753	58,553
21.	Ongeluk's Nek		11,000	11,000
	Total Area	591,971	2,128,181	2,720,152
		21.8%	78.2%	100.0%

Source: Conservation Division, Ministry of Agriculture, Maseru, January 1978.

Table III-9. Generalized Land Use in Lesotho

	Acres	Percent
Cultivated cropland	914,000	12.1
Idle cropland	186,000	2.5
Total cropland	1,100,000	14.6
Rangeland		
High production potential	3,000,000	39.7
Low production potential	1,760,000	23.3
Total rangeland	4,760,000	63.0
Escarpments, rockland, very steep and gullied lands	1,500,000	19.8
Villages, roads, and built up areas	160,000	2.1
Water areas	38,000	0.5
Total Lesotho	7,558,000	100.0

Source: Estimates provided by Ivan F. Wymore of the LSCE Team, January 1978.

Table III-10. Soil Crop Guidelines for Lesotho

	Soil Group*				
Crop	Leribe	Thabana	Mats'aba	Berea	Sephula
Maize	Good	Good	Good	Fair	Fair-Poor
Sorghum	Good	Good	Good	Fair	Poor
Wheat	Good	Good	Good	Good	Fair
Beans	Good	Good	Good	Fair	Fair
Peas	Good	Good	Good	Good	Poor
Potatoes	Good	Poor	Good	Fair	Unsuited
Sunflower	Good	Good	Good	Fair	Poor
Fodder	Good	Good	Good	Good	Good

*Rating applies to Land Capability Classes I to IV only.

Source: Conservation Division, Ministry of Agriculture, Maseru, January 1978.

Concern with soils and soil conservation has a long history in Lesotho, in part because of the marginal and problematic nature of the soils and the spectacular erosion forms. Thus, although soil analyses and detailed mapping still are far from complete, the general state of soil knowledge is much more advanced than in many other countries at similar comparable stages of economic development.

Climate

The climate of Lesotho is mostly sub-humid with warm summers and cool winters, but it varies from semi-arid in the southwestern Lowlands to humid in the Higher Mountains. Two aspects of climate, temperature and precipitation, are of particular interest when evaluating soil and water conservation programs. 1/

Temperature

The temperature of Lesotho is generally related to altitude; the mean monthly temperatures decrease about 3°F (1.7°C) for each 1,000 ft increase in elevation. An analysis of seven Lowland stations indicates a relatively uniform average annual temperature of about 14.8°C (39°F) with the high mean monthly temperature normally in January at 20.5°C (69°F), and the lowest average temperatures normally in June or July with mean daily temperatures of 7.4°C (45°F). In contrast the average annual temperature for the Mokhotlong, Thaba Tseka, and Qacha's Nek stations is 12.4°C (49°F), the December average is 17.3°C (63°F) and the July average temperature is 60.0°C (43°F). Oxbow at 2,600 meters (8,530 ft) elevation has a mean annual temperature of 7.4°C (45°F). Temperature records do not exist for the high elevation mountain areas.

Precipitation

Lesotho has a very pronounced wet and dry seasonality of precipitation, with the majority coming during the growing season. Snow may occur at any time in the high mountains, and some may fall in the lowlands during the winter, but it rarely lasts for any length of time. Snow is generally considered a negligible source of precipitation in Lesotho.

A number of long-term rainfall records are available although these are all in the more populated areas and mostly in the western Lowlands. Table III-11 summarizes the 1921-70 (50-year) mean monthly precipitation for ten Lesotho stations. The seven western Lowland stations have an annual precipitation averaging 735 mm (28.9") with 78.9 percent

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1/ For a more complete review of climatic conditions in Lesotho, refer to Gene C. Wilken, Agroclimatology of Lesotho, LASA Discussion Paper No. 1, Ministry of Agriculture, Kingdom of Lesotho and Department of Economics, Colorado State University, Maseru, Lesotho, April 1978.

Table III-11. Mean Monthly Precipitation (mm) for Ten Stations in Lesotho (50 years)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Western Lowlands													
Butha-Buthe	127	107	105	58	30	13	12	14	27	78	99	110	780
Leribe	132	115	112	60	34	13	13	13	30	76	104	117	819
Teyateyaneng	111	93	99	57	31	11	11	12	22	68	90	93	698
Maseru	108	91	99	60	29	11	12	13	20	61	88	89	681
Mafeteng	104	107	107	66	33	13	12	15	26	59	82	88	712
Mohale's Hoek	113	101	106	61	37	15	14	15	26	62	86	95	731
Quthing	101	93	102	66	37	15	14	17	34	64	83	98	724
Average	114	101	104	61	33	13	13	14	26	67	90	99	735
Eastern Mountains													
Mokhotlong	103	78	65	36	21	9	9	14	23	56	77	89	580
Thaba Tseka	94	70	72	38	26	8	10	14	22	57	65	84	560
Qacha's Nek	163	140	120	46	26	18	13	19	39	66	103	147	900
Average	120	96	85	40	24	12	10	16	28	60	82	107	680
10-Station Average	116	99	99	55	30	13	12	15	27	65	88	101	720
Percent	16.1	13.8	13.8	7.6	4.2	1.8	1.7	2.1	3.8	9.0	12.2	14.0	100.0
Average in inches	4.6	3.9	3.9	2.2	1.2	0.5	0.5	0.6	1.1	2.6	3.5	4.0	28.3

Source: Seckler and Nobe, LSCE Report, op. cit., p. II-35.

normally coming during the October-March growing season. This distribution is highly desirable because most of the precipitation comes during the growing season. While analyses show that the Lesotho precipitation is highly variable, it is no more variable than found in many rain-fed agricultural cropping areas of the world, such as the Great Plains of the United States.

In attempting to describe an average precipitation over the country, one method is to use a weighting for selected stations by use of Thiessen diagrams. An evaluation by de Baulny of the 1971-76 period provided the factors, using data from nine Lesotho stations. 1/ The 1967-76 weighted average (Thiessen Polygons) precipitation for Lesotho is given in Table III-12, as follows:

Table III-12. Weighted Average Annual Rainfall at Selected Stations in Lesotho, 1967-1976

Year	mm	inches
67	791	31.1
68	493	19.4
69	565	22.2
70	567	22.3
71	624	24.6
72	699	27.5
73	590	23.2
74	790	31.1
75	841	33.1
76	939	37.0
10-year average	690	27.2
1936-76 average	688	27.1
50-year average	707	27.8

Source: Seckler and Nobe, LSCE report, op. cit., pp. II-36, 37.

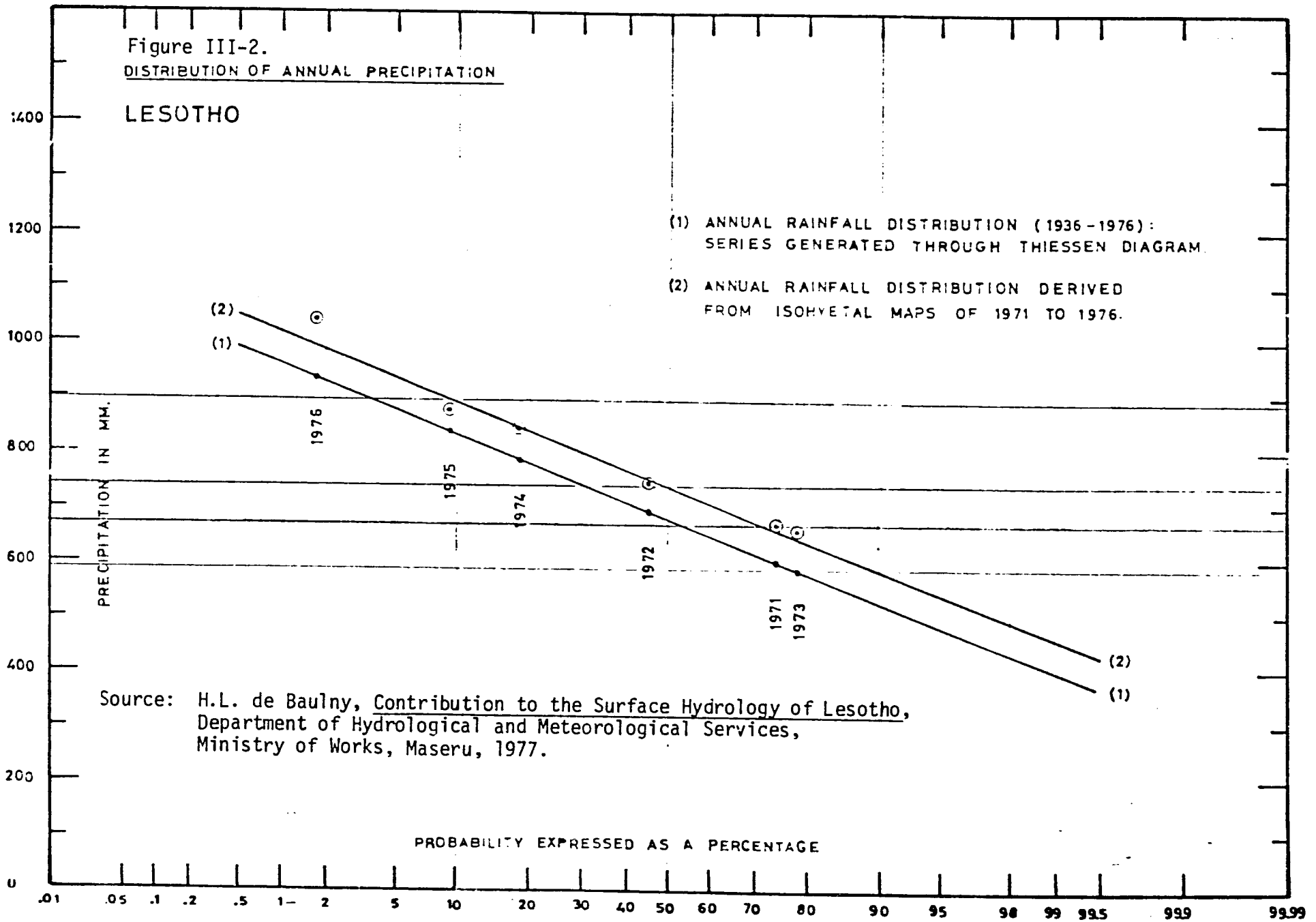
As indicated by this evaluation, the water years 1967-76 were about normal for Lesotho conditions. Figure III-2 provides an estimate of both the rainfall probability distribution from the Thiessen diagram analysis and from rainfall distributions based on 1971-76 isohyetal maps for Lesotho. The isohyetal map analysis is basically 7.1 percent higher than the Thiessen diagram figures. The isohyetal analysis shows a ten percent probability of 895 mm (35.3") precipitation, a 50 percent probability of 745 mm (29.3") and a 90 percent probability of 590 mm

1/ de Baulny, H.L., Contribution to the Surface Hydrology of Lesotho, Department of Hydrological and Meteorological Services, Ministry of Works, Maseru, 1977.

Figure III-2.

DISTRIBUTION OF ANNUAL PRECIPITATION

LESOTHO



Source: H.L. de Baulny, Contribution to the Surface Hydrology of Lesotho, Department of Hydrological and Meteorological Services, Ministry of Works, Maseru, 1977.

(23.2"). This analysis also checks out well with the precipitation probability analysis for individual stations performed by Binnie and Partners (1972).

Rainfall intensity is the other important factor in determining runoff and erosion potential of specific areas. The 24-hour rainfall frequency data shown in Table III-13 provide one indication of likely problem areas:

Table III-13. Twenty-four Hour Rainfall Frequencies at Selected Weather Stations in Lesotho

Location	10-year	25-year	50-year	100-year
	24-hour rainfall depth (mm) frequency			
Butha-Buthe	78	84	95	105
Leribe	64	70	75	80
Teyateyaneng	77	90	100	110
Maseru	97	120	--	--
Mafeteng	120	130	--	--
Mohale's Hoek	74	85	94	101
Roma CKS	76	90	101	111
Mokhotlong	65	75	81	88
Qacha's Nek	58	65	71	75
St. Martin's (Tlokeng)	55	62	70	77

Source: Personal communication with Leroy Scherer, Conservation Engineer, Conservation Division, MOA, Maseru, February 1978.

This analysis indicates that high intensity rains are quite common in the southern Lowlands and relatively uncommon in the northern Mountain valleys.

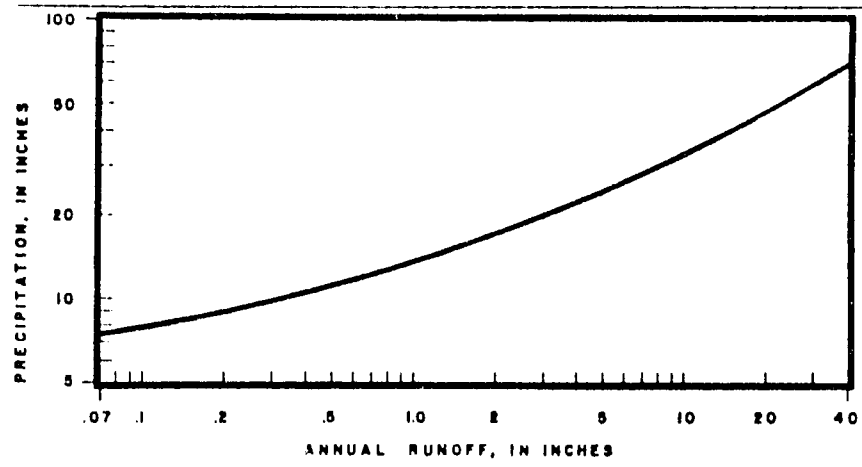
Runoff

Runoff from watershed lands is important for several reasons. First, because it is required for beneficial uses downstream such as domestic, industrial, livestock water and cropping. Secondly, runoff is the primary force in initiating soil movement from the land and transporting sediment and dissolved solids to rivers and reservoirs. Thirdly, in a rain-fed agriculture area, all water losses in excess of the evapotranspiration demand will result in reduced crop or range forage production. Evaluation of the extent of land and water conservation problems is difficult without detailed studies of runoff and water quality parameters, both spatially and temporally.

For evaluation purposes, runoff data is usually divided into three major components: (1) surface runoff, (2) storm seepage or interflow, and (3) groundwater flows. Surface runoff or overland flow is that part of runoff that travels over the soil surface to the nearest stream channel. Depending upon the velocity, soil erodibility, cover conditions and other factors it is the type of runoff that causes most soil erosion. Storm seepage or interflow is that part of precipitation that infiltrates into the soil to a relatively impermeable layer, then spreads out and flows laterally to the stream. This type of runoff is very important in the shallow rangeland soils of the foothills and mountain zones of Lesotho. Groundwater runoff is precipitation that percolates through the soil mantle to the groundwater table and is eventually discharged into a stream. The ephemeral nature of most Lesotho streams indicate that an undesirable portion of runoff is from surface runoff, and interflow from shallow soils.

There have been many statements in the written record to the effect that runoff rates from Lesotho are unusually high in relation to other areas of the world. This assumption is questionable, given the data shown in Figure III-3 which provides a relationship between runoff and annual precipitation. This figure indicates that for about 29 inches of annual precipitation, normal runoff would be about seven inches for areas with a mean annual temperature of 50°F. The Lesotho annual temperatures are higher than this so one would expect slightly less runoff because there is a longer growing season, and hence more opportunities for water use. An analysis of the available data suggests that the mean annual runoff from Lesotho watersheds is generally in the 5-7 inch range, which in turn would indicate a fairly normal situation for most watersheds. There are of course some high mountain watersheds with much higher runoff rates but they also have very high precipitation rates.

Figure III-3. Relationship between runoff and annual precipitation. Runoff data used were adjusted to that which would occur at a mean annual temperature of 50F.



Source: de Baulney, op. cit.; after Langbein and Schumm, 1958.

Binnie and Partners provided an estimate of total average runoff for Lesotho of 130.2 m^3/second, which corresponds to 4,106 million m^3/year, or a water yield of 137 mm/year on a catchment of about 30,000 km^2. 1/ In the English system, this equates to an average flow of 4,605 cfs for a total of 3,328,700 acre-ft/year, or 5.4 inches of annual water yield from 7.4 million acres. If we assume that the composite 50 percent chance precipitation for Lesotho (Fig. III-3) is about 745 mm (29.3 inches), runoff would amount to about 18 percent of total precipitation.

The Binnie and Partners report also provided estimates of average runoff by major river basins in Lesotho (Table III-14). 2/ It should be emphasized that these estimates are based on limited hydrologic data and are included only to provide an overview of conservation problems. This limited evaluation, however, does not indicate any nationwide severe watershed problems that cannot be solved. In fact, considering the steep topography of Lesotho watershed lands, the runoff rates would not be considered excessive. But if infiltration capabilities can be increased, the extra soil water could be utilized by plants to increase crop and forage production.

Table III-14. Average Runoff, by Major River Basins, in Lesotho

Lesotho River Basins	Drainage Area km^2	Average Flow m^3/sec.	Runoff million m^3	Runoff Acre-feet	Water Yield mm/yr	Water Yield in/yr
Senqu River (Orange)	20,379	91.9	2,898.2	2,349,537	142	5.6
Makhaleng Basin	3,051	14.2	447.8	363,041	147	5.8
Caledon River Basin	6,570	24.1	760.0	616,146	116	4.6
Totals	30,000	130.2	4,106.0	3,328,723	137	5.4

Source: Binnie and Partners, op. cit.

Erosion and Sedimentation

Soil erosion is the detachment of soil by the action of water, ice, gravity, or wind. Of these, erosion by water is by far the most important in Lesotho (although some wind erosion does occur in the spring windy periods). Wind erosion is a problem primarily in the Mahkaleng Lowlands and the Dissected Molteno Plains of the southwestern portion of the country. Based on historical records, accelerated erosion caused by man's activities has been going on in Lesotho for at least 150 years, and was being recognized as a serious problem by the early 1900's.

1/ Binnie and Partners, op. cit.

2/ Ibid.

Wischmeier and Smith in their pioneering 1962 work emphasize that four factors and their interrelations are the principal determinants of rainfall erosion:

1. Climate--largely rainfall and temperature.
2. Soil--the inherent resistance to dispersion, water intake and transmission rates, and particle size are the important factors.
3. Topography--particularly steepness and length of slope.
4. Plant cover--either living or plant residues provide protection against raindrop splash. 1/

More recent workers have pointed out that surface geology, the action of freezing or thawing, burning rangelands, soil depth, land use and management, and channel development in the watershed also affect erosion rates. These factors are interrelated and very complex, and still only partially understood by most workers in conservation. But only vegetal cover, slope and slope length, and infiltration characteristics of soil are generally subject to change. Plant cover is by far the most important of these, and in Lesotho it is generally easy to establish, given the proper cultural practices and management, including protection from overgrazing.

Sheet, rill and gully erosion are separate phases of the degradation process. The most evident of these are the rills or gullies (dongas). The factors contributing to gully formation are generally poorly defined but natural soil erodibility, overgrazing, cropping of natural water channels, trails or roads in natural waterways, intense summer storms, and general climatic changes from drought to wet cycle are all important factors in Lesotho. Since a watercourse is normally in balance--that is, the size of channel and its shape and gradient are on the whole suitable for the flows it has to carry--it is in fact in equilibrium within the watershed ecosystem. If this balance is slightly changed by a single flood or other factor, the stream will tend to come back to its equilibrium position. Since gullies are generally created by floods that exceed the carrying capacity of the natural watercourse, or by a decrease in the ability of the watercourse to handle flows without erosion, it would seem logical that all of the factors listed above have been important in forming specific dongas in Lesotho.

This leaves us with the questions of when were most of the 20-30,000 dongas in the Lowlands of Lesotho created, and are they increasing in length or width? Historical references indicate that the problem was first noticed about 150 years ago. But, there is little question that the major period of donga formation was in the early 1900's and particularly in 1933, as the drought of 1932-33 was broken by very heavy rainfall. For example, in the period from November 1, 1933 to January 31,

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1/ Wischmeier and Smith, op. cit.

1934, the Leribe station received 883.4 mm (34.8"), Maseru received 746.0 mm (29.4"), and Teyateyaneng received 737.6 (29"). This deluge amounted to 8.0 to 9.6 mm (0.32-0.38") average rainfall per day for the total period, and the resulting heavy runoff over a long period caused severe erosion. Thus, it is reasonably certain that most of the dongas of Lesotho are at least 45 years old. The overgrazing related to a preceeding drought period and the cultivation across natural drainageways were probably the major factors in creating this gully system. The continued overgrazing, particularly of the Cave Sandstone mesas, and the consequent floods have caused many donga heads to reach the sandstone escarpment.

Binnie and Partners reached the conclusion that the average gully is slowly widening as the sides collapse, is stabilizing and silting in the lower reaches, and proliferating at the top until it meets the sandstone. 1/ This is to say that the recent favorable precipitation years have permitted the gullies to reach a generally stable equilibrium that will likely continue until the next drought cycle or other major disruption of the watershed system.

The extent of gully erosion in Lesotho continues to be a hotly debated topic that does not have agreement with presently available information. Our discussion with personnel of the Conservation Division, MOA, who have studied time series aerial photographs, together with other evidence, however, leads us to believe that, on the whole, donga formation currently is in a state of short-term equilibrium. In many cases, the dongas have reached bedrock and their erosion is now limited primarily to some bank sloughing and meander.

Some specific research has recently been conducted on soil erosion and sedimentation by Mr. Qalabane Chakela for his Ph.D. dissertation in Physical Geography at the University of Uppsala, Sweden. Based on this preliminary work, he has concluded that sheet erosion is dominant on both cultivated and pasture land, while most gullies occupy the lower parts of slopes close to the main channel, or are an extension of the ephemeral streams. 2/ For gullies that have not reached the bedrock scarp he concluded that the rate of growth is on the order of one to ten meters per year, based on the analysis of aerial photos taken in 1951 and 1961. 3/ Table III-15 provides a summary of Chakela's analysis of gully extensions in the Khomokhoana Catchment between 1951 and 1961.

1/ Binnie and Partners, op. cit.

2/ Q.K. Chakela, Erosion and Sedimentation in some Selected Catchment Areas in Lesotho: 1974/75, Department of Physical Geography, Uppsala University, Uppsala, Sweden, September 1975.

3/ Ibid., p. 3.

Table III-15. Summary of Headward Extension of Gullies in the Khomokhoana Catchment Area, Lesotho; Based on Air-photo Comparison Between 1951 and 1961

Gully Extension in Meteres Between 1951 and 1961							
Area Site	No Visible Growth	0-4	5-10	10-15	15-20	Greater Than 20	Sum
1	2	4	7	3	0	0	16
2	8	14	5	3	0	0	30
3	7	3	0	0	0	2(100)	19
4	1	27	2	0	0	0	30
Totals	18	48	21	6	0	2	95

Source: Chakela, op. cit., 1975.

If we conclude that the donga areas are reasonably stable at the present time, then it follows that the major sources of sediment are: (1) sheet and rill erosion on crop and rangelands, (2) gully erosion from bank sloughing and limited headward extensions, (3) roads and trails, and (4) various construction sites, villages and urban developments.

In order to put erosion and sediment yields in Lesotho into perspective, it is useful to look at erosion records from other countries. Holeman indicates the average sediment yields of rivers in Africa to be 70 tons per square mile of drainage area (24.5 m tons/km^2, while those of Asia are indicated to average 1,530 tons/mi^2 (536 m tons/km^2). 1/ The other continents generally have erosion rates between these values. For example, representative erosion rates for various land uses in the United States are given in Table III-16.

Table III-16. Representative Soil Erosion Rates in the United States, by Land Use, 1973

Land Use	M tons per km^2/year	Tons per mi^2/year	Tons per acre/year
Forest	8.5	24	0.04
Grassland	85.0	240	0.38
Cropland	850	4,800	3.70
Harvested Forest	1,700	12,000	7.50
Construction	17,000	48,000	75.00

Source: U.S. Environmental Protection Agency, 1973. Methods for Identifying and Evaluating the Nature and Extent of Nonpoint Sources of Pollutants.

1/ Holeman, J.N., The Sediment Yield of Major Rivers of the World, Water Resources Research, Vol. 4, 1968: pp. 737-747.

Sediment sampling has been carried out on a sporadic basis at some 19 different locations in the Lesotho river network. This sediment sampling was carried out by the Hydrological Department in 1970-73 and again in 1976-77. But there are only four locations where sufficient information is available to evaluate the sediment load. 1/ Binnie and Partners also provided a valuable estimate of the probable division of sediment sources in the Caledon River Basin. These available sediment yield estimates for Lesotho are summarized in Table III-17.

Table III-17. Sediment Yield Estimates for Selected Locations in Lesotho

Location	Drainage Area sq. km	Runoff $m^3 \times 10^6$	Sediment Yield tons $\times 10^6$	Tons/ km^2/ Year	Tons/ Acre/ Year
Binnie and Partners (1972)					
Caledon River at Jammerdrift	13,320	1,147.9	14.372	1,079	4.8
Caledon Left Bank (Lesotho)	6,570	760.0	11.491	1,749	7.8
Caledon Right Bank	6,750	387.9	2.882	427	1.9
Orange River at Aliwal North	37,200	4,856.5	32.364	870	3.9
Jacobi (1977) Summary of 1971-76 Data					
Puthiatsana at Mapoteng	386	100.2	1.146	2,968	13.2
Little Caledon at Masianokeng	945	191.7	1.870	1.979	8.8
Matsoku at Seshote	662	145.4	0.216	327	1.5
Malibamatso at Paray	3,240	1,006.0	0.710	219	1.0

Summary and Conclusions

In summary, the following generalized statements of conventional wisdom about the physical infrastructure of Lesotho appear to be reasonably accurate:

1. Lesotho is a mountainous country with nearly five million acres, or two-thirds of the country, above 6,500 ft. elevation; almost all of this upland area is suitable only for grazing and watershed uses.

1/ Jacobi, Sven, Sediment Load Estimates of Rivers in Lesotho, Lesotho Ministry of Works, Department of Hydrological and Meteorological Services, Project No. LES/SIDA/10, June 1977.

2. Ten of the 25 soil series described for Lesotho are classified as highly erodible, but most of the gully erosion (dongas) actually occurs in the duplex or claypan soils (Maseru, Sephula and Tsike series).

3. Recent statistics indicate there is a total of about 1.1 million acres of cropland, but much of this land is so highly eroded that it should be returned to permanent cover with only very limited grazing permitted; up to 30 percent has lain fallow in recent years. 1/

4. Lesotho is fortunate to have normal precipitation rates that range from 500 to 900 mm (19.7 to 35.4") per year for most weather stations, and it is also fortunate that approximately 80 percent of the precipitation occurs during the growing season.

5. The much discussed variability of annual precipitation is not particularly more variable than that found in many other rainfed agricultural areas of the world.

6. Comparatively few storms produce surface runoff and channel flow. But, individual exceptional storms in some years produce as much surface runoff and sediment production as several years of normal runoff.

7. Water yields for most Lesotho watersheds do not appear to be as excessive as might be expected from the cover conditions; in fact, they are about normal for areas elsewhere in the world receiving similar precipitation.

8. The dongas of Lesotho are more or less stable under current conditions; therefore, sheet or rill erosion is the source of most of the sediment production currently being delivered to the streams.

1/ With the current level of acres lying fallow or abandoned, acres under cultivation range from 750,000 to 800,000 in any one year, according to recent estimates from Bureau of Statistics personnel (personal communication, March 1978).

IV. PRE-INDEPENDENCE CONSERVATION PROGRAMS

The Kingdom of Lesotho was a protectorate of the British government from 1848 to 1854 and again was under British sovereignty from 1884 until granted independence in 1966. Although British agricultural technicians noted soil erosion as a potential problem as early as 1902, little corrective action was taken until after completion of the Pim report in 1935. 1/ Various conservation projects were in operation as parts of a continuous program from 1935 to 1966. The first phase, from 1935 to about 1950, focused heavily on structural measures and tree planting. It was designed to place all of Basutoland's arable acreage under protective measures. By and large the program objectives were met. Phase II began shortly after World War II at which time lack of maintenance on installed structural measures had emerged as a major problem. This phase continued until Independence and was focused primarily on so-called pilot projects with major emphasis on donga (gully) control and Extension education. It was not nearly as successful in meeting program objectives as Phase I had been.

British Conservation Works: Phase I (1935-1950)

The 1935 Pim report had provided the first overall assessment of soil and water resource conditions of Lesotho (then known as Basutoland) and set forth a set of recommendations for initiating a comprehensive erosion control program. Its findings in terms of the huge magnitude of the soil erosion problem led to immediate implementation of a crash program to combat it. Key phrases from the report that sum up the problem included "It has been estimated that ten percent of the arable land is threatened by existing dongas, and in the lowlands--it is the best land that is affected...The whole fabric of the land is threatened by the erosion of dongas."

The Pim team recommended a soil conservation scheme including contour bank construction, grass buffer strips, returning some high erosion areas (particularly above the heads of dongas) to grass, dam building and tree planting in and along the dongas. A budget of £160,000* was made available to carry out the recommended soil conservation measures. In addition to the importation of some mechanized equipment and construction support personnel, the government added a Soil Conservation Section to the Department of Agriculture to assist in managing the schemes. It consisted initially of one engineer and seven agricultural officers. "The country was one of the first in the world to combat erosion officially and one of the very earliest to have its own Soil Conservation Department." 2/

*This symbol is used to denote the British Pound Sterling wherever used throughout this report.

1/ Pim, op. cit.

2/ FAO/UNDP, Development of a Pilot Agricultural Program in the Leribe Area, Lesotho (mimeographed report based on the work of D.W. Sanders and T.J. Leduma, Maseru), 1972.

Implementation of the scheme began in late 1935 with an objective of placing all cropland in the country under contour farming and conservation related structural measures as quickly as it could be done. Although only incomplete records of the rate of progress and the location of the structural works initially installed in the scheme have survived, it appears that during the early years of the program, the goal was largely being achieved in the more accessible and intensively used agricultural areas in the Lowlands. Some data about the early conservation program, expressed in physical terms, appeared in a British government report released in 1939. 1/ The data for Basutoland was based on information contained in the first annual report on soil conservation and therefore included information from the beginning of project works in 1935. These data on constructed works are summarized in Table IV-1, as follows:

Table IV-1. Comparative Statistics of Progress: Soil Conservation Works in Basutoland (Lesotho)

Item	Before 30.9.36	Year Ending 30.9.37	Year Ending 30.9.38	Total to date*
Area reclaimed (Ac)	1,569	6,747	19,240	27,556
Terraces (Yds)	121,938	736,893	2,078,746	2,937,577
Weirs (Nos)	Nil	4	4	8
Grass inlets (Nos)	Nil	2	29	31
Dams (Nos)	23	6	20	49
Trees planted (Nos)	12,070	31,226	128,662	171,958
Area fenced (Ac)	155.5	112	386	653.5

*Total column was added since it did not appear in the original report.

Source: A Review of the Position in Regard to Soil Conservation in the British Empire, op. cit., 1939.

The data provided in this comparative statistics table is of interest on several counts. First, it shows definitely that the soil conservation program was accelerating rapidly during the late 1930's. Second, the basic kinds of measures still being used in soil conservation programs today were being installed but, as time went on, some new things were being tried, e.g., grass inlets. Third, nonstructural elements were a part of the program from the beginning, e.g., tree planting and

1/ A Review of the Position in Regard to Soil Conservation in the Colonial Empire in 1938: Section, Basutoland, London, 1939, p. 79.

fencing off eroded areas such as dongas. Further, since a "totals" column was missing, it is apparent that there was no particular concern with a determination of how much of the total program had been accomplished to date. Finally, since there are no figures given here or elsewhere in the report on the magnitude of the total job, other than the original recommendations in the Pim report (which surely were modified), one cannot determine how far along the effort had gotten by the end of the reporting period.

The narrative section of the 1939 British government report provides some additional data on construction costs and amount of earthmoving involved. For example, the report states: "The 2,078,746 yards, i.e., approximately 1,181 miles, of terrace banks constructed represents a total of about 2,100,000 cubic yards of earth moved." 1/ But unit cost and its distribution among machinery, labor and other costs is not given (and most likely was never calculated). The only reference to costs found in the report is in regard to weir construction: "Four weirs, either masonary or stone or wire were constructed during the year but since their initial cost is high and they usually need considerable maintenance, no more will be constructed unless there is no practical alternative." 2/ There was also an interesting section in the report, "Experience Gained in Construction of Anti-erosion Works." It details the usual engineering problems but says nothing about ways to achieve cost effectiveness, the degree to which the local farmers were accepting the program, whether it was beginning to have a positive effect of agricultural output, or whether in fact there were signs of reduced erosion.

In adopting the recommendations of the Pim report, the British government had committed itself to a ten-year program to protect some 150,000 acres of badly eroded land. 3/ Based on experience gained in soil conservation work in the mid-west of the United States during the early 1930's, a system of mechanical structures was laid out across the arable areas of Basutoland. Work began in the Maseru District and proceeded into the mountainous areas only after much of the cropland in the Lowlands and Foothills Regions had been treated. The early work was carried out under the supervision of the Engineering Section of the Department of Agriculture, working in gangs of 50 to 100 Basotho laborers, supervised by European foremen. 4/

1/ Ibid., p. 79.

2/ Ibid., p. 79.

3/ Hailey, op. cit., p. 139.

4/ Turner, S.D., Soil Conservation in Lesotho (Downing College, Cambridge, January 1975), p. 16.

Contour banks (terraces) were constructed that cut arbitrarily through fields allocated to different farmers. In the early phases, the standard terrace had the following dimensions:

base width	13 ft.
center height	15 in. (above original ground level)
width of upper furrow	2 ft.
width of lower furrow	1 ft. 1/

Initially all terrace banks were planted to grass and in attempts to control dongas, earth dams were constructed, "the distance between the major dams, being as a rule, about four miles." 2/ Tree planting was extremely popular. In 1942, the conservation campaign was extended to the mountain areas where the work was based on "contour buffer grass strips...six to nine feet wide at six foot vertical intervals," although some terraces were also built. 3/ For reasons of expense, it was found necessary after World War II to replace lowland terracing with grass strips, a change welcome to the farmers but less acceptable to the conservationists. 4/

By 1945, the dislocation of the war years notwithstanding, the early goals had essentially been achieved, based on a summary of accomplishments reported by the Basutoland Department of Agriculture. 5/ Specific accomplishments listed included the following: 154,000 acres of arable lands in the lowlands out of some 350,000 or 44 percent, had been protected with terracing; out of a mountainous area of 450,000 acres, 80,000 acres (or 18%) had been protected with buffer strips; 179 dams with an average capacity of 1,689,000 gallons had been constructed; and, over 822,000 trees had been planted. Further, according to this report, these conservation measures were supported by the Chieftainship who had issued directives that required farmers to plow on the contour and to utilize the grass strips installed. 6/ It is not known whether or not a supplemental appropriation was provided to carry out this first 10-year conservation program but if not the cost effectiveness rate achieved certainly has not been closely approximated since. To have even accomplished the physical targets is remarkable. As will be shown subsequently, the picture was not nearly so bright in

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1/ Annual Report, Department of Agriculture, 1937.

2/ Ibid., 1939.

3/ Ibid., 1944, 1945, 1946.

4/ Turner, op. cit., p. 17.

5/ Annual Report, Department of Agriculture, 1946, p. 25.

6/ Ibid., p. 25.

terms of soil conservation effectiveness of these structures. But this was not to become common knowledge until after Fitzgerald-Lee and others had published in the literature about the "success" of this early program.

According to Fitzgerald-Lee:

> By the end of 1948, about 227,000 acres of the densely populated lowlands had been terraced, and in the mountains, 203,000 acres had been protected by grass buffer strips...About 260 earth dams had also been constructed to seal off gullies. Grazing control has been successfully introduced and is being rigidly enforced by many of the chiefs; mountainsides and valleys are being ungrazed for as long as a year, and the ravaged grasslands are being given a chance to recover. 1/

By 1952, the Department reported that approximately two-thirds of the arable acreage in the Lowlands had been protected by terraces and grass strips, about three-fourths of the Foothills had been protected with grass or buffer strips and that the whole Mountain area should be completely protected by 1953. 2/ "The basic recommendations of the Pim report...were substantially implemented by the mid-1950's." 3/ Future observers should note that in spite of the optimism of outside reviewers who viewed the early works from the mid-1950's on,* a new policy direction in the country's soil conservation program was already being started at about that time, (e.g., the 1946-56 10-year development plan), as will be discussed below.

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*Fitzgerald-Lee's article title is in itself indicative of this optimism, e.g., "Basotholand's Success with Soil Conservation." He quotes Dr. W.V. Lambert of the University of Nebraska, who was then head of an ECA agricultural mission to British African dependencies, as follows: One of the most encouraging things we observed (in Africa) is the great extent to which soil conservation practices are being employed in many areas." Another American, Dr. W.C. Lowdermilk, who visited this area at that time was quoted as saying that the fight against erosion in the Basutoland was the finest work he had seen in Africa south of the Sahara.

1/ Fitzgerald-Lee, op. cit., p. 523.

2/ Turner, op. cit., p. 17.

3/ Ibid.

But before doing so, it is of importance to determine why a change in the program came about in the early 1950's if at that time it was judged to be so successful. Our initial view was that a change in policy direction occurred because by then it was common knowledge among British technical personnel and administrators that the system had been a failure and rather than making the necessary investments in research and organizational and institutional arrangements to salvage the sunk capital in structures, it was simply easier to walk away from the problem by defining a new kind of crisis and attempting to head it off in other ways (e.g., donga control and reforestation). But later analysis of a change in structural maintenance policy modified our view, as will be discussed below.

A report published by Qalabane K. Chakela in 1973 provides a most sobering assessment of the state of affairs at this point of major policy shift in 1950. 1/ He stated in part:

> However, the following facts were clear as far as the work launched in the 1930's for stabilization of soil was concerned:
>
> 1. Deterioration of pastures had increased thus endangering soil resources.
>
> 2. The anti-erosion works had a very limited effect and their maintenance was very poor. The erosion was still increasing to harass the land.
>
> Lack of maintenance is the most obvious problem as far as the effect of these measures were concerned.* This seems to show very clearly that more education work was required to the local peasants to understand the importance of these groups of progressive farmers. Some of the recommendations of Pim's report and those after him were followed without taking into account local factors. Such things as campaigns for row planting and monoculture of crops rather worsened than improved the soil resources of the country. Some of the works were badly constructed and emptied into dongas, thus aggravating the erosional process. Planting of trees whose effect was opposed to what was required was the result. Research and experiment in all conservation works

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*Underlining added for emphasis.

1/ Chakela, Qalabane K., Review and Bibliography: Water and Soil Resources of Lesotho, 1935-1970, Uppsala Universitet Naturgeografiska Institutionen, Sweden, February 1973.

mentioned in Pim's report were not followed and thus it is not (up to now) realized that grass can prove to be a better alternative than tree planting as far as soil conservation in the country is concerned.*

At this point, it is worth noting just what it was in the 1935 Pim report set of recommendations that was ignored at the time when there was such a rush to get on with installing the structural measures of the soil conservation scheme. The report states in part:

> It will be seen that the whole question is one of great complexity. To make wholesale attempts at reclamation without knowledge of what areas are liable to erosion, as well as those already affected, of the progress of the evil, and the probable rate of rehabilitation if stock is locally removed or reduced to reasonable numbers, of the best grasses to be used to reclaim depastured slopes, and of ecological significance of the presence of the "bitter Karoo" would simply amount to working in the dark. Survey, observation and experiment are all necessary. (Pim provided the underlining here.) 1/

In this regard, there has not been much change in point of view; that is, there continues to be a rush to proceed with implementation of more and more project schemes without waiting to develop an adequate research data base.

In fairness to those responsible for implementing the early British schemes, however, one must note that at least some attempts were made to initiate a research component during Phase I. For example, Fitzgerald-Lee noted that three mixed-farming demonstration units were established to popularize improved systems of agriculture. And, the ecological survey recommended in the Pim report was carried out. The team report, by Staples, et. al., released in 1938, included geological and pedological studies of the mountainous areas. 2/ Emphasis was given to programs designed to protect deteriorated pastures and to determining the interrelationships between grazing levels and the physical soil erosion and water yield parameters. But what is accurate to say is that in designing follow up soil conservation projects, not only were the results of these early research surveys and demonstration plot results ignored, the causes of failure of the earlier projects installed were not taken into account in designing those that were to follow.

