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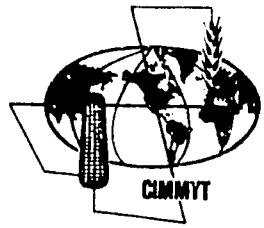

INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER

DRAUGHT POWER PROBLEMS AND RELATED RESEARCH IN BOTSWANA LESOTHO AND SWAZILAND

by

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INTRODUCTION

Background

The International Maize and Wheat Improvement Centre (CIMMYT) in co-operation with USAID is currently involved in a project to promote on-farm research with a farming systems perspective in Eastern and Southern Africa. USAID's interest stemmed from its commitments to agricultural research and extension projects while CIMMYT's interest stemmed from its world-wide experience in on-farm research with a farming systems perspective and the desire to expand the coverage of its on-farm research support programme in Eastern and Southern Africa.

One of the major activities of the combined CIMMYT/USAID project is networking. This activity is defined as the facilitation of discussion and exchange among both national researchers and USAID team members in various programmes so that the accumulating experience can be shared. At a CIMMYT networking seminar held at Nairobi in April 1983 it was decided that focus should be directed on specific technology issues and the inventorying of cross-country agricultural problems and solutions.

The need for networking cannot be overemphasized particularly in a new field of activity such as on-farm research where researchers are few and scattered, no formal links exist, and progressive development depends on feedback from trial and error experience.

Particularly in Eastern and Southern Africa where on-farm research is being promoted through international donor-aided projects, there lacks provision for exchange of ideas and experience among various contractors. Under these circumstances it is imperative to promote dialogue between the various parties concerned so that lessons and experiences gained in one project in one area can be taken into account when planning or implementing the next project in another area.

In order to achieve the goals of networking, three modes of information, consolidation and dissemination have been identified:

(a) the production of a regular newsletter;

(b) the production of special reports focusing on particular issues and related research relevant to those issues; and

(c) the convening of workshops where researchers can gather and actively participate in discussions on particular issues and topics.

These three modes are meant to complement each other. The following special study falls into category (b) above and overlapped with the CIMMYT networkshop on the same issue of draught power and animal feeding in Eastern and Southern Africa.

The Nature of the Draught Power Problem

The draught power problem is a feature of farming in much of Eastern and Southern Africa. While cattle still provide the major source of draught power in many areas, ready access to this source of power is difficult for many farming households. The extent of this problem and the response of farmers differs in different areas as it does for different farming households within the same area.

Timely access to draught power for initial cultivation has been observed to be a major problem and limiting factor in the development of many local farming systems in Southern Africa. Because oxen are weak at the start of the season, or because they are not readily available at all, plantings are delayed, seedbeds are inadequately prepared and weeding becomes a problem. In order to overcome the draught power problem farm households may attempt to:

(a) seek ways of reducing and spreading tillage needs through winter ploughing, herbicide use, minimum tillage, etc.

(b) seek ways of improving animal performance through planting of fodders for dry season feed, conservation of crop residues for feeding, use of better draught equipment, improved breeding;

(c) seek supplementary or alternative sources of draught power through purchase of additional cattle, tractor hire or purchase.

The particular strategies chosen by households to overcome their draught power problem will depend on the extent of the existing cattle demand/supply pressure and will also be influenced by:

(a) management and cultural factors limiting the feasibility of shifting primary cultivations from one time in the season to another;

(b) agronomic factors (soil, climate) affecting the potential for fodder production;

(c) technical factors related to the availability and performance of cultivation methods and equipment;

(d) economic factors - the opportunity costs of using family labour time in more intensive oxen management and husbandry and,

(e) market factors affecting the availability of purchased feeds or alternative draught power sources.

The objective of this study has been to obtain a general overview of the draught power problem in Botswana, Lesotho and Swaziland and inventory the strategies used by farmers when coping with this problem as well as relating their responses to the circumstances in which they operate. At the same time, past

(from 1975 to present) and current technical research in specific related fields has been inventoried for each of those three countries. This aspect of the study is of particular interest to agricultural researchers as it indicates directions being taken, prevents unnecessary duplication and disseminates research results. The entire study is intended to provide on-farm researchers with a body of knowledge to bring to bear on the draught power problem when it is diagnosed as important in a local farming situation. It will also provide guidance on where to focus when planning further work on this particular topic.

Methodology

For each of the three countries under study, two distinct geographic areas were chosen to be examined in detail, hence six area reports. The areas were chosen on the basis of:

(a) Geographic location - which can determine the number of employment alternatives locally available to the household and can influence the extent of reliance on farming for subsistence needs, while also presenting physical land constraints to farming which limit draught power options; and

(b) the amount of documentation already existing on the areas which helped reduce the time required to gather basic descriptive data. The areas chosen for this study were:

in Botswana: the Pelotshetlha area operating under the Integrated Farming Pilot Project (IFPP); and

the Mahalapye area under the Agricultural Technology Improvement Project (ATIP), (subdivided between Shoshong and Makwate settlements);

in Lesotho: the Leribe Block 1 Lowlands formerly under the Basic Agricultural Services Programme (BASP); and

the Nyakosoba area under the Farming Systems Research Project (FSRP);

in Swaziland: the Central Rural Development Area(RDA); and

Southern Rural Development Area, both under the Rural Development Areas Programme of the Ministry of Agriculture.