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*Underlining added for emphasis.

1/Pim, op. cit.

2/Staples, R.R. and Hudson, W.K., An Ecological Survey of the Mountain Area of Basutoland (London: Crown Agents), 1938.

Unfortunately, no complete records relating specifically to the progress and problems inherent in the early British soil conservation program could be located and probably do not exist. At that time, all agricultural works were reported on in annual reports of the Department of Agriculture and Chakela has noted that it was not the format style of these reports to dwell too much on problems. As a result, few clues exist about projects that were in difficulty before they failed and then ceased to be referred to in the annual reports. To any researcher so inclined it would likely be fruitful to locate some of the diaries and journals of British personnel working in Basutoland during that era for therein would most likely lie some detailed day-to-day accounts of what really went on. But even without such information in hand, there is enough evidence available to conclude that, following a resurgence of British interest in Lesotho's soil erosion problem after World War II, it was decided to walk away from the first approach in favor of one that was less dependent upon the construction and maintenance of terraces than the Phase I program had been.

During the first 10-year program, from 1935 to 1945, when the Pim report recommendations for soil conservation measures were being implemented, the British government was almost totally responsible for both the construction and maintenance of the conservation structures. Although these structures were almost universally resented and opposed by Basotho farmers, there were cases of new lands being opened in the Foothills, perhaps illegally, where farmers without government sanction plowed on the contour and constructed rudimentary banks or checks at intervals across the slope. Such cases were exceptions to the rule. 1/ 2/ We hypothesize that, during the war years, not only did the construction phase virtually grind to a halt but that due to machinery, budget and technical manpower constraints, maintenance likewise was not effectively being carried out.

We further hypothesize that upon reexamination of the systems after the War, the responsible technical personnel decided it would be too expensive to reconstruct the systems, particularly in cases where the terraces had been breached. And, in any case, it was not considered to be the right thing to do, given the prevailing feeling at the time that in the final analysis, such structures should be totally maintained by local farmers and at their own expense. History has shown, of course, that many key sections of the original system fell into misuse and/or failed outright, e.g., breached terraces and washed out grass waterways that have turned into dongas.

Our conclusion is that the system failures were more due to lack of maintenance than due to design and installation deficiencies. The

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1/ Turner, S.D., op. cit., p. 19.

2/ Binnie and Partners, op. cit., "Inventory Report," Vol. 4 (Irrigation Appendices, London and Maseru, UNDP, March 1972), p. 411.

basis for this conclusion was drawn largely from information recorded in a Master's thesis by J.M. Quirion in 1958. 1/ Further research might of course lead to a modification of our conclusion. But, nonetheless, the analysis provided by Mr. Quirion cannot be dismissed without careful consideration of the implications that the policy decisions reached about 1950 in Lesotho's soil conservation program have had on the following course of history. For this reason, relevant sections of his report are presented below. He stated in part:

> The 10-year development plan (1946-56) gave particular attention to anti-erosion measures. Summarizing the work done in terms of the area to be protected by such measures by the end of 1954, it could be said that approximately 80 percent of the arable land of the Lowlands had been protected by a combination of terraces and grass strips, while the work of protection of the remarkably fertile lands of the Foothills and the buffer strip protection in the Mountains had been virtually completed.* Yet, in the Annual Report of the Department of Agriculture for 1953, the section dealing with soil conservation works in the Pilot Project area contains this startling statement: "Except for old-established contour furrows at the lower end of the valley (Tebetebeng) and some scattered buffer-stripping, virtually the whole area requires attention." Such a statement may leave one skeptical on the effectiveness of the work accomplished up to now. (*Annual Report, Department of Agriculture, 1954, p. 23.)
>
> So far, soil conservation in Basutoland has been primarily, though not exclusively, concerned with anti-erosion measures in the form of contours, dams, tree planting, such steps directed towards soil stabilization being considered the essential prerequisites to improve agriculture. This preliminary stage has now come to a close. The maintenance, however, of those anti-erosion works is a matter of fundamental importance. Since 1950, the Chieftainship through the National Treasury has taken over full responsibility for this work of maintenance in all areas where the protective measures have been completed.** (**Annual Report, Department of Agriculture, 1950, p. 19.) (Note: We have added underlining for emphasis.) 2/ 3/

1/ Quirion, J.M., "The Economics of Agriculture in Basutoland," thesis submitted in the Faculty of Economics, University of London, for the degree of M. Sc. (Econ), 1958.

2/ Ibid., pp. 123-124.

3/ According to the Department of Agriculture Annual Report of 1947, "After one year of consolidation, the anti-erosion work is handed over to the people for maintenance. For each 3-5,000 acres of consolidated work a maintenance man is employed and paid for by the National Treasury."

We believe that herein lies the key to the failure of many structural elements in the early British conservation works. It was assumed at that time that for agricultural modernization to occur, the land tenure system would have to be changed to allow for individual ownership of land. One could argue in that context, perhaps, that turning over total maintenance responsibility to the farmers would be a useful tool in forcing a revision of the tenure system. 1/ We further believe that since Lesotho gained independence in 1966, with the old collective tenure system in place, it is no longer valid to make the assumption that Basotho farmers will bear the out-of-pocket repair and maintenance costs of conservation works on "their" land. 2/ (They would, however, likely continue to do the necessary work which doesn't require machinery, particularly if granted a subsidy to do so.) One could even argue that since the British terrace systems are still the most visible conservation features in Lesotho today, after the weak links had washed out, either those that remain don't need further maintenance or the farmers are doing the necessary maintenance. This paradox should be investigated. But for the moment, let us return to Quiron's thesis to see how his story unfolded.

Quirion argues that:

> The maintenance of terrace banks is the responsibility of the land occupier. The apathy of many farmers in this respect and the slowness of many chiefs in applying the necessary sanctions provided for such negligence left doubt at first as to the wisdom of such a transfer of responsibility.* The following year, a marked improvement in this direction was noted: "Heavy fines have been imposed on landowners who have deliberately

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1/ Significantly, however, a 1938 Department of Agriculture report had already argued that: "Maintenance of terrace banks and furrows should be carried out by the Native land-occupiers themselves, as it is impossible for thorough, regular injection of the huge terrace systems already constructed, to be made by the Department." In 1941, the Paramount Chief offered three orders to the Laws of Lerotholi which made "compulsory the maintenance of conservation works already installed; cooperation with Department of Agriculture conservation work; and individual initiative in caring for entreated land," (Turner, p. 18). But given the lack of incentive to the individual farmer provided for in the overall land tenure system, apparently these new orders were largely ignored and almost totally ineffective.

2/ A thorough understanding of Lesotho's land tenure system is essential to designing effective soil and water conservation programs because the system is not necessarily compatible with the introduction of U.S. oriented conservation measures which were designed to work in accordance with a western-oriented land tenure system. Refer to Appendix C for a brief summary of Lesotho's land tenure system--the Laws of Lerotholi.

ploughed out buffer grass strips."** And the report ends on a very satisfactory tone: "The ploughing of land between the terraced banks in the Lowlands area now very nearly (is) a hundred percent correct. In 1956, the anti-erosion maintenance staff was reorganized with a view to getting more efficiency with a better type of worker."*** (*Annual Report, Department of Agriculture, 1950, p. 20; **Ibid., 1954, p. 34; ***Ibid., 1956, p. 21.) (Underlining again added for emphasis.) 1/

The above section of Quirion's thesis shows how strongly the view was held at the time that farmers (note, "land occupier" instead of land owner, which is a big difference) should bear the total cost and responsibility for terrace maintenance. Note also that the government resorted to "heavy fines" for plowing up grass strips but apparently did not insist upon them being replaced. Turner, reporting on what followed immediately after 1950, stated in part:

> ...as the years passed the effects of ignorance...became more and more visible and distressing, despite moves made to protect conservation works (meaning the imposition of heavy fines in 1951 for misuse of the system components). It was complained that new land was being ploughed without the grass strips first being marked as required: that in some mountain areas grass strips were being "willfully ploughed out": that the people were reluctant to construct diversion furrows for payment (we added underlining for emphasis) despite the fact that the legal requirement to care for the soil made the money essentially a gift. Elsewhere plantations of trees were uprooted the night after they were put in. The mood of the frustrated conservationist is summed up in their complaint that "Basotho are by and large apathetic, and many chiefs are slow in applying the necessary sanctions..." (Annual Report, Department of Agriculture, 1951.) 2/

Once the damage had been done (e.g., the terraces had been breached) what did it really matter that by 1954 all farmers were again correctly plowing along the contour? (Except where interrupted by new dongas, we presume.) It doesn't take much reading between the lines to realize that once it was clear that the forced farmer maintenance system wouldn't work and that the conservation systems had partially failed, it was time to invent a new conservation program (e.g., "In 1956, the anti-erosion maintenance staff was reorganized...").

But there is more to this sad story. Quirion went on to calculate the economic benefits of the program so far installed. Unfortunately, he

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1/ Ibid., p. 124.

2/ Turner, op. cit., p. 19.

drew the wrong conclusion from his analysis. Nonetheless, his analysis did show how sound the original program was in economic cost effectiveness terms. He proceeded as follows:

> In trying to assess the value of the anti-erosion programme implemented over the last 20 years (1935-1956) it is necessary to state the objectives aimed at explicitly in order to evaluate the effectiveness of the means used in attaining them. The stabilization of the soil which was seriously threatened of destruction was the objective and it was to be attained through bank terraces, buffer strips, diversion furrows, dams construction and tree planting. This initial phase has been achieved at a total cost of approximately half a million pounds, a fabulous sum for Basutoland financial resources when one bears in mind that the average annual revenue for the five year period from 1945 to 1950 (alone) amounted to £772,995.* It has been made possible through the injection of capital grants from the Colonial Development and Welfare funds; thus has laid the foundation upon which the improvement of farming methods may give permanancy to anti-erosion works. (*Hailey, op. cit., p. 19.)
>
> The whole programme over twenty years works out at approximately 12/- per acre of arable land, that is roughly 7d. per acre per annum. Since the average holding per family is 5.75 acres, the programme corresponds to an average yearly investment of 3s.6d. per household. On that basis, it would have surely been economic to the individual farmer to undertake anti-erosion works to save his land and it seems quite reasonable to explain his failure to do so in terms of ignorance and apathy. 1/

We believe that Quirion's concluding comment is in error and the fundamental mistake arises from his assumption that it is his (the farmer's) land. One could only wonder what the present might have been like if an opposite judgment had been made--to the effect that, since under Basutoland land tenure rules, the land is held in trust by the Paramount Chief, it would behoove the government to protect its own investment with a relatively low maintenance investment. Further, given the fact that since Basutoland farmers were not willing to protect the government's investment of only 12/- per acre by 1950, 1/ what basis do we have for assuming that almost 30 years later the farmers in the

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1/ Ibid., pp. 125-126.

2/ In this regard, it is noteworthy that for the original 10-year project undertaken in response to the recommendations in the Pim report, the British government had committed itself to protect only some 150,000 acres of badly eroded land at an estimated cost of £1. per acre (Hailey, op. cit., p. 139).

Thaba Bosiu Project area will protect the recent government investment of almost $150 per acre (as will be shown below)--when net returns per acre have not increased significantly while off-farm employment opportunities and wages have significantly increased in the interim?

British Conservation Works: Phase II (1950-1966)

During the decade of the 50's, a new policy of soil conservation and improvement of agricultural production in Lesotho was initiated. It consisted primarily of a reclamation program directed particularly to gully erosion areas (the dongas) and an expanded program of Extension education to be directed to the so-called "progressive farmers." The groundwork for this change in emphasis had been laid during the war years when a shortage of mechanical equipment and funds forced a virtual halt to terrace construction and their maintenance. In 1943, the High Commissioner in Basutoland had suggested an extensive tree-planting campaign which was of low capital intensity and which could be carried out primarily with Basotho labor. The objectives of this scheme were the development of a fuel supply, release of dung for field fertilization and tying the soil down with tree roots in badly eroded areas. Again the early efforts were considered to be a huge success (Fitzgerald-Lee) and led in part to the granting of an £830,000 allocation in 1945 for the second 10-year development program. Of the total allocation, £303,480 was earmarked for the agricultural sector, primarily for soil erosion control. A follow up grant for the same purpose in the amount of £133,000 was provided in 1950.

Available records shed little light on what was actually accomplished during the next decade in terms of agricultural development and related soil conservation measures. But it is evident at least that an awful lot of the effort went into the reforestation program. Fitzgerald-Lee reports, for example, that in 1948 alone, about 13,000 trees were planted, "making a total of nearly 850,000 since the beginning of the scheme." 1/ But he makes no mention of the fact that, as reported by others, a large number were being planted each year to replace those that had died the year previous. Yet, the reforestation program continued into the 1960's, although in the aggregate less than 10 percent survived. 2/

According to official reports reviewed by Chakela, the major soil and water conservation policy elements during the decade of the 50's were as follows:

1/ Fitzgerald-Lee, op. cit., p. 523.

2/ Baldwin, M.C. and Carroll, D.M., op. cit., p. 25.

1. Demarcation of dongas (equivalent to establishing grass strips along the edges).

2. Dam constructions (mostly for local water supplies).

3. Terracing (mostly through so-called Pilot Projects).

4. Runoff observations under varying soil erosion conditions (although no records exist as to whether or not these were actually carried out).
5. Rotational grazing and grazing control (for reclamation of pastures and eroded areas).

At this time, according to Chakela, "An anthropologist's services were obtained to investigate the land tenure system which everybody except the peasants thought was a hinderance to agricultural development. 1/ (Again, refer to Appendix 3 for an opposite view.)

Pilot Projects

The Pilot Projects program of the 1950's and 60's in a sense served as a prototype for the area based projects funded by various donor groups in Lesotho in recent years (e.g., Thaba Bosiu, Senqu, Leribe/Khomokhoana, and Thaba Tseka). Fortunately, Chakela had previously made a review of the available literature on these projects and what is presented here on these projects is drawn primarily from his 1973 report (cited earlier). Eleven of the major project areas were identified by location in the available reports (see Map No. IV-1) and enough technical information was found to report herein on several of them.

Tebe-Tebeng Valley Scheme (1951-1957)

Since it was the first project in the second phase scheme, it was known officially as the Pilot Project. It covered over 62 square miles and an area with a population estimated at about 8,000. The main objectives of the project were: "Construction of roads, protection of land by soil conservation methods, building of dams and establishment of cooperative group farms;...it will be stressed throughout that the function of the Pilot Project Team is to work with rather than for the people, and in its larger aspect the project will be an experiment in Community Development aimed at progress through the stimulation of local initiative and self-help." 2/

According to the Colonial reports, the Tebe-Tebeng Valley Scheme was considered to be a success in its early stages and was even expanded to

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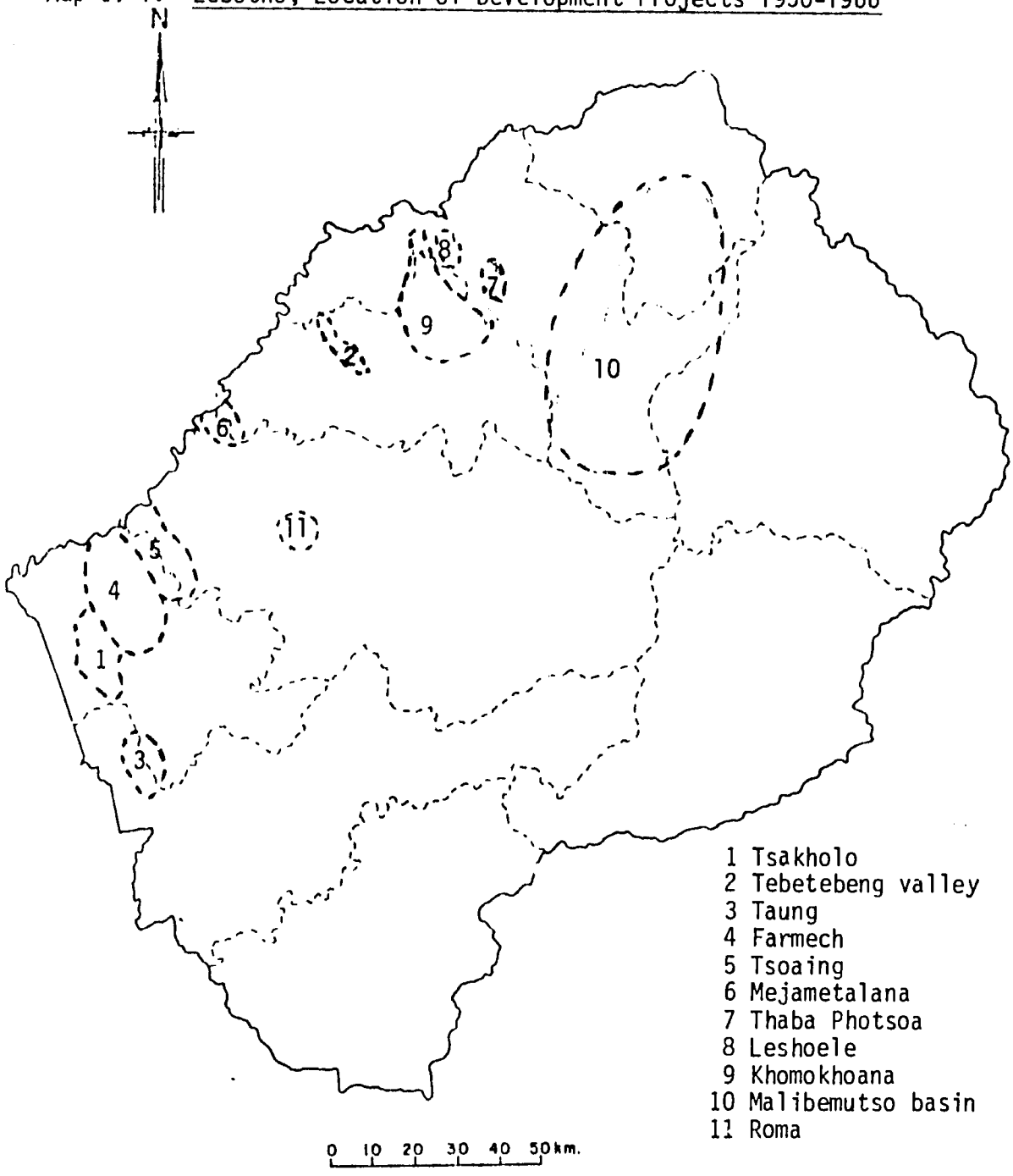
1/Chakela, op. cit., p. 8.

2/Annual Report, Department of Agriculture, op. cit., 1952.

Map IV-1. Lesotho, Location of Development Projects 1950-1966



1 Tsakholo
2 Tebetebeng valley
3 Taung
4 Farmech
5 Tsoaing
6 Mejametalana
7 Thaba Photsoa
8 Leshoele
9 Khomokhoana
10 Malibemutso basin
11 Roma

include mechanized agricultural methods. Nonetheless, it was closed down abruptly in 1957. Although no project evaluation is known to exist, in Wallman's 1967 book it was reported to be a failure. She noted that it was one of the factors that prejudiced Bataung in the Taung Reclamation scheme that followed it. 1/ One of the reasons cited for its failure was lack of cooperation by the administrative authorities. Turner has pointed out that this project marked the beginnings of a government concern for the human element of the erosion problem. But, nonetheless, because of the regulatory and enforcement methods used, the problem of maintenance grew more serious while relations between the Department and the public deteriorated. 2/..."The Department field staff have of necessity become involved in policing activities which are not strictly their responsibility. The feeling of the people towards the staff is reflected in their distrust of any attempt to introduce Extension work and their unwillingness to accept the staff as the 'farmer's friend'." 3/

Taung Reclamation Scheme (1956-1961)

Announced as a model scheme for dealing with erosion hazards, it focused primarily on problems of overgrazing and sought to reclaim "badly eroded" areas. It too was initially hailed as a success; (for example, see the Economic Survey Mission [Morse] Report of 1960). 4/ But in 1961 it was judged a complete failure and withdrawn, with several structures left unfinished and with considerable resentment and insecurity expressed by local inhabitants. Taung was one of the project areas visited by Dr. Sandra Wallman, a Social Anthropologist, in researching her book, Take Out Hunger (1969). She provided a more complete record of its expectations and reasons for failure than is available for most past projects. According to her report, it was planned to make a thorough soil erosion survey of the total project area. Based upon this study, badly eroded cropland would be rested and "non-arable land would be closed to the plough while excess livestock would be sent temporarily to the cattle posts while the grazing areas could be rejuvenated." 5/ An "agro-pastoral-socio-economic" survey was made in June 1956 when the project was implemented but "by the end of 1961,

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1/ Wallman, Sandra, Take Out Hunger: Two Case Studies of Rural Development in Basutoland (The Athlone Press: University of London), 1969.

2/ Turner, op. cit., p. 20.

3/ Annual Report, Department of Agriculture, op. cit., 1957.

4/ Morse, C. (Chairman), et. al., Economic Survey Mission Report: Basutoland, Bechuanaland Protectorate and Swaziland (London, H.M.S.O.), 1960.

5/ Wallman, op. cit.

the Department of Agriculture withdrew the scheme from Taung because of its considerable (economic) losses." 1/

Based on her observations and discussions with both villagers and project personnel, Dr. Wallman concluded that the following were the primary causative factors leading to the failure of the project:

1. Communication
   Circulars describing the project were sent to the chiefs to be read at the "Pitso," but often the chiefs did not understand the message and thus could not explain it to the people; there was not even time left for discussion questions.

2. Shortage of personnel
   There was only one single demonstrator/Extension agent and two very junior assistants to cover 160,000 people.

3. Lack of cooperation
   The whole scheme rested on the cooperation of the chiefs. Taking into account that no more than a small minority understood the technicalities at stake, there is still evidence that many chiefs were simply unwilling to cooperate with the scheme. The District Committee (where all the groups in the scheme were represented) was accused of taking an area of authority away from the chiefs of Taung.

4. Result of bad planning and surveying
   The surrounding areas were already exhausted, so it was impossible to find a permanent cattle post. Some people who sent their cattle away lost them through theft. The people (the chiefs included) felt that they needed their animals at the spot (for prestige, perhaps??) and refused to send them away. The government conceded that all in all 50 head of cattle should be left in Taung, but that number was exceeded by more than 10,000 animals.

5. Economic insecurity
   Land was never properly reallocated by the chiefs, and the Ba-Taung saw themselves to be utterly dependent on the lands they had. Without land there would be no insurance against starvation. Many people also complained that Taung was being used as the country's experimental plot and that the scheme was obviously discriminatory. 2/

1/ Ibid.

2/ Ibid.

When asked afterwards some people said that they were just beginning to understand, but then after four years "the machines went away."

There is a missing link in the historical record of previous efforts to combine livestock management and erosion control objectives. It would have been one thing if the Taung scheme had been the first attempt but obviously it was not. Further, it was not designed on the basis of experience gained with other programs prior to 1950. Apparently a massive program was implemented during the first 20 years of the soil conservation effort and it appears that in the initial stages it was successful. At any rate, Quirion reports in 1958 (after the Taung scheme began) as follows:

> The relative success achieved over the last twenty years in restoring pasture fertility is most remarkable from the standpoint of adaptation to local conditions and education of the Basotho farmers, which in turn results in social contentment and economic returns. By adaptation and education, we refer to the fact that controlled grazing has been achieved within the framework and the machinery of the communal system, by using natural boundaries such as rivers, streams in lieu of fencing or beacons, employing a limited number of grazing caretakers, persuading the chiefs and the people of the need and value of such changes, and making the whole scheme the responsibility of the Basotho, with the least possible European supervision.* By 1949, 2,800 square miles of the mountain pasture out of a total of 6,100, this is almost 50 percent, had been brought under control,** and by 1951, it could be stated that with the exception of two small districts "all mountain areas have now been brought under control and the time has arrived for the cattle post areas which were destocked four or five years ago to be restocked on the basis of carrying capacity and rotation."*** (*Annual Report, Department of Agriculture, 1949, p. 39; **Ibid., p. 33; ***Ibid., 1951, p. 13.) 1/
>
> It can be safely said that today the majority of the chiefs and of the people have come to realize the value of good grass cover in the Mountain areas. Destocking of defined areas has now been completed both in the villages and the mountains and attempts at rationalizing the use of pasture land which calls for changes in custom are done along two main lines: first limitations of numbers in defined areas and secondly, control of grazing rights by Ward chiefs in respect both of holders and sites. This policy was embodied in an order issued by the Paramount Chief in November 1955 as Part III of the Laws of Lerotholi.* (*Ibid., 1955, p. 65.)

1/Quirion, op. cit., pp. 149-150.

The above information provided by Quirion raises more questions than it answers. For example, is the data reporting huge successes that he gleaned from official Department of Agriculture Annual Reports merely an undocumented assertion or did it really happen? Assuming it did, at least in part, then why was it deemed necessary the very next year (after the glowing report of 1955) to initiate the Taung Reclamation Scheme? And why at least didn't it benefit from the experience gained from the previous efforts? The principles supposedly used sound sensible to us, very similar in fact to those being advocated by expatriate specialists in the Ministry of Agriculture at the present time. Yet, the mystery remains, as we have noted, as to why projects such as these continued to fail. All we can suggest is that policy makers investigate why the principles embodied in the "Laws of Lerotholi" failed to be sustained before again advocating tampering with Lesotho's cultural views of cattle in efforts to achieve conservation of the mountain grazing areas.

Farmech Mechanization Scheme (1961-19??)

Implemented on the initiative of the District Council of Mafeteng, the main objective of the project was to introduce tractors into the area which was described as "essentially arable area and relatively well suited to cultivation." The Council obtained a loan of 45,000 Pounds Sterling from the High-Commissioner-in-Council to provide tractor hire for cultivation and threshing with the individual loans for farm cooperators to be repaid from increased yields and net returns. In 1975, Chakela reported:

> The first two years of the scheme proved to have no progress for the same reasons that led to failure in Taung. However, this was partially corrected and the scheme still operates (although now at a worse economic loss) as the new "Lema-Tractor Hire." It is doubtful if this scheme is the best that the area can produce (see Wallman's studies). 1/

Dr. Wallman's assessment, based on a four-month stay in the local village, is revealing in that essentially the same causitive factors for the lack of progress were noted. But after adjustments were made in Phase 2, some "success" was obtained, (although not in an economic sense). Dr. Wallman stated in part:

Phase 1 (1961-63) and its factors of failure

The two first years of the scheme were unsuccessful due to the following factors:

1/ Chakela, op. cit., p. 12.

1. Bad planning and surveying
The preparatory surveys were inefficient due to inadequate financial provision. The initial land measurements turned out to be inaccurate. The use of tractors was less than it was estimated in the planning. The cost increased so much that it was impossible to employ a properly qualified staff.

2. Attitude of the management
The first two managers isolated themselves completely from the people. They neither knew the language nor did they respect the Basotho traditions, and this obstructed the cooperation with the indigenous population.

3. Communication
"Pitsos" were arranged to explain the scheme to the people, but just like in Taung this medium was inadequate. The letters were too long and complex.

4. Political conflicts
Various political conflicts arose: The chiefs felt threatened by the new elected local body. There were even some disagreements between the various political parties concerning the responsibility of the scheme.

5. Economic insecurity
The people complained that the alleged credit benefits never materialized. The cost of tractor hire was too risky for the limited resources of the villagers.

Phase 2 and its factors of success

The scheme changed in three important respects and began to show signs of success. These were:

1. Better economy
The loan was extended according to the original plan and a properly qualified manager was appointed, and six field organizers were added and managed to maintain contact with the land holders.

2. Management
The new manager was a professional and was given greater responsibility. He knew the language and the customs of the people and this created a mutual confidence between him and the people. Men were employed on their qualifications and personality without regard to political affiliations. It was made clear to all parties concerned that the tractors belonged to the people of Mafeteng.

3. Share-cropping
The manager realized that the land holder would not run the risk of failed crops unless it was shared by the creditor; he then took the gamble of buying fewer tractors and set up a share-cropping venture. The operation was confined to wheat since that is a cash crop. People became increasingly enthusiastic and by the time of spring planting Farmech had more applications than it could handle. 1/

Elsewhere in her book, Dr. Wallman observed that the success of rural development projects (which apply equally well to those concerned only with soil conservation measures) depends on being able to deal effectively with social realities. She defined the three most important of these as "1) communication, 2) economy, 3) planning." 2/ Chakela, in commenting on these observations, stated: "Dr. Wallman shows how important it is to adjust the projects to the people and not the reverse." 3/

While we concur in Dr. Wallman's observations, we nonetheless wonder why, in retrospect, the planners of the Farmech Mechanization Scheme failed to benefit during Phase I from lessons learned from the earlier Pilot Project on Cooperative Mechanized Farming. It operated in the mid-1950's on a grant of £85,854 made in 1952 by the Colonial Development and Welfare fund, followed by a Mechanized Group Farming project with a further grant of £31,795, also in 1952. 4/ Quirion reported in 1958 that the project had ceased and observed that "All these observations indicate that mechanization is not purely a technical and economic problem, but a social one as well..." 5/

Mejametalana Improvement Area (1959-19??)

Little information on the early years of this project are available. Chakela notes that in an official report issued in 1961, the project was listed as making "success." He notes, however, that "The 'success' meant is not clear to me as all the former schemes in these reports are reported as successes." 6/ The project became one of the first areas to which the land use planning approach was applied

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1/ Wallman, op. cit.

2/ Ibid.

3/ Chakela, op. cit., p. 69.

4/ Annual Report, Dept. of Agriculture, 1952, p. 13.

5/ Quirion, op. cit., p. 171.

6/ Chakela, op. cit., p. 12.

by the Soil Conservation Service of the Department of Agriculture. In 1964, a conservation and land use plan was prepared for discussion with local chiefs, district councils and district commissioners. The aim of the project was reported as "to raise the level of production to beyond semi-extensive to intensive production of horticultural crops of high income rate to be coupled with dairy and poultry projects where conditions are suitable." 1/

Development of water resources became a project purpose in 1965 when fish ponds were constructed and a sprinkler irrigation scheme was introduced. The project area also figured prominently in developing the current soil survey program based in part on the pancromatic aerial photographic coverage obtained in 1961-62. According to Carroll and Bascomb (1967), detailed field surveys began with the "Mejametalatana and Thaba Phatsoa development areas and finally a reconnaissance soil survey of the rest of the remainder of the country." 2/ One cannot help but agree with Chakela that it is most unfortunate that so little technical material is available upon which to judge progress in this, the first of the project areas to which the land use planning approach was applied in Lesotho.

Thaba-Phatsoa Improvement Area (1961-19??)

The focal point of this project is the Lionel Collect Dam which was constructed, along with the usual conservation works and diversion furrows, to prevent silting of the dam and stabilization of the upstream catchment area. It is known that a great deal of crop testing in response to irrigation, as well as pasture research, was conducted. But other than information of a non-research results nature contained in annual reports, no research data from these tests has survived. Such data as is available is of very little relevance for improving the watershed management and erosion capability of Lesotho. As noted with some obvious frustration by Chakela: "I could not find any material on this scheme except what is found in annual reports and that (from reading through them) does not give one any clear idea of what any scheme is about except that it makes 'good progress,' it is 'a success,' showed 'improved progress,' and one has no idea what any of these words are supposed to imply because suddenly the scheme disappears from the reports without comment." 3/

1/ Lesotho, Soil Conservation Service, Conservation and Land Use Plan for Maseru-Teyateyaneng. Project--Mejametalana Improvement Area. Internal Report of Department of Agriculture, Maseru, 1964.

2/ Carroll, D.M. and Bascomb, C.L., op. cit.

3/ Chakela, op. cit., p. 13.

Leshoele's Irrigation Project

While there was obvious enthusiasm for this project and that important things were done there, Chakela reports that about all he could learn of this project is that it was located adjacent to the Khomokhoana Project. There is some indication that it later was absorbed into the Leribe Pilot Project, one of the first area based projects to be initiated after Independence.

Another Policy Shift (1960)

About mid-way during the 1950-1970 time period in which the above listed projects were being implemented, another major policy shift occurred in the soil conservation program. It appears to have been the direct result of the sequence of dramatic project failures during the preceeding period. Chakela reports on the mood of agricultural researchers at that time: "All was use of fertilizers, pesticides and condemnation of the stupidity of peasants in not having enough sense to buy these new fruits of science which would magically increase their crop production. The end of the decade was crowned with another thorough over-look of the economic situation of the country (Morse, et. al.)." 1/

The so-called Morse report was the product of the Economic Survey Mission of 1960. 2/ Given the recommendations of this report, and the availability of data from the 1960 agricultural census, the Department of Agriculture once again shifted its policy for land and water resources development and the role of its conservation program. As far as the Soil Conservation Service was concerned, the theme was now changed to what was then called the "model reclamation scheme," of which the Taung project reported on above became the first unit. But in addition, some important work was undertaken for developing the data base required for sound and operational conservation programs. A hydrological network was set up for most of the rivers of the country, meterological data was being collected, land resource and soil surveys were undertaken in earnest and a new aerial photographic survey was completed in 1961/62. 3/ The stage was now set for initiating the donor funded projects undertaken during the post-independence period.

Evaluation

While the work on soil resource mapping got off to a good start in the early 1960's and effectively continues to date, the early work in hydrology in general was not clearly so helpful. For example, detailed

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1/ Ibid.

2/ Morse, op. cit.

3/ The most recent aerial photographic coverage of Lesotho was flown in 1978/79.

hydrologic studies of the catchment areas in which projects were being proposed were almost non-existent. Since the mood was again shifting to a concern with an impending crisis, there appeared to be little sympathy with taking the time necessary to develop a sound planning information base. As in previous times of imminent danger, most of the emphasis was put on mechanical structures for the conservation of soil and water resources. Too much optimism was directed to the new rehabilitation schemes. Further, there apparently was no serious attempt to learn from the mistakes in the past, and, in particular, there was no concern with learning why prior similar projects had failed.

Before leaving this review of the early soil conservation and resource development era (from 1935 to 1966), we will cite one more quote from Chakela in which he summarizes the need for sound planning information. His recommendations were unheeded, of course, as the continuing problems with the donor-funded projects of the 1970's have shown. Nonetheless, we believe his message was sound. Speaking of this era, Chakela stated:

> From the study of these schemes one thing is very clear and I think it is best expressed in what I quoted in Part III about reports from Lesotho (pp. 52-53). There is very little or nothing ever said about the past projects. It would be of great help to get the materials concerning these former projects and to find how the experience gained therefrom is being applied in the new schemes. From the only two studied projects (Taung and Farmech) it is clear that past experience with the soil conservation schemes was not taken into account. It is clear, despite limited ground material, that the mistakes in the Tebetebeng were reproduced both in Taung and in the first part of Farmech. Another striking feature of these schemes is the lack of hydrological data and analysis. The only thing of main concern seems to be soil, soil and nothing but soil (of studies on Khomokhoana). How the erosional processes can be dealt with without hydrological data is a puzzle as water is the main driving force in this process.
>
> It is my greatest hope that these facts which are not in the reports and surveys concerning these projects are found somewhere else, otherwise it is like building a house without testing the firmness of the basement material.
>
> Compilation of the material concerning these schemes described above and related ones which I have not been able to find would be one of the greatest helps to a clear and rational anlaysis of the past heritage of soil and water conservation, use and trials at their development and improvement in Lesotho. A thorough description of the fluvial and geomorphological features of the catchment

areas of Lesotho and an extensive inventory of the present extent of erosional activities, pasture status and vegetation regime, are some of the things which would improve the knowledge so much required for rational use of the country's land resource. 1/

To Chakela's message we would only add that this list of prerequisites, while valid, is still woefully incomplete. But since he was not a social scientist, one should not fault him too much for not listing the managerial, institutional, cultural and economic incentive data requirements of the needed package.

Future historians will no doubt mark Independence Day, October 4, 1966, as a point of departure for assessing Lesotho's responsibility for its own destiny. For this reason, our assessment of early conservation programs was limited to the period prior to that date--that is, the program the British began in late 1935 and continued through late 1966. Ideally, one should be able to say with great accuracy just what had been accomplished during this period, at least in such physical terms as the units of conservation works installed, the number still in operation at the end of the period, and the acreages protected, with the latter subdivided into land use capability classes. Unfortunately, such data are not available in totality, although there are some estimates recorded for different years for some of these items. A summary of this kind of information is provided in Table IV-2. But these data are limited to figures of physical units put into place. No similar data were available as to the miles of terraces still in use, the number of dams still operable, miles of grass waterways that have survived without turning into manmade dongas, the number of trees remaining, or, more important, the number of acres of cropland, by land use capability classes, that have remained adequately protected.

It would also have been useful if we could have related the location of the terraces and other structural works to the acreage of arable land protected. For example, the 1966 figure cited for acreage of cropland protected, 543,423, is not directly comparable to an arable acreage figure of 930,000 reported in the 1949-50 agricultural census. 2/ It is not even realistic to compare it to the arable acreage figure cited by Morojele in the 1960 census, 871,687, which he explains "is lower than the 1949-50 figure because of abandonment of land since 1950, due to soil erosion and depletion of fertility." 3/ At a later date,

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1/ Chakela, op. cit., pp. 13-14.

2/ Douglas, A.S.J. and Tennant, R.K., Basutoland Agricultural Survey 1949-1950 (Maseru, Government Printer, 1952), p. 80.

3/ Morojele, C.M.H., 1960 Agricultural Census: Basutoland, Part 2, "Households and Families," Table 20.

Table IV-2. Conservation Works Installed in Lesotho (Basutoland) during the Period, 1935-1966
(Cumulative totals for each year listed.)

Item	1935-36[1/]	1938[2/]	1945[3/]	1948[4/]	1963[5/]	1966[6/]
Cropland protected--terraces, etc. (acres)	1,569	27,556	154,000	227,000	518,958	547,423
Acres protected by buffer strips (acres)			80,000	203,000	688,064*	188,218
Terraces (miles)	693	1,759			27,295	27,891
Diversions (miles)					3,996	4,067
Grass waterways (miles)						1,409
Reclamation beaconing (miles)						14,040
Dongas demarcated (number)						5,658
Dams constructed (number)	23	49	179	260	690	787
Trees planted (number)	12,070	171,958	822,000	850,000	**	4,500,000

*Note the variation for the buffer strips acreage, particularly the high figure cited in the 1963 column.

**This report cited a figure of "about 50 million," possibly a misplaced decimal point.

1/ A Review of the Position in Regard to Soil Conservation in the Colonial Empire in 1938, Section: "Basutoland," 1939, p. 78.

2/ Ibid.

3/ Quirion, J.M., "The Economics of Agriculture in Basutoland," thesis submitted to the Faculty of Economics, University of London for the degree of M. Sc. (Econ.), 1958, pp. 122-123.

4/ Fitzgerald-Lee, G., "Basutoland's Success with Soil Conservation," New Commonwealth, 1951, pp. 520-523.

5/ Baldwin, M.G. and Carroll, D.M., The Land Resources of Lesotho, Land Resources Study No. 3, (Directorate of Overseas Surveys, Tolworth, Surrey, England, 1958, p. 24.

6/ IBRD, Appraisal of Thaba Bosiu Rural Development Project, Report No. PA-147a, for official use only, Annex 3 (IBRD, Washington, D.C., January 1973), p. 3.

Morojele reported in an unpublished paper, "The Lesotho Five-Year Development Plan, 1967-72," that only 700,000 acres of land remain that are suitable for cultivation. Of perhaps more interest is a calculation by Smit, reported in 1967, that due to excessive slope on the marginal lands, only 540,000 acres in Lesotho should be cultivated. 1/ It is not known to what degree the acreage identified by Smit is the same as the 547,423 acres reported as protected by the British before 1967, but there is likely a high correlation.

Summary and Conclusions

The conventional wisdom about the early conservation era generally holds that the program of soil conservation did check the rapid rate of soil erosion that had been so evident in the mid-1930's, that the loss of topsoil on cropland was significantly reduced, and that most farmers adopted the contour farming practice. On the negative side, it was generally felt that the program had failed to reach its objective of stabilizing the soil resource and that the rate of erosion, while reduced, was still continuing at an unacceptable level. The blame was placed at least in part on the engineering aspects of the works that were installed; they were judged to be less effective, relative to the more modern structures that have been installed in some areas since 1966. In making this judgement, however, it appears to us that such critics ignored the fact that, in terms of the level of soil conservation achieved per unit of money spent by the British, the scheme was reasonably cost effective. But, unfortunately no soil loss records were kept, so even this tentative conclusion cannot be substantiated with empirical data.

The lack of satisfaction with the early British works, as expressed by modern conservationists, was captured in part by Turner (writing in 1975) in which he reported on these views, including the view expressed by D. Munk, who worked on the Thaba Bosiu Project during its early years (1973-75). He wrote about Munk's views, as follows:

> A number of more concrete (engineering) failures can be noted. Most important of these was the insufficient installation of diversion works at the break of the slope between the sandstone outcrop so common in the lowlands, and the cultivated pediment. Where these were lacking, the great terrace systems lower down could only be of limited effect. Further a number of technical errors were made in alignment and layout of terrace systems; this compounded with poor maintenance, resulted in some runoff inlets becoming new dongas. The situation in some areas

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1/ Smit, P., Lesotho: A Geographical Study (Pretoria, Africa Institute of South Africa, 1967), pp. 24-27.

has now so deteriorated that it was felt necessary to destroy all the original works and lay out a more carefully constructed system." (D. Munk--personal communication. Underlining added for emphasis.) 1/

Munk's views explain to a large degree why erosion control was actually achieved on so small an acreage by that project, relative to the original objectives. It also demonstrates quite clearly that cost effectiveness was not a major objective in that latter day project, in contrast to the operating procedure adhered to in installing the British conservation works during the 1935-1966 period.

It is also generally recognized that part of the lack of effectiveness of the early soil conservation programs was due to improper management of the structures, cropland and of livestock. Physical evidence thereof was the narrowing of the grass strips over time, inadequate maintenance of terraces, waterways and buffer strips, (particularly in terms of not rapidly making repairs when breaches occurred), continued moving of people, cattle and farm machinery over the terrace banks, and overgrazing of crop residue in the fields, on the grass strips and in the donga areas. All of these so-called undesirable practices were attributed to a lack of involvement and support of the program by farmers. Causative factors listed ranged from constraints imposed by the land tenure system to simply ignorance and stupidity of the farmers themselves. 2/ Turner has noted that while no accurate records are available, "a mailaise must have hung over the last years of British rule, as the colonial conservationists' 'task' became more and more frustrating...Serious fiscal difficulties in 1964 resulted in the retrenchment of the few Extension workers concerned with the maintenance of conservation works; this and the extreme antiquity of the Division's equipment meant that all aspects of anti-erosion work were at a very low ebb at Independence in 1966." 3/

1/ Turner, op. cit.

2/ Quirion, op. cit., pp. 172-182.

3/ Turner, op. cit., pp. 21-22.

V. POST-INDEPENDENCE CONSERVATION PROGRAMS

Several external observers in the mid-1960's had noted that one of the major constraints leading to lack of total effectiveness of the early conservation systems was that no real effort had been made to relate the physical structural elements of the program to effective conservation farming practices. 1/ The inability to demonstrate their benefits to farmers in terms of increased short-term income earning potential appears to be a plausible explanation for the disappointingly low level of farmer response to and acceptance of government conservation programs.

A recognition of these realities by Lesotho government policy makers in the late 1960's led to the large scale use of donor agency funding for semiautonomous, area-based crash projects to modernize the agricultural sector. And, of course, conservation programs were again included in these packages, often with more reliance on structural measures than before. This approach was illustrated, for example, in the following unnamed assessment of the Thaba Bosiu Project: "Implementation of project conservation will involve a heavy component of a new construction of terraces, drop structures, grassed waterways, etc., as well as repair and maintenance of existing facilities," 2/--with the latter appearing to have been added only as an afterthought.

Four major area-based projects with major conservation program elements are reviewed and evaluated in this section of the report. These are: 1) the Thaba Bosiu Rural Development Project; 2) Senqu River Agricultural Extension Project; 3) Leribe/Khomokhoana Rural Development Project; and, 4) the Thaba Tseka Mountain Development Project. One additional non-area based project was reviewed--the USAID Technical Assistance Project for the Conservation Division of the Ministry of Agriculture. Economic analysis in the benefit/cost sense of the term was limited primarily to the Thaba Bosiu Project, because of the almost complete lack of data for the other projects on which such analyses depend. In lieu thereof, the relative performance of each project team was assessed in terms of the following selected set of criteria: 1) increasing short-term productivity; 2) increasing long-term productivity; 3) increasing technical knowledge; 4) dissemination of knowledge; 5) development of basic data; 6) achieving project program integration with related public programs; and, 7) modification of institutional constraints. Ideally, direct assessments of economic efficiency and reduction of erosion and sedimentation should also have been made but the data needed for such analysis simply was not available.

1/ The degree to which erosion losses were checked by the government programs during the British era is unknown because no research in this area of concern was carried out.

2/ Unpublished project report, 1974.

Thaba Bosiu Rural Development Project (1973-1977)

Overview

The Thaba Bosiu Rural Development Project had the goal of improving the livelihood of 17,500 Lesotho farm families in a 300,000 acre area comprising most of the Little Caledon River watershed and the Berea Plateau, as shown in Map V-1. The project extends from a few miles east of Maseru to the watershed divide along the Maluti (Front) Range. The high eleveation eastern boundary includes Moteki's, Mohlachene's and Bushman's Passes and Machache Peak, with an elevation of 2,885 meters (9,465 ft).

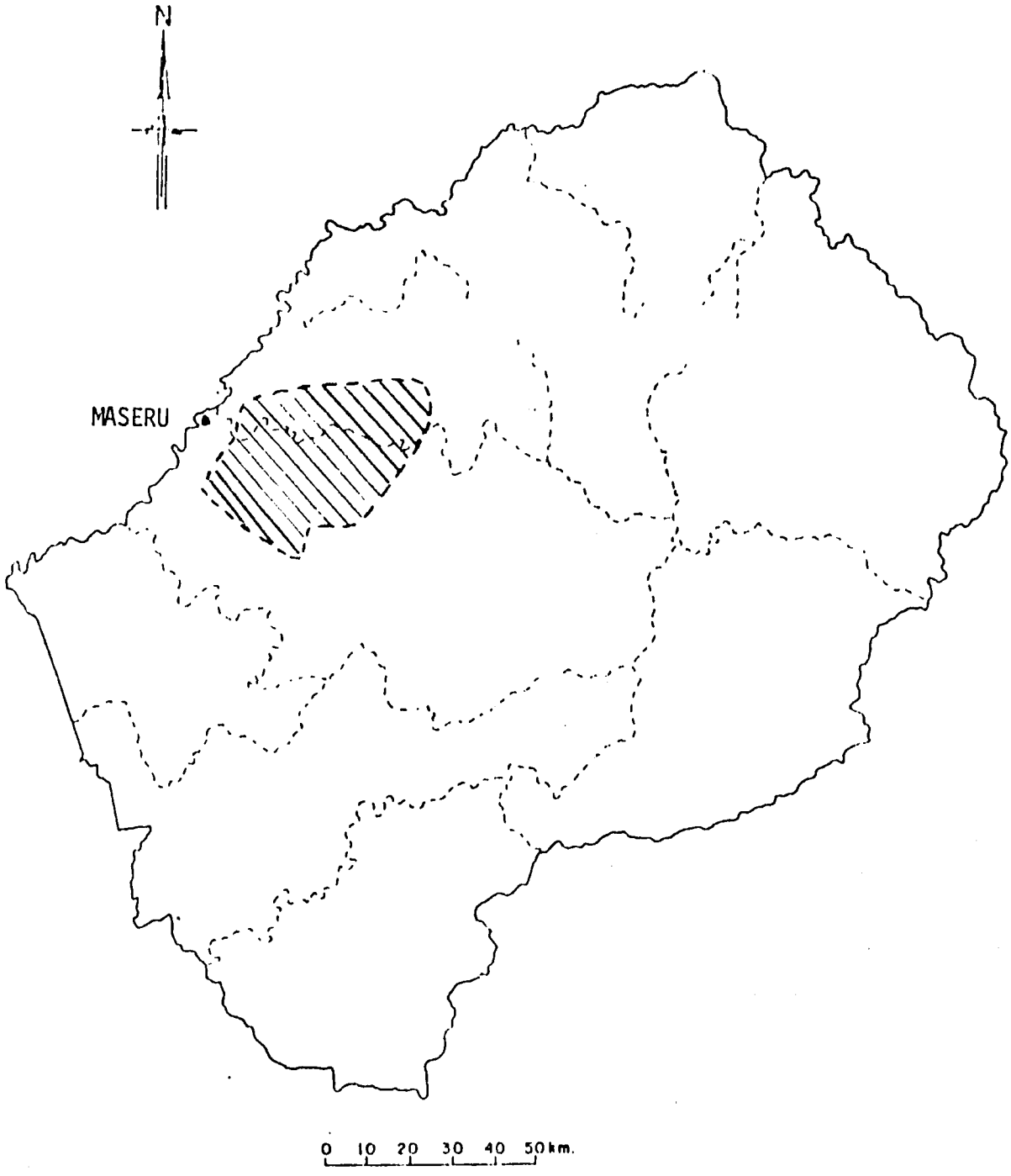
The Thaba Bosiu Project resulted from the findings of an evaluation team mission to Lesotho for the International Development Association (IDA) in March 1972 and a concurrent evaluation by the U.S. Agency for International Development (AID). The project was related to Lesotho's First Five-Year Development Plan for 1970/71-74/75 which gave a high priority to increasing productivity of agriculture, including soil conservation and control of livestock to arrest long-recognized and persistent soil erosion in the country. The generalized objective was to transform the traditional subsistence agriculture to cash cropping, providing for import substitution and export, with the emphasis on achieving self-sufficiency in maize and sorghum production. The project was the first IBRD/AID joint agricultural project in Lesotho and was initiated because it was assumed replication in the rest of the country would rapidly follow success in this effort.

The Thaba Bosiu Rural Development Project was initiated in early 1973 after negotiation of IDA credit and receipt of an AID grant in December 1972. The project manager was at post by February 1973, and the AID Project Agreement was signed February 26, 1973. The Development Credit Agreement between the Kingdom of Lesotho (GOL) and IDA was signed on March 23, 1973. Since the Government of Lesotho's fiscal year is April 1 to March 31, the Project actually started on April 1, 1973. The IDA credit was originally for a project with a closing date of December 31, 1979. But the Thaba Bosiu Rural Development Project ceased operating as an integrated project on October 31, 1977, when funds for overall integrated development efforts were exhausted. The USAID grant for conservation work is expected to continue until about March 31, 1979, with present remaining AID budget, as an integrated effort within the Conservation Division of the Ministry of Agriculture. The BASP proposal calls for integration of ongoing rural development activities as part of the Block 4 section. But, to date, no donor funds have been pledged for this block.

Project Objectives

An indication of the ambitious nature of the project proposal can be gleaned from the following extracts from the World Bank/IDA project appraisal report:

Map V-1. Thaba Bosiu Project Area, Lesotho



> The project comprises the timely provision to about 12,000 peasant farmers of improved seed, fertilizer and cultivation services; the credit to acquire them; technical agricultural guidance in their use; marketing for the resultant crop; road development; and soil conservation. Over six years, including about a year of planning and preparation, it would improve maize, sorghum, wheat and bean production on about 60,000 acres of land which is poorly cultivated at present... 1/

The conservation component of this project was designed to treat no less than 40,000 acres, comprising, "...approximately 1,680 km of diversion terraces; 600 drainage structures; repairs to, or reconstruction of 4,800 km of terraces; 400 km of 12-ft. access roads, with associated protective fencing, grass and tree planting." 2/

The formal project objectives, as described in the Thaba Bosiu Rural Development Project Annual Reports, are:

- to provide a more assured subsistence for farm households and to increase the income derived from crop and livestock production;

- to control erosion and transform land use patterns to permit the introduction of a permanent system of integrated farming combining rotational cropping with improved livestock production;

- to provide data for the preparation of similar rural development projects in other areas.

This statement of project objectives is somewhat different from that in the original IBRD-IDA project appraisal which stated that the primary objective was to control erosion and improve crop production and rural living within the existing social system, and thus to move the area from subsistence to cash cropping for import substitution and export. The longer term objective was to transform land use customs so that integrated farming, combining rotational cropping with improved livestock production, could be introduced.

The USAID project design summary indicates a project objective of assisting and supporting the Government of Lesotho's (GOL) priorities in development and implementation of national policies of agricultural development which focus on increasing rural income and the protection

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1/ Appraisal of the Thaba Bosiu Rural Development Project, Document #PA-147, IBRD-IDA, Washington, D.C., January 1973.

2/ Ibid.

of land and water resources. These efforts were to be a part of the larger program of IDA. The AID project purposes included: 1) to apply soil conservation measures and improve farm roads within the Thaba Bosiu project area and to demonstrate how such measures will increase crop production and farm income, and 2) concurrently develop GOL organizational and manpower capability to implement soil conservation and improved land use programs.

Budget

IDA Credit - The March 23, 1973 Development Credit Agreement (Credit 361 LSO) between the GOL and IDA was for a credit of US $5,600,000. This credit is repayable by the GOL in semi-annual installments commencing in 1983, ten years after signing the agreement. Interest repayments are at one percent per annum for the principal amount for the first ten years (1983-1993), and at three percent of the principal amount for the next thirty years (1994-2023). Since the project has been terminated only recently, the final project financial statement was not yet available at the time the field work was conducted so as to precisely identify total project expenditures from this fund.

USAID Grant - A grant was provided on February 26, 1973 for $1,056,000 to cover the first two years of the program. A revision of the AID funding was made on June 25, 1976 to increase the total grant to $3,294,000. These funds were specifically granted for a program of testing conservation oriented farm systems.

UNCDF Grant - On September 30, 1975 an agreement between the GOL and the United Nations Capital Development Fund (UNCDF) was signed for a grant of $185,000 for the Pilot Asparagus Plant, and all of these funds were dispersed by July 1977.

Other Sources of Finance - The other minor sources of finance and staff support included the United Nations Development Program (UNDP), commercial banks, farmers' contributions, the Government of Lesotho, the U.S. Peace Corps, International Volunteer Service and Food-Aid labor. Food-Aid labor has been a major factor in accomplishing many of the rock structures and other hand labor conservation measures. Food-Aid laborers were paid 60 cents per day plus food-aid supplies (5-hrs cash labor and 3-hrs food), and the force was changed every 15 days to maximize the total number given a chance to work. But no data was readily available on the total Food-Aid work hours expended on the project.

Project Costs - Project financial and accounting records, to the degree that they were available, were structured in such a manner that it was exceedingly difficult if not impossible to reconstruct the project cost history. An integrated financial account for the total project effort incorporating sources and amounts of funds expended from all sources simply was not kept.

We do know from project documents that the total funding from major donor sources--IDA, USAID and UNCDF--slightly exceeded nine million dollars. We also know those project activities dependent upon IDA funds were terminated on October 31, 1977, because the funds had been expended. Most of project costs for soil conservation activities came from AID and, given current estimate, sufficient funds remain for continued work to the end of the fiscal year on March 31, 1979.

In attempting to reconstruct an overview of total project expenditures, so as to put the conservation component into perspective, the best we could do was the accounting for expenditures from the major donor and GOL sources for the first four years of effort--March 1973 through March 1977--given in Table V-4. Although these data were extracted for us from central accounts by Mr. Brian Falconer, for which we were grateful, they only total 2,464,835 Rand (U.S.$2,785,264), versus the roughly nine million dollars available from the major funding sources as noted above. In particular, it does not appear reasonable that that portion supposedly remaining for GOL/IDA sources on April 1, 1977 would have been totally expended by October 31, 1977 when funds ran out. 1/ For the GOL/USAID portion, the ratio of expended versus remaining funds as of April 1, 1977 is more realistic, given the assumption that funds are available to continue soil conservation operations through March 31, 1979. On the basis of the data available to us at the time of our field work in Lesotho in early 1978, we have no explanation of the matter--the aggregate data in Table V-1 was the best that was available.

In further disaggregating project cost data for the first four years of the project, we determined that approximately one million Rand, or 42 percent, was spent on conservation works and associated operation costs (excluding access road construction but including such associated costs as housing, financing, planning, Extension education and project administration). Line item sources of funds from GOL/IDA and GOL/USAID are given in Table V-2 and disaggregated by functional items to the degree possible in Table V-3. Based on these data, it appears that almost 75 percent or about 811,000 Rand of the 1.1 million Rand expended on conservation and related support activities came from the GOL/USAID budget component.

Direct cost data for conservation related items appearing in Table V-3 are rather straightforward. But some further explanation is needed on how the figures for cost share items (e.g., the soil conservation components' share of such overall project costs as administration) were obtained. The data shown were calculated, based on project personnel estimates of conservation's share of the following joint-cost items: administration (5%); finance and credit (20%); planning and evaluation

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1/ Certain indirect costs for expenditures outside of the Conservation and Roads Division have, of course, not been included in Table V-4.

Table V-1. Total Expenditures, by Major Funding Sources, for Integrated Rural Development, Including Conservation but Excluding Access Roads, Thaba Bosiu Project.
March 1973-March 1977
(RAND)

Items	Source of Funding GOL/IDA	UNCDF	GOL/USAID	Cumulative Totals 3/73-3/77
Joint Cost Items				
Administration	310,179	--	588	310,767
Finance Credits	229,184	--	2,048	231,232
Planning & Evaluation	96,735	--	156	96,891
Extension & Training	305,013	--	824	305,837
Matela Farmer Training Center	23,128	--	--	23,128
Supplies & Marketing	242,626	--	302	242,928
Research	63,455	--	4,566	68,021
Sub-total	1,270,320	--	8,484	1,278,804
Conservation Activities				
Contract Services	--	--	320,923	320,923
Participants	--	--	136,565	136,565
Commodities	--	--	22,759	22,759
Conservation & Roads	160,198	--	199,942	360,140
Sub-total	160,198	--	680,189	840,387
Other Items				
Livestock	204,302	--	--	204,302
Asparagus	--	69,499	--	69,499
Interest Earned	(+64,540)	--	(+3,128)	(+67,668)
Net Income over Misc. Costs	(+112,500)	60	388	(+112,052)
Depreciation	117,570	8,735	125,258	251,563
Sub-total	144,832	78,294	122,518	345,644
GRAND TOTAL	1,575,350	78,294	811,191	2,464,835

Source: Tabulated from central accounts by Mr. Brian Falconer, MOA, for use by the LSCE Team, January 1978.

Table V-2. Line Item Sources of Funding for Conservation Activities, Thaba Bosiu Project

March 1973-March 1977
(RAND)

	GOL/IDA	GOL/USAID	Totals
Line Items			
Cost-Shared Items	115,992	8,484	124,476
Operating Costs for Conservation/Roads	160,198	199,942	360,140
Construction and Commodities	---	474,379	474,379
Interest Earned		3,128	3,128
Depreciation Fund	---	125,258	125,258
Totals	276,190	811,191	1,087,381

Source: Extrapolated from data in Table V-1.

(10%); Extension and training (10%); Matela Training Center (15%); supplies and marketing (5%); and, research (10%). While these individual percentage figures do not appear to be exceptionally large, in the aggregate the joint cost items to which they were applied produced a total of about 124,500 Rand or 12 percent of the 1.1 million Rand project conservation costs for the first four years of the project.

While it was difficult enough to disaggregate conservation related costs from the total budget for the integrated project, AID requested the LASA team to provide a further separate breakdown and analysis of its monetary contribution to this effort (per Table V-3, the R811,191 of the total R1,087,381 expended). In our view, given the joint GOL/IDA and GOL/USAID funding for this single project purpose, such refinement has relatively little value. Nonetheless, the following data summaries and analysis were made by the LSCE team in response to this AID request.

Table V-4 provides a listing of the GOL and USAID expenses for the Thaba Bosiu Project, by years from March 1973 through March 31, 1977. (Again, see Column 2 of Table V-3 for the same data in a different format.) Unfortunately, it was impossible to separate out the specific expenses for the Conservation and Roads Division. The accounting system utilized lumps the funds expended for expatriate hire under contract services and

Table V-3. Expenditures for Conservation Activities, Thaba Bosiu Project

March 1973-April 1977
(RAND)

	GOL/IDA	GOL/USAID	TOTAL
Cost-Share Items			
Administration	14,495	588	15,538
Finance and Credit	44,198	2,048	46,246
Planning and Evaluation	9,535	156	9,691
Extension & Training	29,760	824	30,584
Matela Farm Training Center	3,469	--	3,469
Supplies and Marketing	11,844	302	12,146
Research Support	2,236	4,566	6,802
Sub-Totals	115,992	8,484	124,476
Construction			
Housing	--	147,342	147,342
Buildings	--	20,612	20,612
Terraces and Waterways	--	145,800	145,800
General Construction (Dongas, etc.)	--	28,476	28,476
Sub-totals	--	342,230	342,230
Operating Cost--Conservation Division	160,198	199,942	360,140
Other Costs			
USAID Misc. Contract Services	--	230,925	230,925
Commodities	--	22,759	22,759
Office Equipment & Furniture	--	6,851	6,851
Sub-totals	--	260,535	260,535
GRAND TOTAL (Gross)	276,190	811,191	1,087,381
Minus Road Operation & Maintenance	-46,307	-16,022	-62,329
GRAND TOTAL (Net)	229,883	795,169	1,025,052

Source: Tabulated from Central Accounts by Mr. Brian Falconer, MOA, for use by the LSCE team, January 1978.

Table V-4. Total GOL/USAID Expenditures, by Years, Thaba Bosiu Project

March 1973 Through March 1977
(RAND)

	Year 1	Year 2	Year 3	Year 4	Total
Administration	1	32	438	117	588
Finance and Credit	100	219	979	750	2,048
Planning and Evaluation			156		156
Conservation and Roads	173	30,639	65,049	104,081	199,942
Extension and Training			728	96	824
Matela Farm Training Centre					
Supplies and Marketing			184	118	302
Research		469	1,696	2,401	4,566
Livestock					
Subtotal	274	31,359	69,230	107,563	208,426
Contract Services 1/	26,666	58,599	83,261	152,397	320,923
Participants	6,966	28,203	52,208	49,188	136,565
Commodities	32,726	(-32,726)		22,759	22,759
Total	66,632	95,435	204,699	331,907	688,673
Depreciation	111	23,967	49,325	51,855	125,258
Interest Earned	(66)	(1,585)	(1,105)	(438)	(3,194)
Loss on Sale of Fixed Assets			112		112
Theft		276			276
Total Balance April 1	66,677	108,093	253,031	383,324	811,125*

*The total figure, R811,125, differs slightly from the total figure shown in Table V-3, R811,191, due to rounding and disaggregation by years.

1/ Includes hired expatriate personnel.

paricipants, and the charges for commodities are also aggregated. Table V-5 summarizes data on costs incurred for fixed conservation-related assets by the project's Conservation and Roads Division; it was obtained directly from former division personnel. Total expenditures during the first four years totaled 596,789 Rand, of which 190,298 Rand were for "Construction of Field Works" (32%) and the balance for offices, housing, roads, vehicles, and equipment. It is known that some of these charges were for non-conservation activities but no means exist for providing a more specific breakdown of the costs, given the nature of the available data.

Tables V-4 and V-5 indicate a total (direct and indirect) USAID fund expenditure of approximately 1,407,914 Rand during the four-year period, which at current exchange rates 1/ would amount to U.S. 1.63 million dollars. 2/ Since the tables cover four years of a six-year project with a total funding of $3,394,000 it is estimated that the total expenditures will probably exceed U.S. 2.2 million dollars, rather than the 1.63 million accounted for in Tables V-4 and V-5. The total direct costs for activities of the Conservation and Roads Division of the Thaba Bosiu Project are shown in Table V-6. The four-year expenditure of 309,277 Rand included 109,035 Rand in funds from GOL/IDA transfer payments, which were mostly for feeder road construction in the project area but which were incorporated into the conservation works of the project.

Accomplishments

A total evaluation of the complete project accomplishments for the Thaba Bosiu Rural Development Project was not undertaken. Nonetheless, such a study should be undertaken to adequately evaluate the specific accomplishments in relation to total project objectives and costs. Results from such a study could materially reduce the occurrence of similar problems in future projects. The accomplishments reviewed in our study are primarily limited to those of the Conservation and Roads Division, along with a limited number of comments on accomplishments by personnel in Extension, training and research programs.

Our evaluation of conservation activities was complicated by the general lack of accurate and consolidated records and reports. As a result, there are a number of missing factors and inconsistencies in the following section. Therefore, there were probably a number of accomplishments that we did not credit to the project. On the other

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1/ The 1978 exchange rate was approximately 1.00 Rand = U.S. $1.163, during January-March.

2/ Given the nature of the data available, we could not determine the degree to which double counting is inherent in these two data sets.

Table V-5. Fixed Asset Project Costs, from US/AID and GOL Funds--Thaba Bosiu Project, March 1973-March 1977

(Rand)

Description	Year 1 Balance at 1 April 74	Year 2 1 April 74-31 March 75	Year 3 1 April 75-31 March 76	Year 4 1 April 76-31 March 77	Total to 31 March 77
Office Equipment & Furniture					
Office Fixtures & Fittings		880			880
Office Equipment		1,463	1,537		3,000
House Furniture	2,215	555	201		2,971
Subtotal	2,215	2,898	1,738	-	6,851
Housing and Roads					
Housing	29,988	44,722	2,478	70,154	147,342
Workshop	14,760	5,850	-	-	20,610
Subtotal	44,748	50,572	2,478	70,154	167,952
Field Works					
Roads-Conservation		13,887	2,135		16,022
Terraces-Waterways		20,022	67,235	58,543	145,800
General Construction		3,085	22,350	3,041	28,476
Subtotal		36,994	91,720	61,584	190,298
Vehicles & Equipment					
Heavy Equipment		177,426	16,706		194,132
Loose Tools		86			86
Conservation Equipment		20,993	2,064	1,769	24,826
Research Equipment		1,498			1,498
Workshop Equipment		11,284	(453)	315	11,146
Subtotal		211,287	18,317	2,084	231,688
Total Fixed Cost	46,963	301,751	114,253	133,822	596,789
Less Depreciation	111	23,967	49,325	51,855	125,258
Total Book Value	46,852	324,636	389,564	471,531	(471,531)

Table V-6. Total Direct Costs for Activities of the Conservation and Roads Division, Thaba Bosiu Project, March 1973-March 1977

(Rand)

	Year 1	Year 2	Year 3	Year 4	Total
Conservation and Roads Division					
Salaries and Charges for Service		19,780	42,041	43,519	105,340
Gratuities		1,775	4,593	10,036	16,404
Pension Contributions		586	2,145	1,046	3,777
Temporary Wages		431	4,176	3,128	7,735
Subtotal		22,572	52,955	57,729	133,256
Travel & Subsistence		766	4,654	4,761	10,181
Electricity, Water & Sewer			424		424
Postage, Cables & Telephones			646	93	739
Printing & Stationery		584	705	2,124	3,413
Maintenance & Repairs					
- Buildings		351	867	865	2,083
- Equipment		14	1,006	8,465	9,485
-Main Access Roads			1,718	44,599	46,317
Recruitment Expenses	173	36			209
Motor Vehicle Costs		3,219	28,893	54,895	87,007
Consumable Material, Tools & Clothing		2,335	3,645	2,881	8,861
Transport Charges		453	365	174	992
Course Training Expenses		471	11	4,679	5,161
Sundries		(162)	286	1,025	1,149
Total Conservation & Roads	173	30,639	96,175	182,290	309,277
Less GOL/IDA Payments			31,126	78,209	109,335
Total USAID Charges	173	30,639	65,049	104,081	199,942

hand, accurate costs per unit of conservation works can only be crudely estimated. It is known, however, that in the aggregate the cost per acre protected is very high, as will be shown below.

In attempting to measure soil conservation accomplishments for the Thaba Bosiu Project, we recognized that the plan set forth in the IDA Appraisal Report was unrealistic for a developing country. 1/ As noted by H. Dale Monk, Chief Conservation Officer, 1973-75, the most serious restraints were: 2/

1. Lack of trained local personnel;

2. Late delivery of transport and all conservation equipment; and

3. Construction equipment as ordered was often of the wrong size, wrong in number, or not needed.

Mr. Monk also noted that the plan to develop the Conservation Plans, based on four market areas, was not workable for the following reasons: 3/

1. Each plan would encompass approximately 75,000 acres of which 18,750 acres would be cropland. A plan of this size would be difficult to develop, complicated and cumbersome.

2. There would be no local leader who could make decisions regarding the improvements proposed.

An alternative conservation planning method that was finally selected was to develop all plans on a village basis, with villages grouped under a chief who has allocation rights to all lands. These village Conservation Planning Units, or CPU's, average 4,000 acres of which 1,000 acres are cropland. It was also recognized that, even under ideal conditions, it is never possible to achieve 100 percent acceptance of any program. Therefore, provision was made for working only with villages willing to accept the program. But in so doing, it was not possible to fully implement a total watershed approach--thus violating a major conservation development guideline, as discussed in Section II.

1/ Ibid., Annex 3, p. 4.

2/ Monk, H. Dale, Completion of Assignment Report, Appendix 2, "Plan of Work," October 16, 1975.

3/ Ibid., p. 2.

A specific area of 25,000 acres containing seven "target" villages in the Foothills zone was selected because it was assumed to have a high potential for improvement. 1/ The specific strategy was to begin the conservation program with the "simple" operations such as construction of waterways, renovation of contour banks, and efforts to improve crop yields that, in theory, would be readily acceptable to the local farmers. Related practices such as changes in farm boundaries, consolidation changes in farming practices, etc., were noted as being acceptable only after long periods of negotiation, education and demonstration. 2/

The actual cost of the conservation and education component of the Thaba Bosiu Project cannot be determined from the limited and aggregated information available. For example, the conservation education work was all reported under conservation planning through year three of the project, and would be accounted for in the 11,204.62 Rand of allocated project costs for that year (Table V-7); the costs for the remaining years are not available, although they must be substantial. It should also be noted that the cost of the USAID degree training program in the USA was not available and therefore was not included in any of the project cost tables.

The soil conservation function of the Thaba Bosiu Rural Development Project was viewed as an adjunct to the Integrated Farming Program. 3/ The conservation program had a principal goal of "reducing soil losses to acceptable levels, suitable for long-term resource protection (about 5 tons/ac/year) while simultaneously increasing the total agricultural productivity of the land." 4/ This type of goal for an area of 300,000 acres and 17,500 families was rather obviously not likely to be attained in a six-year project. Perhaps it is the primary reason that the conservation work was concentrated on only seven villages with 18,542 acres and 894 farm families involved. At any rate, the original project objectives were not achieved.

A comparison between some of the major Thaba Bosiu Project accomplishments to July 1977 and the level of activities listed in the objectives

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1/ The following villages were included: Ratau, Mpao, Phaloane, Khotso, Ngosa, Tumahole and Masue. Refer to the LSCE contract report (Seckler and Nobe, op. cit.), pages V-68 to V-96 for a detailed discussion of project accomplishments in these seven village areas.

2/ Monk, H. Dale, Completion of Assignment Report, October 16, 1975, Appendix 1--Soil Conservation Scheme, p. 2.

3/ IDA, Appraisal Report, Annex 3, p. 4.

4/ Ibid., p. 5.

Table V-7. Summary of Allocated Project Costs for Conservation Measures Installed 1 April 1975-30 June 1977 within the Thaba Bosiu Project Area. (All values in Rand.)

Practice	Year 3 April 1975 March 1976	Year 4 April 1976 March 1977	1st ¼ Yr 5 April 1977 June 1977	Total	%
Grassed waterways					
Construction	40,739.77	30,884.67	5,279.98	76,904.42	
Rock checks	3,065.94	3,956.19	1,175.72	8,197.85	
Grass Nurseries	1,351.38	14.97		1,366.35	
TOTAL	45,157.09	34,855.83	6,455.70	86,468.62	32.6
Diversions	110.43	2,596.27	902.09	3,608.79	1.4
Donga Control					
Grass planting	4,024.57	3,603.39	507.43	8,135.39	
Rock checks	10,633.29	22,054.47	2,536.65	35,224.41	
Gully fill	1,671.94	3,133.49	1,061.13	5,866.56	
TOTAL	16,329.80	28,791.35	4,105.21	49,226.36	18.6
Terraces					
Construction	8,725.17	20,737.26	8,567.94	38,030.37	
Repair terraces	425.84	1,173.05	992.38	2,591.27	
Grass strips	203.86	565.17		769.03	
Land Preparation	4,157.84	2,575.46	60.19	6,793.49	
TOTAL	13,512.71	25,050.94	9,620.51	48,184.16	18.2
Stock ponds or dams	237.57			237.57	0.1
Woodlots	904.76	442.95		1,347.71	0.5
Village roads	1,493.27	1,431.83	1,062.36	3,987.46	1.5
Field roads	843.32	287.41		1,130.73	0.4
Roadside rock checks & grass planting	229.62			229.62	0.1
Wells, springs & fencing	64.22	4.80	198.97	267.99	0.1
Conservation planning	11,204.62	7,546.62	2,625.48	21,376.72	8.1
Land reallocation assistance		1,193.29		1,193.29	0.5
Conservation maintenance		65.83		65.83	
Total conservation measures	90,087.41	102,267.12	24,970.32	217,324.85	82.0
Main access and VDP roads	18,176.28	16,871.83	1,555.64	36,603.70	13.8
Private works	8,857.46	2,026.51	195.87	11,079.84	4.2
Total allocated costs	117,121.10	121,165.46	26,721.83	265,008.39	100.0
Percent	44.2%	45.7%	10.1%	100.0%	

in the original project proposal is provided in Table V-8. Even at first glance, it is obvious that accomplishments in this small part of the project area failed to make much of a dent in reaching the optimistic goals of the original plan for total project area. It is a serious failing when viewed in respect to how much additional time and expense would be required to finish the protection of the original 300,000 acre area, given the rate and cost of progress to date. On the other hand, it should be noted that most of the soil conservation activities contained in the Land Use and Conservation Plans for the seven target villages have been accomplished. One of the key missing pieces of information is a reliable estimate for the acreage of land that was actually provided with protection from erosion within the total project area; the LSCE team estimated that it probably was less than 7,000 acres.

Another area for comparison of accomplishment is that of crop yields. This item is extremely important to project evaluation. According to the original economic justification for this project, the project benefits were to be in the form of large increased production in the short run. 1/ Benefits expected to the erosion control sector of the project were computed on the assumption, based on "expert opinion," that without the project, yields would decline at an annual rate of five percent per year. "On this basis the total value lost would be six Rand per acre (R240,000 of 40,000 ac) against estimated soil conservation expenditure, to save this value of 1.8 Rand per acre, or a cost benefit ratio due to conservation, of about 0.3." 2/ As it turned out, these estimates were totally unrealistic. 3/

1/ IBRD-IDA, Appraisal Report, op. cit.

2/ IDA, Appraisal Report, Annex 3, pp. 7-8 (underlining added for emphasis).

3/ The extremely cavalier method by which these estimated conservation benefits were derived may be illustrated by the following: "While no valid data exist in Lesotho, a study of the 1960 agricultural census indicated that, as erosion increased to 'severe,' yields decreased, over 10 years as follows:

Maize	24%
Sorghum	28%
Wheat	12%

While no specific criteria are provided to define 'severe erosion' it is understood to be on fields subject to general soil depletion due to sheet erosion." (Annex 3, p. 7.)

This statement appears to rest on the deduction that since yields have declined it must have been due to "severe erosion," used in the sense of "that which causes yields to decline." There simply was no measurement of any kind of erosion in the project area. It also neglects the possibility that other things may have caused the decline in yields--for example, loss of labor on the land (see the "Agricultural Manpower in Lesotho" section of the LSCE report, Seckler and Nobe, op. cit., pages III-10 through III-45) as, given the limited and perhaps unreliable data available, could also be due to statistical accident, sampling techniques and measurement errors.

Table V-8. Comparison of Thaba Bosiu Project Conservation Accomplishments through July 1977 Versus Total Planned Project Activities

(In Rand)

Conservation Practices	Units	Original Project Targets	Conservation Plans-7 Target Villages	Accomplishments to July 1977
Grassed Waterways	Km.	241.3	28.5	23.2
Diversions	Km.	1,673.	37.1	3.7
Donga Control	Km.		22.7	27.2
Donga Control Structures	No.	600.	12.	114.
Terraces	Km.	3,000.[1/]	185.4	103.5
Multi-Purpose Dams	No.	20.	3.	1.
Roads:				
Main Access Roads	Km.	92.		74.0
Village or Rural Roads	Km.	100.	40.3	60.8
Field Access	Km.	400.[2/]		13.4
Integrated Farming	Acres.	5,000.	-	-
Fencing	Km.	24.		N.A.
Treeplanting	No.	1,500,000.		N.A.

[1/] Included existing or new terraces, and grass stripped cover to be repaired, regraded or constructed as required.

[2/] Provided for 12-foot wide rural access roads in general; their construction was allied to construction of diversion terraces in adjacent areas.

In this regard, three observations must be made: (a) no "experts" were cited--the yield reduction estimate was quite obviously pulled out of the hat; (b) the cost estimate of 1.8 Rand per acre was inanely low--as subsequent events proved, and as any trained observor should have known at the time; and (c) one always divides the benefits by the cost --even if, as in English usage, it is called the cost-benefit ratio. Thus the ratio should have been 3.0--computationally (even though 0.3 may have been more realistic).

Although project completion reports for IDA will soon be forthcoming and may shed more light on the matter, two sets of information from the Draft No. 4, Thaba Bosiu Annual Report, indicate that the original hope to achieve large increases in total crop production with this project, at least in the short run, was unfulfilled. That is, the percent of land in fallow is increasing significantly each year in the project area while yield levels on the remaining cropland harvested are falling drastically. The land in fallow has increased since 1969-70 as is summarized in Table V-9. Yield trends for major crops in the project area are given in Table V-10.

Table V-9. Trends in Cropland Acreage in Fallow, Thaba Bosiu Project Area, 1969-70/1975-76

Year	Percent Fallow
1969-70	15
1973-74	16
1974-75	20
1975-76	25

Source: Thaba Bosiu Annual Report No. 4, (Draft copy), January 1978.

Table V-10. Yield Levels of Major Crops Grown in the Thaba Bosiu Project Area, 1969-70/1975-76 (expressed as the number of 90 kg bags)

Yields (90 kg bags)	1969-70	1973-74	1974-75	1975-76
Maize	1.4	2.6	1.4	.7
Sorghum	1.8	2.5	.7	.8
Beans	.6	.8	.6	.4

Source: Thaba Bosiu Annual Report No. 4, (Draft copy), January 1978.

Evaluation

The Thaba Bosiu Rural Development Project was designed as an integrated effort wherein a number of individual objectives and goals were interrelated in an attempt to significantly increase rural development and productivity in the project area. This situation makes an evaluation of only the soil and water conservation activities difficult. For example, this resulted in eliminating some factors from the evaluation, such as the criterion of increased employment opportunities. It was not a part of the conservation program component, even though it was important to the total project effort. A summary of the LSCE team evaluation of the major program elements is given in Table V-19 of the LSCE report. 1/

Overall, performance criteria in which less than satisfactory progress was achieved were in increasing either short- or long-term crop yields--outputs on which most of the original project justification was based. On the other hand satisfactory progress was made in increasing and disseminating technical knowledge, including development of needed basic research data and in integrating project programs into ongoing related public programs. Of all the performance criteria considered, outstanding progress was made in only one area--modifying institutional constraints.