At least one of the two areas chosen in each of the three countries is relatively near a significant sized urban centre which offers substantial off-farm employment opportunities and a source of cash income, while the second area in each may be considered rural, with fewer locally available off-farm employment opportunities. Most households in all the areas

chosen are involved in agricultural activity. All 6 areas are currently or have been involved in an agricultural research and/or improvement programme functioning under their respective Ministry of Agriculture. Hence the households located in these areas are in the process of being exposed to extension services and improved agricultural techniques and practices aimed at increasing their productivity, although it does not necessarily mean that the households will adopt these improvements.

For each area, a general description of the physical environment and farming system is given followed by a discussion on the draught power situation and farmer strategies adopted to overcome draught power problems. Information was obtained from written documents on each area as well as visits to Botswana and Lesotho where discussions with Ministry of Agriculture personnel directly involved or knowledgeable on the areas under examination were held. In some cases statistical survey data was available on the particular subject under study, but this was not the case for all the areas and there was not sufficient time to carry out my own survey. Therefore, the quality of the information for each varies considerably, although enough data was available to provide a general understanding of the problems farmers face and the solutions they adopt - which was adequate for the purpose of this study.

This report is divided into two main sections; Section I comprises the 6 area studies while Section II consists of the component research activities by country.

General Observations

In all of the areas examined there was a portion of the population which did not have its own draught animals. For those households without cattle or with an insufficient quantity of cattle to constitute a draught team a variety of strategies were employed to overcome the draught power problem. Basically, there are two main categories of strategies, those that do not require cash resources and those that do. Non-cash arrangements include:

(a) **providing one's labour in exchange for access to draught power and equipment** - one of the most common means of gaining access;

(b) **sharecropping** - allowing a portion of your land to be cropped (or sharing a portion of your harvest) with the household who lends you draught oxen, equipment abd/or labour;

(c) **borrowing oxen** from family or friends;

(d) **using a combination** of your own cows and oxen to make a complete team;

(e) **making a "sisa" arrangement** - whereby you look after a portion of someone else's cattle and can use them for draught purposes and milking;

Cash arrangements are basically for hiring a draught team - be it oxen, donkeys or horses - or for hiring a tractor.

Most small-scale farming households seek to organise a non-cash arrangement, usually because they lack the financial resources for anything else. All of the above five non-cash arrangements occur in Botswana, Lesotho and Swaziland - in different degrees of prevalence.

The cash arrangements also occur in these three countries - with ox-drawn teams and equipment costing considerably less than tractor hire. However, often those households hiring tractors do not lack oxen, rather they have more than ample cattle to make a draught team. They choose to hire a tractor because ploughing can be done more quickly with less physical effort on their part and sometimes their cattle are weak. Tractor hiring may not be the most economic means of ploughing their small fields but it is less labour intensive which makes it an attractive alternative.

In Swaziland, the Rural Development Areas (RDAs) operate tractor hire pools, where tractors can be hired for ploughing purposes at subsidized rates. It is in Swaziland where tractor usage seems to be highest because of their ready availability. Lesotho has the problem of its topography which makes tractor usage in the foothills and mountains unfeasible although it is becoming more prevalent in the lowlands areas. In Botswana, tractor usage is very much dependent on the availability of tractors in the area. There is no government run tractor hire pool as in the Swaziland RDAs, so rental is only possible from private tractor owners who can be few and far between.

In areas where tractors are not used either because there are none available or because topography is not suitable, other types of draught power are being introduced. In Botswana, particularly in Makwate near Mahalapye, donkeys have become a very popular source of draught power, while in Lesotho experimentation is under way using horses as draught animals in select foothills and mountain areas. The advantage of horses is that only 2 are needed for ploughing and it is easier to feed 2 horses than 6 or 8 oxen.

Animal feeding is a very important factor. Botswana, Lesotho and Swaziland have a common practice of providing communal grazing areas for livestock. These areas are not usually managed in any particular way and suffer from overgrazing and insufficient chance to recover. Drought also severely affects these zones causing further pressure on the already limited grazing resources. Because the communal grazing area is taken for granted, few farmers make any attempt to grow their own fodder.

All six of the areas examined face the major problem of lack of dry season animal feed to varying degrees, but particularly in years of drought. The subsequent weak condition of draught animals at the crucial ploughing time at the start of the rainy season can cause agricultural activities to be delayed or force

the farmer to seek an alternative method to plough his land. The fact that animals are strongest around the harvest period and just after has helped to promote the practice of winter ploughing. This activity is being promoted by extension workers in all 3 countries not only as a means of spreading tillage needs and reducing draught pressure at the start o' the rainy season, but also to help reduce the weed population and increase the absorption of water into the soil.

Research has been under way for a number of years on identifying suitable fodder crops which could be planted by farmers and would provide a source of dry season feed, as well as improving the methods of fodder and crop residue storage. Attention is also being given to management of communal range resources. The task now remains to get farmers to adopt these practices in order to tackle the feeding problem.

Draught power is a feature of small-scale farming which is here to stay and a concerted effort has to be made in order to improve the draught power situation and help eradicate its problems.