Major constraints to project effectiveness appear to have been a lack of trained Basotho staff, lack of proper size and type of construction equipment, and the lack of coordination and direction from the project director and the Ministry of Agriculture. Areas that appear to us that needed strengthening or that were questioned by the LSCE team include: (1) concentration of the total effort on the Area I villages to the exclusion of other project area problems in soil conservation; (2) a general lack of records for self-analysis and cost-effectiveness determinations; (3) a failure to construct terraces as soon as possible after grassed waterways were vegetated; and (4) failure to initiate a program of range management for the project area as a whole.

A depressing feature of the Thaba Bosiu Project experience is the tremendously high cost of implementing conservation activities, relative to the level of output achieved. For example, Table V-3 shows that expenditures for conservation and support activities during the first four years of substantial project operation, net of expenditures on roads, totaled 1,025,052 Rand. If one assumes that, say, only 7,000 acres of cropland were protected by this expenditure (which appears to us to be a reasonable estimate in view of lack of data on this matter), then the cost amounts to 146 Rand per acre. To put this figure into perspective, one needs to be aware that it amounts to 730 Rand per average household holding of five acres. At ten percent interest this would yield 73 Rand per annum, which would be about equal to the annual net return from cropland per

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1/ Seckler and Nobe, op. cit., pp. V-102/103.

household in the project area. And, at this cost level, over 87 million Rand would have to be spent to protect the remaining 600,000 acres of land requiring protection in Lesotho.

Some observors would agree, of course, that (a) much of this cost was due to learning by doing; (b) that economies of scale would appear on larger projects; and, (c) that some of the buildings and machinery are still usable assets. As to (a), the learning by doing was (aside from seeding versus sodding) mainly machine operator learning. This feature would be more, not less, troublesome in large projects; (b) one would expect diseconomies of scale due to management problems as area treated expands; and (c), while the total costs should be reduced to reflect the post-project value of houses, shops, and machinery, these costs in future projects nevertheless would be considerably higher. When put in this perspective, the costs of the Thaba Bosiu project's conservation effort appear to be a reliable guide to the costs of future conservation projects of the same nature. If this is true, then such kinds of efforts in the future will not be economically viable.

Senqu River Agricultural Extension Project (1974-1977)

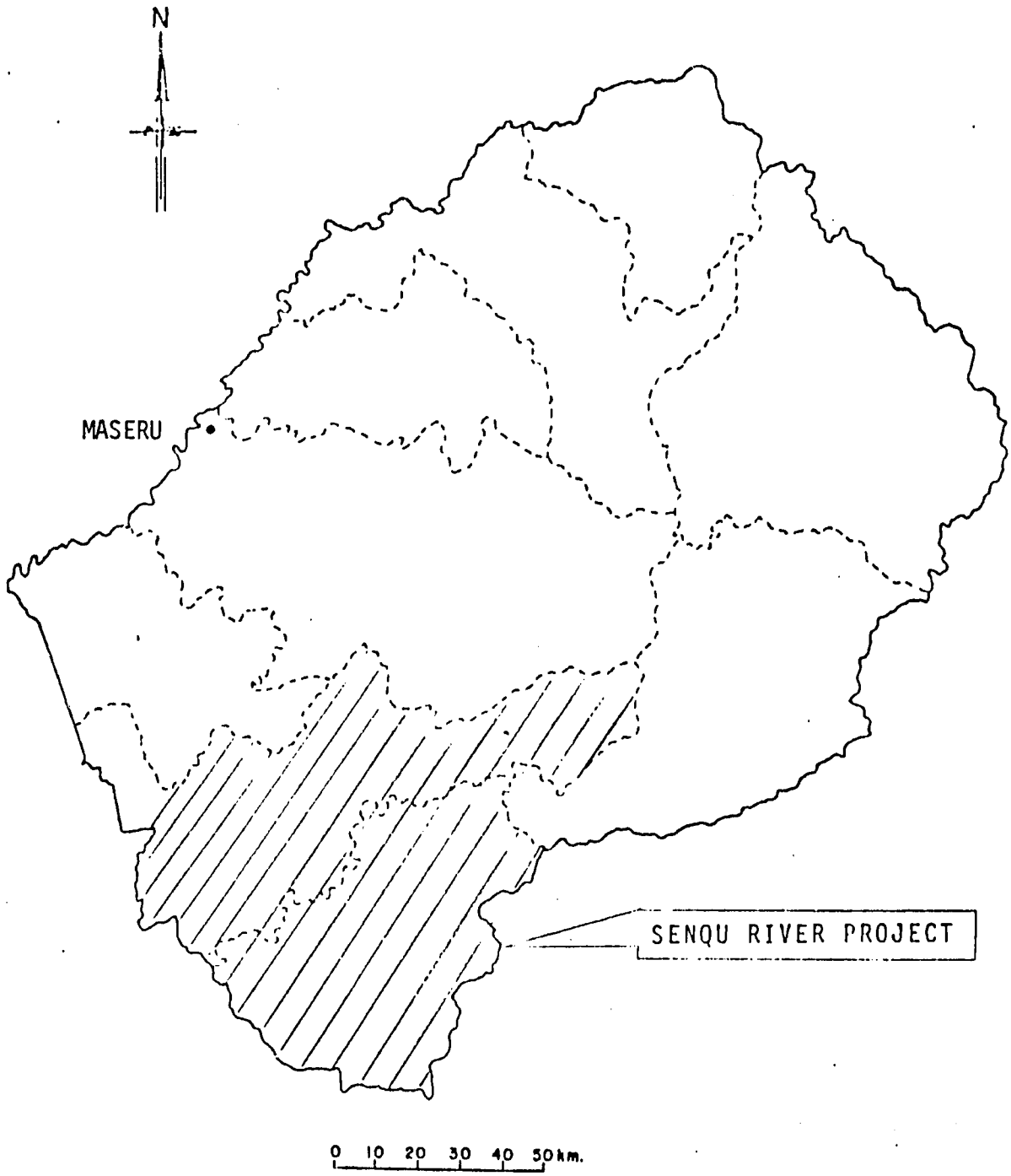
Overview

In the early 1970's, the Government of Lesotho began to attack the particularly difficult agricultural problems of its two southern districts --Mohale's Hoek and Quthing, a total area of 2,489 square miles. (Map No. V-2.) This area amounts to about 20 percent of the entire country and includes some very highly eroded lands.

The Senqu River Agricultural Extension Project became the first United Nations Development Program (UNDP) funded Country Programme in Lesotho. The project was approved by the Governing Council of the UNDP in January 1972. A preparatory phase was initiated in September 1972. This phase was supposed to be for one year but it was extended until April 1974 because of a number of problems. The project became operational in May 1974.

In April 1976, the UNDP/FAO Project Formulation Mission completed a Phase II Project Document and forwarded it to UNDP for approval and

Map No. V-2. Location of the Senqu Project, Lesotho



funding under the UNDP/Government of Lesotho Country Programme. 1/ Unfortunately, this funding was not approved and as of August 31, 1976, Phase I of the project terminated and most of the experienced staff was immediately lost because of lack of funding. Subsequent to the end of Phase I, a small remaining contingent of specialists and staff maintained some progress under the Ministry of Agriculture, as efforts were made to integrate the ongoing activities with BASP. 2/ At the time of the LSCE Field Team visit to the project area in early February 1978, however, the machinery and equipment had been reallocated to BASP and the last two members of the FAO International Staff were preparing to leave. Therefore, the Senqu River Agricultural Extension Project, as such, can be considered to have ceased operations in late 1977.

The project absorbed almost the entire staff of the Agricultural Extension Service of the Mohale's Hoek and Quthing Districts. It was designed to develop ongoing Extension work throughout the project area; but, the focus was primarily on seven selected intensive input areas, each covering about 50,000 acres that showed particular promise for improvement. The data gathering and planning was designed, however, to prepare the agricultural sector of this entire region for a large scale comprehensive rural development program (e.g., BASP).

The project area is in the southern part of Lesotho and covers all of the Mohale's Hoek (1,363 mi^2) and Quthing (1,126 mi^2) Districts. The area is divided into four ecologic regions--the Orange (Senqu) River Valley (35%), Lowlands (10%), Foothills (5%) and Mountains (50%). Arable land is limited to about 164,000 acres, or 10.3 percent of the project area. Soils in the lowlands, where the population is concentrated, are derived from sandstone and are generally poorly structured and eroded. Soils above 1,800 m (5,900 ft) are derived from basalt and are generally more fertile and stable, but arable land is generally limited to the mountain valleys and most of the people live in small villages near these valleys. Population estimates for the two districts in 1973 totaled 218,900, or about 88 persons per square mile.

The mean annual rainfall of the area is reported to range from 470 to 1,000 mm (18.5 to 39.4") with most of the rainfall occurring during the summer growing season. The normal rainfall is adequate but precipitation is variable and droughts are said to occur every five or six years. Temperatures vary widely according to season and latitude. Summer highs of 34°C (93°F) are common and freezing temperatures occur frequently between May and September.

Agriculture is generally limited to subsistence with most of the crop farming taking place in the foothills and lowlands, or river valleys

1/ United Nations Development Program (UNDP), Food and Agriculture Organization of the United Nations, Senqu River Agricultural Extension Project Lesotho: Interim Report, Rome, 1976. AG:DP/LES72/003.

2/ Refers to a new rural development effort--Basic Agricultural Services Program.

where suitable. Maize, sorghum, wheat and pulses are the most common crops grown and the yields are relatively low, even for Lesotho conditions. Some winter crops of wheat, peas or vegetables are grown in this area. The higher mountain areas have no permanent settlements and are used mostly for summer grazing in large tracts called "cattle posts." The 1970 livestock population amounted to 89,393 cattle, 389,037 sheep and 252,190 goats. The majority of the income from livestock comes from the sale of wool and mohair. The Senqu Project Farm Management Survey found that the average farm family interviewed had an average investment in livestock of about 423 Rand. 1/ Cattle and oxen accounted for about 61 percent of the livestock investment, followed by sheep (16.5%) and goats (7.3%).

Project Objectives

The long range objectives of the Senqu River Agricultural Extension Project were to assist the Government of Lesotho in meeting its national objective to increase agricultural production above the present largely subsistence level, and to create employment opportunity by promoting competitive earning from agricultural production. To achieve these targets, it was believed necessary to:

1. Identify the constraints to rural development in the project area;
2. Determine and demonstrate the economic feasibility of overcoming these constraints; and
3. Strengthen the Government services to carry out the needed development activities.

The immediate objectives of the project were to:

1. Expand the application of sound animal production practices through improved feeding, breeding and management.
2. Expand the application of sound crop production and conservation practices (final target: 2,000 acres).
3. Demonstrate economic methods for run-of-river irrigation, with particular emphasis on fodder production (final target: 500 acres).
4. Expand conservation works and practices.
5. Provide short- and medium-term credit for:
   (a) purchase of improved livestock;
   (b) seasonal inputs for production of crops;
   (c) adequate supplies of anthelminthics and dipping agents for sale to farmers;
   (d) purchase of irrigation equipment;
   (e) purchase of four tractor units for selected tractor contractors.

1/ Guma, T., and Majoso, W., Phase I-Farm Management Economics, Terminal Report on Socio-Economic Survey, Senqu River Agricultural Extension Project, June 1976.

6. Leave behind a well-trained cadre of national staff.
7. Assist Government in the formulation of a comprehensive rural development plan for the entire project area. 1/

In 1975, a UNDP evaluation team reviewed the project and recommended some major program revisions. The mission specifically recommended that the immediate objectives be redrafted as follows: 2/

1. To identify the socio-economic and technical constraints to agricultural development in the project area by means of surveys, investigations and trials.
2. To determine and demonstrate the economic and technical feasibility of overcoming these constraints in the fields of animal production, crop production (including irrigation), and conservation practices.
3. To strengthen government capacity to implement agricultural development in the area by:
   (a) improving marketing arrangements and facilitating provision of inputs;
   (b) improved agricultural credit systems;
   (c) better programme planning for Extension agents;
   (d) more effective methods of passing information to farmers.
4. To work towards the identification and preparation of an agricultural project or sub-projects for external capital financing within the context of a future integrated rural development project.
5. To strengthen government capacity to plan a comprehensive development of the area by:
   (a) the collection and review of existing maps, reports and studies pertaining to the area which are relevant to the preparation of physical development plans;
   (b) preparing an inventory of existing services and infrastructure;
   (c) formulating criteria for desirable future settlement patterns bearing in mind possible changes in land use and other economic and social considerations;
   (d) recommending a specific pilot resettlement project, if warranted;
   (e) investigating alternative organizational and administrative structures for planning and implementing the area's development.

Although these suggestions were not fully incorporated into the project, they did result in a strengthening of the emphasis on development aspects

1/ Unpublished project document.

2/ The United Nations Development Programme, Lesotho, The Senqu River Agricultural Extension Project: Interim Report of the Evaluation Mission, June 1975, LES/72/003.

rather than on Extension. And, the project was redirected from its initial concentration only on limited areas and farmers in consolidated farming blocks. Greater emphasis was also given to conducting socio-economic studies and basic data collection.

The original project plan envisioned a project that would be conducted within the administrative structure of the Ministry of Agriculture (MOA). All work plans were to be prepared by the Project Manager and the MOA Co-Manager for submission to the MOA Permanent Secretary, in his capacity as Chairman of the Project Coordinating Committee. This Project Coordinating Committee was comprised of the Permanent Secretaries of the Ministries of Agriculture, Interior, Works, Education and Health, the Director of Central Planning, the Director of the Bureau of Statistics, the District Chiefs, farmers' representatives, and UNDP/FAO representatives. This large committee was to meet every six months, but it seems to have met only once during the life of the project. 1/

At the district level, monthly meetings of the District Coordinating Committee were held at either Quthing or Mohale's Hoek. These meetings seem to have been more successful with all of the senior district staff, district administration, and Ministry of Agriculture staff regularly attending to discuss project development and innovations. A senior District Extension Officer was assigned as Project Co-Manager and this seemed to aid in the effective execution of the overall Extension program. The participation of the local staff in developing the Project Document during the initial project phase no doubt helped to encourage staff cooperation on the local level. 2/

Budget

The original request for preparatory assistance from the Government of the Kingdom of Lesotho for the Senqu River Agricultural Extension Project was submitted May 1, 1972 and called for UNDP contributions of US$219,500 and GOL contributions of 49,100 Rand. This initial funding permitted for partial staffing, initiation of activities and development of the project work plan.

The project work plan called for an additional UNDP contribution of US$1,048,469, and a GOL contribution of 215,700 Rand for a project duration of 51 months. A revision in November 1975 raised the UNDP contribution to US$1,543,300 while the GOL contribution remained at 215,700 Rand. 3/ The UNDP contribution included a personnel component of $734,533 (47.6%), a training component of $10,000 (0.7%), an equipment component of $612,969 (39.7%) and a miscellaneous component of $185,698 (12.0%). A separate conservation program for the Mt. Moorosi area was funded at a level of

1/ UNDP, Interim Report, p. 4.

2/ Ibid.

3/ US$1.00 = 0.75 Rand (South African Rand) from January 1972.
US$1.00 = 0.867 Rand after September 1975.

24,000 Rand by the Overseas Development Authority of the British Government. 1/ The Government of Lesotho contribution consisted of paying the salaries and wages of all local staff who were counterparts, field workers and laborers necessary to the functioning of the project, plus provision of office accommodations at Mohale's Hoek. The GOL also paid for local maintenance of trainee's families while they were overseas and the cost of running and maintaining the government owned vehicles used in the project.

As with most other development projects in Lesotho, there is no accounting provided for the value of the United Nations Volunteers and other donated services. There is also no record available of the extent to which food-aid labor was used in the construction of roads and conservation practices.

Accomplishments

The major project activities included watershed management, livestock production, crop production and introduction of new crops, irrigation development, farm mechanization, credit, marketing, provision of crop inputs and socio-economic surveys. With this many facets to the project, it is remarkable that any type of coordinated accomplishment could be observed. But it appears doubtful if much change has been made towards increasing total agricultural production above the subsistence level. For this evaluation only those listed under watershed management were directly considered.

During the course of the project, data was collected and collated for land use plans to protect and improve 284,792 acres of land within the following areas:

	Acres
Mohale's Hoek - Ntjepereng	103,120
Maphutseng Valley	85,624
Qomo-Qomong Valley	73,148
Mt. Moorosi - Phamong	22,900

These areas were selected on a river catchment basis to facilitate the watershed management aspect of the plans. While these plans were never completed, the information collected has been used to initiate the BASP effort in the project area. The work on all field programs was carried out with the cooperation of the chiefs and farmers concerned. 2/

1/ Layzell, D., Irrigation, Watershed Management, Soil and Water Conservation, Final Report, Phase I, Senqu River Agricultural Extension Project, Mohale's Hoek, June 1976, p. 19.

2/ Ibid., p. 20.

Two other major activities were planned for the Conservation Division during the project period. First, a large dam was surveyed and designed for the Leloaleng Trade School to supply water for domestic and irrigation purposes. This dam has a catchment area of 620 hectares, contains 21,230 m^3 of fill and was built at an estimated cost of 12,000 Rand. 1/ The other major effort was a British government funded conservation program for the Mt. Moorosi area. It consisted of dams in the major dongas. diversions below the steep escarpments, waterways, terraces and weirs, together with tree planting on the steep slopes and abandoned cropland.

Limited conservation planning information was also collected for the Mphhaki and Qhoobeng areas in the mountains. The Mphhaki information was used in planning a 2,400,000 Rand proposal to the Commission des Communautés Européennes for a Mountain Livestock Development Project, which was approved in April 1976. 2/ Watershed management was also a key component of this project.

A considerable amount of land surveying was also carried out in the Mphhaki and Qhoobeng areas as a part of the planning effort for land consolidation and other practices. A total of some 30 maps was produced at a scale of 1:1250, by plane table and alidade. These maps provided a record for equitable distribution of cropland in cooperatives, and for use in planning terraces and related conservation practices.

Conservation Structures

The Evaluation Mission for the Senqu Project in 1975 recommended that an integrated conservation system should be applied to one or two large unconsolidated areas of not less than 500 acres each. 3/ This recommendation resulted in the development of a project effort in the Masitas/Ntjepeleng area. Since implementation of this project first required the construction of an access road, a full scale conservation development effort was not initiated until July 1976. After considerable negotiation with the chiefs and farmers in the area, a comprehensive plan was developed that included dams, fish ponds, terracing and road building. This area has some of the better soils and flatter slopes observed in the Senqu Project area and, coupled with the availability of fertilizers and insecticides provided by the project, the present and future crop production potential appeared to be excellent.

Terraces. The terraces constructed in the Senqu Project area are generally of the broad base type constructed on the contour in contrast

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1/ Ibid., p. 19.

2/ Interim Report, op. cit., p. 8.

3/ Report of Evaluation Mission, op. cit., p. 44.

to the gradient terraces with grass cover on the enbankment and channel generally recommended by the Conservation Division. The former Project Manager explained that the broad base terraces were used because they can be cultivated and thus brought more land under production from the grass strips that they replaced. Being on the contour, they conserve more moisture and do not require grassed waterways for disposal of excess water. Channel grade, where used, was 0.5 percent. The terraces were designed for a maximum rainfall intensity of only 4.0 inches per hour, even though rainfall intensities of 6.0 inches per hour have occurred in the project area. 1/ According to project reports, broad base terraces can be constructed for 20 Rand per hectare. Data on total yards of terraces built was not available.

Other Conservation Structures

The Senqu Project personnel did not construct many waterways, in part because of the type and limited quantity of the equipment available. Diversion ditches were used to protect cultivated land. The diversions were initially all constructed with hand labor. After a MF 188 tractor became available, they were constructed with a combination of disc and mouldboard plows for slopes up to 12 percent. It was reported that all diversions were constructed with a channel cross section of approximately 12 square feet and a grade of 0.5 percent. 2/ If this is true, it may be a technical error in that the size of channel for diversions should be carefully designed to some specific rainfall frequency capacity for the specific drainage area above the diversion channel, rather than to standard specifications.

Only two minor dams were built at dip tanks, using hand labor. One of these washed out during a heavy storm because of an inadequate spillway. A large dam at Leloaleng Trade School that was planned for the Conservation Division was constructed under project supervision, using Ford 5000 tractors with tandem scrapers. This dam took seven months to build, including a 40 meter pipe spillway and 10 meter high drop inlet.

Roads

The project staff quickly recognized that a lack of access roads was one of the major limitations to efforts to increase agricultural production in the Senqu region. They found it necessary to build access roads to each of the 14 dryland and/or irrigation project sites before works could be initiated. Road construction was primarily by hand labor supplemented by a tractor drawn grader blade. Unfortunately, the road construction need was beyond the scope of project funding or equipment to solve, so many areas of good quality agricultural land are still

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1/ For example, the January 5, 1976 record was 84.8 mm for 24 hours with a peak intensity of 150 mm per hour for a 15 minute period.

2/ Layzell, D., op. cit., p. 15.

without access roads of any kind. The project staff had developed a proposal for a "Road Construction Unit," but the advent of the BASP proposal caused it to be set aside for later implementation under the new project. Construction of roads using food-aid labor was curtailed mid-way in the project because it was found that too much time was being wasted supervising food-aid teams. 1/

Irrigation

The Binnie and Partners (1972) report indicated there were about 17,000 hectares of land suitable for irrigation in the Senqu Project area. As a demonstration effort, the Senqu project plan called for developing irrigation on 516 acres in six areas. 2/ The project staff did eventually develop 306 acres of sprinkler irrigation, and 30 acres of surface irrigation. The project staff seem to have been able to overcome most of the technical problems, such as flooding of the pumps, poor maintenance, lack of mechanics and spare parts, and the high silt loads. But they were not able to overcome the sociological problem of getting the farmers to move the sprinkler irrigation lines at timely intervals. Neither the farmers nor paid laborers have followed the required watering schedule for long in any of the sprinkler project areas. 3/

Range Management or Grazing Control Programs

It has long been recognized that any improvement in grazing control has to involve the complete cooperation of the chiefs and the stockowners. In an attempt to reduce overgrazing, two grazing control officers for the Quthing and Mohale's Hoek Districts were appointed. The post for the Quthing District was filled late in the project and the incumbent quickly resigned, but it was reported that the Ministry had an effective grazing caretaker working in the Mphhakis area which prevented the situation from being critical. 4/ Success was reported to be good in the Qhoobeng area of Mohale's Hoek, and it was recommended that work should be intensified in that area because of the successful response to the project activities. 5/

The project also contained three major livestock management improvement schemes. The Mphhakis Breeder's Association was a scheme to improve livestock using Brown Swiss cattle. It seems to have been enough of a

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1/ Ibid., pp. 25 and 33.

2/ Project Plan, op. cit., p. 15.

3/ Layzell, D., op. cit., Final Report-Phase I, p. 22.

4/ Layzell, D., op. cit., Interim Report, p. 10.

5/ Ibid., p. 23.

success to have resulted in the development of the previously mentioned 2.4 million Rand project in the Mphhakis area funded by the European Development Fund. The Ongeluks Nek Group Ranch scheme really never became functional. About all that resulted was a survey of the area and some simple pasture improvement and fertilizer demonstrations. The Rankitsen Breeders' Association was tied to a 10,000 acre cattle post area where six Brown Swiss bulls were provided to a group of small livestock owners. Actual grazing improvement, if any, in these three project areas was not documented.

Land Consolidation

The Ministry of Agriculture requested the Senqu Project team to investigate the advantages of consolidated farming blocks. Eventually, eight test sites were chosen, two for irrigation and six for dryland. After a series of pitsos and follow up visits to other farming communities where land consolidation had been tried, agreement was reached with the farmers involved. The project advanced credit for inputs of seed, fertilizer, seed dressing and insecticides and tractor inputs for cultivation and planting. The project staff also agreed to provide information on costs, planting methods, weeding and harvesting programs, and assistance in marketing. The landholders involved agreed to consolidate and farm as a single unit, keep records, accept advice given regarding operations, organize their labor effectively, and to devise acceptable harvest sharing methods. 1/

Evaluation

The Senqu Agricultural Extension Project was very similar to the Thaba Bosiu Project in that they were both designed to solve all of the physical, institutional, sociological and economic problems that had been developing over the last hundred years within a short-term integrated project effort. Both were designed to increase national agricultural production without any real prior analysis to identify the factors that were limiting agricultural production. A much more reasonable objective would have been to develop agriculture as an integral part of the area's economy, with a recognition that a large part of the male labor force was employed in the mines of South Africa, where the wage level is highly competitive.

Field observations by the LSCE team indicated that the broad base level terraces are very subject to damage by improper ploughing and heavy rainfall. One example was observed of a terrace embankment that was topped and starting to rill erode after only 18 months of use. Instances were also observed where oxen ploughing had severely damaged the terrace system by crossing the embankment at an angle. The type of broad base terrace in use was constructed with a tractor and plough and is subject to

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1/ Ibid., p 12.

damage because the ridge height was only 18 inches at the time of construction. Another factor is that the terrace slopes were all constructed with 12 foot cross sections to fit the combines used by the Project. The Senqu project staff had also noted that they have had considerable difficulty in constructing broad base level terraces in areas that had been gullied by previous erosion.

The consolidated farms are not popular with the farmers because the system brings with it a very high demand on the farmer's labor. A high degree of group participation is also necessary, and like farmers the world over, Basotho are generally too independent to appreciate "taking orders" from government technicians. From the limited data available for the consolidated farms, it appears that maize and sorghum are very marginal crops while beans and wheat are more reliable as cash crops.

Progress on increasing short term productivity was minimal, based on the limited acreage on which improvements and the package of production inputs that were actually applied. Overall, there appeared to be some minimal immediate increase in crop acreage from taking out of grass strips, and there was some response to the extra moisture in the terrace channels. High yield levels were observed in only one project area where terraces had recently been established and where a project staff member was providing custom plowing, initial cultivation and Extension management advice. It was apparent in this instance that most of the yield response was to the management inputs being provided.

Crop yields in all of the irrigation schemes have been disappointing and many of the crops raised have a very low net return, at best. Part of this problem seems to be related to the fact that the farmers lost all identity with their land in the cooperative sprinkler irrigation systems, once project technical support was terminated. At the time of the LSCE team field trip to the Senqu Project area in February 1978, it was reported that irrigation equipment valued at 50,000 Rand was setting idle in the Orange River bottoms. 1/ The surface irrigation system on land adjacent to the Silver Springs River at Qomoqomong by 10 farmers seems to have been more successful, largely a function of the fact that the farmers are irrigating their own land allocations. 2/ The surface irrigation system is reported to be still functioning, although there is considerable doubt as to the profitability of the crops being raised.

Progress in promoting long term productivity is questionable, primarily because of the observed maintenance problems with the broad base level terrace system. There were also some possible questions as to the design

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1/ Personal communication Don Layzell, Watershed Management Officer, FAO.

2/ Ibid.

criteria used in both terrace and diversion construction because experience elsewhere indicates the drastic effects of structural failure in such cases.

The project definitely resulted in an increase in technical knowledge, as developed by the staff through reseach and from conservation training programs and via the Extension nature of the projects, such information was disseminated to farmers. There seemed to have been good success in gaining farmers' acceptance of improved seeds and the use of fertilizers, insecticides and improved cultural practices. The farmer groups seem to have accepted the terracing and other conservation practices as well. But neither the consolidated farming or irrigation schemes were popular with the farmers involved. One limiting factor was that only a small part of the total area received any concentrated project effort directed towards introducing better agronomic practices and conservation farming.

Good progress was made on the development of basic data. The Watershed Manager and Conservationist collected considerable physical data, and some 30 individual project areas were mapped. The socio-economic surveys and studies were extensive and valuable in terms of farm level data and explaining farmers' attitudes. On the other hand, no economic data on total project costs attributable to individual project components, or for ascertaining their cost effectiveness, were obtained. A limitation was that the project terminated while the individual watershed management plans were still being developed.

Not much emphasis was placed on integrating this project with other economic development thrusts of the government. Several sources stated that there was a definite lack of cooperation and coordination at the upper levels in the various ministries of the GOL. On the other hand, the agricultural Extension focus of the project seems to have fostered a general cooperative spirit within the field staff.

The project staff gained considerable experience in the problems of land consolidation and in the operation of irrigation schemes under Lesotho conditions, most of which showed negative farmer response. Unfortunately, it is somewhat doubtful if these problems ever became apparent to central government planners, but very similar projects are still being proposed.

The project staff seems to have committed a common mistake of attempting to show too much immediate progress. The Watershed Management Officer from FAO, upon his arrival on-site in February 1973 found that "with an equipment component of a pickup and a second hand Landrover, the Agronomist and volunteers were trying to run six dryland and two irrigation schemes using equipment hired from LEMA (Government Tractor hire service)." He further recognized that in projects of this type the pre-project period should be spent in work of an experimental nature. 1/ In many

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1/ Ibid.

respects, the 52 month Senqu Project effort can be viewed as mostly experimental. Perhaps the staff finally would have been ready to create a viable project during Phase II, but it was, of course, not funded.

The major constraints to accomplishment were the lack of equipment (both size and type, as well as lateness in arriving), lack of an adequate number of qualified nationals, lack of full support and coordination by MOA, and lack of interministry coordination. The main concern about the project's physical accomplishments is the definite lack of a maintenance program for the conservation structures applied, in the face of certainty of failure of these broad base terrace systems without such maintenance.

Relative to most other projects evaluated by the LSCE Team, the Senqu effort was not particularly sensitive to project economics--either costs or benefits. While several extensive socio-economic surveys were carried out, with findings presented in project reports, there is no evidence that the results were being applied in project design and operation, even in a cost-effectiveness sense. The project activities have now been merged into the BASP effort so there is reason to expect that future benefits will flow from the sunk capital investments already made in the area.

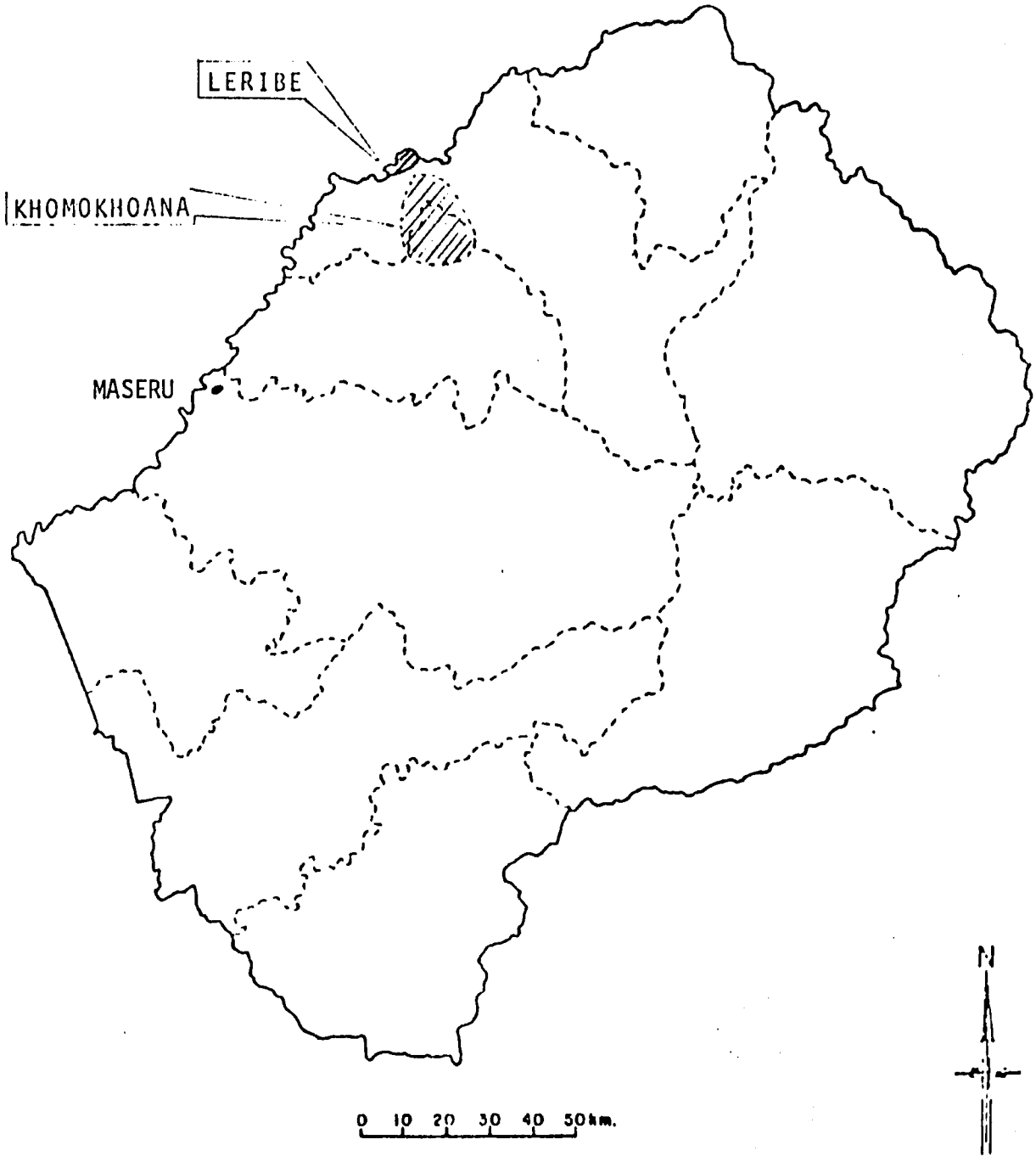
Leribe/Khomokhoana Projects (1970-1980)

Overview

The Leribe/Khomokhoana Project sites selected by the Government of Lesotho for implementation of the projects are situated in the northern lowlands some ten kilometers south of Leribe (Hlotse) and 72 kilometers north of Maseru (Map V-3). The Leribe Project began in 1970 as a pilot project, followed by implementation of the larger Khomokhoana Project in 1975. They are bounded on the north by the Caledon River, on the east by the Khomokhoana River, on the west by the Likhetlane River and on the south by the Leabua Highway. Elevation ranges from about 1,480 to 1,550 meters.

Average annual precipitation in these project areas is approximately 750 mm (29.5"), some 80 percent falling during the spring and summer months from October through March. Precipitation, which is very localized, is erratic in respect to volume, intensity and distribution, with frequent water shortages (or moisture deficits), even during the rainy season. Normally August and September are the windy months, with numerous dust storms of varying severity. Temperatures during the summer months rarely exceed 32°C (90°F), with night temperatures in the 7°C to 15°C range, while in the winter the average temperature is around 16°C (61°F)

Map V-3. Location of Project Leribe/Khomokhoana, Lesotho



with subzero temperatures commonly experienced during the night. The earliest ground frost is usually experienced in April and incidence continues through September, occasionally into October and more rarely into November, therefore affording a frost-free period of about six to seven months in the year.

There are 13 settlements within the boundaries of these two projects. Together with four adjacent villages, where a minority of farmers holding fields within the project areas reside, a total of 17 villages, with an estimated 1,034 landholders farming 1,533 individual fields, were involved in project activities. Average size of the total farm holding was 5.8 acres, ranging from 0.2 to 17.0 acres. Multiple holdings are usually dispersed but the fields of most farmers are close to their respective villages. Access to the majority of villages and fields is by rough, ungraded tracks and footpaths, many of which become impassable to vehicular traffic during periods of heavy rainfall.

The vicinity of Ficksburg Bridge together with the adjacent town of Ficksburg in the Republic of South Africa forms the economic focus for the area. A significant proportion of the population in the Ficksburg Bridge area migrate daily to work in Ficksburg. Close proximity to this focal point with its attendant labour opportunities, markets, sources of supplies, etc., coupled with potentially fertile soils for the greater part, low erosion incidence, reasonably good road communications, and perhaps the most complex and confused rights of administration over land prevailing in Lesotho, did not provide a reasonably typical area for the siting of a pilot scheme for the Lowlands. Nevertheless, as experience showed, the major differences lay not in the nature of the diverse range of problems but in their respective magnitudes. Hence, much of the information and experience gained can have application to a greater or lesser extent in many other Lowland areas of the country.

The project team embraced a wide range of disciplines relevant to development and included:

- Rural Sociology
- Watershed Management and Soil Conservation Planning
- Farm Management and Production Economics
- Soil Survey
- Agronomy
- Agricultural Mechanization
- Agricultural Extension and Training
- Marketing and Credit
- Livestock Production
- Development Organization and Management
- Administration

The project team was comprised of a series of units representing the various disciplines, each consisting of counterpart officer(s) and FAO experts. These units were directed by the FAO Project Manager and Basotho Project Co-Manager. Through this approach, an effective working relationship between nationals and expatriates was established, which in turn helped foster a purposeful team approach--an assumed fundamental requirement for effective development efforts. 1/

The Khomokhoana Project, which started in April 1975, increased the project area and provided additional funding. Soil conservation measures to be applied were those outlined in the work plan developed in the Leribe Project. To implement the watershed plan, a Soil Conservationist, a Conservation Engineer, and a U.N. Volunteer Soil Conservationist were recruited by FAO. On the GOL side there were to be seven positions; however, there were never more than three positions filled at one time.

Project Objectives

The overall objective of the Leribe Project was development of a pilot agricultural scheme to demonstrate the efficiency of an integrated approach in increasing and intensifying crop production in the Lowlands. The watershed management objectives of this project included the following: 2/

> Develop possible soil/water conservation work plans in accordance with criteria established for sound land use;
>
> Plan, develop and supervise the construction of all soil and water conservation structural measures, as well as conservation practices, which might be required;
>
> Conduct the necessary surveys applicable to conservation engineering needs and evaluate criteria for all soil and water conservation engineering work necessary for inclusion in the work plan;
>
> In consultation with other professional staff members, carry out a simple soil and water research programme on soil losses by runoff under different management practices and on different soil units;

1/ The Food and Agricultural Organization of the United Nations (FAO), "Project Site" and "Staffing and Organization" sections, Lesotho: Development of a Pilot Agricultural Scheme in the Leribe Area. Report on Project Results, Conclusions and Recommendations, Rome, Italy, 1975.

2/ Food and Agriculture Organization of the United Nations, Technical Document 10, Development of a Pilot Agricultural Scheme in the Leribe Area, Lesotho, 1975.

Provide in-service training to selected national counterpart staff, with emphasis on practical field training.

The conservation objectives of the Khomokhoana Project were the implementation of the watershed plan developed in the Leribe Pilot Project and to improve and conserve soils through the practice of conservation farming methods embracing both crops and livestock. The Soil Conservationist post was filled from the Leribe Project and some field work was well underway before the Khomokhoana Project was officially started.

Budget

The first of these two joint projects, the Leribe Pilot Scheme, became operational in December 1970 and was terminated in March 1975. During this period a sum of US$1,384,500 was allocated by UNDP (Special Fund) and GOL contribution in kind was US$602,000. The Leribe Project was amended in 1971 to increase the special fund allocation to US$1,484,500.

In April 1975, a follow-on to the Leribe Project was funded by the Government of Sweden through FAO, "Rural Development in the Khomokhoana and Adjacent Areas." It was originally to be a five-year, nine-month project with a funding of US$2,817,700 by FAO and a GOL contribution of S.A. Rand 1,445,504. It, too, may be extended but is now scheduled to end in late 1980.

Accomplishments

A detailed conservation plan was developed for the 7,000 acre Pilot Leribe Project and the 35,000 acre Khomokhoana River Catchment, adjacent to the Pilot Project area. The Khomokhoana plan outlined the erosion control and improved farming practices as well as the Extension and training required, equipment and supplies needed, maintenance and follow up work necessary, and called for a benefit-cost analysis of the scheme. By the end of the Leribe Project (April 1975), the following work had been done on the combined Khomokhoana and Leribe Pilot Project areas:

Reconstruction of the contour system on 2,000 hectares of the Pilot area.

Planting of 62,000 trees along water courses and in badly eroded areas.

Construction of 25 fish ponds with a total surface of two hectares.

Construction of approximately three kilometers of diversion banks along with some construction of short waterways.

Construction of eight small dams and repair of nine old dams.

Construction or repair of 30 kilometers of roads and tracks.

Establishment of a small nursery capable of producing 20,000 rooted cuttings per year.

Construction of 35 groynes and two silt traps.

Installation of miscellaneous conservation works including kikuyu plantings, gully treatments, and contour maintenance.

Establishment of a meteorological station.

The Komokhoana site was subdivided into 13 subcatchments and work was initially begun on the 690 hectare Subcatchment "A." Considering work already started on the Leribe Project, the work done as of September 1977 included the following: 1/

Construction of six ponds with a total area of 1.7 hectares on Subcatchment "A."

Treatment of 400 hectares of construction of contour banks, installment of a gully head structure, tree planting in gullies, and miscellaneous small works installed on Subcatchment "A."

Development of a four hectare demonstration rotation grazing plot.

Construction of contour banks on an additional 100 hectares.

Construction of eight concrete gully head structures.

Planting of 92,000 trees (includes replanting).

Establishment of a second small nursery.

Construction of a total of 32 fish ponds with a combined surface of 3.5 hectares.

Construction of 115 stone-in-mesh groynes and silt traps.

Construction of 10.6 kilometers of new roads, 29.2 kilometers of road reconstruction, and 57.6 kilometers of tracks improved.

Summarization of all meteorological data collected from January 1974 to December 1976.

1/ Sanders, D.W., Interim Soil Conservation Report, Rural Development of the Khomokhoana and Adjacent Areas, Lesotho, Technical Document 36, TF/LES/9(SWE), Leribe, 1977. FAO/U.N.

Collection of stream measurements and silt loads at four stations.

Assisted in construction of six marketing/supply stores.

Partial in-service training to six GOL employees.

Evaluation

The Khomokhoana Project was the only project reviewed by the LSCE team that actually grew out of a pilot effort (Leribe). Soil and water conservation efforts were linked with those designed to increase production of both crops and livestock. Our evaluation concentrates on the soil and water aspects of the project.

The actual acreage worked on was only 7,000 out of the 30,000 acres planned. This project, as with most, set overambitious goals on what was actually accomplishable. One of the key problems was getting agricultural contractors to perform at the proper time. Yield increases at the Lipeleseng crop demonstration area were impressive but less so on farmers' fields in the project area.

The conservation practices applied generally are good and should assist in achieving long-term productivity increases. Large, well designed diversions were used above terraced areas and there was adequate provision for water disposal. The use of concrete drop structures for head-cut control is an expensive approach but was tied in with road construction which allows for some cost-sharing. Using a system of terraces with a diversion at every fifth interval appeared to work well. The question of maintenance of installed terraces remains an unresolved issue as with all such land treatments in Lesotho. But, we note that numerous local farmers have requested assistance in maintaining these structures.

The major objective of this effort was to demonstrate an improved farming system. Overall, we feel this is being done well. A closely related objective was to train a cadre of national staff. Five nationals have been sent abroad for B.S. level education. In addition, the project resulted in the training of 12 equipment operators and 12 laborers knowledgeable in conservation work. However, there were never more than three counterparts (out of seven proposed) on the project at any one time. Lack of coordination and MOA support was cited as a problem in this regard.

Although dissemination of knowledge as a project objective was of relatively high importance (20% of project effort) the progress achieved was only fair. The reason cited by project personnel for less than average performance was that the available Extension personnel were not considered to be very knowledgeable in the area of conservation. On the other hand, their attempt to use the agricultural contractor as a bridge to the farmer is a worthwhile one; it met with limited

success. Lack of capital, of technical and management skills, and of suitable equipment appeared to be major constraints to agricultural contractor effectiveness. Risk of financial loss, lack of formal production incentives, and an attitude that agriculture is viewed only as supplementary income sources were noted as constraints on farmer acceptance.

In terms of basic data development, soil surveys, the intensive watershed management plan developed for the 15,000 hectare Khomokhoana watershed, the establishment of a hydrometeorological station, and the collection of statistical data can be cited as valuable outputs. In addition, several economic and farm management studies were carried out; reports on these studies were published but only in limited quantities so none were available for the LSCE team during their brief visit to project headquarters. Overall, progress on basic data development was considered to be very good.

The integration of crop and livestock considerations and the inclusion of fish production for protein are considered as examples of good progress. Less progress was made in integrating project efforts with the long-term activities of the Conservation Division, MOA, and other government agencies. Few efforts were made to modify institutional constraints to agricultural development. The projects have, however, generated some information on experience with credit, insurance, and marketing.

Major constraints to effectiveness of project efforts included lack of full support and coordination by the MOA, lack of interministry coordination, and lack of adequate number of available nationals with technical training. Our general observations were that the practices are sound technically but that there is some question concerning the economic justification of individual project elements; e.g., the concrete drop structures for headcut control. There is also concern that the recommendation that local farmers take over maintenance of the structural measures will not be followed. Further, at the present time, the technical staff is not working closely enough with Conservation Division personnel. Therefore, it is highly likely that Basotho project staff will be lost to the system at the end of the project instead of integrated into the Conservation Division as planned. Unless specific plans for MOA followthru on the project area are developed soon, much of the potential benefits from this project effort will likely be lost in the near future.

Thaba Tseka Mountain Development Program-Phase I (1975-1978) 1/

Overview

The Thaba Tseka project is designed to be a long term program in rural development for the mountain areas of Lesotho. During Phase I of a four year project which began concurrently with Lesotho's Second Five-Year Development Plan in May 1975, the primary effort will be directed to achieving "an increase in the productivity and incomes of the project area population." 2/ The Second Five-Year Plan emphasizes the Government's commitment to the development of the Mountain Region. The Thaba Tseka Project represents one of the main thrusts toward this objective. While Phase I will be concentrated in the 130,000 acre project area (see Map V-4), Phase II would be designed to use the findings from Phase I for a development program that would encompass the total mountain area, or about three-fourth's of the country.

The rationale for the Thaba Tseka Project is set forth in a PRC/PAM submission paper prepared by the Canadian International Development Agency (CIDA), dated January 31, 1975, and forwarded for formal Government of Canada review under cover letter from the Country Program Manager dated February 10, 1975. 3/ The Canadian Minister of External Affairs approved Canada's role in the project on March 16, 1975. 4/

The Thaba Tseka Project is designed as a phased development program, commencing with field activities on a limited scale in Phase I in order to provide a data base and experience for eventual extension to the 8,000 square mile mountainous area of Lesotho (e.g., approximately 75% of the country). During Phase I, 53,000 hectares around Thaba Tseka in the center of the country have been selected as the project area. It is typical of the mountain region, with two major elevation zones --the mountain grazing zone that lies between 7,000 and 8,000 feet, and the highland grazing zone that lies above 8,000 feet. It falls

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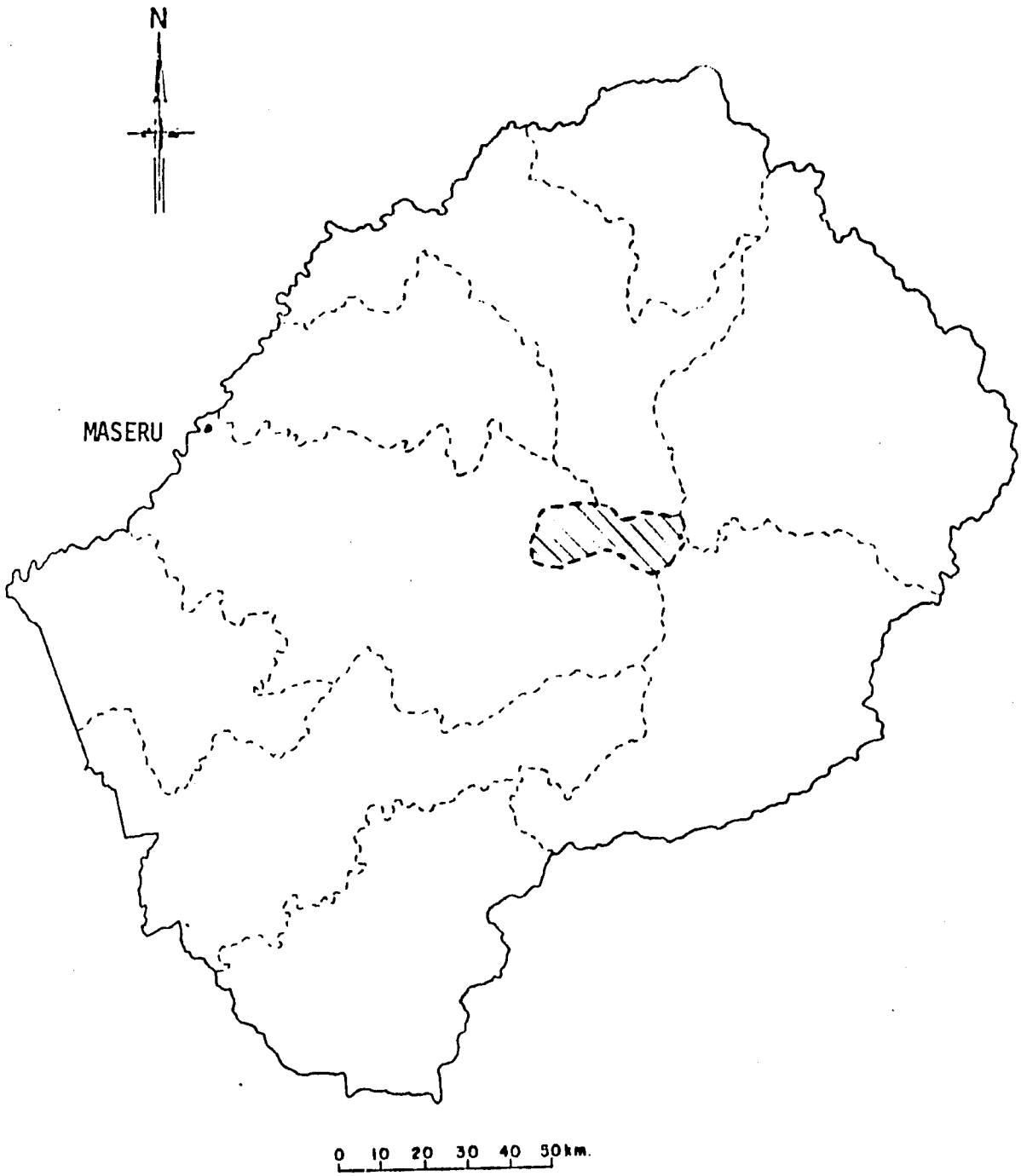
1/ Our review of Thaba Tseka, Phase I, was conducted during February 1978: Since then a number of major changes have occurred in this project. It has now evolved into a pilot experiment of administrative decentralization. The project area was greatly expanded and designated as Lesotho's Tenth District, its newest and largest, with the headquarters located in the new town of Thaba Tseka. Our analysis presented in this section necessarily predates these changes and is therefore descriptive of only Phase I of the project.

2/ Memorandum of Understanding Between Lesotho and Canada for Mountain Development Programme, Phase I, (Thaba Tseka), Ottawa, Canada, May 8, 1975.

3/ Mountain Development-Lesotho: PRC/PAM Submission, Transmittal Letter, CIDA Country Program Manager, Reference No. 554/00410, February 10, 1975.

4/ Project Report, Thaba Tseka Mountain Development Project, Maseru, September 1975, p. 2.

Map V-4. Location of the Thaba Tseka Project, Phase I, Lesotho



within the jurisdiction of one Paramount Chief and its boundaries follow natural physical barriers so that it is a self-contained socio-ecosystem. Project headquarters is at the new community of Thaba Tseka which is being built adjacent to a Canadian religious mission. Prior to the start of the project, preliminary surveys of the study area had been carried out regarding livestock, soil reconnaissance and land use, as well as demographic and sociological factors. 1/

According to these preliminary surveys, the lower elevation zone is primarily suited for cattle and angora goats and provides winter grazing for merino sheep. The highland area is primarily short grass terrain suitable only for summer grazing by small stock. Sheet erosion is evident on the steeper slopes where overgrazing has occurred while the more moderate slopes and the valley floors appear to be relatively more stable. Only about 7,000 acres are under crop use. There are an estimated 1,540 households in the original project area who own 14,300 grazing units (i.e., 5,100 cattle, 26,600 merino sheep, 9,800 angora goats and 2,300 equines). Primary access to the project area, other than by air, is via a mountain road which has recently been greatly improved.

"The project is being implemented within the existing Government structure by three separate Ministries, as follows:

Ministry of Works	...Main and subsidiary road components.
Ministry of Agriculture	...Through a new Division created for the Project.
The Prime Minister's Office	...Village infrastructure development.

Implementation would require the support of these other public bodies:

Ministry of the Interior	...Close liaison with the Administration and Chiefs.
Conservation Division, (MOA)	...Land use planning and range classification.
LEMA, (MOA)	...Agricultural machinery hire service.
Ministry of Works	...Maintenance of buildings, vehicles and equipment, town planning.

The various development activities of the Project are coordinated by the Thaba Tseka Coordinating Committee under the chairmanship of the Permanent Secretary of the Ministry of Agriculture with members representing the various interested ministries and departments, i.e., Finance, Interior,

1/ Mountain Development-Lesotho, op. cit., p 2.

Works, Central Planning Office, Community Development, etc. The committee would also be specifically responsible for development of policy including the identification and preparation of a second phase project." 1/

Project Objectives

The broader goal of the project is to formulate an integrated pattern of rural development for application to the Mountain Region of Lesotho, to be based on the research data collected and experience gained in the Phase I effort in Thaba Tseka. The immediate objective of Phase I, then, is to increase the productivity and income of the population within the project area; therefore, the Thaba Tseka effort may be regarded as a pilot project "designed to test the viability of a wide range of rural development methods and techniques to improve economic viability and social conditions." 2/

The project plan includes the construction of a modern township at Thaba Tseka which will serve as a major commercial and administrative center and construction of an all-weather access road to link Thaba Tseka with Maseru. The project plan is evolving on three broad program fronts, namely: (1) the agricultural program, (2) the engineering program, and (3) the mountain road program.

The agricultural program, which was of primary concern in the LSCE analysis, was designed to include the following: (1) economic and social studies and analysis, (2) crop production, (3) range improvement, (4) animal production, (5) agricultural infrastructure, and (6) miscellaneous other programs (e.g., the LEMA tractor hire service, woodlot program, certified seed potato program). In addition, a seventh objective, farmer and professional participant training, should also be listed.

A functional format for the project effort is provided in the implementation document, as follows: 3/

Item (Function)	Objectively Verifiable Indications
Goal: The broader objective to which this project contributes is the formulation of a suitable model for integrated rural development in the mountains of Lesotho.	(a) Goal Level (1) The beginning of Phase II of any integrated Mountain Development Program by April 78/79 using the project as a model will indicate attainment of the goal.

1/ Ibid., pp. 6-7.

2/ Progress Report, Thaba-Tseka Mountain Development Project, Maseru, September 1976, p. 2.

3/ Memorandum of Understanding, op. cit.

Item (Function)	Objectively Verifiable Indications
Purpose: The specific purpose of this project is to increase productivity and incomes of project area farmers.	Purpose Level: (1) An increase by R80 per year in individual earnings of the lowest 40% of income earners by April 1979. (2) An increase in average family income from R100 to 230. (3) Incremental production resulting from the project equal to: (i) grains-4,300 tons (mostly wheat); (ii) meat-500 tons; (iii) wool-40 tons; (iv) mohair-10 tons.
Outputs: In order to achieve the goal and purpose of this project, CIDA and Lesotho will be responsible for the establishment of a range development program, a village development program, a crops production program; farmer training inst.; administration buildings; trans. & comm. de. prgm; & plans for Phase II of the Mountain Development Program.	Output Level: (1) Eight 4,000 hectare grazing blocks established with one-tenth of each block upgraded to improve pasture by October 1977. (2) Piped water system to 16 villages completed by April 1976. (3) Sanitary facilities provided for 8 primary schools by April 1976. (4) 60 acre stands of eucalyptus established for 13 villages by April 1976. (5) Formal training of 600 farmers per year by January 1977. (6) 27 man/years of training overseas by June 1979.

The project design calls for establishing facilities to accommodate and train up to 30 persons simultaneously. It was anticipated that up to 20 weekly courses for farmers would be carried out annually and that about five, 4-week, in-service training courses for project staff at the sub-professional and technical levels would also be conducted each year. In addition, the project is to train Basotho staff for the Phase II effort, including overseas training of up to 27 man-years. Closely related research and economic evaluation functions are specified as integral components of the agricultural sector development purpose of the project.

The organizational structure and management of the project was designed to be flexible and susceptible to change. It was intended that it should continuously respond to the requirements for involvement of the participants at both the governmental and farmer levels.

The Canadian funding provided for seven expatriates to service the Phase I effort, as follows:

Project Director
Project Administrator
Project Engineer
Range Management Officer
Agricultural Economist
Village Program Engineer
Clerk of Works

By October 1975, all personnel had reported for duty. 1/

Budget

On May 8, 1975, the Government of Canada and the Government of Lesotho entered into a formal Memorandum of Understanding for Phase I of the Thaba Tseka Mountain Development Program. 2/ Under the terms of this agreement, CIDA is providing a budget allocation of $6,000,000 and approximately 24 man-years of expatriate staff to assist in the project. The total estimated budget for Phase I of the project (through April 1980) is $11,034,150, with major funding sources as follows: 3/

Source	Budget
CIDA	$ 6,000,000
IBRD	4,380,200
GOL	449,350
Total	$ 11,034,150

Accomplishments

Since field level project activities in the Thaba Tseka area did not actually get underway until September 1975, the project effort has only been in operation three years. As expected, much of the project effort during this period has been geared to the village construction program, road development and provision of basic infrastructure services. Starting from gound zero, the Thaba Tseka town construction is nearing completion and with the beginning of the new fiscal year in April 1978, major efforts were focused on the broader rural development objectives of the project.

1/ Progress Report, op. cit., September 1975.

2/ Memorandum of Understanding, op. cit.

3/ Ibid.

In spite of the predominance of the basic construction effort, key elements of the agricultural program were started during this initial period, particularly in the area of initiating basic research. Major accomplishments under the agricultural program objective are outlined below by major program elements, based on information provided in monthly and quarterly project reports.

Economic and Social Studies

An agricultural base study of the project area was the first effort undertaken and a research report was published in April 1977. 1/ Other related studies initiated during the first year included: (a) an economic analysis of growing special crops, e.g., certified seed potatoes; (b) a comparative cost analysis of mechanical versus oxen power; (c) an economic analysis of various levels of mechanization; (d) a range carrying capacity and rate of return analysis; (e) post harvest surveys; and, (f) a study of farmer participation in the Village Distribution Point Program. During the second year of the project, a series of village socio-economic surveys were started and the project staff began to participate in the National Farm Management Survey. Four villages in the project area are included in this survey.

Crop Production

Long-term variety testing and fertilizer response trials were started early in the project. Approximately 450 varieties of cereals, legumes, grasses, and brassicas are included in two trial areas. The field level trials were established on an experimental farm adjacent to the Farmer Demonstration Center. During the first year, demonstration plots were also established in 25 farmers' fields and duplicated at the experimental farm. In the second year, asparagus trials were added. Also, during the second year, a Crop Growers Association was formed in the Rantsemane-Thaba Tseka Village Distribution Point area.

Range Improvement

Little work was done in this area of concern during the first year but 65 range trial plots of several acres each have now been established in the cattle post area and are being routinely cut and harvested. Overseeding trials on native rangelands have been carried out, using various grass and clover mixtures. Most of the test areas have now been fenced. Initial responses to overseeding have been disappointing but dramatic natural revegetation has occurred in the fenced areas. One dip tank area was closed to grazing for one year and reopened in

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1/ Jensen, K.A., Report on Households, Land Use, Crop Production and Incomes, Economic Survey Report No. 1, Thaba Tseka Mountain Development Project, Maseru, April 1977.

late 1977. Preliminary discussions have been started with farmers in the project area with the intent of establishing grazing associations and complementing rotational grazing management practices.

Animal Production

Initially, work in this area consisted of helping to implement the ongoing program of the Ministry of Agriculture's Livestock Center at Thaba Tseka. Over time, the effort has been expanded from disease control to include management for increased production and marketing. A veterinary clinic was established at project headquarters the first year but due to increased farmer demand, this program has now been decentralized to the village level. Successful disease vaccination programs have been carried out. A feedlot program has been established but sustained losses the first year due to high transportation costs for imported feed. Several livestock sales have been held with varying degrees of farmer response, with the last sale held resulting in only a few animals being purchased. An annual wool shearing program has been relatively successful.

Agricultural Infrastructure

The major effort the first year was the establishment of five Village Distribution Points for the sale of fertilizer, seeds and farm supplies. Farmer response has been increasingly positive and this program is now a successful ongoing operation. Also, during the first year, a Farmer Training Center was built at project headquarters. The project office staff serve as an agent contact for the Produce Marketing Corporation's activities in the immediate area. Additional infrastructure activities are planned for the next phase of the project as it enters more directly into structuring a rural development program for the area.

Support Programs

One of the major support programs is an effort to establish woodlots for all of the villages in the study area. A nursery has been established at project neadquarters and with the assistance of Food-Aid labor, plantings have been made adjacent to seven villages. The largest of these is a 400 hectare area adjacent to Thaba Tseka. The woodlot program is under the direction of a Forestry Officer from the Ministry of Agriculture who has been seconded to the project. A target planting of 110,000 trees had reached the half-way mark in early 1978. Records on survival rates are being maintained on several test sites.

Another major support effort is the tractor hire program which began at subsidized rates but is now being shifted to farmers paying full operation costs. The program was established at each of the five Village Distribution Points and has now been expanded to custom hiring of a thresher, baler and grain sheller. During the first year, the Conservation Division carried out a soil survey of the area and provided maps on

a scale of 1/25,000. A pilot credit program was established and is gradually being expanded as farmer interest continues to expand. Speciality crop programs including seed potatoes, barley forage and, more recently, wheat, and beehives have been initiated. Weather data collected at the Paray Mission is being routinely analyzed.

Training and Extension

An Extension staff ranging from four to six persons has been stationed at the Village Distribution Points and has carried out a program of demonstrations, pitsoes and workshops. The Farmer Training Center is now in full scale operation with participants provided meals and quarters while they are at the Center for classes. Some of the project staff have also been teaching agricultural classes at the Paray Secondary School. The first agricultural show was held at project headquarters in May 1977 which was attended by over 500 local farmers. The project objectives include 27 man-years of technical overseas participant training but, while the program is underway, no information was obtained on its status.

Evaluation

Per the project objectives, the Thaba Tseka effort is focused on an emerging rural development program that can serve as a prototype for the mountain regions of Lesotho. At its present stage of conceptualization, it is not directly geared to soil conservation *per se*. Nonetheless, range management is a primary concern of the project personnel and since adequate and properly managed grass cover is a primary retardant to erosion, this project will be of particular significance to Lesotho's future soil conservation program. Further, since this project is directed to a broadbased agricultural research program, it can serve as a useful prototype for future projects in Lesotho that are directly geared to soil erosion concerns in the mountain region.

The high ratings given the Thaba Tseka Mountain Development Project by the LSCE team are in part a recognition of the extremely difficult conditions under which the project was initiated. 1/ The building of a village, administrative center and training center while the Maseru to Thaba Tseka road was being built illustrates the infrastructure elements. The carefully developed research program to determine adapted varieties and potential productivity of various crops, forages and grasses is also notable.

Direct activity on increasing both short and long term productivity involves limited areas of range improvement, nursery establishment, and tree planting. Progress on these activities is good even though

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1/ See LSCE report (Seckler and Nobe, op. cit.), p. V-22.

it is judged to be a very limited effort to date (10%). There is some problem with some of the terraces and water disposal areas at the test trial and at the project site; these should be corrected with the assistance of the MOA Conservation Division.

Increasing technical knowledge constitutes by far the greatest soil-water conservation effort on the project so far and progress was judged by the LSCE team to be very good. The well-planned test plots, as well as effective training and utilization of nationals on the project, are very impressive. There is some concern that the shift from Phase I to Phase II will result in deemphasis of these efforts, especially in relation to the plot studies. The evaluation team strongly recommended that these well-planned efforts be continued and expanded. The development and operation of the farmer training center and Extension efforts through the village distribution points are specific highlights of progress on dissemination of knowledge. These activities, plus a strong orientation by project personnel to local needs and local people, are the basis for an evaluation of "very good" in this area of project concern.

The economic and social studies together with the base statistical data accompanying them, as well as the soil and agricultural surveys, are very positive features of the project. The crop variety production tests and records of experimental tractor hire and livestock feeding trials add to the basic data on mountain areas of Lesotho. The program seems to be producing a considerable amount of knowledge as to probable success or falure of various development approaches in the mountain areas of Lesotho.

Efforts to modify institutional constraints involve a number of problems but one of the key issues relates to achieving effective grazing management. Progress has been good but the problems are complex. There is an obvious need for greater coordination between the various government ministries involved in rural development--Health, Education, and Rural Development. This is a GOL as well as a Project problem.

Overall, this project was given very high ratings by the LSCE evaluation team. But there is a need to reinforce the applied research begun in Phase I to be sure that it is carried through. Increased practical training for applied research technicians would be helpful. Because of the good beginnings on nursery establishment and tree planting, a program of applied research on tree planting potentials, species, and silvacultural practices would be a highly desirable addition to the project. There are some local soil conservation practices that could be improved at the project headquarters site. The overall local needs-orientation and people-orientation of the project personnel is an outstanding attribute of this project, along with the substantial initial investment in obtaining needed information. To date, the project has

not focused heavily on program areas directly related to soil conservation. Indirectly, related range and livestock program areas are underway and a long term research program, including major economic studies, has been implemented.

Available project cost data is aggregated in such a manner which precludes even a cursory economic analysis of individual program areas. The newly appointed Project Director is an economist, however, and he is planning to keep separate cost accounts for all major program areas. Therefore, at a future date, cost-effective analyses can likely be carried out. And, the continuation of the series of economic-research-studies currently underway will likely provide a considerable volume of data that will be useful in expanding the major program areas to the rest of the mountainous region in Lesotho.

Land and Water Resource Development Project (1975-1983)

Overview

The Land and Water Resource Development Project (LWRD) is an eight-year institutional and technical manpower development effort directed primarily to Lesotho's soil erosion problem. It was initiated on April 1, 1975 with funding from the United States Agency for International Development (AID). It was designed to be one of the major efforts in support of the agricultural self-sufficiency goal specified in Lesotho's Second Five-Year Development Plan. To accomplish its specific goal, "to increase agricultural production and rural income through improved utilization of land and water resources," the project is oriented to upgrading and expanding the capability of the Division of Conservation in the Ministry of Agriculture. 1/ The rationale for the LWRD Project is set forth in detail in an AID Project Paper (PROP) and therefore it will not be commented on in this section of our report, other than to illustrate suggested changes or other relevant issues.

The Project is now in phase two of a three-phase effort, as specified in the PROP:

a) Planning and development (years 1 and 2)
b) Operations with senior U.S. staff (years 3-6)
c) Basotho staff management with U.S. advisors (years 7 and 8)

1/ AID Project Paper (PROP): Land and Water Resource Development, A Technical Assistance Project with the Government of Lesotho, No. 690-11-120-048, OSARAC, June 1974, p. 3.

To carry out these three phases, AID has planned to provide an expatriate technical team aggregating 37 man-years, with a salary budget of $1,503,800. In addition, funds are being provided for training of Basotho employees of the Conservation Division: specifically $499,000 for 52 years of degree of sub-professional training and for up to 26 long-term participants in appropriate discipline areas.

One of the basic design criteria of the LWRD PROP specified that all AID provided staff be officed in the Conservation Division of the Ministry of Agriculture. The PROP provided a schedule for AID funded expatriate manpower to be provided, and its time sequence, as follows: 1/

Job Title	Duration		
	Man-Years	FY/QTR	to FY/Qtr
Chief Conservation Officer	7	75/2	82/2
Conservation Operations Officer	5	75/2	80/2
Conservation Soil Scientist	5	75/2	80/2
Conservation Engineer	4.5	77/1	81/2
Conservation Planner	4.5	77/1	81/2
Range Conservationist	4	75/2	79/2
Soil Scientist (Mapping)	3	75/2	78/2
Conservation Extension Teacher	3	75/2	78/2
Consultants (+)	(ave. of 2 man-months per year) 1.3	75/2	82/4
Total	37.3		

(+) Personnel to assist in (1) designing the intensive labor use tests, (2) to provide U.S. specialists for evaluation, and (3) to provide technical experts as need is determined by the GOL and approved by OSARAC.

In accordance with the PROP, a cadre of eight expatriate conservationists has been provided to the Conservation Division. In addition, a total of six Peace Corps volunteers (two Soil Scientists, two Soil Conservationists, one typist and one Machinery Expert) have made inputs for variable time periods into the soil conservation programs.

1/ Conservation Division Summary-1/4/75 to 30/6/77, unpublished Progress Report presented at the Donor Conference, Maseru, Lesotho, October 1977, p. 16.

And, five professional Peace Corps volunteers have been working on the Senlabathebe National Park project which is now administered by the Conservation Division. As of June 1977, there were also 53 Basotho personnel on the payroll, including those away to school and full-time workshop personnel. Seven of these personnel were seconded to area-based projects and after accounting for those away at school and temporary vacancies, only 22 Basotho are on the job at any one time. In spite of the expatriate inputs, this will leave the Division seriously understaffed until the large number away to school return. As of June 1977, 27 Basotho personnel were on educational leave to obtain advanced degrees and two had previously been trained but did not return to the Division, having been posted elsewhere in the Ministry. Conservation personnel assigned to Maseru are now headquartered in the former Thaba Bosiu project building which is one of the most modern physical plants available within the MOA.

Project Objectives

The LWRD Project is one of the few donor-supported agricultural development efforts that is not area-based. It is the first such major effort in Lesotho primarily supported by AID. It is designed to assist the agricultural development effort on a countrywide basis and its accomplishments must be viewed in that context. Broadly stated, the two primary project purposes are to: "a) promote incorporation of land and water use plans in all agricultural development projects, and b) to assist Lesotho farmers to adopt proper land management practices." 1/

The specific objectives of the project are not stated directly in the PROP but may be inferred from sub-elements identified as "project input-output linkages." These are: 2/

1. Skill transfer
2. Adoption of technology
3. Institutional development
4. GOL-rural population linkages

Further, information on expectations and their form, in terms of output, can be obtained from the "logical framework" section of the PROP, which can be summarized in a functional format, as follows: 3/

1/ PROP, op. cit., p. 4.

2/ Ibid., pp. 7-11.

3/ Ibid., pp. 12-14.

Item	Objectively Verifiable Indicators
Program or Sector Goal:	
To increase agricultural production and rural income through improved systems of land and water resources utilization.	A net per-capita increase in agricultural productivity.
Purposes	
1) Sound land use and management principles and practices are incorporated into the national agricultural development effort.	1-a Land use plans for all area-based and integrated conservation development projects. 1-b Division is coordinating land use efforts of the Ministry with competent technical staff. 1-c Land use management practices and conservation construction techniques in use are adapted to Lesotho conditions.
2) Proper land use and management practices are accepted and adopted by farmers and herdsmen within agricultural development project impact areas.	2-a Effective two-way communication linkages between GOL personnel and the farmer/herdsmen group. 2-b Proper land use and management practices are adopted. 2-c Net farm incomes are increased.
Outputs	
1) Appropriate land and water use management practices incorporated in GOL/MOA Integrated Area Development project (e.g., BASP).	1) Degree to which targets for preparation of land use plans, construction and management programs, as specified in the PROP, are achieved.
2) Adequate MOA capacity to design development projects which include appropriate conservation practices.	2) Degree to which staff positions in Conservation Division, Livestock Division and elsewhere in MOA are authorized and filled.

Item	Objectively Verifiable Indicators
Outputs (Continued)	
3) Adequate numbers of technically trained manpower for all levels of MOA administration and programs.	3) Degree to which manpower training targets specified in the PROP are met (and degree to which flexibility in training can be made to fill needs not originally anticipated, both in terms of numbers and kinds of discipline).
4) An expanded MOA capability to construct, repair and maintain conservation structures and to adequately maintain their equipment.	4) Increased output per unit of input as affected by use of mobile field service units, increased staff mobility, effective use of an adequate level of equipment and reduced down time.
5) Improved communication links between GOL personnel and rural farmers and herdsmen re: planning and implementation of agricultural development projects.	5) Degree to which development committees in all villages are participating in such efforts and the degree to which practices are continued after area-based project efforts have ended.
6) Incorporation of effective soil and conservation educational materials into Extension programs.	6) Degree to which various materials, methods and programs are used and positively responded to in rural areas.
7) Relative cost analysis of alternative levels of labor utilization in conservation construction work is achieved and incorporated in MOA agricultural development policy.	7) Number of alternatives to be tested determined in first six months of project and study completed by 4/1/77--specifies viable policy recommendations.

(Note that no cost-effective analysis was specified for other program elements; nor was there a research component.)

Budget

AID is the major donor agency with a proposed eight-year technical assistance budget of $2,893,800, along with contributing financial support from the other donor agencies involved in soil conservation work and from the Government of Lesotho (GOL). The total estimated budget for LWRD through March 1983 is in excess of 7.9 million dollars. 1/ A disaggregation of the total budget is as follows:

Source	(In US Dollars) Budget
U.S. (AID)	2,893,800
Other donors (UK, UNDP, SIDA, Anglo-Amer/DeBeers)	3,000,000
Government of Lesotho	2,053,500
Total	7,947,300

The GOL contribution to the LWRD Project is for recurring budget (ongoing programs and staff). The other donor agency contributions are directed to specific area-based projects in which conservation is only one of the project purposes. Therefore, the relevant budget figure for the LSCE project evaluation was the 2.89 million to be provided by AID.

The major program areas of the Conservation Division, along with funding levels for the period April 1, 1975 through June 30, 1977, are summarized in Table V-11. It provides a measure of the relative magnitude of the LWRD Project within the Division. But, for the purposes of the LSCE evaluation report, only the accomplishments of that project were reviewed and assessed.

Although Table V-11 provides a budget expenditure of 2,847,500 Rand for total LWRD Project activities, a breakdown of these expenditures by the six program functions listed above is not available. Rather, the USAID budget is disaggregated for this period by the line items listed in Table V-12.

Accomplishments

The LWRD Project has now been in operation for about three years. A progress report prepared by the Conservation Division for the Donor Conference in Maseru in October 1977, covering the first 26 months of operation, provides a rough guide to program accomplishments. 2/ The major areas of LWRD Project accomplishment given in this progress report may be subdivided into the following six major functional elements:

1/ PROP, op. cit., p. 12.

2/ Ibid.

Table V-11. Rand Expenditures for Major Programs in the Conservation Division, MOA, April 1, 1975 to June 30, 1977

Subsectors	Source	Total Budget Expenditures in Rand. Duration: from 1/4/75 to 30/6/77
LWRD Project	USAID	R 2,847,500
Intensive Arable Area Conservation	U.K.	4,138,200
Woodlots Project	MOA, U.K. & ABFOL	3,717,100
Non-capital Project (technical assistance)	MOA, U.K. & ABFOL	-
Overall Conservation Program	MOA	4,682,600
TOTALS		R 15,385,400

Source: Conservation Division Summary, op. cit.

TABLE V-12. Line-Item Expenditures, LWRD Project, April 1975-June 1977

Subsectors	Source	Total Budget Expenditures in Rand. Duration: from 1/4/75 to 30/6/77
Expatriate personnel	USAID	R 1,659,900
Training	USAID	489,700
Commodities	USAID	472,000
Administration and logistics	USAID	138,600
Labor intensive effort	USAID	87,300
TOTALS		R 2,847,500

Source: Ibid., Table I, Supplement I.

1) training; 2) soil survey and mapping; 3) land use and conservation planning; 4) systematic crop and rangeland protection; 5) extension; and 6) equipment (LEMA).

Even though only one project function, training, is identified in the accounting system outlined above, we nonetheless decided to use the six function breakdown for reporting accomplishments and assessing project progress. 1/

Training

As of June 30, 1977, formal degree training in conservation related disciplines was being provided to 27 Basotho personnel (and two others who had completed training had already left the Division). Those in training in the United States during the reporting period, subdivided by discipline orientation, were five agronomists, five agricultural engineers, two soil scientists, two range managers, one civil engineer and one agricultural economist. With the exception of one agricultural engineer enrolled in a Master's degree program, all of the Basotho trainees were enrolled in B.Sc. programs.

In addition, during the reporting period, 15 students were given diploma level training: 11 in conservation, one in welding and three in mechanics. The total cost of this phase of the program was 50,850 Rand, or an average of 3,390 Rand per diploma granted. This compares with an average cost for 20 degree holders trained (19 B.Sc. and 1 M.Sc.) of 13,352 Rand. In addition, on-the-job training courses and a series of one to five day technical workshops were being provided to Basotho employees of the Division. The expatriates on the LWRD project provided the instruction which varied, depending upon the specific requirements of the Division employees. Therefore, in one way or another all of the Division employees have received the benefit of some technical training as a result of the LWRD Project.

Small Integrated Conservation Development Projects

In addition to general technical services provided to land users through the nine District Agricultural Coordinators and the major donor-funded area-based projects, the Conservation Division is carrying out systematic conservation planning, installing structures, and encouraging conservation farming systems in eight integrated conservation development projects that in the aggregate total 63,150 acres, per the information given in Table V-13 (Map No. V-5). It now appears that conservation planning and application of protective measures, including

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1/ In our view, however, it is an absolute necessity to modify the accounting procedure so that, in the future, accomplishments by functions can be compared directly with budget levels allocated for each function.

Table V-13. Conservation Activities of the Conservation Division, Ministry of Agriculture and LWRD Project Targets, 1975/76-1979/80 1/

Project Areas	Soil Survey & Mapping		Land Use & Conservation Planning		Systematic Cropland Protection		Systematic Rangeland Protection	
	Targets	Completed	Targets	Completed	Targets	Completed	Targets	Completed
Conservation Project Areas (8 integrated areas)	54,000	43,259	33,000	24,620 1/	28,000	12,300	84,000	None 3/
Donor-funded Area-based Projects	189,000	180,434	226,000	None 2/	27,000	None 2/	81,000	None
Special Areas	-	3,766	-	3,766	-	-	-	-
Totals	243,000	227,459 (93.6%)	259,000	28,386 (11.0%)	55,000	12,300 (22.4%)	165,000	- 3/ (0.0%)

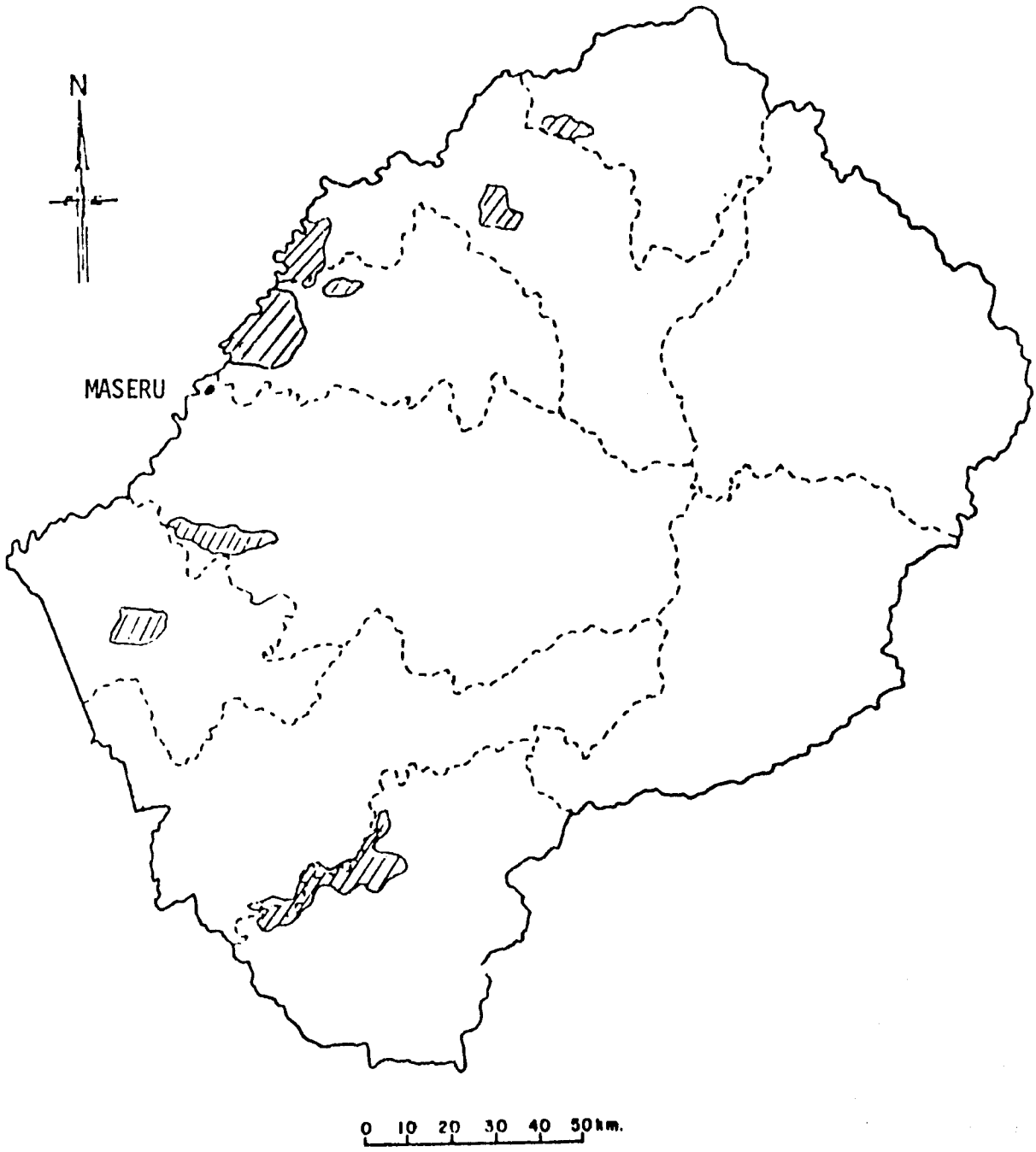
1/ 13 conservation plans were completed.