SECTION ONE

Area Reports

BOTSWANA

Agricultural Technology Improvement Project based at Mahalapye

I. INTRODUCTION

In October 1982 the Agricultural Technology Improvement Project (ATIP), sponsored by USAID began the first phase of its farming systems programme in the Mahalapye area, located in Central District in eastern Botswana.

The main objectives of ATIP, which is a five year duration, are to help strengthen:

(a) experiment station-based research;

(b) links between research and farmers by implementing a Farming Systems Approach to Development in Mahalapye and later in Francistown;

(c) linkage between research workers and extension personnel (through appointment of a Research Extension Liaison Officer).

(Baker, et al, 1983:1)

During the first year, emphasis was placed on the descriptive/diagnostic stage in order to provide an in-depth understanding of the technical and human environment in the region. Two villages, Shoshong East and Makwate, were chosen by the Mahalapye team for detailed study and presently the data from various surveys undertaken in these two villages are being analysed. Although no published results are yet available, information needed for this draught power study has been obtained through discussions with D. Baker (Agricultural Economist) and J. Siebert (Agronomist), two members of the Mahalapye ATIP team. It must be emphasised that some material presented herein is based on a preliminary analysis of recent surveys and should be regarded as provisional.

II. LOCATION AND PHYSICAL DESCRIPTION

The village of Shoshong is located approximately 40 kms west-northwest of Mahalapye on the south side of the Shoshong hills in the 1 000 - 1 150 metre altitude zone, while Makwate is approximately 57 kms south-east of Mahalapye with an altitude range of 850 - 1 000 metres. The natural vegetation is classed as tree savannah with close tree savannah and rocky hills north of Shoshong. Both villages are situated in the "hardveld" zone of eastern Botswana where rainfall generally tends to be higher than average per annum and soil is considered more suitable for agricultural activities than areas due west.

More than 90% of the rains fall in the summer months from November to April, although in an erratic fashion and drought

tends to be a regular occurrence making farming activities rather precarious. Annual rainfall measurements for Makwate and Shoshong on average range between 400 - 500mm, which is comparable to the average annual rainfall for Mahalapye (see Table 1).

TABLE 1

Average Monthly Rainfall: Mahalapye and Other Centres

(mm)	Shakawe	Maun	Ghanzi	Tshane	Tsabong	Francis-town	Mahalapye	Gaborone
July	0,1	0,2	0,5	1,2	1,6	0,5	2,1	3,9
Aug.	0,1	1,4	0,5	0,2	1,8	0,8	0,6	2,4
Sept.	4,7	3,7	3,1	2,7	7,6	7,9	9,7	16,3
Oct.	12,8	16,0	16,7	14,9	16,3	24,3	30,7	41,4
Nov.	62,8	49,9	51,1	29,8	24,7	61,7	67,2	65,3
Dec.	101,4	93,1	68,5	31,6	38,2	101,6	93,9	89,5
Jan.	135,0	122,5	94,3	89,3	46,9	98,7	85,4	94,6
Feb.	140,9	111,3	72,6	71,8	52,0	83,5	91,7	87,3
Mar.	84,7	75,5	60,4	66,0	52,0	46,1	48,4	54,1
April	24,7	30,9	39,7	37,6	52,8	25,9	31,2	53,7
May	2,2	5,7	9,8	7,5	17,4	10,9	12,3	16,1
June	0,6	1,6	1,5	1,7	11,3	2,2	4,3	5,1
TOTAL	569,1	511,8	418,7	356,3	322,6	464,1	477,5	529,7

Average rainfall over 30 years (mm) (except for Shakwe, Ghanzi and Tshane which are over 26, 29 and 21 years respectively).

Source: Gaborone Hydrological Statistics

Generally, the soils in both these villages consist of somewhat acid, sandy loams with patches of loamy sand, which are typical of the eastern Botswana hardveld soils. In the Shoshong area there are some sandier patches due to its proximity to the Kalahari desert and production potential is limited "because of fairly poor water holding capacity and low fertility." (Siderius, 1972: 66). Relatively speaking, although these soils are considered suitable for agriculture in Botswana, they are not of particularly good quality. They harden up during the dry season and are difficult to plough without rain.

The planting season, which is heavily dependent on the rains, can begin in October and continue until early February at the latest. Harvesting, which is dependent on when crops were planted, can begin in March and carry on until July. Frost is common, occurring at some time nearly every year. Winter cropping is not practised, the main constraint being the inadequate rainfall during those months.

National figures for average yields of sorghum and maize range between 200 - 300 kg/ha., and have been as low as 44 kg/ha. (maize) and 66 kg/ha. (sorghum) in the 1978/79 season due to drought (Ministry of Finance and Development Planning, 1980: 138). Improved crop husbandry techniques, which require

substantial input expenditure, can increase productivity, but are generally out of the financial range of the bulk of small farmers.

III. FARM HOUSEHOLD SITUATION

Population Density and Settlement Pattern

Botswana, covering an area of 582 000 square kilometres, is one of the least densely populated countries per land area in the world with an average density of 16 persons/km^2 (Ministry of Finance and Development Planning, 1980: 6), although, in fact, the majority of the population is concentrated in the eastern third of the country. Central District, where both villages under study are located, contains about 34% of the rural population, but as it is one of the largest districts such a proportion is not entirely unreasonable. Shoshong, the larger of the two villages contains approximately 1 000 households while Makwate contains about 140 - 150 households. On average a household is composed of 6 persons.