2/ Area-based project personnel were responsible for land use plans and structural works.

3/ Via Extension effort, "several thousand hectares are receiving protection."

Source: Conservation Division Summary, A Progress Report to the Donor Conference, Maseru, October 1977.

Map No. V-5. Integrated Conservation Development Project Areas, Lesotho



constructing the necessary works will now take longer than the three to five years originally estimated. Nonetheless, some work is underway in all eight areas, as summarized in Table V-14.

Under MOA policy, use is made of hand labor, including food-aid program labor, to the degree possible. These programs relate directly to the LWRD project effort because of the technical support staff being provided, as well as to the Labor Intensive Project purpose. Its objective was to compare labor utilization under labor intensive methods with capital intensive methods. So far, a 50-man crew has been working in Upper Matsieng and has completed a dam for a fish pond scheme, followed by building a diversion to bring water to the dam. One 50-man crew has also been working in Thaba Phatsoa, building a grass waterway. Although called for in the PROP, an evaluation report after two years of project effort has not yet been completed. Over the life of the project, the Conservation Division has supervised up to 2,400 food-aid workers each year who do small but important conservation project work in all districts. Complete reports of accomplishments have not yet been assembled but, generally speaking, much of the work is directed toward repair of damaged existing conservation structures and related measures. No estimates of the value of food-aid labor are available but as of February 1976, 60,000 Rand had been spent on this program.

Soil Classification and Mapping

The soil survey and mapping program is ahead of schedule with about 94 percent of the program target having been completed by October 1977. Of a total project target of 243,000 hectares, 227,459 hectares have been surveyed and mapped (Table V-14). Soils are mapped on an air photo base and released in various forms, primarily associated with area-based projects; for example, as the "Soil Survey of the Thaba-Bosiu Project, Lesotho Technical Appendix," "Soil Survey Descriptive Legend for Sehlaba-Thebe National Park," and "Descriptive Legend for the Thaba Tseka Mountain Development Project."

Land Use and Conservation Planning

During the period April 1, 1975 to May 31, 1977, a complete set of 1:50,000 foot contour maps have been indexed and filed, along with an index of contact aerial photo prints, most of which were recently flown (1975 and early 1976). A system of standard map symbols has been developed for uniform use within the MOA. Structural measures planning was accomplished in the following projects (see also, Table V-14 for a summary figure):

Table V-14. Conservation Activities in the Eight Integrated Conservation Development Project Areas, April 1, 1975 through June 30, 1977 1/

Activity	Thaba Phats'oa	Kolonyama	Matsieng-Morija	Mount Mooros
Support Efforts				
Soil Survey (ha)	6,514	8,097	8,164	2,863
Cons. Plans (ha)	(1) 3,000	(2) 6,020	(1) 5,800	(1) 2,800
Tng. Meetings (Comm. level) #	(5)	(10)	(4)	-
Pitsos (No. & attendance)	(5) 920	(17) 1,650	(15) 1,020	-
Housing Built	(1) rondoval -	4 rondovals 2 3-room houses	4 rondovals 1 3-room house	3 rondovals -
Conservation Practices Applied or Installed				
Waterways (ha)	12.5	24.2	6.5	(3,736 meters)
Fencing (km)	4	20	14	-
Gabions (cubic Meters)	505	300	250	1,755
Access Roads (km)	12	8	3.8	-
Fishponds (ha)	4.4	(2) 0.5	(4) 8.2	-
Conservation Dams	-	2	5	-
Tree Planting (ha)	-	18.5	4.5	-
Grass Planting (ha)	-	1.4	2	236
Terracing (ha)	-	43	2.5	(1,395 meters)
Diversions (km)	-	-	7.4	(5,358 meters)

1/ Lack of capital construction funds; withdrawn completely in 1976/77.

Source: Conservation Division Summary, A Progress Report for the Donor Conference, Maseru, October 1977.

Table V-14 (Continued). Conservation Activities in the Eight Integrated Conservation Development Areas, April 1, 1975 through June 30, 1977 1/

Activity	Qalo	Berea-Martinsi	Berea-Majara	Tsoaing
Support Efforts				
Soil Survey (ha)	10,324	1,376	8,704	930
Cons. Plans (ha)	(2) 3,900	-	(2) 5,300	-
Tng. Meetings (Comm. level) #	(10)	(8)	(10)	(11)
Pitsos (No. & attendance)	(10) 1,006	(9) 892	(9) 824	(1) 43
Housing Built	1 rondoval 1 3-room house	- -	4 rondovals 2 3-room houses	1 rondoval 1 3-room house
Conservation Practices Applied or Installed				
Waterways (ha)	None 1/	None 1/	None 1/	None 1/
Fencing (km)	"	"		
Gabions (cubic meters)	"	"		
Access Roads (km)	"	"		
Fishponds (ha)	"	"		
Conservation Dams				
Tree Planting (ha)				
Grass Planting (ha)				
Terracing (ha)				
Diversions (km)				

1/ Lack of capital construction funds; withdrawn completely in 1976/77.

Source: Conservation Division Summary, A Progress Report for the Donor Conference, Maseru, October 1977.

Project Name	No. of Planning Units Worked in	Hectares Mapped
Matsieng-Morija	3	5,800
Kolonyama	2	6,020
Thaba-Phats'oa	1	3,600
Mount Moorosi	1	2,800
Berea-Majara	2	5,300
Qualo	2	3,900
Miscellaneous	-	966
Totals	11	28,386

The LWRD project target for land use and conservation planning for the total period is 259,000 hectares; only 28,386 hectares or 11.0 percent, have been completed. (See summary Table V-14.) As noted above, however, most of the planning has been for the eight conservation project areas; out of a total target figure of 33,000, 24,620 hectares, or about 75 percent have been completed (Table V-13). The preparation of grazing management plans for these project areas is only now getting underway and is being developed in cooperation with personnel from the Livestock Division. Some joint work in developing cropping systems is also being carried out with Crops Division personnel. For example, crop suitability information by soil type, has been developed in the Thaba-Phats'oa, and Matsieng-Morija project areas.

Systematic Crop and Rangeland Protection

The project's target figure for hectares of cropland to be protected is 55,000; of this total, 12,300 hectares, or 22.4 percent of the area, has been completed. The target distribution is about equally divided between conservation project areas and area-based projects but to date all of the areas protected have been in the conservation project areas. In addition, 165,000 hectares were targeted for rangeland protection but none of this target has yet been achieved. A summary of specific protection measures completed during the 1975-1977 reporting period, including work done by other units, is provided in Table V-15.

Conservation Extension Activities

Adult training is being carried out both within and outside of specified project areas and in all nine administrative districts. The primary mechanism in use is the Conservation Pitsos which have been attended by "several thousand rural land users." 1/ Another major tool is the use of scheduled radio Extension programs. Within the integrated

1/ Ibid., p. 12.

Table V-15. Cropland Protection Measures by the Conservation Division, 1975-77

Type of Protection Measure	Unit	No. of Units	
Conservation Dams	Number	6	
Conservation Plans	Number	13	
Food Aid Dams	Number	50	
Catchment Dams	Number	22	
Broad-Base Terraces	Hectares	45.5	
Buffer Strips	Meters	2,654.8	
Diversions	Kilometers	30.9	
Graded Contours	Kilometers	19.4	
Waterways	Hectares	91.2	
Stone Structures	Cubic Meters	5,570.8	
Gabions	Cubic Meters	2,810.0	
Spillways	Cubic Meters	1,900	
Grass Planting	Hectares	354	
Reed Planting	Hectares	208	
Fish Ponds	Hectares	32.5	
Field Surveys	Hectares	646.4	
Soil Surveys	Hectares	184,200	
Tree Planting	Hectares	25	
Fencing	Kilometers	40	
Pitsos Held	(No) & attendance	(405)	27,109
Access Roads	Kilometers	15.8	
Cropland Protection Completed	Hectares	12,300*	

*This figure was not included in the summary but did appear separately in unnumbered tables in the Conservation Division Summary progress report for the Donor Conference, Maseru, October 1978.

Source: Conservation Division Summary, A Progress Report for the Donor Conference, Maseru, October 1977.

conservation project areas, 58 committee level training meeings were held prior to June 30, 1977 at which 1,218 rural people attended; in addition 66 village level training sessions were held with 6,355 people in attendance (see also Table V-13). Within the districts, outside of the project areas, 70 Pitsos were held with 12,433 people in attendance. Four district level technical and coordinating meetings of MOA personnel were held with all nine districts represented from among the 108 people in attendance. A number of miscellaneous activities--radio programs, exhibits, floats, etc.--were engaged in. Overall, no information is available on the Extension program other than the kind of activities carried out. 1/

Equipment (LEMA) Program

The only information readily available on this part of the Conservation Division program effort is in the form of a list of construction equipment on hand, as of June 30, 1977. Ideally, information on hours of use for different purposes along with costs per hour for operation and maintenance would have been provided. But, to date, it appears that such records are not being kept within the Division.

Development of Policy

The Conservation Division has long been a strong advocate of better and more effective conservation programs and has been instrumental in the development of policy recommendations, with particular reference to soil conservation, grazing control, management of national parks, recreation use, land use planning, water management and related matters. In this regard, although not a normal function of the project, one additional product emanating from the LWRD effort has been the development of a draft statement of policy for the conservation of soil, water and renewable natural resources in Lesotho. This document may be viewed as an expansion of the original set of objectives of the LWRD PROP and, as such, is relevant to a review and evaluation of that project. 2/

Evaluation

The LSCE Team's evaluation was made near the end of the third year of this eight year project. For purposes of the evaluation, this project was considered as one of the several projects (i.e., along with others sponsored by outside donors) aimed at soil and water conservation. In making this evaluation it was recognized that in the future the GOL plans to incorporate all such donor projects into the MOA with the Conservation

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1/ Ibid.

2/ The Conservation of Soil, Water and Renewable Natural Resources in Lesotho: A Statement of Policy (unpublished working document of the Conservation Division, MOA, Maseru, 1977).

Division having a major coordinating role. In this regard, the absence of economic expertise within the Conservation Division was viewed as a definite constraint to assuming an overall coordinating role.

The PROP did not provide for expatriate personnel with economics training and only provided for a cost effectiveness analysis of the intensive labor conservation construction element. We noted with interest the rationale given for not including an economic component within the project; the PROP stated in part:

> ...the technical staff skills required, while appearing to be large, have been carefully selected to assure that adequate coverage of the Conservation Division's programs and those of the MOA requiring Division support is available, and that the basic core of skills critical to long range land and water resource development will be introduced.
>
> ...(But) any attempt to determine the "economics" of this project is immediately confronted with three problems. First, hard data on the costs in and the benefits from applying improved soil and water management techniques in Lesotho is largely unavailable (data currently being developed in the Thaba Bosiu and Leribe projects will be available in the future).*...Second, the exact areas, both in terms of acreage and location, which will be affected during the life of the project cannot be determined at this time...Third, a significant portion of the project costs relate to the establishment of an institutional capability in the COL to provide land and water utilization plans and to implement the physical construction elements of these plans. 1/ (*The LSCE review has shown that such data are not in fact forthcoming from these area-base, donor-funded projects.)

It appears to us that rather than being reasons for not including an economic evaluation component in the project, the reasons cited above alone would have been ample justification for doing so. Further, the economic justification for the project provided in the PROP is not only inaccurate but amply demonstrates that the project planners had little concrete understanding of the role of economic expertise in developing a conservation capability in the MOA. Suffice it to say that, as originally planned, cost effectiveness and promotion of economically viable program elements were not included among the objectives of the LWPD Project, although they should have been.

Another project objective not provided for in the PROP was a research component. While both the training aspects and the various action

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1/ PROP, op. cit., p. 17.

programs did envision some data gathering activities, the distinction between that function and research per se was apparently not clearly recognized. Further, there was an apparent faith that research and technology developed elsewhere could be imported and easily adapted for use in Lesotho. In this regard, the PROP states:

> The basic information relative to the relationships between climate, rainfall, soil types, slope of land and erodibility is, in general, well known. Worldwide studies are available for use by the Land Use Planning staff and the Conservation Engineer as they adapt this technology to the conditions of the specific watershed under analysis. Similarly available is a large body of experience and research which can be utilized and adapted by the project relative to the developing of conservation-oriented farming systems. 1/

Personnel well versed in research methodology will recognize the weaknesses in these assumptions. Therefore, we will not comment further at this point other than to note that, to our knowledge, there is no adequate available research elsewhere on adapting conservation programs to the unique land tenure system of Lesotho. Other examples of non-adaptability of research elsewhere could easily be developed. But, as designed, the project cannot be faulted for not contributing to the conservation-oriented research needs of Lesotho. But this deficiency should be corrected at the earliest opportunity.

Project efforts directed to increasing short-term agricultural productivity focused primarily on protecting existing cropland from erosion. Although such conservation measures provide a basis for increased yields, experience in Lesotho has shown that major institutional constraints will have to be removed before significant positive yield response can be expected. While these may well be reduced in the long-run, there remains the question of whether yield responses to the structural measures will be forthcoming if adequate maintenance of these structures under public direction is not provided for.

Good progress is being made on the training program. But, there is a need for both individual training plans and an overall master training plan for the Division. For example, applied or adaptive research was not included in Division objectives. This component is a critical need and should be provided within MOA. Additional in-service, problem oriented training is also needed at all levels. Evaluation of the dissemination of knowledge requires a longer time frame than now exists but a good start has been made through a variety of approaches. Very good progress has been made on soil survey and interpretation. Crop production information synthesis is underway. Economic data is an obvious and critical missing link. Nonetheless, progress under the data

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1/ Ibid., p. 6.

base criterion is rated good. Even greater emphasis should be placed in all project activities on collection of both physical and economic data. These data will be highly valuable for future planning and evaluation.

A very high level of achievement was noted in the area of natural resource program integration. The "total conservation approach" being followed, as well as provision of soil, crop and conservation expertise to a large number of public agency programs form the basis of this evaluation. Although the Conservation Division has only a limited role in efforts to modify institutional constraints to increasing agricultural production, its top administrative officers have had very positive influences on GOL policy makers concerned with these kind of barriers to development; e.g., development of language for legislative consideration to identify grass as a crop in the Laws of Lerotholi.

Overall, this project is progressing well toward accomplishment of its goals and objectives. But, areas that are questioned or need strengthening include: provision for maintenance of land treatment structures, in-service training, and a program of data collection for self-analysis and planning, including economic analysis. The major constraints on greater effectiveness are the limited supply of nationals, overemphasis on structural measures and responsibility for programs not directly geared to soil conservation efforts; e.g., the national Park system, Extension, and a village woodlot program.

In regard to this project, unlike the area-based projects, there is a long-term goal involved to upgrade the delivery capacity of the major conservation agency in the MOA--the Conservation Division. Therefore, on a relative basis, it seems critical to us that noted deficiencies in economic data collection and analysis are removed at an early date. This concern led directly to a recommendation by the LSCF team that an Economic Evaluation Unit in the Division should be established to serve as a connecting link to the Planning Unit of the MOA.

Summary and Conclusions

The foregoing analysis of the post-independence projects has shown that the soil conservation efforts were no more successful in increasing agricultural output than were those installed by the British during the pre-independence period. And again, since no erosion research data were collected, their effects on soil losses are unknown. But the record does show clearly that they were definitely more expensive and at least as disruptive of local village life in the selected project areas as the earlier British programs had been. A more complete assessment of these post-independence programs follows in Section VI.

VI. ASSESSMENT OF PAST PROGRAMS AND FUTURE OPTIONS

Statement of the Problem

The foregoing analysis has attempted to show that conservation practices are tied to agricultural productivity in two important respects. First, they are physically tied since ground cover and soil management in agriculture affect both the degree of soil erosion and maintenance of installed conservation works. Secondly, they are tied economically since the primary justification for the conservation of agricultural lands is higher agricultural productivity of those lands, either now and/or in the future, than they would have had without the conservation efforts.

Now the problem is this: under present conditions, the productivity of agricultural land in Lesotho is so low that the economic conditions of a conventional conservation program do not adequately exist. Agricultural practices are such that even with the best possible conservation works the land, and the works themselves, will continue to erode. Secondly, the agricultural productivity of land is so low that it is questionable if the net returns are sufficient to pay even the maintenance costs of the conservation works--much less their total costs.

While most people familiar with agricultural conditions in Lesotho would perhaps agree with this description of the problem, there is some disagreement over the cause. Some people attribute a decline in agricultural production in Lesotho over the past few decades to soil erosion. Other people attribute it to sociological factors such as the propensity of the Basotho to be herdsmen rather than farmers. Our own interpretation, as outlined in detail in the LSCE report, is that while both of these factors may aggravate the problem, the primary reason for presently low agricultural productivity in Lesotho is inadequate labor inputs to agriculture. 1/

Over the past three decades, progressively increasing numbers of Basotho have gone to work in the South African mines. Approximately 60 percent of the total potential male work force of Lesotho is now so employed. Further, the wages paid the miners have more than quadrupled in the past five years to an amount in excess of 1,000 Rand per year. Consequently, the relative contribution of cropland agriculture to the household income of the Basotho (at least of the large number with migrants) is much less important today than in the past. This situation has reduced the incentive of the non-migrant members of the household to intensively farm their land. In sum, as more Basotho work in the mines, and as they

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1/ Seckler and Nobe, op. cit.

send more money back home, labor inputs to agriculture decline and agricultural production declines pari passu.

Figure VI-1 provides a brief picture of the empirical grounds for this conclusion. Within the limitations of regression analysis, fully 96 percent of the decrease in agricultural production over the past 25 years can be accounted for simply by the number of migrants employed in South Africa. The basis for this conclusion is, of course, further documented in the text of the LSCE report, but is not readily accepted by some researchers in Lesotho at the present time. 1/

In our view, Lesotho finds itself in a particularly vicious cycle. Under present conditions of low labor inputs to agriculture and low productivity, conservation efforts are hardly viable, much less justifiable. But if conservation efforts are not carried out on a continuous basis, the land will continue to erode which in turn will adversely affect its future productivity. And it is possible that, whether through government policy changes or mine mechanization, South Africa may someday not employ these large numbers of Basotho. If the miners then return home they will have only eroded fields available to cultivate. In this contingency, with a

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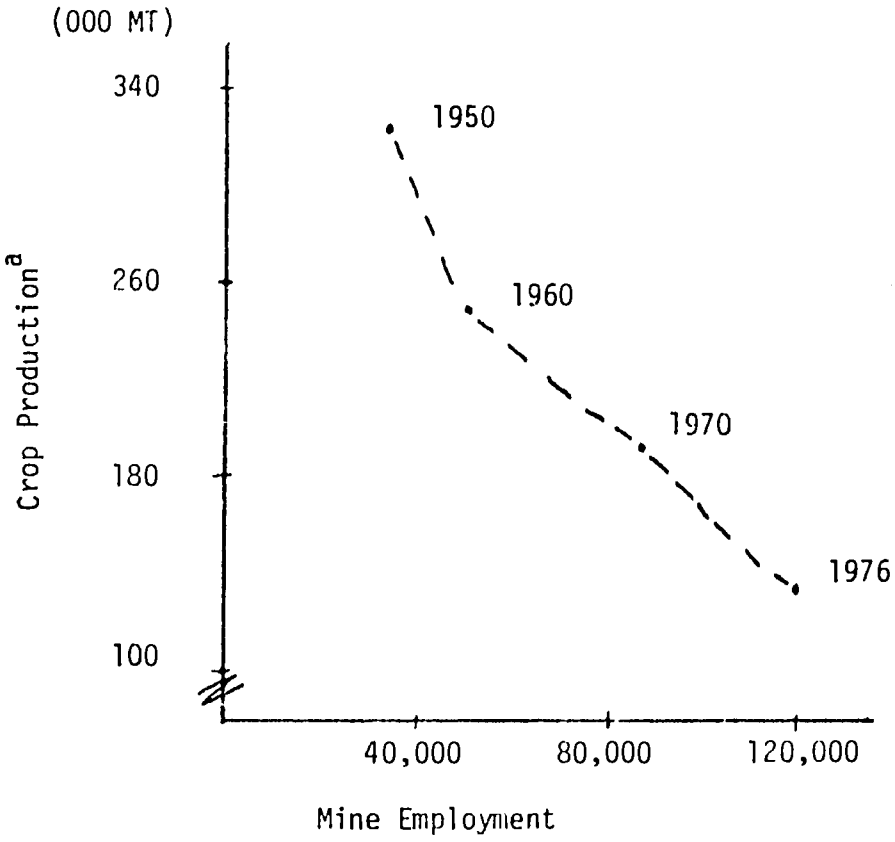
1/ A conclusion based on only four data points over the past 25 years, even though a function of limited data availability and reliability, may in fact be seriously misleading as to the actual long-run crop yield trends in Lesotho. For example, it has been pointed out that the 1950 data contains gross measurement errors; e.g., crops were cut and weighed during April and May which were some of the wettest months in Lesotho history; thus, the high yields recorded included a lot of water for which inadequate moisture correction was made. In 1960 weather conditions were more normal and probably did not significantly distort crop yields away from a long-term average. But 1970 was the "worst drought in living memory" according to the Ministry of Agriculture's annual report, while 1976 was the year almost all the maize crop was rained out. Therefore, if indeed the four data points selected were abnormal years, the dramatic decline in crop yields depicted in Figure VI-1 may simply be a statistical accident.

Further, Dr. Jerry Eckert, LASA Project Field Party Leader, points out that according to his recent analysis of Lesotho labor force data, there has been very little change in the percent of the male labor force included in migration during the 1945-1978 period. He noted in part: "If the percent of the male labor force in migration stayed about the same, then so did the percent in the domestic labor force. Even after deleting those who found employment in the modern sector there must have been an increase in labor available, though maybe not used, in the rural areas. Therefore Figure VI-1 is misleading as is the regression R^2 and the statistics listed." (Jerry Eckert, personal correspondence to the authors, September 1979.) Such data and analysis was, of course, not available to us at the time we conducted our field research in early 1978, but is included here so that the reader may draw his own conclusions.

Figure VI-1. RSA Employment in Mines and Crop Production[a], 1950-1976



	1950	1960	1970	1976
Gross Crop Production (000 MT)[a]	322	248	190	133
RSA Mining Employment (000)	34	51	87	120
Area Planted (000 acres)	738	810	860	556
Yield Per Acre (200 lb. bag)	4.8	3.4	2.4	2.6

[a]Maize, Sorghum, Wheat, Beans and Peas.

Source: Bureau of Statistics, Annual Statistical Bulletins; and IBRD, Economic Memorandum on Lesotho, 1976.

plentiful supply of labor, agricultural productivity could be high so it would have been profitable to conserve the soil. But at that point it would likely be too late to initiate an effective soil conservation program.

It is because of the rather unique nature of the problem outlined above that the LSCE report necessarily ranged further in scope than one would ordinarily expect. The analysis section of the report has shown that conservation is tied to agriculture, and agriculture is tied to the labor supply, and thence to the economic infrastructure of Lesotho. Within this complex arises the dilemma described above. In economic parlance, Lesotho's soil conservation problem is one of providing in the short run an option for the future, which may not necessarily be used, but for which one is willing to pay some amount rather than do without. The solution, therefore, is to provide for this option in the most cost-effective manner possible.

Recommendations

The reconnaissance report prepared by the LSCE team listed a set of detailed recommendations, which were discussed in considerable detail in the concluding chapter. 1/ A listing of these recommendations, along with more brief discussions, are set forth below. As co-team leaders for the LSCE effort, we of course concur in these recommendations. For purposes of convenience, the recommendations have been divided into three broad categories. First, program objectives: these are the action levels we believe programs should be striving toward. Second, organizational improvements: changes which seem to us to be important in effectively managing the programs. Third, infrastructural/institutional improvements: these are policies designed to provide improved inputs to the organizations responsible for conducting the programs.

(I) Program Objectives

1. Implement a nationwide Grasslands Soil Bank Program to help reduce Lesotho's soil erosion problem in the short-run while providing an option for the future use of its land resources.

Given the enormity of the problem of soil conservation in Lesotho and the limited financial and labor resources currently available to attack this problem, we believe that the most cost-effective means is to take much of the land which is subject to a high erosion hazard out of field crop production and put it into production of grass forages. Therefore, we recommend an ambitious Grasslands Soil Bank to protect the land against erosion while providing Lesotho with an option of its future use--either as grasslands or, if through the miners returning and/or population growth there would be sufficient labor, reversion to croplands.

1/ LSCE Report (Seckler and Nobe, op. cit.), Chapter VI, pp. VI-1/VI-41.

Of the approximately 900,000 acres of cultivated land in Lesotho, 250,000 to 300,000 acres are Class I, Class II and some Class III lands that require little or no intensive conservation works. But the remaining acreages do require the use of intensive conservation practices and land treatment. In accordance with this recommendation, the Government of Lesotho (GOL) would work toward the objective of placing the marginal land into the Grasslands Soil Bank on a field by field basis. A non-cultivation cash payment could be paid to villagers as a group, as a set-aside compensation, at a rate of, say, an average of five Rand per acre per year. This policy would have a complementary effect on agricultural production in the Class I and II croplands, and Class III lands adequately protected, by releasing a significant supply of labor to those lands. We believe that by this means the soil can be conserved in the most cost-effective manner and that total crop production in Lesotho will not be adversely affected, and may even improve. The set-aside compensations paid to local governing units could be used for discretionary village needs, subject to guidelines to be established by the central government, say, the MOA, thus providing for various capital or infrastructure needs of local people.

2. A moratorium should be placed on new area-based conservation projects.

We recommend that the GOL place a temporary moratorium on initiating new structurally intensive conservation projects, unless these projects can be shown to contribute to (1) above. Insofar as possible, all resources now being expended on such projects should be redirected toward the achievement of recommendation (1) and/or (4) below.

3. Livestock production should be recognized as an important social and economically viable enterprise that can be supportive of soil conservation objectives.

Efforts should be directed to improving the productivity of this sector, particularly in relating such improvements to the grasslands program proposed in (1) above.

4. The GOL should capitalize on, and maintain, the soil conservation works already installed.

(a) The GOL should undertake primary responsibility for these maintenance obligations as it is beyond the capability of the individual farmers to do so. The belief that these farmers will provide adequate maintenance is a well refuted, but nonetheless persistent, myth that has had very destructive consequences in Lesotho, given its unique land tenure system.

(b) Funding for new projects to provide conservation works should include a sinking fund for maintenance of these structures.

(c) Existing conservation project lands should be incorporated in the improved agricultural component proposed in recommendation (1) for

production and for research-demonstration efforts as are being proposed under the Farming Systems Project.

(d) Least cost minimal improvements to existing soil conservation systems should be undertaken.

5. Efforts should be made to help reduce the current agricultural labor bottleneck by promoting some non-labor intensive aspects of agricultural development efforts.

Every effort possible should be directed toward alleviating the current labor bottleneck to increasing agricultural production. 1/ Crops whose production cycles fall in the off-peak seasons should be promoted. Small scale machines should be made available to farmers--either from domestic production, or through importation. All cooperative enterprises that can help make the better lands available for larger scale mechanization should be encouraged, insofar as they are on a voluntary basis, and compatible with the interests of the farmers and the GOL under the existing land tenure system. In addition, Basotho with gardens should have access to technical assistance from the MOA.

(II) Organizational Improvements

1. Provide for effective GOL direction and coordination of soil conservation programs.

We recommend that a much greater, more deliberate effort should be made at all administrative levels to provide continuity and linkages in the soil conservation effort. New programs and people should build on past experience and be designed to serve as a basis for future efforts. Linkages between program elements within and between the Conservation Division, the Ministry of Agriculture, and related ministries should be carefully and systematically employed. For example, a technical conservation input should become a part of the overall road construction effort of the Ministry of Works. In order to promote integration of all GOL soil conservation efforts, a Soil, Water and Natural Resources Coordinating Council should be established.

2. Develop a continuing soil and water research and basic data collection network within the MOA.

Research and basic data collection should be placed high on the priority list of Ministry of Agriculture programs. Recent area-based donor-funded projects have already provided "laboratory" areas for the soil conservation aspects and should form the core of an expanded

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1/ Particular emphasis should be placed upon the female component of the work force that is responsible for both farm and domestic labor requirements. Also reemployment plans for male migrant workers are needed.

research and data collection program. Ideally, a research program would be established to include the following elements:

(a) A synthesis of existing information, especially that available from the various area-based rural development and soil conservation projects already completed.

(b) Analysis and synthesis of information from neighboring countries and world research centers that can be adapted to Lesotho conditions.

(c) Establishment of an applied adaptive research effort for Lesotho conditions with emphasis on grassland agriculture and field crop production on the lower erosion hazard lands (land use capability Classes I, II and III).

3. Reorganize and expand the Conservation Division of the Ministry of Agriculture.

The Conservation Division within the MOA would necessarily be a focal point for implementing most of the recommendations outlined above. Major changes that we would propose in its organizational structure include:

(a) Adding an Economic Evaluation Unit to a new Planning and Evaluation Division which would have direct liaison with the Conservation Division. Initially, one expatriate advisor trained in agriculture economics should be provided to work directly with this unit.

(b) Concentrating the Conservation Division's efforts on overall program development and initiating high priority program elements. These include:

(1) Assist in the development of a long-range, nationwide conservation education program and promote the adoption of national conservation standards, operating initially at least in a leadership role.

(2) As a primary short-run activity, complete the necessary land resource inventories and evaluations as quickly as staff capability and budget will permit; a high priority item in this area would be the completion of a nationwide soil erosion and sediment source survey.

(3) Place a high priority on the development of systems to improve range conditions through range management. This may require that the Crops and Livestock Divisions be more directly oriented toward activities of the Conservation Division, via reorganization or emerging a multidivisional policy board for the MOA; in short, the Conservation Division needs greater capability to work effectively with the Crops and Livestock Divisions;

taking responsibility for administering the proposed Grasslands Soil Bank program, as outlined in recommendation I-1, would be highly desirable.

(4) Develop and operate a nationwide assistance program for the maintenance of existing conservation works, along with emphasis on vegetative erosion control practices; donor-agency aid can and should be sought for this activity.

(5) Initiate land use planning efforts to promote residential and commercial development on non-prime agricultural lands; land in land use capability Classes I, II and III should be retained in agricultural use, to the degree possible, and operators of such lands should continue to receive technical assistance from the MOA.

(6) Seek a leadership role in coordinating national conservation program and policy development, ideally through the proposed Soil, Water and Natural Resources Coordinating Council as outlined in recommendation II-1.

(c) Consider reorganizing and/or transfering the following Division activities to other agencies, if and when they have the capacity to accept them.

(1) Conservation management of the mountainous areas under grazing--to a new Division of Range Management in the MOA.

(2) Construction and maintenance of feeder road systems in the BASP areas--to committees with local responsibility under BASP, while retaining design responsibility as it relates to reducing erosion hazards.

(3) Responsibility for the national Parks system should remain for now with the Conservation Division to enhance "selective use" of the land resources demarcated as "parks." But, the MOA should work more closely on a liaison and advisory basis with agencies concerned with the development of a tourist industry in Lesotho.

(4) Responsibility for a major research program related to soil conservation, other than the unit costing and benefit/cost analysis work of the Economic Evaluation Unit noted above--to a new Research Division of the MOA, as outlined in the BASP proposal.

(5) Responsibility for Extension type activities related to soil conservation--to the reorganized Extension Division proposed

in the BASP but with the Conservation Division continuing to produce maps and educational material for Extension use.

(III) Infrastructural/Institutional Improvements

1. Carry out an assessment of the agricultural labor force and initiate a manpower development program within the MOA.

In order to overcome potential bottlenecks in the labor force, an assessment of current labor force resources by types of labor should be accomplished, together with projections of developing shortages over the future. Once this assessment is accomplished, appropriate manpower development projects can be undertaken to alleviate the impending shortages.

Training programs for Basotho technical and managerial personnel should be accelerated with a major emphasis on in-country training. 1/ The GOL should seek donor funds to establish an "Agricultural Management Institute" in Maseru. The primary purpose of the Institute would be to fill the gap between existing educational facilities and training programs in Lesotho and the continuing need of sending some personnel abroad for academic training. It would provide a mechanism for either full or part-time education to upgrade skills of people already employed and for those seeking higher employment opportunities. Teaching assistance could be solicited from the faculty at the Lesotho National University and the Lesotho Agricultural College, Basotho personnel in the Ministry of Agriculture and various expatriates in Lesotho.

2. Obtain legislative action to recognize grass as a crop within the legal context of land use, as defined in the Laws of Lerotholi.

We strongly support efforts by the Conservation Division to have grasslands legally recognized as an agricultural use of land (e.g., by defining grass as a crop) and, thereby, to lift the obligation of landholders to cultivate their land periodically in order to retain their land allocation. We recommend that the GOL proceed to facilitate this critical modification of its land tenure system.

A New Look at Future Policy Options

It is a matter of record that the massive British directed soil and water conservation program that began in Basutoland in 1935 was patterned closely after the soil and water conservation program in the

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1/ Such a training program could also concentrate on developing a "most probable progressive farmer cadre" (per terminology provided by Chaka Ntsane, Deputy Permanent Secretary of Agriculture) that would include training in repair and maintenance of capital equipment to be utilized in future mechanized farming operations.

United States that had begun a few years earlier. The foregoing analysis shows clearly that even during the post-independence period, Lesotho's area-based projects were still tied closely to these western ideals--both in terms of practices to be carried out and expected levels of benefits from increased crop yields. The one common thread through 45 years of such programs in Lesotho was the hope that somehow the western model could be successfully adopted in Lesotho, in spite of elements in Lesotho's land tenure system that have constrained the success of such efforts, at least up to the present.

Our analysis has shown, however, that Lesotho's Laws of Lerotholi are not nearly as constraining to the adoption of effective soil and water conservation programs as most contemporary observers have assumed. True, the programs would have to be modified somewhat so as to depend less on structural measures; a key addition to the tenure laws is needed that would define grass as a crop, and a solution to the maintenance problem on existing structural works must still be found. But, in developing a plan of action to make the necessary changes, Lesotho policy makers should be aware that at the present time, similar changes in the U.S. soil conservation program and the institutional rules that govern it are occurring rapidly. We believe, therefore, that a brief review of the U.S. situation and a suggested procedure for viewing these alternative policy options would be a valuable addition to this report. 1/

Evolution of Conservation Programs in the U.S.

Soil erosion became a matter of urgent public policy concern in the early 1930's. 2/ At the time the country found itself in the midst of the Great Depression, had alternately faced severe droughts and floods that had taken considerable tolls of life and property, and throughout the federal government, unprecedented efforts at social engineering and institutional reform were taking place. The soil and water conservation policies that emerged out of this situation focused on maintaining farmland productivity, continuation of a family farm lifestyle, reducing flood damages and increasing available water supplies for irrigation and power production. 3/ The perceived inter-

1/ In presenting this brief history of the soil and water conservation movement in the United States, and a model for evaluating alternative policy options for the future, we are endebted to the work of W.D. Seitz and R.G.F. Spitze in the Department of Agricultural Economics at the University of Illinois. For a recent reference pertaining to their work, see Seitz, W.D. and Spitze, R.G.F., "Soil Erosion Control Policies: Institutional Alternatives and Costs," Journal of Soil and Water Conservation, May-June, 1978, pp. 118-125.

2/ Benedict, M.R., Farm Policies of the United States, 1790-1950, Twentieth Century Fund, New York, N.Y., 1953.

3/ Botton, J.C., et. al., Land Retirement and Farm Policy, Research Bulletin 704, Purdue University Agricultural Experiment Station, West Lafayette, Indiana, 1961.

relationships between land and water resources were limited primarily to quantity, although water quality was at least considered in the case of irrigation demands in the western states. The early soil conservation measures implemented under these policies relied heavily on structural measures, including in particular gradient terraces, grass waterways, strip farming, and dams of various sizes. The results were impressive in terms of reduced soil erosion, less river flooding and, most importantly, increased crop yields--although not necessarily in terms of increased profits in cases where farmers were bearing most of the costs.

Beginning in the late thirties, other federal policies designed to increase farm prices were geared to reducing total farm production. 1/ The most common technique used was mandatory reductions in crop acreage. The objective of these measures was to balance supply with demand which quite often meant a desire to make the adjustment in the production side of the equation. Individual farmers responded to reduced acreage quotas by idling their marginal lands and concentrating their variable inputs on the remaining acreages in production so the yields per acre harvested continued to increase rapidly. Following the World War II years when all controls were lifted, the policy of reducing acreages in production was reinstated through a system known as the Soil Bank Program in which indirect economic incentives were given to farmers through price support payments. More recently, the program shifted to encouraging voluntary retirement of cropland with direct subsidy payments made per acre of land switched from grain crops to forage-type cover crops. 2/ Such acreage remained potentially available and could be brought back into crop production quickly, as was clearly demonstrated in the mid-1970's when wheat prices reached high levels in the international market and the large scale reduction in idle cropland acreage which followed.

During the 1960's, the United States accelerated its efforts to reduce pollution, ranging from point sources such as factories to nonpoint sources such as runoff from agricultural lands. Initially, the focus was primarily on reducing industrial and urban caused pollution. But, gradually, the water pollution control laws were amended to require similar efforts to control nonpoint pollution. Public Law 92-500, for example, requires that states and designated areas within the states develop plans for control of nonpoint pollution. In such efforts, the focus necessarily falls heavily on agricultural land from which much of the sediment and nutrients present in streams and reservoirs originates.

It comes as no surprise then that presently a great deal of attention is again being given to soil erosion control on agricultural land.

1/ Ibid.

2/ Spitze, R.F.G., "Policy Direction and the Economic Interpretations of the U.S. Agricultural Act of 1970," American Journal of Agricultural Economics, Vol. 23, 1972, pp. 99-108.

Only in this case, the concern is with areas affected by the sediment and nutrients deposited, rather than with their adverse effects on lands from which they are lost, which was the primary concern back in the 1930's. In a nutshell, the technical problem remains the same but the basis for public concern has changed significantly so that the basis for program justification must necessarily change as well.