Both villages are located on communal land and use rights are allocated by the Tribal Land Board. Availability of arable land historically has not been a problem for these two villages, but it has been found that in good seasons a majority of households do use their entire allocations. This suggests that many households will have to intensify in order to increase production, not increase the area under cultivation. In Shoshong the cropped area per household during the 1982/83 season ranged from 2 to 7 hectares , while in Makwate it ranged from 1 - 4 hectares. For that season, 75% of the cleared arable area was ploughed and planted, leaving 25% fallow, but not all the allocated arable land is actually cleared for cultivation. On average, farm sizes range from 3 to 5 hectares.

The seasonal migratory pattern (moving from village to lands to cattle post), characteristic of Botswana, is evident in these two villages. Makwate, the smaller village of the two, has about 20% of its population permanently resident on the lands (arable zone), without having a village dwelling, while a substantial proportion of Makwate farmers live permanently in the village with no lands dwelling because their fields are within easy walking distance (1 - 2 km) from Makwate itself. The remainder, however, do migrate to their lands dwelling during the growing season, November to May, in order to tend their crops. The furthest lands area for Makwate lies approximately 10 kms from the village, and although it is sufficient for arable activity, there is pressure to get lands nearer to the village.

Shoshong, on the other hand, is more tradition oriented, and most families have a compound within the village as well as on the lands. Due to its size and geographic location with hills to the north, the lands areas are a fair distance from the village, making daily commuting unfeasible. Generally, the Shoshong lands areas are located between 10 and 35 kms from the village.

Those with cattle in both villages also run cattle posts on the communal grazing area. If the herds are large, a portion of the cattle will remain at the cattle post all year round, whereas small herds migrate back and forth between the cattle post and the lands area.

Cropping Enterprises

Crops grown in this general region include sorghum, maize, cow peas, jugo beans and the cucurbits (pumpkin, squash and various melons). Sorghum, used for porridge and beer brewing, is the main crop grown by virtually all farming households and covers 80% - 90% of the household area cultivated. The cucurbit family and also cow peas and beans are grown by most households, but on a very small scale and often intercropped with sorghum, mostly to be used for home consumption. Maize is not grown on a large scale due to its poor drought tolerance.

In Shoshong, about 80% of the households surveyed were involved with cropping although their main interest is in livestock, and they use local seed varieties. No agricultural extension workers have been active in this village. Makwate, on the other hand, has received extension advice for a number of years, which may account for the tendency of farmers to purchase improved local varieties of seed and generally have a more serious view of crop farming.

The planting season, which is heavily dependent on the rains, can begin in October, but the prevailing tendency is to plant in December in Shoshong and during November - December in Makwate. Planting can continue into January and even early February. The slight difference in planting dates between Shoshong and Makwate is possibly a result of the type of draught power used (discussed in Section IV).

The migratory household pattern predominant in both villages is a significant factor which prevents the practice of winter cropping. During the winter months, various traditional meetings, celebrations and feasts are held in the village, drawing families back to their village compounds. However, the main underlying reason that families return to the village is due to the lack of a continuous water supply in the lands area, which may well have been responsible for the migratory pattern arising in the first place.

Sources of Cash Income

The main source of farm income in this area derives from cattle sales, but as ownership is skewed, those without cattle are forced to seek an alternative source of income. Crop sales rate rather low as a source of farm income because the overwhelming majority of crops are grown for home consumption. Non-farm activities which also generate some income for households include beer brewing, thatching, gathering and selling firewood, and handicraft activities. Beer brewing appears quite an important cash-earning activity for households in these two villages, classed as middle and low income earners - especially those

without cattle.

The main sources of off-farm income are remittances from migrant workers employed outside the country and from those family members working elsewhere within Botswana. Local employment opportunities are limited in this region. On average, there is one off-farm wage earner per household, but not every household actually does have a wage earner. Especially for households without cattle, wage employment is a common alternative source of income.

More households in Makwate have wage earners than Shoshong which can be a direct result of the higher percentage without cattle (40%) in Makwate.

Income is primarily needed for purchasing food for the household since productivity, on average, is low and the effects of the recent drought have exacerbated the problem. "In a normal rainfall year, the average farm harvests about half its subsistence requirements" (Kerven, 1982: 16) and therefore needs cash to purchase the remainder of food required as well as clothing and household durables.

IV. DRAUGHT POWER AND ANIMAL FEEDING

Cattle Ownership and Uses

Shoshong, as previously indicated, is more tradition-oriented which is manifested by the emphasis it places on cattle herding as opposed to crop production. The herd size here is larger than Makwate, approximately 85% of the community own cattle, with an average of 30 head of cattle per owning household. Only 60% of Makwate households own cattle with an average herd size per owner of approximately 20 head.

From November to April the majority of cattle are at the cattle post, with only a few in the lands area. Farmers fence the lands area to protect crops from being destroyed by roaming livestock.

It is interesting to note that some farmers will preserve their cattle and use other means to prepare their land and to provide power for transport. The reason being that cattle will sell at a higher price on the beef market if they are not extensively used for such strenuous tasks. However, this does not preclude their use for such activities altogether. The practice of using cattle for bride price is strong here which emphasizes the desire to accumulate cattle. Other common uses are as a source of milk and meat and for draught power.

In general, a draught team for ploughing in this region is normally composed of 6.8 oxen. There are no specific figures currently available for oxen holdings per household but teams are often composed of a mixture of tollies, cows and oxen because there are not sufficient oxen to make up the entire team. The range in size of draught teams does vary, however, from 4 to 16 animals. Farmers believe that the larger the team, the less

stress on each animal which means less depreciation when they come to sell these animals. There is a tendency to use oxen for 3 years or less for ploughing, and each year a new animal is introduced into the team for training, thus allowing for a rotation and high turnover of cattle. Teams for planting would consist of 2 or 4 animals but very few farmers act ally use ox-drawn planters, and ox-drawn cultivators are not used at all because most seed is broadcast and, therefore, not in rows.

Land Preparation

Land preparation begins with field clearance, which is done by hand and burning. When a new field is opened, tree stumps have to be removed and this is often done with the assistance of ox-drawn mouldboard ploughs and is rather costly. As most fields have, on average, been cultivated for more than 20 years, the process of clearing and destumping are not major ongoing activities. After clearing the previous season's crop residue, the usual routine is to plough the field, with the majority of farmers doing only one single tillage operation of broadcasting seed and then ploughing it in. The date for this falls between October and January depending on the rainfall. Often planting will be staggered in order to reduce losses should dry conditions suddenly prevail. Weeding is predominatly done by hand and usually only once per crop at some stage between January and March. As this reveals, minimum labour effort is expended on land preparation and weeding activities which cannot be considered intensive. Intercropping is a common practice, fertilizer is not used and there seems to be no practice of crop rotation and very few do any winter ploughing. These combined factors can account for the low yields generally obtained.

Draught Strategies

In spite of the presence of cattle in both areas, it is interesting to discover that the use of cattle for draught is lower than one might expect. In Shoshong there is a high rate of tractor ploughing, with at least 11 private tractor owners in the village - most of whom hire out their tractors. This is not so much due to a shortage of draught animals but more as an alternative in order to accomplish the task faster and preserve the condition of cattle which will bring in higher returns wher sold.

TABLE 2

Type of Traction used by Farmers for Ploughing(*)

Traction	% households using as primary traction
Donkeys/mules	29
Cattle	48
Tractor	23 (Shoshong only)

(*) In the 1983/84 season, following the second year of drought, donkeys were able to plough 1 - 2 months earlier than were cattle, and in Shoshong a majority of those farmers who were

able to do any ploughing used tractor traction (pers. comm.)

Some Shoshong farmers stated that tractor ploughing was a faster operation than ploughing with cattle and the quality of tractor ploughing was better. Those in Shoshong not using tractors felt that the quality of ox-drawn ploughing was adequate and some just did not have the financial means to hire a tractor. It was not common to find donkeys used for ploughing in Shoshong though they are used for transportation (carts), again primarily to preserve cattle.

In Makwate the situation is rather different. There are no tractor owners in the immediate area, so there is no opportunity to even hire tractors. Therefore, all ploughing is accomplished with draught power. It is interesting, however, to note that 82% of ploughing is done by donkeys rather than oxen/cattle. As indicated earlier, Makwate has a lower overall number of cattle which are distributed among fewer households - 40% are without cattle. In the 1960s donkeys were introduced here for ploughing by migrant workers returning from the Transvaal, and the practice caught on rapidly. Donkey plough teams usually range in size from 4 to 6 animals and there have been reports of double furrow ploughs being drawn by 8 donkeys. Farmers remark that donkeys are easier to handle, revive faster and require less training than cattle. They also remain in the lands area all year round while cattle are sent out to grazing posts during the cropping season so there is usually easy access to donkeys when required. The fact that donkeys:

(a) are always around the lands area: and

(b) revive faster after the rains begin

can account for the fact that ploughing in Makwate tends to begin in November which is earlier than in Shoshong.

In a sample survey of 77 households from both villages, the supply of traction for land preparation derived from a variety of sources (see Table 3).

TABLE 3

Source of Traction for Sample of Makwate and Shoshong Farmers

(n = 77)

Source	% Farmers
Owned	29
Hired	27
Plough together arrangement - pooling resources	19
Co-owned or from relatives	9
Managed - mafisa'd	8
Borrowed	1
No response	6

37% of responses indicated that their source of traction was

secured by some sort of non-cash agreement. One major factor which may influence the form of draught power used is the cost of hiring it. Donkeys are the cheapest form of draught to hire while cattle rank second and tractors, being the most expensive, rank third (see Table 4).

TABLE 4

Hire Costs for Ploughing

Source of Power	Cost	Place
Tractor Hire	P12 - 15 per acre	Shoshong only
Cattle	P 3 - 9 per acre	(In donkey area ((Makwate) cattle hire (competes with donkey (hire P3-4; in cattle (area cost is P5-9
Donkey	P 3 - 5 per acre	Makwate only

Further survey results (see Table 5) indicate that of the farmers who tend to hire in their means of ploughing, 51% hire tractors, but this only occurs in Shoshong. Cattle and donkey hire figures are not so different, but it must be remembered that donkeys are not much used in Shoshong for ploughing, so those figures only refer to Makwate. Those farmers who own their own source of traction tend to own the accompanying equipment - usually only a plough, as planters are uncommon.