Institutional Mechanisms for Implementing U.S. Conservation Policy

The emergence of the federal program of soil and water conservation in the early 1930's required the development of new institutions to implement the new policies. In 1935, the Soil Conservation Service (SCS) was established within the U.S. Department of Agriculture to help implement these policies through a program which provided land use planning, assistance in organizing conservation projects and technical assistance to individual farmers on a cost-sharing basis. Initially, the rate of progress was extremely slow, in part because farmers were reluctant to make cash and labor investments in the short-run which at best appeared to have a positive payoff only in the long-run. Equally important, perhaps, was adverse farmer reaction to central government control of the program which conflicted with their concepts of individual freedom of decision making in their farm business operations.

Clearly, another institutional innovation was needed to get this new conservation program in gear. The solution came in the form of local soil conservation districts, formed under state enabling laws. 1/ Operating under memoranda of understanding with SCS, these districts are empowered to develop local policies and programs for farmers located within the respective districts. In due time, all the states enacted district enabling legislation and today nearly 3,000 such districts encompass nearly all of the farmland in the U.S. Districts in most states have the power to prescribe compulsory land use regulations to control erosion but they have been adopted in only a few of the western states.

In essence, the SCS thrust to achieving erosion control was in the nature of federal cost-shared technical assistance including construction of structural measures as deemed necessary, local organizational and administrative direction provided through mandatory control of land use to control erosion which, though rarely used, is nonetheless available should the need arise.

The SCS approach, as outlined above, began to make significant headway in reducing the soil erosion problem. But, it soon became apparent that additional institutions would be needed in order to convince more farmers to join the effort. While a soil conservation district could

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1/ Parks, W.R., Soil Conservation Programs in Action, Iowa State College Press, Ames, 1952.

be created, there was understandably a reluctance to make land use controls mandatory for all farmers in the district. As a result, many farmers still refused to join the program, in particular those at the lower end of the income scale which tended to also be those with farming lands most in need of conservation measures.

The institutional response to this situation was the creation of another federal government agency in the Department of Agriculture--the Agricultural Stabilization and Conservation Service (ASCS). It was empowered to implement the Agricultural Conservation Program (ACP) which used as its major tool the provision of financial incentive payments to farmers for adopting recommended conservation practices. Over the years, this program was variously known as the Rural Environmental Assistance Program and the Rural Environmental and Conservation Program but is now again called ACP. At the present time it allows payments to individual farmers of up to $2,500 a year for the adoption of acceptable soil conservation practices. 1/

With the increasing concern about environmental degradation during the 1960's and early 1970's, a new federal agency emerged to coordinate anti-pollution programs. Initially, the land and water oriented arm of this attack had been housed within the Public Health Service. Then, after a brief period in which this program was administered within the Department of the Interior, a new Environmental Protection Agency emerged, which encompasses responsibility for all pollution control programs. It is empowered to enforce the Federal Water Pollution Control Act.

The point-source pollution control aspects have been reasonably successful, through a series of actions that relied heavily on regulation and fines to pollution producers for noncompliance. In the non-point pollution area, however, such an approach will not likely yield positive results, largely because the level of pollution contribution by an individual producer to, say, sediment or fertilizer residue cannot be accurately determined. The problem has been particularly acute in regard to agricultural pollutants and presently U.S. farmers and EPA officials are often at swordpoints. Yet, as a result of the soil conservation program implemented in the 1930's and those still in effect, there is a wealth of available experience in the areas of technical assistance, subsidy payments and even the infrequently used compulsory performance features of soil conservation policies. U.S. policy makers are well aware that in the early 1930's none of the institutional mechanisms for implementing the soil conservation policies existed so they are studying the problem closely as they struggle with the need to devise workable institutions for implementing the new non-point pollution control aspects of the Federal Water Pollution Control Act. The technical aspects of the control problem have not changed all that much but because of the new public goals to be

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1/ Seitz and Spitze, op. cit., p. 119.

achieved, the policy options have increased in magnitude and complexity.

A Model for Evaluating Policy Options

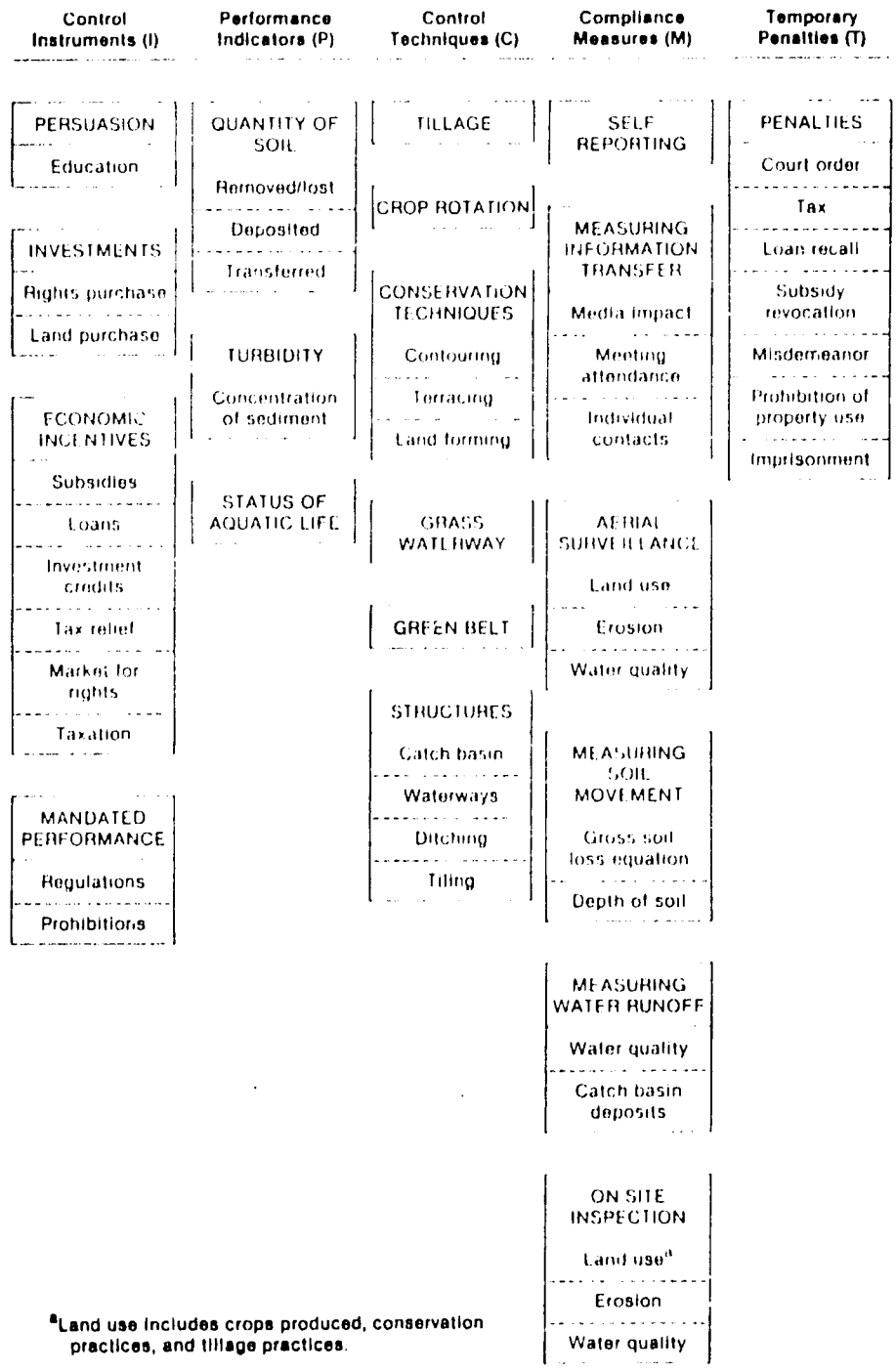
Figure VI-2 shows a model developed by Seitz and Spitze which can be used to develop appropriate policies for achieving the current soil and water conservation and pollution control objectives in the United States. With suitable modifications, the model can be applied to areas with different public objectives but with similar soil and water problems, such as in Lesotho.

As outlined in Figure VI-2, public policy has five principal components: (1) control instruments; (2) performance indicators; (3) control techniques; (4) compliance measures; and, (5) temporary penalties. These will be outlined briefly in turn, as discussed by Seitz and Spitze. 1/

> Control instruments attempt to induce farm operators to modify their operations to achieve a desired objective --in this case, reduced soil loss. Methods range from voluntary programs...to manditory programs...Between these two extremes are other methods, such as economic incentives...
>
> Performance indicators assess the degree of change in the base problem, here, a change in the amount and type of environmental damage occurring...For erosion and sediment control the most likely indicators are the amount of soil lost...
>
> Control techniques are means adopted to achieve the policy objective or produce a change detectable by performance indicators. Soil erosion control techniques range from modification in tillage practices, which would have minor impacts on farm operations in most areas, to structural modifications, which would require significant investments...for example, one policy approach might require terracing all land having a slope greater than a specified percentage. Another approach could prohibit a soil loss of more than a specified number of tons per acre per year...
>
> Compliance measures determine whether the individuals to whom the control instruments are directed respond to the policy requirements. For educational oriented policies, compliance measures might determine whether meetings on the required subject are being held and

1/ Ibid., pp. 119-121.

Figure VI-2. Schematic Diagram for Development of Public Policies to Control Soil Erosion and Sedimentation



Source: Seitz and Spitze, 1978, p. 120.

attended. Under other policies, the means for determining compliance might range from an individual's own reports of his or her actions to aerial surveillance or on-site inspection of actual practices. Estimates of soil loss would likely be made with such techniques as the universal soil loss equation, but depth of topsoil remaining or water quality could conceivably be measured...

Temporary penalties, used only in policies that mandate performance, assure that individual farm operators follow a prescribed action. The penalities are temporary. A violator is penalized only if his actions are inconsistent with the policy's requirements, and the penalty ceases when he complies...

Seitz and Spitze have simulated a number of policy options and priced out the relative levels of public investment involved. For illustrative purposes, three such options--(1) Education, (2) Subsidization, and (3) Mandatory Implementation--are shown in Figure VI-3. Based on the U.S. experience, the implementation of policies to control soil erosion (whether to protect farmland or to control non-point pollution) requires changes in existing institutional arrangements. Implementing a relatively simple policy might require nothing more than a modification or expansion of the activities of an existing government agency. Another, more complicated policy, however, might well require the establishment of a new agency and/or the expenditure of large amounts of public funds. Seitz and Spitze have applied the three policy options outlined in Figure VI-3 to Illinois conditions and determined the average cost per county to implement them. According to their analysis, these costs range from $162,900 for the Education Option, to $582,200 for the Manditory Implementation Option, to $981,200 for the Subsidization Option.

These cost estimates for Illinois conditions are, of course, not directly relevant to Lesotho conditions. Nonetheless, given the orders of magnitude differences in costs among these options, this exercise conforms to the expectation that restrictive policies are more expensive than voluntary policies. The important point is that the Seitz and Spitze analysis demonstrates that it is possible to deal systematically with the issue of selecting among viable soil and water conservation policy options, including estimation of their institutional costs. Application of the principles involved could serve as a useful tool for Lesotho policy makers as they consider their future options for dealing with their soil and water problems.

Summary and Conclusions

Our review of prior soil and water problems and conservation efforts in Lesotho shows clearly that the soil erosion problem has from time to time been given high priority and that huge amounts of capital and

Figure VI-3. Key Elements of Alternative Erosion and Sediment Control Policies

Policy example A: Education

I	P	M
Persuasion	Performance indicators	Public action
Education	Status of aquatic life	Meeting attendance

Policy example B: Subsidization

I	P	C	M	T
Economic incentives	Quantity of soil	Conservation techniques	On-site inspection	Penalties
Subsidies	Removed or lost	Terracing	Land use	Revocation of subsidy

Policy example C: Mandatory conservation plan implementation

I	P	M	T
Mandated performance	Quantity of soil	On-Site inspection	Penalties imposed
Regulation	Transferred	Land use and Measuring soil movement	Prohibition of property use
		Gross soil Loss equation	

Source: Seitz and Spitze, op. cit., 1978, p. 121.

personnel resources have been allocated to solving it. Starting with recognition of the magnitude of the problem in the mid-1930's, the British Government embarked on a countrywide effort to place Lesotho's cropland under a terracing system and related conservation measures. During the next two decades, this goal was largely achieved. But, over time, this terrace system has largely fallen into disuse, primarily due to a lack of maintenance but also in part because of structural failures resulting from design errors. And, in cases where more recent structural programs have been initiated, such as in the Thaba Bosiu and the Senqu Projects, most of the grass strips and terraces originally installed by the British have been removed. From time to time, program elements directed to non-cropland areas such as check dams in dongas, tree planting and range management have been implemented, sometimes on a massive scale.

Increasingly over time, starting with the pilot projects of the 1950's and the 1960's, soil conservation projects have been initiated as crash programs and there has been an underlying, strong sense of urgency in expanding such efforts to a countrywide basis. By and large, as shown in the history of the early programs presented in Section IV, these projects ended in failure. Since 1966, when Lesotho gained its independence, major soil conservation projects have been largely funded by various international donor agencies and were area-based. Building on the earlier perceived sense of urgency, most of these projects were time-specific. They were designed with over-ambitious goals of achieving large increases in crop production in the short-run and/or rapid development of the rural sector in an integrated manner. While some projects are still underway, those that have ended recently again fell far short of achieving the objectives stated in the original project proposals. Farm labor and institutional constraints were primary causative factors. But inadequate project management was also a factor leading to less than optimum achievement levels.

The argument that all of Lesotho's cropland should be allocated to food crop production, intensified and made more productive in terms of yield levels was used as a justification statement for all of the development projects initiated during the post-independence period. In light of the prevailing tenure system, small landholdings, a preference for livestock and high risks from hail and drought, however, this hypothesis does not make sense under Lesotho conditions. In our view, it is simply another "myth"--the conventional wisdom--in support of approaches to solving a problem that have not produced the results expected. Under current conditions, the Basotho farmer with a small land holding simply cannot afford the risks of high input costs necessary for maximum crop or even livestock production. Therefore, a means will need to be found to insure against the risks of failure for farm operators and to encourage access to larger cropland acreages for those individuals who really want to be farmers. If, for example, specific programs were developed to provide risk insurance and leasing of cropland to provide economic units was encouraged, there would be a much better chance that programs such as BASP

that are designed to make needed input factors and technical knowledge more readily available, will have a chance of reaching some of the production goals envisioned. The value of such added production would in turn provide part of the economic justification for future soil conservation projects.

All five of the projects initiated since Independence were judged to be making at least reasonable progress in the physical aspects of their soil and water conservation activities. Considering the entire group, it is estimated that roughly 29 percent of the overall effort is going into increasing the knowledge base, either through applied research or through training efforts. An estimated additional 11 percent of effort is directed toward improving the data base. Approximately 22 percent of the effort is on measures to directly increase long term productivity, as contrasted to only about seven percent aimed at directly increasing short term pr ductivity. Dissemination of knowledge to farmers is consuming about 18 percent of efforts. The remaining efforts are directed toward natural resource program integration (2%), modification of institutional constraints (10%), and increasing employment opportunities (1%). In total, these activities will likely be of some value in efforts to increase productivity in the short term.

Ideally, the analysis of these projects should have been further refined by considering the actual monies spent on these various efforts and analyses made of cost effectiveness as compared to other possible approaches. But sufficient information was not available to accomplish such analyses.

Some common constraints and problems appeared throughout the projects. These are briefly identified in the following summary evaluations of the various conservation project efforts.

Short Term Productivity

Project plans generally overstate what can be realistically accomplished in this regard. There is presently a very high risk to the individual farmer in attempting high yield farming in Lesotho. Adequate farming systems that consider not only the physical inputs required but also provide institutional arrangements to provide incentives and minimize risks have not been fully developed and tested. Several donor projects made a good start on this problem, but comparative analyses of various systems are now needed. We believe an approach using agricultural contractors who can provide physical inputs such as plowing, planting and fertilizers, and also to serve as a link between farmers and Extension efforts is worth consideration. Physically, there is a high potential for increased productivity if the institutional and cultural constraints can be removed, and if a system to make inputs readily available to all villages can be developed. But, as noted specifically in our evaluation of the Thaba Bosiu project, economic project justifications based on large short-run yield increases, as assumed in the project proposal documents, are by and large unobtainable. In our view, it simply is

not realistic to expect significant yield increases in the short-run and certainly not within the very short time frame of these kinds of projects. Therefore, large crop yield response expectations should be de-emphasized and put in proper perspective in future economic project justification statements.

Long Term Productivity

A major constraint to effectively increasing long term productivity is the lack of a workable management approach to the linkage between livestock grazing and cultivated crop production. Several of the projects reviewed had personnel who have either worked on, or had plans to work on, this problem; these efforts should be encouraged. Unless a concerted effort is made to link range management of high elevation grassland, winter grazing and fodder production on cropland, and cultivated food crop production, the efforts to increase both short and long term productivity will be of limited effectiveness.

Another problem exists with the use of mechanical erosion control practices; that is, there is presently not a realistic approach to maintenance. To simply say that it is the "responsibility of the farmer" is to ignore the problem. It appears to us that the greatest long term productivity can be achieved if efforts to protect cultivated land are centered on the better lands (Classes I, II and III) and if the remainder of the lands are managed for grass/livestock production.

Increased Technical Knowledge

This criterion includes two components: (1) increased staff capability, either in numbers or skills; and, (2) increased knowledge from applied research.

There is a severe lack of detailed information applicable to Lesotho conditions that could lead to development of productive farming systems. And, in the few cases where such information was collected, it was seldom completely analyzed. All projects reviewed failed in this regard, although a limited amount of information was collected in each project. It was perhaps beyond project staff capability to develop this applied knowledge. Nonetheless, a research program is needed within the MOA to insure a comprehensive well designed approach for the future. Area-based projects could make substantial contributions to such a program if they were used as field demonstration units.

In the area of training, several problems were identified. Almost universally among the expatriate technical personnel there was dissatisfication with the low numbers and timing of nationals available. There are many reasons for these problems in a developing country but a master training plan, along with individual training plans, would help alleviate some of the difficulties. Also, there is a definite lack of "doers" in the conservation field. Short intensive courses on

specific topics could help train a vital cadre of people to fill the gap between college-trained staff on the one hand and laborers on the other. A training institute that could be staffed jointly by Lesotho Agricultural College (LAC), National University of Lesotho (NUL), and MOA utilizing the returned nationals and the large number of expatriates has been suggested as a possible solution to this problem. Emphasis in this kind of training effort should be placed on rapid, flexible response capability by coordinating existing administrative structures, rather than on creating elaborate new administrative structures.

Dissemination of Knowledge

The major constraint identified here was the lack of conservation-trained Extension people. This is a very large problem for which there is no easy solution. Three recommendations are made for consideration: (1) develop a conservation training program for Extension people as part of a training institute in the MOA, as suggested in the previous section; (2) concentrate efforts at the farmer level on a select group of agricultural contractors who can serve as effective change agents at the grassroots level; and, (3) develop a system of conservation and vocational education in the secondary schools.

Employment Opportunities

Although this area of concern was only a very small part of the overall efforts of the projects reviewed, there was a large use of labor as part of direct project operations. In the long run, there is the possibility of employment opportunities for several thousand agriculturally employed persons, along with the necessary support services, if the agricultural sector begins to modernize. There is also opportunity for a moderate amount of employment in the livestock sales and processing sectors if grassland management and commercial livestock production systems would be developed. Successful application of these approaches requires a concentrated effort on the part of GOL to provide technical, financial, and institutional support.

Basic Data Development

Although several projects are doing a fair job on basic data development, there is a strong need for better records of both financial and physical input/output relationships on all conservation efforts. Research and evaluation personnel at the project level, working closely with the newly established Planning and Evaluation Unit within the MOA could provide a valuable service by planning and supervising this data collection and analysis. A major constraint in past projects appears to have been lack of a clear identification of data needs. A major future constraint will be manpower. Hence, there is a need for a carefully planned approach to removing these bottlenecks.

Reduced Sedimentation

There is currently very little direct attention given to sedimentation reduction in the projects reviewed. Of course all efforts to control soil erosion on the land contribute to this goal. Nevertheless, there is little knowledge as to the source of the large amount of sediment in the stream and channel systems, let alone about the large potential for additional sediment yield from donga and near-stream deposits. As future demands for water storage, industrial water, and recreational use of streams develop, there will be increased need for sediment management. A research program should be established now to investigate major erosion and sediment source areas, delivery processes, and possible control practices in channel and near-channel areas.

Natural Resource Program Integration

The most frequently identified problem in the integrated development projects was the lack of coordination across the several ministries involved in rural development. Planning the effective integration of the ministries in relation to conservation in particular and agriculture in general will require considerable direct action by the individual ministers, plus day-to-day coordination and development of a working relationship among delegated officers or division chiefs from the separate ministries. For the MOA, the Planning and Evaluation Unit is suggested as the lead group in developing the necessary integrated approach to natural resources program management.

Modification of Institutional Constraints

Because a major part of our report focuses on this subject, the discussion here will be limited to identification of some of the problems uncovered in the evaluation process. The single greatest problem in range management is believed to be lack of adequate control of numbers, timing, and distribution of grazing animals. On cultivated croplands, there is need for incentives to increase production beyond subsistence levels as well as provisions to reduce risks involved which should include government assuming major responsibility for maintaining conservation works. Thirdly, there is a need for institutional measures that will support a shift in the use of marginal cultivated cropland to grassland. These three major problems must be approached in an integrated manner if progress is to be made.

Concluding Comments

As a result of the LSCE team evaluation of the major post-independence conservation projects, we are not optimistic about use of capital-intensive structurally-oriented projects in Lesotho at the present time or during the forseeable future. On the other hand, we realize that due to donor country pressure to expend funds, some future projects of that type may well be undertaken. Before leaving our review

of the projects initiated during the post-independence era, therefore, we deem it advisable to highlight five recommendations for improvement made by Dale Monk, based on his experience with the Thaba Bosiu project. We concur in these observations, which follow; they could benefit future projects greatly if implemented.

1. Maintenance of conservation works is vital if serious erosion is to be stopped and if our work is to have meaning. This was not fully realized when the project proposal was developed.

2. A project committee on legislation should be established to provide institutional means for control of grazing and other conservation items.

3. A record system must be established to provide data on costs of doing each element of conservation work. (Monk provided a "Logical Framework" for this item--complete with a work form--which was not carried out by his successor.)

4. The Planning and Evaluation Unit should provide more socio-economic data on the project and...provide more direct assistance in gathering data by which we can evaluate the effectiveness of the conservation program.

5. Finally, USAID and other donor groups should be more careful...that equipment and supplies are delivered when needed. 1/

The lack of a clearly formulated statement of Lesotho agricultural policy was a definite limitation to our review and evaluation of Lesotho's soil and water conservation efforts. There is an urgent need for the MOA to develop a definite statement of agricultural policy. This statement should include a consideration of the labor problems of agriculture, both in regard to the miners in South Africa and the heavy reliance on female labor for crop production activities.

We were often frustrated during our study wherein we noted the lack of continuity among projects and lack of financial accountability for using scarce money and manpower resources in effective efforts to achieve project objectives. It appears to us that, to a large degree, the ready availability of high levels of donor funding in recent years has led to too many poorly designed and executed projects. The goal of placing the soil erosion problem in Lesotho within manageable limits will not be served if such practices are permitted to continue.

1/ Monk, op. cit.

APPENDIX A

Discounting and Benefit/Cost Analysis

Discounting: The Present Value of Long-Term Investments

It is a fundamental principle of economics that the value of costs and benefits decreases the more distant they are in the future. In order to explain why this is so, we may use an example from everyday life.

Assume that you have savings of R1,000 and that you can safely lend this money to someone at an interest of 10 percent per annum. Column 2 (SPCA) of Table A shows how much money would have to be paid to you at the end of various time periods for this loan. For example, if the loan was for only one year, R1,100 would be due. If it were for two years, not 1,200, but 1,210 would be due. The reason is the interest on the R100 interest of the first year (or 10% of R100). The amount compounds at a rate $(1 + i)^t$, where i is the interest rate and t the number of years of the loan. If the loan is five years, the amount due would be R1,611 principle and interest; in 10 years R2,594 and in 50 years no less than R117,391 would be due! "From small acorns mighty oaks grow."

Now let us ask a somewhat different question; if I offered to pay you R1,000 ten years from now, how much would you lend me today? In order to decide that question you would want to know that amount of money "Y" which, if lent at 10 percent interest for ten years, would return R1,000. The reason is that if 10 percent is the going rate of interest, then you could loan "Y" to somebody else and receive a R1,000 payment on 10 years. You would be foolish to loan me more than "Y" because more than "Y" would return more than R1,000. If you lent me more, you would "lose money" in terms of the opportunity cost of "Y," or its alternative return.

So the problem is to determine "Y." The formula is given in Table A, Column 3 (SPPV) where "Y" is equal to $\frac{1}{(1 + i)^t}$. You would now loan me no more than R385.50. Thus, R1,000 10 years from now is worth no more than R385.50 today. We can test this theory with Column 2. If we multiply R385.50 by the factor 2.594 we obtain R1,000. Present value is the inverse of future value.

Just as the future value of R1,000 increased dramatically in 50 years, the present value of R1,000 decreases dramatically. R1,000 50 years from now is now worth only R8.50! We can see how discounting can be the great destroyer of long-term projects.

Table A. 10 Percent Discount Factors

(1) Period t	(2) Single-payment Compound amount (SPCA)	(3) Single-payment present-value (SPPV)	(4) Uniform Series Compound amount (USCA)	(5) Present Value of (PVUS) Uniform Series
	Future value of Rs. 1 $(1 + i)^t$	Present value of Rs. 1 $\frac{1}{(1 + i)^t}$	Future value of uniform series of Rs. 1 $\frac{(1 + i)^t - 1}{1}$	Present value of uniform series of Rs. 1 $\frac{(1 + i)^t - 1}{1\ (1 + i)^t}$
1	1.100	0.9091	1.000	0.909
2	1.210	0.8264	2.100	1.736
3	1.331	0.7513	3.310	2.487
4	1.464	0.6830	4.641	3.170
5	1.611	0.6209	6.105	3.791
6	1.772	0.5645	7.716	4.355
7	1.949	0.5132	9.487	4.868
8	2.144	0.4665	11.436	5.335
9	2.358	0.4241	13.579	5.759
10	2.594	0.3855	15.937	6.144
11	2.853	0.3505	18.531	6.495
12	3.138	0.3186	21.384	6.814
13	3.452	0.2897	24.523	7.103
14	3.797	0.2633	27.975	7.367
15	4.177	0.2394	31.772	7.606

Table A. 10 Percent Discount Factors (Continued)

(1)	(2) Single-payment Compound amount (SPCA)	(3) Single-payment present-value (SPPV)	(4) Uniform Series Compound amount (USCA)	(5) Present Value of (PVUS) Uniform Series
16	4.595	0.2176	35.950	7.824
17	5.054	0.1978	40.545	8.022
18	5.500	0.1799	45.599	8.201
19	6.116	0.1635	51.159	8.365
20	6.727	0.1486	57.275	8.514
21	7.400	0.1351	64.002	8.649
22	8.140	0.1228	71.403	8.772
23	8.954	0.1117	79.543	8.883
24	9.850	0.1015	88.497	8.985
25	10.835	0.0923	98.347	9.077
30	17.449	0.0573	164.494	9.427
35	28.102	0.0356	271.024	9.644
40	45.259	0.0221	442.593	9.779
45	72.890	0.0137	718.905	9.863
50	117.391	0.0085	1,163.909	9.915

Source: From Sadık Toksoz, "Profitability Analysis," Ford Foundation, mimeograph.

Discounting future benefits and costs of projects creates more friction among economists, engineers and public officials, than any other practice of economics. Yet it is valid and necessary. For it is the only means by which society can be assured that it is not investing its scarce resources in a foolish manner. The fundamental reason for discounting is that the sooner the funds are paid back to society from one project, the sooner they can be put to work earning compound interest on other projects. Long-term pay-out projects must yield greater total net benefits than short pay-out projects so that the opportunity cost of having money tied up on these projects, rather than in alternative projects, is minimized.

Thus, in evaluating projects, we attempt to compare the present value of the entire benefit stream of the project to the present value of the entire cost stream of the project.

$$\frac{\text{Present Value of Benefits}}{\text{Present Value of Cost}} = \frac{\sum_{t=1}^{t} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{t} \frac{C_t}{(1+i)^t}}$$

If the resulting benefit cost ratio is less than one, we know that there exist economically more beneficial projects and, if our calculations are right, this project should not be undertaken. If the benefit-cost ratio is one or more, we do not know that we have the best of all possible projects--there may be some with even higher ratios, but we at least know (again, if our calculations are right) that it is not absolutely bad.

Further Considerations in Benefit-Cost Analysis

(1) When it is said that a benefit cost ratio of 1 indicates feasibility, two assumptions are implicitly made.

(a) That parameters within which the analysis is made are known with virtual certainty--that there is little or no risk to the project. As noted above, the discount rate assumes even a lesser degree of risk than that on prime loans to large commercial establishments. Almost no project will be this certain. Thus, the "acceptable" benefit-cost ratio must be more than 1 for most projects. How much greater than 1 it should be is ultimately a matter of subjective judgement of the risks involved. The greater the risk the greater the premium, or "cushion," one naturally demands. On the whole, one normally would be skeptical of anything less than 1.20:1. This provides a 20 percent cushion against adverse contingencies, or errors of estimation.

(b) If a nation operates under tight budgetary constraints where it is unable to undertake all favorable projects, then the benefit-cost ratio necessary to qualify a given project may be very high indeed.

If a nation exhausts its budget on projects with ratios of 2 or more, then naturally a project of 1.8 may not be acceptable.

The decision on where the cutoff point is should be made by central authorities, for only they have access to all the project proposals of the nation. They may rationally decide on the basis of priorities to let projects in one area of endeavor, for example, welfare programs, proceed at lesser ratios than other programs, such as steel mills or flood control.

(2) Computational Details.

(a) Some economists like to capitalize all project costs (through use of the future value series--SPCA, Column 2 of Table A) up to the period when the first project benefits appear. Then, all costs and benefits accruing after that period are brought to their present value. Alternatively, one sometimes finds the benefit-cost ratio is expressed in terms of the future value of all project costs and benefits at some future cut-off point--say, 25 years in the future.

The approach of the present writers is to simply start the project in year zero and take the present values of all project benefits and costs from that point. That is to say, the expenditures in the first year of project operation occur in year zero and are, accordingly, not discounted. The second year of the project operation is thus discounting year 1, on Table A, and so on.

(b) An interesting question arises with respect to such annual operating costs as fertilizers for agricultural crops or harvesting and cutting costs for fuel and fodder plantations. These costs are reimbursed shortly after they are incurred, certainly within the same year. Therefore, the question is: Should these operating costs be added to the stream of annual project benefits? More specifically, the question is if:

pv = the present value
b = the stream of annual gross benefits
o = the stream of annual operating costs
k = capital investment (or expenditure in year 0)
B/C = the benefit cost ratio

then is:

A. $B/C = \frac{pv\ (b - o)}{k}$, <u>or</u>

B. $B/C = \frac{pv\ (b)}{k + pv\ (o)}$.

While many economists favor (B) over (A); we, however, favor (A) over (B). Among the several reasons why this is so, the following is perhaps sufficient for the present purposes: Any project with a ratio of 1 under

(A) will also have a ratio of 1 under (B). However, (A) will give higher ratios to projects above 1 than will (B). Thus, (A) discriminates more severely between good and bad projects than does (B). Since the two agree on the "first cut" of 1, it would appear that the one which discriminates most strongly between good and better is to be preferred.

These alternative arithmetics can make a difference in ranking projects. However, it is a complex subject far beyond the scope of this discussion. The purpose here is simply to make the reader aware of the various alternatives and to explicate the particular method employed here.

(3) In projecting costs and benefits it is of course necessary to estimate future input and output prices. In a non-inflationary world, of course, the analyst can simply use recent average prices. However, if there is good reason to think that there will be inflation in the future, then these inflated prices must be estimated for each cost-benefit item. The reason for this is perhaps obvious when one believes that various components will inflate at different rates. What is not so obvious is that <u>even if</u> all components are expected to inflate at the same rate, these inflated prices should be used. The reason, very briefly, is this: the market rate of interest presumably reflects the expected inflation rate--i.e., borrowers would not be willing to pay so much, nor would lenders demand so much, if the expected rate of inflation were lower. Thus the true social rate of discount must be the market interest rate <u>minus</u> the inflation rate, assuming the market is working reasonably well. Inclusion of the inflation rate in projected costs and benefits in effect lowers the discount rate used. This in turn tends to favor projects with longer benefit streams over those with shorter benefit streams, and against those with longer cost streams. This bias should be avoided. There are many complications in this position which cannot be gone into here. But the principle is that if it is the objective of benefit-cost analysis to simulate what a perfectly functioning market would do in the same situation, and if the market would indeed lower the private discount rate from the interest rate because of expected inflation, then not to do so distorts the simulation.

(4) Every project evaluation must entail, either formally or informally, sensitivity analysis. As observed in the discussion of the principle of sufficient information in Section II, sensitivity analysis consists of assigning arbitrary errors of estimation to the major project parameters, and then computing benefit-cost ratios under different regimes of error. By this means, one obtains both a feel for the sensitivity of the project to errors and locates those specific areas of the project to which feasibility is most sensitive.

A key question is this: On what premise does one base the original, <u>pro forma</u> estimates before sensitivity analysis is performed; should these estimates be "conservative," "optimistic" or merely "reasonable"? The opinion of the LSCE team was that the original estimates should be as <u>optimistic</u> as possible.

The technical specialist should be asked to estimate parameters on the basis of "what if all your dreams come true," on the basis, that is, of minimum cost and maximum benefits. The pro forma ratio achieved on this basis then gives the evaluator a "feel" for the project, a means of testing how much error the project can "stand" before it succumbs to infeasibility.

It is not unusual to find that some projects provide a benefit-cost ratio less than 1 even under these most optimistic assumptions. This result creates a stimulus to further thought.

APPENDIX B

A Model of the Economic Evaluation of Soil Conservation Projects in India

This appendix presents the results of a recent study of the economics of soil conservation in India carried out by one of the LSCE team members. 1/ It is included here as a concrete example of how one approaches the problem in detail, given that similar necessary data for Lesotho conditions are not available.

As noted earlier, in estimating the benefits of soil conservation projects, one must know the value of the damage done by erosion without the conservation project. An experiment has been conducted at the Institute at Dehra Dun in India to quantify these damages. Six plots (with replicates) were selected and increasing amounts of topsoil were initially removed from each successive plot. Maize was then grown on the plots and uniform amounts of fertilizer were applied (120 kg of N; 60 kg of P_2O_5; and 40 kg of K_2O per hectare basis). The results are shown in Table B-1 and Figure B-1. A freehand regression curve has been drawn through the observations in Figure B-1. Statistical readings from this curve are shown in Column 4 of Table B-1.

For purposes of economic evaluation, it may reasonably be assumed that all costs of farming this land are fixed. Therefore, the value of the marginal loss due to these various states of erosion would simply be the reduction of yields times the value of maize. Maize is worth Rs .74/kg. 2/ The value of the loss for each amount of simulated erosion is shown in Column 5 (in Table B-1). Given these data, the present value of the losses over a 20 year horizon can be determined by multiplying the annual loss times the PVUS factor for 20 years of 8.514. The present value of the loss for each amount of "erosion" is shown in Column 6 of Table B-1.

Thus, for example, one could spend up to Rs 10,396 per hectare on conservation projects which would prevent the situation represented by Plot 1 from deteriorating into the situation represented by Plot 6. This amount may seem excessive. One must note, however, that irrigated land capable of producing at the level of Plot 1 has a current market

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1/ Seckler, D., A Guide to the Economic Evaluation of Soil and Water Conservation Projects, Ford Foundation and Central Soil and Water Conservation Institute, Dehra Dun, India, September 1977.

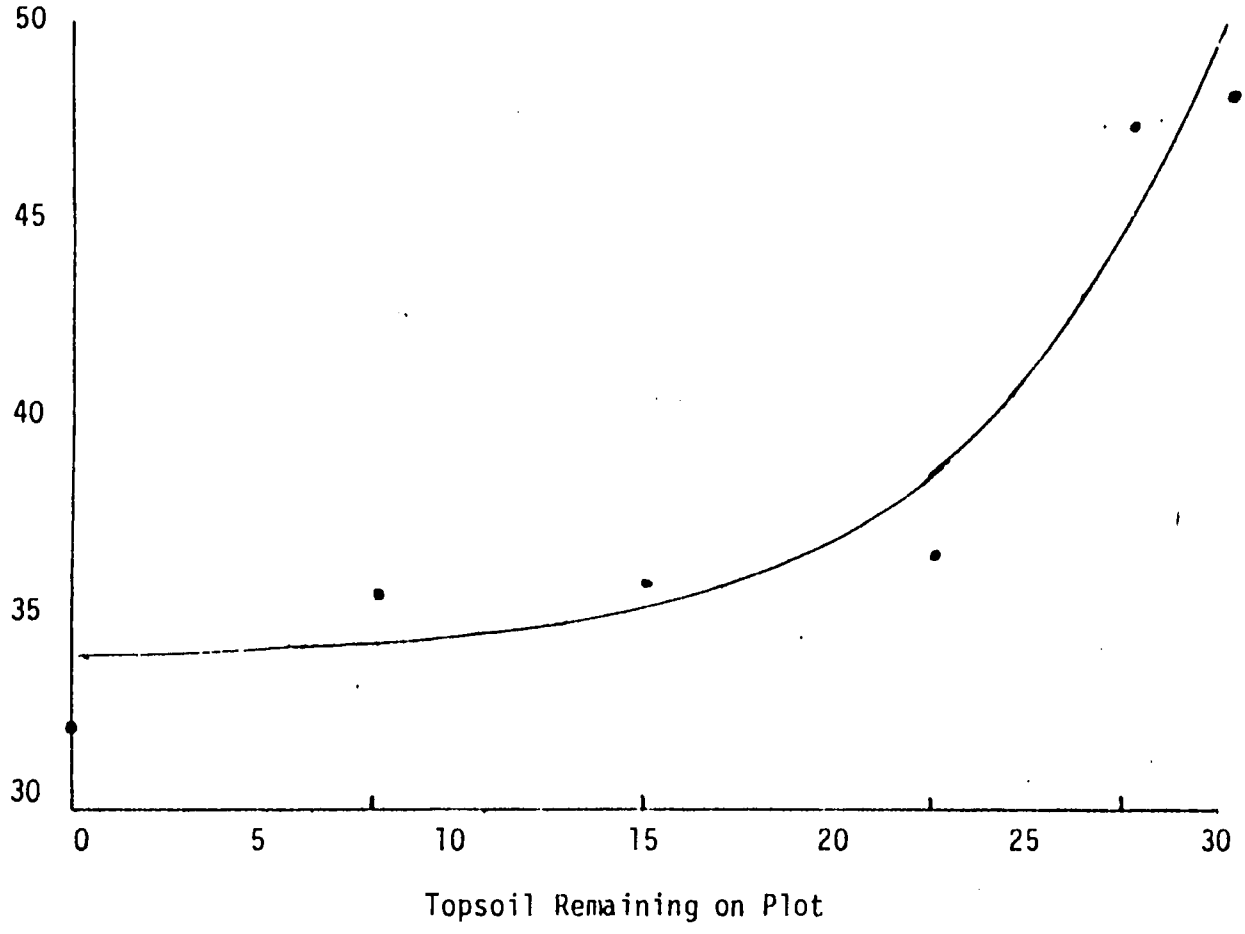
2/ At the June 1978 rate of exchange, one U.S. dollar was equal to 8.7 Ruppes.

Table B-1. Control of Soil Erosion, Selected Control Plots at the Central Soil and Water Conservation Institute, Dehra Dun, India, 1977.