TABLE 5

Farmers Hiring in Means for Ploughing

(n = 39)

Means	# Farmers	% Farmers	Place
Donkeys/Mules	8	20	Makwate
Cattle	11	28	Shoshong & Makwate
Tractor	20	51	Shoshong

As seen above, land preparation activities are not labour intensive and the amount of cash spent on preparation and planting tends to be small.

TABLE 6

Cash Expenditure on Crop Enterprises

Expenditure	No. of Farmers	% Farmers	(n = 77)
0	12	16	
< P10	25	32)	
11 - 50	23	30)	62%
51 - 100	8	10	
101 - 150	4	5	
151 - 200	4	5	
201 - 250	0		
251 - 300	1	1	

As Table 6 reveals, the majority of the sample (62%) spent less than P50 on cropping activities which include some or all of the following: ploughing, planting, seed, cash hire, repairs, equipment, labour.

Sources of Cattle Feed

Generally, cattle are sent to the cattle post to feed on communal range area during the cropping season and larger herds remain at the post all year round. Some households bring in part or all of their herd to the lands area during the winter months to graze on crop residues and on local communal grazing areas but often lack of water forces them back to the cattle post before the end of the dry season. For those with the financial means, sorghum hay can be purchased from farmers in the Tuli Block - but the majority do not purchase feed. Currently, no fodder crops are specifically grown in the area because all effort goes into trying to produce food crops. Even though all available arable land is not used, the labour effort needed to produce animal fodder crops is high and fencing of the plot would be a necessity in order to keep livestock out of it. Experimentation is underway by EFSAIP to identify suitable fodder crops that could be grown, but consideration has to be given when choosing which type of farmers such an enterprise would most suit.

Makwate, however, relies solely on animal traction for ploughing and as a result of outside influence, which was further encouraged by extension workers, donkeys have become a very popular source of draught power. Once again, an underlying desire on the part of some farmers is to preserve their cattle in order to obtain maximum price when they decide to sell. Another advantage to using donkeys is that they revive faster after the dry season, enabling a farmer to begin ploughing earlier than with cattle. The usual practice farmers follow with cattle involves allowing cattle about one month to graze after the rains have started before harnessing them for ploughing. This allows the cattle the chance to graze on new shoots and build up their strength before starting this strenuous task.

Summary

Shoshong East and Makwate, the two areas under study by the Agricultural Technology Improvement Project based at Mahalapye have less than optimal farming conditions. Rainfall is erratic and tends to be on the low side while soils are weak and difficult to work when dried out.

As population density is relatively low, there is sufficient arable land available to households but not all of this allocated land is actually cleared or always in use by these households. Productivity is low with focus almost entirely on subsistence crops which generally do not provide any income but neither do they meet the subsistence needs of the family, requiring supplementary food to be purchased. Achieving a higher output requires expenditure for inputs and labour intensive husbandry practices on the part of the farmer.

Most households rely heavily on cash income, which is used to meet their subsistence and other needs. This income is predominantly derived from cattle sales, remittances and non-farm income generating activities.

Although approximately 15% of the Shoshong households and 40% of the Makwate households do not own cattle, access to draught power is not seen as a severe problem. The problem seems to focus on the matter of timely access to the supply of draught power. In both villages, alternatives to draught oxen exist - in Makwate there is high adoption of using donkeys for ploughing while in Shoshong tractor usage is becoming popular. The usual draught oxen team consists of 6 - 8 animals while donkey teams are usually comprised of 4 - 6 animals. It also appears that some of those wealthier households with large cattle holdings and therefore good draught potential deliberately prefer not to use their cattle/oxen for ploughing in order to preserve their conditions, enabling these farmers to get a better price for cattle when they come to sell them.

Land preparation activities are not labour intensive and improved crop husbandry techniques are not yet commonly practised, which contributes to the low outputs achieved in this zone. Fodder crop production is non-existent and still requires further experimentation to determine the species suitable for the region and the population group who would most benefit from such an undertaking.

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BOTSWANA

Pelotshetlha Lands Area

I. LOCATION AND PHYSICAL CHARACTERISTICS

The Integrated Farming Pilot Project (IFPP), established in November 1975 in the Pelotshetlha lands area (the term "lands area" is used to designate arable zones in Botswana) is located 25 kms south of Kanye and 30 kms west of Lobatse, in the Southern District of Botswana. This area is representative of the farming conditions found in eastern Botswana where 80% of the population of 770 000 is situated and where agricultural activity is concentrated (especially on the hardveld where rainfall is higher). The total area covered by the project is 52 000 hectares of which 23 000 ha. (44%) is classed as arable (lands) area and 29 000 (56%) is grazing. Of the arable area, only about 12 000 ha. (21%) of total area has actually seen the plough. The arable region is almost totally surrounded by a drift fence which physically demarks where it ends and the grazing range begins.

The soil in the arable region, although not of particularly high quality, is considered to be some of the most suitable in the country for agricultural activity and is basically of two main types:

(a) The eastern section of the project area is composed of a clay loam which is black-grey in colour and fairly heavy, requiring more management to keep it from compacting.

(b) The western section is composed of a red sandy loam, which has a massive structure but requires less management than the clay loams of the eastern section, and is more productive.

Both soil types, due to their heavy nature and massive structure, require large draught teams when ploughing. The grazing area tends to have very shallow soils covering the bedrock with a high gravel and rock content. There are pockets of deeper soils in the grazing zone which, due to various pressures, are being ploughed and used for cultivation by some farmers. Reasons cited for resorting to this practice include:

(a) lack of land within the lands area, or soil old and depleted of nutrients;

(b) desire to cultivate near the cattle post where animals are kept in order to be near to the herd to manage and water them;

(c) desire to be near main Lobatse-Kanye road in order to get to places faster and cut travel time.

The opening of this grazing area for ploughing, however, is controlled and monitored by the Tribal Land Board, and is

therefore an organised expansion.

In Botswana inadequate rainfall is one of the main factors affecting crop production. The national mean annual rainfall is 450mm while in this particular region the mean annual rainfall ranges from 500-600mm. 90% of rain falls in the summer months from November to April.

Within the Pelotshetlha lands (arable) area approximately 45 rain gauges have been set up recently, on selected farms, to measure the local variations in rainfall during the growing season.

As much as a 30% difference in total monthly rainfall has been measured within the 230km² arable area. This local variation has had a significant effect on crop yields within this zone and demonstrates how variable the climatic situation is in Botswana (pers. comm.). Monthly rainfall figures for Pelotshetlha are presented in Table 1 along with the Kanye 12 year monthly average for comparative purposes. The Pelotshetlha figures indicate that rainfall has been somewhat higher lately, although the tendency is to have occasional heavy torrential downpours rather than light rainfall over a prolonged period.

TABLE 1

Pelotshetlha Monthly Rainfall Figures: 1979 - 1982

Month	1979	1980	1981	1982	Kanye 1970-1981 12 year average
January	98.8	109.5	272.9	166.4	143.7
February	42.1	216.0	100.9	51.5	88.1
March	33.5	6.9	44.2	91.4	60.0
April	9.4	15.7	7.3	124.8	34.1
May	18.4	0.3	1.3	0.0	6.9
June	0.0	0.0	0.1	0.0	1.3
July	0.0	0.0	0.0	8.6	0.3
August	26.8	0.0	19.0	0.0	6.9
September	12.0	53.2	0.2	3.0	23.1
October	140.1	8.0	41.1	77.5	40.0
November	98.9	108.8	93.8	79.0	68.0
December	65.8	120.7	112.6	149.0	77.3
TOTAL	545.8	641.1	693.4	751.2	543.8

Source: Pelotshetlha Raingauge at Project Centre
Kanye Hydrological Station

The cropping season corresponds with the higher rainfall period, with planting dates ranging from November to January and harvesting occurring from March to June. Although winter cropping is not feasible due to the very dry conditions, there is a possibility of getting in 2 plantings during the summer by using improved short season seed varieties, planting once in November and again in January. Grain crop yields on experimental

plots have exceeded 1000 kg/ha but are dependent on adequate land preparation, application of fertilizers and high labour inputs for weeding, birdscaring, etc. Actual yields data from subsistence farming, discussed in the following section, has quite a high degree of variation dependent on the methods of land preparation and planting.

II. ACTUAL FARM HOUSEHOLD SITUATION

Population Density

According to estimates, the number of households situated in the 52 000 hectares covered by the IFPP stands at approximately 1 000, of which approximately 750 are located in the lands (arable) area and approximately 250 are in the grazing zone. The 1981 census calculates average household size to be 6 people. On the basis of these figures, the population for the total IFPP area stands at approximately 6 000, and the overall population density stands at 11.5 persons per km^2. Average density on IFPP arable land stands at 19.6 people per km^2.

However, it is necessary to explain the local settlement pattern which follows along the traditionally established practice of living in large communities and is generally applicable to a large portion of the population. The overwhelming majority of the farmers cultivating in the lands area live permanently in Kanye and only come to their lands dwelling during the crop growing season and do not necessarily bring the entire family. At the end of the season there is a migration of families back to Kanye. The main explanation for the continuation of this traditional practice was primarily due to the lack of a perennial water supply in the lands area. Since the initiation of the IFPP, 6 more boreholes have been opened in the Pelotshetlha lands area, with a total of 8 now in operation. However, in spite of this and the creation of a school and clinic near the IFPP headquarters in Pelotshetlha, a majority of families still migrate back to Kanye - mainly in order to participate in the traditional feasts and celebrations held there which occur in the dry season (May - October). However, there has been an increase in the number of families who now live permanently on the lands area as the water situation has improved (IFPP, pers. comm.).

For this reason, figures on population density are not particularly indicative of the overall situation in the arable area due to the continuous migration of household members and the fact that crop production may actually be supporting larger households whose members are permanently based in Kanye.

Farm Size and Crops Grown

The Farm Management Survey, based on a sample of 60 farmers, revealed that there is no problem of a shortage of arable land in this area. The range in area ploughed extends from 1 ha. to over 20 hectares, the majority ploughing less than 10 hectares, with an average of about 5 ha. per household. Few households cultivate all the area allocated to them, the main reasons being

lack of: labour, draught power, seed, time or unsuitable climatic conditions. About 90% of households do try to plant each season.