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)
	Amount of Topsoil							
Plot No.	Removed cm.	Remaining cm.	Observed Maize Yield (Grain kg./ha.)	Statis-tical Maize Yield kg./ha.	Annual Value of Yield (Rs74/ kg.) Rs	Total Present Value of Annual Yield (PVUS 20 Yrs = 8.514) Rs	Present Value of Yield Over Base Yield (Rs21,106) Rs	Marginal Present Value of Yield
1	0	30	4,825	5,000	3,700	31,502	10,396	
								3,150
2	2.5	27.5	4,750	4,500	3,330	28,352	7,246	
								4,411
3	7.5	22.5	3,650	3,800	2,812	23,941	2,835	
								1,890
4	15.0	15.0	3,575	3,500	2,590	22,051	945	
								792
5	22.5	7.5	3,550	3,375	2,497	21,259	153	
								153
6	30.0	0	3,200	3,350	2,479	21,106	0	
TOTAL								10,396

Source: Selected Test Plot Data, Central Soil and Water Conservation Institute, Dehra Dun, India, 1977.

Figure B-1. Maize Yield Response to Topsoil Depth



Source: Selected Test Plot Data, Central Soil and Water Conservation Institute, Dehra Dun, India, 1977.

value of about Rs 15,000 per hectare in the Dehra Dun region. This value presumably represents the capitalized value of the profits obtained from the land. The profits are obtained from yields at the margin. A reduction in yield from 5,000 q/ha. to 3,300 q/ha. would probably reduce profit from a positive to a negative amount and the value of the land accordingly. Thus, the estimate does not seem unreasonable. Since the present value of the costs to implement conservation techniques sufficient to this objective would be only about Rs 4,500, depending on given conditions, the benefit-cost ratio of such a program would be approximately 2.9 1. This ratio is, of course, extremely favorable.

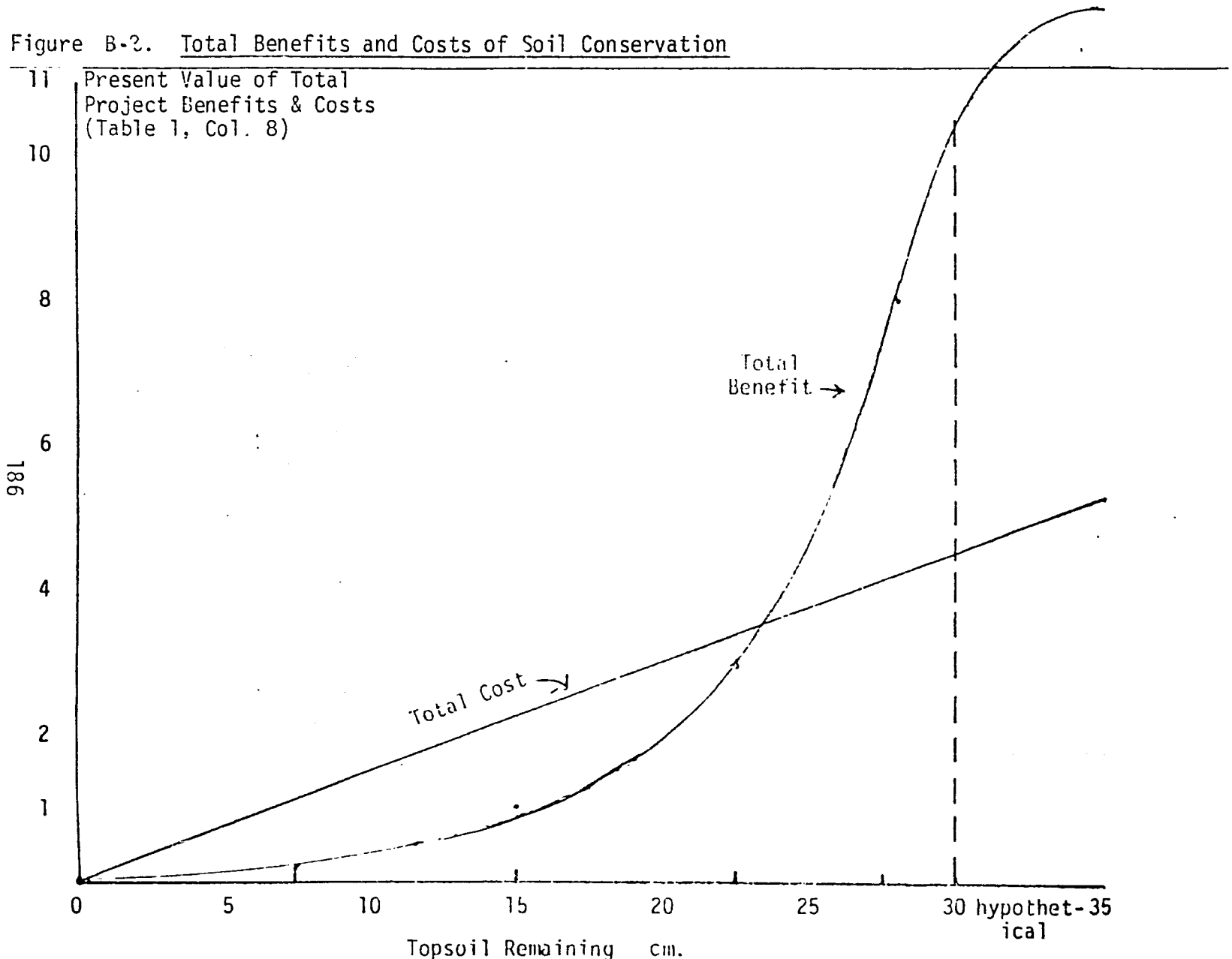
But what of marginality--what is the optimum degree of soil erosion? Couldn't the ratios of controlling all the erosion loss be improved by only controlling some of the loss? The answer would almost universally be "yes." In this case, however, we have discovered a very rare beast in economics. Technically speaking, it is an "upward sloping (resource) demand curve." This fact is illustrated in Figures B-2 and B-3. Figure B-2 shows that the total benefit of increasing amounts of soil continues at an increasing rate, up through 27.5 cm. of soil. After this point, the rate of increase diminishes slightly. This phenomena is also shown in the marginal benefit curve of Figure B-3. The marginal benefit curve rises steeply to 27.5 cm. and then falls. Thus, with the exception of the last segment of the marginal benefit curve, the demand curve for conservation is upward sloping.

We have assumed a constant marginal cost of conserving successive depths of topsoil at Rs 750 per 5 cm. unit. The total cost of conserving all 30 cm. is, accordingly, Rs 4,500. One would expect marginal costs to rise as higher levels of topsoil are conserved, but this is not the important point here. What is important is that with these upward-rising marginal benefits (or resource demand curves), the marginal cost curve intersects from above (reading from left to right) and not from below, as in the previous examples. This means that point (a), the point of intersection, is the loss-maximizing, rather than the profit-maximizing position. This is clearly shown in Figure B-2.

It also follows that if it pays to conserve any of the soil at all, it pays to preserve all the soil available--that is, to 30 cm. of soil. At 30 cm., marginal benefit is still above marginal cost. Indeed, one could make even a greater return by preserving more soil than there actually is (perhaps by adding topsoil)!

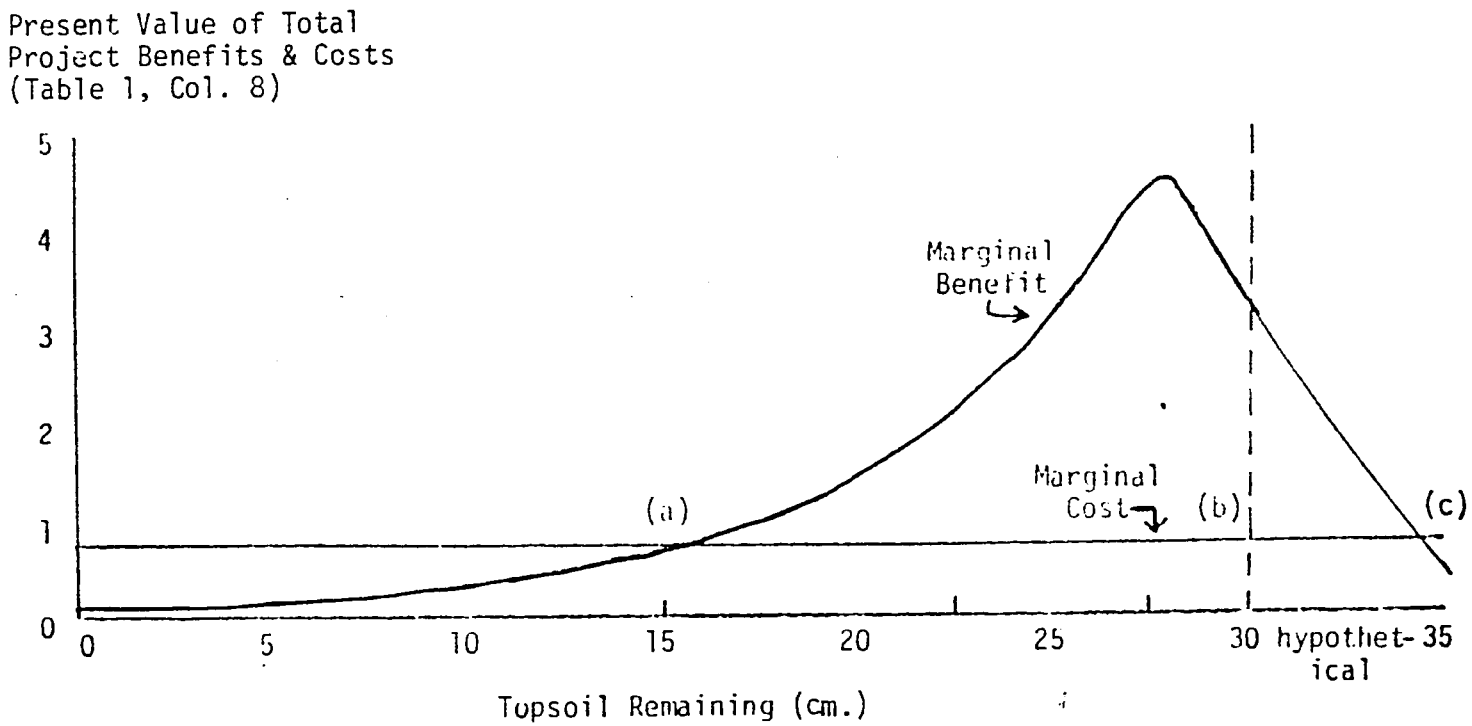
In order to better understand what we are witnessing here, five more hypothetical units of topsoil are assumed to have existed. Then we can see at point (c) of Figure B-3 that one does indeed reach an optimum amount of erosion and/or conservation, short of all the soil. It would pay to conserve soil up to (c) but to let soil erode beyond (c). This is but another way of saying that over the range of soil depth covered

Figure B-2. Total Benefits and Costs of Soil Conservation



Source: Selected Test Plot Data, Central Soil and Water Conservation Institute, Dehra Dun, India, 1977.

Figure B-3. Marginal Benefits and Costs of Soil Conservation



Source: Selected Test Plot Data, Central Soil and Water Conservation Institute, Dehra Dun, India, 1977.

in the experiment, we are in the area of increasing marginal returns to soil depth. After 27.5 cm. is reached, however, diminishing marginal returns set in and we are back in our familiar, cozy economic world of optimizing.

APPENDIX C

THE LAND TENURE SYSTEM OF LESOTHO

Of all the factors identified as constraints to modernization of the agricultural sector, Lesotho's land tenure system seems to have received the most criticism. And because of the association of the soil conservation program with this modernization effort, it has generally been assumed that the tenure system is limiting its effectiveness as well. It became necessary, therefore, for us to review the system in order to ascertain whether this claim is valid. There is considerable literature available about Lesotho's land tenure system, out of which we perceive how the system evolved and is presently working, as outlined below. 1/

Prior to the intervention of European interests in Basutoland, as in all indigenous societies, the social structure of the local inhabitants and their agrarian conditions formed one indivisible whole. Greaves, in her 1935 study of the economy of primitive peoples wrote: "Under primitive conditions, there is an established relationship of the people to the land on which they live, a relationship which has evolved to meet the requirements of subsistence under the concomitant conditions of environment, which is embodied in the customary system of land tenure and forms the basis of all productive organization." 2/ The Lesotho case is no exception to this observation.

Rights of the Individual

The land tenure system as it evolved in Basutoland, held that all land belongs to the people as a whole and is administered on their behalf by the Chieftainship.

Overall responsibility for proper land administration falls upon the Paramount Chief. 3/ As identified by Sheddick in 1954, (one of the most commonly quoted sources), the rights of the individual under this system are: 4/

1/ For a recent reference, see LASA Research Report No. 2, Lesotho's Agriculture: A Review of Existing Information, October 1978.

2/ Greaves, I.C., Modern Production Among Backward Peoples, London, 1935, p. 43.

3/ Williams, J.C., Lesotho Land Tenure and Economic Development, Pretoria, Communications of the Africa Institute No. 19, 1972, pp. 1-2.

4/ Sheddick, V., Land Tenure in Basutoland, London, 1954, pp. 10-12.

1. Public rights: Free access is provided to such commodities as thatching grass, reeds, wood, water and building materials that are made available to all on a controlled basis, depending upon the level of scarcity.

2. Extraneous rights: Customary Basotho land tenure law did not allow for the use of land in trade, schools and industry, being concerned as it was exclusively with subsistence level food production. Subsequent tenure modifications have recognized a limited number of extraneous uses, including the use of land for dwellings, gardens, paddocks. Any such use allocated to non-Basotho may be only for the purpose specified and the land must be relinquished whenever the activity ceases to function. 1/

3. Private rights: As a point of departure, arable land holdings were allocated to individual farmer heads-of-households with a maximum of three fields, one for wheat, one for maize and one for sorghum. Size of allocation was dependent upon need and usually related to size of household. The rights of the individual farmer to the land for cropping was limited to that period each year required for plowing, planting, cultivation and harvesting of the food for human consumption. After harvesting, his exclusive rights ceased until the next plowing season with the land being opened up for communal grazing by any and all stock of the people resident in his village. But annual rights to the cropland were of long duration, usually for the life of the head of the household.

Evolution of the Land Tenure System

It is too often assumed that land tenure in Lesotho consists of a set of static rules. But as Sheddick took pains to point out, the system is a rather recent and still dynamic institution, "constantly developing and reshaping itself to meet new social, political and economic circumstances." 2/ Nor is it an insecure system for the individual farmer, as some have maintained. Ashton has pointed out that while "rights of tenure are less than full ownership...they give satisfictory and secure title; and are admirably designed to meet the needs of the community. The holder normally has right of occupation and use of land for his lifetime. And he may not 'be deprived of his place or fields without

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1/ Cowen, Denis V., "Land Tenure and Economic Development in Lesotho," South African Journal of Economics, March 1967, p. 62.

2/ Sheddick, op. cit., p. xv.

good reason.'" 1/ Or, as Sheddick had noted before Lesotho gained independence, "Basuto land tenure is concerned with a hierarchy of rights, at the apex of which is the (British) Crown with its over-all rights of administration. Immediately below it lies the Basuto Chieftainship with its more immediate rights of administration. Forming the broad basis of the hierarchy there is the vast complex of preferential usufructurary rights and relatively permanent titles." 2/ Given this structure of the system, it is apparent that the bulk of the criticism which views it as a constraint to modernization is not due to insecurity of the cultivator, as has often been the basis for land reform in countries where a minority controlled the land through ownership while it was cultivated by tenants. Rather it was because of the lack of economic incentives for the farmer that are inherent in the system.

At this point in our review, it is sufficient to recognize that the Western ideal of individual title to land--ownership--is totally alien to the Basuto culture. That is, land is not viewed as a negotiable instrument. The rights of ownership are confined to the produce of the land. Even in the use of land allocated for cultivation, the Basuto farmer remains under the direct control of the chief who decides on when the plowing season is to begin and when harvesting has in fact been achieved so that the land may again be opened to communal grazing. And, permanent grazing land is never allocated to individuals. The recognition of communal use of grazing land is paramount, although there has been some recognition that controls are needed to protect the common interest.

Williams reports that some grazing land is closed periodically so that the grasses may rejuvinate and that there has been some legislation in recent years to discourage improper land use; for example, the Weeds Eradication Act of 1969 and the Land Husbandry Act of 1969 (which allows the Minister of Agriculture to "specify the purposes for which land may be utilized and to impose erosion control measures"). 3/ Earlier, Quirion reported that legislation was introduced during the early 1950's which would have prohibited the breaking of virgin soil in the mountain areas and which would make it the chiefs' responsibility to protect arable land from soil erosion. 4/ During the 1977 legislative session, proposed regulations were considered that would have empowered the Minister of Agriculture to limit the number of cattle on grazing land in accordance with its carrying capacity, but the measure was not

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1/ Ashton, p. 147, quoted in Williams, op. cit.

2/ Sheddick, op. cit., p. 7.

3/ Williams, op. cit., p. 8.

4/ Quirion, J.M., "The Economics of Agriculture in Basutoland," thesis submitted in the Faculty of Economics, University of London, for the degree of M.Sc. (Econ.), 1958 pp. 59-60.

enacted into law. 1/ 2/ In that regard, the situation really hasn't changed much since 1972 when Williams observed that "serious application of these provisions to land deprivation criteria is improbable at the moment." 3/

It is important to note that the head of a family obtains his residential and land rights through his allegiance to the Chieftainship in which rests the power to allocate the use of land and to take it away. The procedure for a male Mosotho to follow is to apply to the Chief for land and he is considered eligible if he meets the following conditions: a) is married; b) accepts the superior and overall authority of the Paramount Chief; and, c) is a taxpayer. Stutley has maintained that the limitation of land to married men originates from the idea that land was granted only to provide for the subsistence of the family group. 4/ Until a man married, it was expected that he would remain an integral part of his father's household who in turn was responsible for his subsistence. Customarily, upon approval of the application, three scattered fields (or lands) were allocated, one each for maize, sorghum and wheat, with two more fields added for each additional wife. At present, however, due in part to a physical land shortage, delays in receiving even one field are experienced and allocation of the second field and beyond may take several years.

There may in fact be a tendency to underestimate the shortage of land. Williams reports that it is the primary family unit to whom the land is allocated and not to the larger household unit which may in fact include several more members of the extended family. 5/ He based this view in part on data provided by Morojele in 1960 who found that although 8.5 percent of households were landless, as high as 25 percent

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1/ MOA, "Grazing Control and Pasture Management Regulations" (draft proposal for exercise of the powers conferred upon the Minister of Agriculture in Section 4(1) of the Land Husbandry Act of 1969--an internal document of the Ministry of Agriculture, Maseru, 1977).

2/ For proposed guidelines for determining stocking rates, see H.W. Cooper, A Guide to Range Site and Condition Determination, Recommended Stocking Rates, Proper Degree of Use, Principles of Range Management, Conservation Division, Ministry of Agriculture, Maseru, 1977.

3/ Williams, op. cit., p. 8.

4/ Sutley, P.W., "Marketing the Agricultural and Livestock Produce of Basutoland: A Survey," (M.Sc. Thesis, Department of Agricultural Economics, University of Reading, 1960), p. 87.

5/ Williams, op. cit., p. 3.

of family units were in this category. 1/ "Land generally becomes available for re-allocation by death of the former holder, forfeiture, or from a landowner who, in the opinion of his chief, has so much acreage that it is possible for him to exceed his family's subsistence requirements." 2/

No empirical information is available on the degree to which Chiefs have followed the practice of depriving farmers of surplus lands as a result of increasing production beyond the subsistence level needs of his household. But, Mampiti Nchapi, an employee in the Central Planning and Development Office of the Ministry of Finance and Planning has recently made the following observations on this matter:

> A general feature of the right to deprive a man of his surplus lands is that it can mean that a man who by hard work and good husbandry increases the yield of his holding may be penalized by forfeiting one of his lands. This problem is, however, recent in origin, since it is only since improved agricultural methods have become more widely available that any qualitative difference in yield could be achieved by those able to take advantage of them. The tiny class of progressive farmers certainly (will) insist on protection against eviction or forfeiture on grounds of surplus, and also (will) lose no time in fencing their fields against neighboring cattle. But such farms (at present) are very rare and not altogether approved of by many chiefs. Also a man who does particularly well, risks becoming the object of envy. 3/

While the matter of how surplus production on allocated croplands is handled remains unclear, the Laws of Lerotholi and current practice for the allocation of garden sites are quite specific. In this regard, Ms. Nchapi writes:

> (Garden and) hut sites are a matter for allocation of the Chief. To qualify, a man must bear allegiance to the Chief or headman of the village or place where he seeks a site. If he betrays this allegiance, he forfeits his rights of residence and therefore his (garden) site, although he is entitled to take away at least part of his hut or huts when

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1/ Morojele, op. cit., Part II, Table 20.

2/ Williams, op. cit.

3/ Nchapi, Mampiti, "Review of Land Tenure," unpublished manuscript for internal use, Planning and Evaluation Unit, Ministry of Agriculture, Maseru, February 1978.

he leaves. Removal results in forfeiture as with lands but title can be deriviatively maintained through close kin and there is no obligation corresponding to the duty to cultivate. Nor can it be taken away from them simply because it is more than is sufficient for their subsistence.

(Hut) sites and gardens have a greater security than masimo (arable lands). This is partly because it is obviously much more difficult for a Chief to reallocate a site unlawfully if people are actually living on or near it, but also because forfeiture cannot take place, even lawfully, except on the special conditions of removal or possibly, as seen, where ownership of several sites is involved.

On the death of a person who has been allocated the use of land for the growing of vegetables or for the purpose of (tree) plantings or for residential purposes, the heir, or in the absence of the heir, the dependents of such deceased person shall be entitled to the use of such land as long as he or they continue to dwell thereon. 1/

Some contemporary observors of the tenure system in operation disagree with the contention that equalization of holdings on a per capita basis still takes place. 2/ Nonetheless, there is evidence that this was the case, at least until 1960: as shown by the following table of per capita acreages drawn from Morojele's 1960 Agricultural Census (Table 1). 3/

Table 1. Per Capita Acreage for Various Farm Sizes in Lesotho (Basutoland), 1960

No. of Persons in Household	Average Size of Holding (Acres)	Per Capita Acreage
1	3.8	3.8
2	4.9	2.4
3	4.6	1.5
4	4.8	1.2
5	5.4	1.1
6	5.2	0.9
7	6.1	0.9
8	6.9	0.9
9	6.8	0.8
10 and over	8.2	0.8

1/ Ibid.

2/ See, for example, LASA Research Report No. 2, 1978.

3/ Morojele, op. cit., Part III, Table 51.

The tendency to retain an equitable per capita land distribution, as shown in Table 1, is unmistakable, particularly for households of five or more individuals. John Gay and other sociologists currently working in Lesotho believe that on the basis of their recent sociological studies, this tendency of increasing the land holdings of individuals over time persists but that the age of the head of the household may be a more important factor in this relationship than the size of the household. 1/

Previous observers of the relatively small size of holdings in Basutoland made strong efforts to discredit the system because of this constraining effect on agricultural modernization efforts. Quirion, writing in 1958, (eight years before independence), was particularly critical. As part of his thesis research, he considered various farm sizes, concluding that at that time the minimum economic unit should be no less than 15 acres. 2/ Since at that time the average farm size was 5.75 acres, his analysis of the expected level of net returns from a six acre farm in the Lowlands is of interest. He concluded that "the cash returns per man-day in the Union mines is almost three times as much as those on the 'good farming with oxen' type of agriculture (for his six acre unit). There is little wonder then that mine employment,...exercises such an economic attraction on the Basuto farmers." 3/ The recent dramatic increases in mine wages (e.g., .70¢ to 2.86 per shift) are such that a man can make from two days working in the mines an amount equal to net returns from farming one acre. 4/

Overall, Quirion concluded that:

> The economic desirability of larger and compact holdings is irrefutable. It is a well established principle of farm mangement that the farm size must be reasonably large so as to insure efficient labor use, adequate living standards and soil fertility maintenance*... The problem under Basutoland conditions consists in deciding whether it is better that the whole nation should be forced to live poorer than that the drive for more efficient production should be carried so far that the authorities have to deny a part of the people the opportunity of being farmers. (*Earlier in his thesis he blamed the lack of maintenance of the soil conservation structures on the tenure system as well.)

1/ Based on internal discussion with John Gay who served as a Rural Sociologist in the Ministry of Agriculture, February 1978.

2/ Quirion, op. cit., p. 176. (And, he concluded if land were allocated in this manner only 38% of the households would remain in farming and there would only be 62,000 farms.)

3/ Ibid., p. 170.

4/ LASA Research Report No. 2, op. cit.

> Put in a different way, one can say that the production of food, of more food, always remains the objective, but since it cannot be achieved by more land, it has to be obtained through better use of the same resources. But why should the individual farmer be worried about the conservation and improvement of the land when there is no adequate incentive to put more labor or capital into it...The answer to such questions all point in the same direction: the necessity of land reforms. 1/

It seems strange to us that once having correctly perceived the problem, Quirion did not question whether or not a substitute economic incentive for carrying out conservation and structural maintenance thereof could not have been provided to farmers within the existing land tenure system; by a subsidy payment, perhaps. Nonetheless, Quirion was well aware that the changes that he proposed for Lesotho's land tenure system were not popular and would not likely be achieved. In this regard, he stated in part:

> Land consolidation and security of tenure are no doubt economic problems, but social as well. When the Pilot Project was initiated in 1953, the Government agreed not to interfere with the existing lawful rights of Chiefs and people in regard to land, the scheme being built on foundations consisting of the Basuto's own customs and system of land tenure. Such a binding condition meant additional difficulties and often uneconomic arrangements in implementing the scheme, but it was no doubt wise in acknowledging that the initiative in improving the land tenure system to meet new conditions in order to raise productivity and living standards must come from the Basuto themselves.
>
> Such an approach means slow progress and no spectacular results, but it emphasizes once more that the development of undeveloped resources cannot be undertaken unless the people themselves want it. In his review of the problems of land tenure in Basutoland, Hailey has suggested revision of the present system...Such reforms would go a long way toward preparing the gradual transition from communal to individual ownership of arable land, but it is not certain whether the state of public opinion at present would permit of this being done. 2/

1/ Ibid., p. 175.

2/ Ibid., p. 179.

The strongly held views about land and cattle in Lesotho, as reflected in a reluctance to change the system (referred to by Quirion as the state of public opinion), can only be fully appreciated within an historical context. The interdependence of the power base of the Chieftainship was supported by the British government throughout most of the period in which the Basutoland was under its protection. While there was some recognition during the last decade before independence that the land tenure system would be a major constraint to modernizing the agricultural sector, it was then really too late to do anything about it. (Refer to a dissertation by J.R. Carpenter, which outlines the sequence of events leading to the state of affairs existing at the time Lesotho achieved its independence in 1966. 1/)

The Lesotho Independence Order of 1966, the Constitution, formalized certain procedures of the land tenure system. But, basically, it emerged in the form in which it had evolved in custom. Section 93(1) of the Order provides that:

> The power to allocate lands that is vested in the Basotho nation, to make grants of interests or rights in or over such land, to revoke or derogate from any allocation or grant that has been made or otherwise to terminate or restrict any interest or right that has been granted is vested in the King in trust for the Basotho nation. 2/

This power was to be exercised by the chiefs, subject to the constitution and subsequent legislation. After the fact, it is apparent that the farmers of the constitution intended that the chiefs should adhere to the advice of elected advisory boards but the fact that this was not specifically spelled out in the Land (Procedure) Act of 1967 attests to the continued power of the chiefs. 3/ While the Land Act attempted to improve the system of land allocation, it chose to neglect a basic problem of inadvisable land use practices. As a result, in June 1968, the Prime Minister once again reminded the chiefs that Lesotho's land allocation system was unsatisfactory. 4/ But except for a few minor changes made

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1/ Carpenter, J. Raymond, "A Critique of Economic Development Planning Since World War II: Selected African Case Studies," (unpublished Ph.D. dissertation, Colorado State University, 1977), pp. 290-293.

2/ Lesotho Independence Order of 1966, Section 93(1).

3/ Lesotho Land (Procedure) Act of 1967.

4/ The Friend, June 15, 1968.

thereafter, the basic land tenure system of Lesotho as set forth in the Laws of Lerotholi remains in place. 1/

Impact of Land Tenure Reform on Agriculture

As noted above, for most of the time of British Control over the Basotho homeland, no efforts were made to alter the traditional powers of the chiefs, particularly in respect to their system of land allocation. Later efforts to do so, mostly during the period after World War II, were concentrated on piecemeal and largely ineffective actions that aroused adverse public opinion and resistance to the various soil conservation and pilot projects then being tried out. For example, Williams notes that the chieftainship managed to suppress the tenure recommendations advanced by Sheddick and "the Chicago University report on Basotho land tenure was received with so much suspicion that it was never published. Even a motion in the former National Council by Chief Johnathan, now Prime Minister, to the effect that changes in the land law were necessary, was defeated." 2/

Our review of the so-called "Chicago Report" shows that it could hardly be considered to be a radical document which advocated drastic action before Lesotho was to be granted its independence. Quite to the contrary, according to the transmittal letter to the Paramount Chief, dated June 3, 1963, it was prepared at his request and supported by a grant from the Ford Foundation instead of by the British government. In the introduction of their unpublished report, the authors stated in part:

> The problem for the future is not whether the land of Basutoland will continue to be held under rules which have existed from "time immemorial" but rather how the existing body of rules, many of them unknown at the time of Moshoeshoe, will evolve to assist in the even more important changes in Basotho life which the Basotho hope for...Our recommendations do not call for a new land law at this time...
>
> We recommend that:
>
> 1. The Basotho people reaffirm the principle that the ownership of the land and of the natural resources of Basutoland is vested in, and is administered in trust for the Basotho nation.
>
> Existing law--This is our understanding of the basic principle of existing land law in Basutoland.

1/ The customary land tenure rules of the Basotho were first codified by Lerotholi, a grandson of King Moshoeshoe, in 1905. His work has since been updated a number of times but continues to be known as the "Laws of Lerotholi."

2/ Williams, op. cit., p. 28.

Changes recommended--None.

Reasons for recommendation--From our discussion with various members of the Basotho nation, we are convinced that this is a principle which the Basotho do not want to change...The principle is a most forceful recognition that land is a great natural resource which should be exploited and utilized for the welfare of the members of the nation present and future. It does not conflict with the equally important principle embodied in the existing constitution that the entire land and its administration are subject to legislative control. 1/

It is now a matter of history that shortly after the Chicago Report was suppressed, the basic land tenure law of Lesotho was embodied in its constitution. But that has not stopped many of those concerned with modernizing Lesotho's agricultural sector from criticizing the land tenure system and offering suggestions for reform. Among the most extensive set of such proposals, based on economic arguments, is set forth in William's report, Lesotho Land Tenure and Economic Development, published in 1972. 2/ He stated his position in part as follows:

> The objective of tenure reform in Lesotho must, of necessity, be to discard the present ethic of subsistence in favour of an environment conducive to rational and unharassed response to market stimuli and maximization of long-run per acre output utilizing labour intensive methods of cultivation...Notwithstanding the difficulty of devising and implementing these essentially administrative modifications, it is the author's belief that more fundamental reforms are required before a satisfactory rate of agriculture progress will be achieved. 3/

The fact that his view was widely shared, at least within the expatriate community in Lesotho, is clearly evident in some of the justification statements prepared for the series of the donor-funded, area-based projects initiated in the late 1960's and early 1970's. For example, AID's Project Paper (PROP) for the Thaba Bosiu Rural Development Project stated in part: "The (land tenure) system admirably suited traditional society when land was plentiful. It is inadequate for the pres-

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1/ Bentsi-Enchill, K., et. al., "Recommendations and Reflections on some Problems of Land Tenure in Basutoland," (Chicago: University of Chicago, 1963, unpublished), pp. 5, 6 and 8.

2/ Williams, op. cit.

3/ Ibid., p 29.

> (Clausen, 1953). In addition to adverse sociological repercussions stemming directly from a particular structural alteration is the prospect that agricultural advance is conditioned not only by isolated structural changes such as the granting of freehold land titles but also by an interdependent milieu of associated reform necessities. Supporting facilities such as the availability of required inputs, a social security system designed to replace that provided by the traditional extended family, and improved marketing channels may have to be introduced before a radical structural change in land tenure is able to achieve the desired effect in productivity. There is no place therefore for static analysis unsupported by dynamic considerations. It is the manipulation of the total economic framework which is relevant. 1/

While, in theory, a total manipulation of the economic framework as outlined by Williams could be attempted in a planned economy such as that of Lesotho, we do not believe that the government or its people wish to or are able to do so at this time. Nor do we believe that it will be impossible to achieve a modest rate of agricultural development within the existing land tenure system--although in our view it will mean concentrating inputs and Extension efforts in the best land areas and, for the time being, on the five to eight percent of the farmers who truly may wish to be "progressive." Finally, we totally reject that premise that conservation programs cannot be successful in Lesotho under the existing land tenure system simply because it is assumed that farmers will not support and maintain such measures --but it will likely require design of a substitute economic incentive system, based on the existing land tenure rules, that will necessarily require some form of direct government incentive payments to farmers.

Summary and Conclusions

Our review and analysis of Lesotho's land tenure system has led us to the conclusion that it is not nearly as constraining to an operational and effective soil conservation program as most earlier reviewers have suggested. It is our view that, far too often, past soil conservation planners have ignored the land tenure system and then when they failed to reach their objectives, the blame was unfairly put on the system. In most cases, however, failure resulted because the programs were designed to lead to conflict with the land tenure system, rather than

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1/ Ibid., p. 28.

accepting it as an overall set of legal conditions within which a sub-optimization approach to the problem could have been more successful.

Doran and Low reached a similar conclusion during their recent evaluation of the overgrazing problem in Swaziland, a country with grazing land conditions and cultural views toward cattle similar to those found in Lesotho. They stated in part:

> ...we see the reason why time, effort and funds expended in cattle development over the last decade have had such little impact on the overgrazing situation. To put it bluntly, their orientation has been wrong. They have been based on the Western concept that increased production will automatically result in increased sales. In Third World countries cattle often serve other purposes, so that it may be neither normal nor rational for cattle owners to increase sales as productive potential increases. We have shown that, in Swaziland, the reverse will hold true, with cattle sales tending to decline as improvements occur in the value and/or condition of the herd. We argue that in the environment under which the Swazi farmer operates, this behaviour is perfectly rational.
>
> Any attempt to increase productive potential of the Swazi Nation herd will therefore, of itself, tend to reduce the overall offtake rate, exacerbate the overgrazing problem and thus lead to long run frustration of production oriented livestock programmes. 1/

Based on our review of past and ongoing livestock and range management programs in Lesotho, we feel that the same undesirable results would occur here in response to future range improvement programs initiated in the absence of effective programs to control livestock numbers. In a similar vein, we feel that, given Lesotho's land tenure system, farmers will not fully accept crop land tillage methods designed to curtail erosion and will not incur major expenses for maintaining structural conservation works unless a substitute incentive system for such actions is provided. That is to say that, since the incentive to improve land resources which in turn leads to its increased market value under the Western system of land tenure is lacking in Lesotho's land tenure system, an alternative incentive system based

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1/ Doran, M.H. and Low, A.R.C., Overgrazing: Evidence of the Need for a New Look at an Old Problem, (internal AID/OSRAC technical paper, Mbabane, Swaziland, October 17, 1977), p. 8.

on government subsidies and inducements, rather than on penalties, is needed. 1/ Nonetheless, given our understanding of Lesotho's land tenure rules and related legislation, we conclude that there is already ample legal precedent for implementing an effective soil conservation program for its crop and rangeland resources. 2/

It appears that most interested and knowledgeable persons within the Ministry of Agriculture with whom we have discussed the matter agree that the Laws of Lerotholi and related legislation are sufficient to sanction an effective soil and water conservation program in Lesotho. They correctly point out, however, that unless these rules are put fully into effect, little progress can be made. Therefore, in 1977, a set of grazing control and pasture management regulations were drawn up, designed to more fully activate the powers of the Minister of Agriculture under the Land Husbandry Act of 1969, which would be directly supportive of conservation efforts. 3/ We find that a number of the key elements of the draft proposal if implemented would directly support our recommendations for emerging an effective soil conservation program; these are paraphrased below:

1. Setting aside Leboella for various purposes by the Chief, would be expanded to specified grazing areas if he considers, upon the advice of the Agricultural Officer, that to do so is "necessary for the purpose of rotational grazing and/or for the improvement of any aspect of agriculture."

2. Responsibility for grazing areas would be under the supervision of the Agricultural Officer while administrative responsibility would remain with the Chiefs.

3. Rights of access to grazing areas would be modified in part as follows: "a) a person with lawful rights to cultivate a land shall have sole rights to all crops grown on that land and to all crop residues:* (and) b) where such a person has sown

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1/ A clarification as to the certainty of a cropland allocation by the Chief would provide a degree of security to the individual farmer but in itself is an insufficient incentive to invest heavily in conservation measures (and their maintenance) from which immediate responses in yield are not readily apparent.

2/ Key excerpts on which this conclusion is based are quoted in FAO/UNDP, I. Development of a Pilot Agricultural Scheme in the Leribe Area, Lesotho (internal unpublished paper by O.W. Sanders and T.J. Ledume), Maseru, 1972.

3/ MOA, "Grazing Control and Pasture Management Regulations," (draft proposal), op. cit.

his land to permanent grasses, such grass shall be considered in all respects as a crop."*

4. Stocking rates would be estimated by the Agricultural Officer; Chiefs would divide all grazing areas into sections for rotational grazing* with access thereto by livestock owners limited by permits.*

5. Regulation of stock numbers: "The total number of stock in the country shall be regulated to equal the total stocking rate of the country by grazing areas as determined...by the Agricultural Officer."

6. Grass burning to be limited to "written permission of the Principal, Ward or Village Chief as the case may be, issued after consultation with an Agricultural Officer," and, "any grazing area or portion thereof in which grass has been burnt shall be deemed to be leboella."

7. Controls on opening up of new land and reestablishment of grass on lands unsuitable for cultivation: "No virgin grassland (thite) or Moshoqa shall be opened for cultivation unless it has been inspected and approved as suitable for cultivation by an Agricultural Officer and that protective measures which he considers necessary for the protection of such lands have been effected" and "a Chief shall, on the advice of the Agricultural Officer, order that any land which has been a) cultivated in unsuitable places; b) unlawfully cultivated; be returned to grassland."*

It was not our function in carrying out this research effort to advise the Government of Lesotho and its representatives on which laws and regulations affecting its natural resources they should enact. Rather, it is our view that the Laws of Lerotholi, associated laws and regulations are to be taken as given in divising effective soil conservation programs. But we do feel that it was our responsibility to comment on proposed changes in these institutions which in our view have a technical basis for improving the soil conservation program; we would do so only as an informational aid to the decision making process. Therefore we have listed the items above, drawn from proposed regulations, which we feel would contribute directly to the implementation of technically proven conservation measures. Further, we would point out that they could provide the legal basis for additional institutional measures such as providing for a retirement program for severely eroded land

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*Underlining added for emphasis.

and the development of economic incentives for compliance with conservation measures that were lacking in Lesotho's traditional land tenure system. 1/

Over and above its value as a politically stabilizing force, we find elements in the existing land tenure system worth preserving, in particular excerpts from the Laws of Lerotholi pertaining to the provision of soil conservation measures. The immediate task will be to devise a soil conservation program that can operate more effectively within the existing land tenure system rather than trying to disregard it while planning more projects predestined for failure. Working within the system will likely continue to be a slow process but then, some progress, however slow, is surely preferable to none at all.

1/ After an extended period of deliberation the Basotho Parliament enacted a new Land Bill on August 6, 1979. A copy of the bill was not available to us for review and analysis prior to publication of this report. But, according to a local news source, the new Land Bill limits the land allocation powers of Chiefs and gives the Government the power to take land away from the holder for development purposes. And at least one provision of the bill will likely have a significant impact on how land holders will view soil conservation measures in the future; "under the Bill's provisions land can now pass from father to son and not only to the chief as before" (Lesotho Weekly, Thursday, August 13, 1979). If this provision is indeed implemented, soil conservation measures will tend to be viewed more as a property asset in which the land holder has a vested interest (e.g., a property right), an incentive element that has been lacking heretofore in Lesotho's land laws.