The main dryland crops are sorghum, maize, legumes, sweet reed (a type of sorghum with a high sugar content, the stalk of which is chewed like sugar cane), melons and pumpkins. The distribution of these crops as a percentage of cropped area is shown in Table 2.

TABLE 2

Main Crops grown by Percentage of Area Cultivated

Crop	% area cultivated
Sorghum	49
Maize	25
Tswana bean and other legumes	19
Sweet Reed	4
Miscellaneous (melon, pumpkin, groundnuts)	3

Source: IFPP Statistics

Virtually all farmers here grow some sorghum as it is the staple grain, and many keep a portion of the harvest as seed for the following season. Sweet reed is one of the first crops planted because it grows fairly quickly and once harvested the stalks can be sold (for chewing) in the Lobatse or Kanye markets, providing a small income, while some of the grain is reserved for next season's seed and the rest is fed to chickens. Most households try to grow some legumes, pumpkins and melons for home consumption, either in their own patch or intercropped with sorghum and/or maize.

Although investigative work is under way on short duration seed varieties, the traditional long season varieties of maize and sorghum (120 days) tend to be more commonly planted in spite of their longer maturation. This is partly due to maximising one's chances of getting a harvest under erratic rainfall conditions, because long season varieties can be more drought tolerant.

Planting can begin as early as October, but most farmers wait until December when rainfall is usually higher. This delay prevents the opportunity of getting 2 harvests in the summer season. Extension workers continue to encourage farmers to prepare land earlier and start planting sooner and over a long period, when appropriate conditions prevail. This staggering of planting helps reduce losses should dry conditions develop at some stage during the growing season, with only a portion of the crop possibly being affected, depending on the growth stage it has achieved.

Crop yields vary tremendously, and part of the activity of IFPP is to monitor output on the basis of the land preparation and planting techniques used by the farmers. There are two main

categories of farmers:

(a) the "traditional" farmers - those planting traditionally, i.e., broadcasting seed; and

(b) the "improved" farmers - those planting in rows using a planter (either oxen, donkey or tractor drawn).

In Botswana, the majority of farmers broadcast their seed and plough it in, all in one operation. In this particular project area, emphasis has been on encouraging farmers to adopt improved techniques of land preparation and planting which will increase production, and comparisons of yields are made each cropping season for a sample of farmers using various techniques. The 2 main categories, "traditional" and "improved" are then divided according to the source of power used, i.e., tractor, adequate oxen, donkey users and inadequate draught power. Farmers in the "traditional" category broadcast seed onto their fields and then plough it in using one of the 4 power sources stated above, while those in the "improved" category first prepare land using one of the four power sources and then row plant their seeds using either a tractor drawn planter or an ox-drawn planter, depending on the power source and equipment available to them. The range of yields obtained for the two categories from the 1980/81 planting season are elaborated in Table 3 below for 3 major crops.

TABLE 3

Range of Average Crop Yields by Farmer Category (1980/81 Season)

	Traditional planting method	Improved planting method
	Yield kg/ha	Yield kg/ha
Sorghum	112 - 541*	273 - 577
Maize	101 - 285	207 - 918
Tswana Beans	87 - 262	159 - 399

* represents one farmer with unusually high output, the next highest average was 272 kg/ha

Source: IFPP Preliminary Report of the 1980/81 Season

As the above figures reveal, a few farmers using the traditional broadcasting method of planting manage to achieve outputs comparable to, if not better than some of those using the improved row planting technique but this is not indicative of the usual trend. In general, those with tractors, adequate oxen or donkey power achieve higher yields when row planting than when broadcasting their seed. Farmers with inadequate draught power using the improved planting method have the lowest average yields of the "improved" category, and are sometimes surpassed by yields of those using the "traditional" planting method. Some tractor users that broadcast their seed do not necessarily have the highest returns in the "traditional" category indicating that equipment alone is not the only factor affecting output (IFPP

Preliminary Report, 1980/81 Season).

Household Cash Income and Sources

Households can have 3 main sources of cash income, namely from farm activities, non-farm activities and off-farm wage earning activities. Farm activities include sale of crops and/or livestock, with livestock being the main source of most farm income, ranging from 26% to 63% of a household's total cash income. Virtually every household sells some livestock each year. Crop sales form a small percentage of farm income ranging from 0 to 28% depending on whether or not a family has produced above its subsistence requirements. Not all households sell crops each year.

In seasons affected by drought where output is low, some households are forced to sell cattle in order to acquire cash to purchase their food needs, especially if they have no source of off-farm income.

Non-farm income can be derived from beer brewing and sale, handicraft production, thatching and practising as a traditional doctor, to name but a few activities. No figures were immediately available to indicate what proportion of the community engaged in such activities but traditional doctors appeared to earn the highest income in this particular category.

Off-farm employment is the single most important source of household income in Pelotshetlha. Almost every household has at least one off-farm wage earner, most of whom are working somewhere within Botswana with only a minority working abroad in South Africa or elsewhere (pers. comm.).

Table 4 indicates the cash income by source for a stratified sample of Pelotshetlha households which have been classified into 4 categories based on their draught power resources, with a fifth group comprised of a cross-section of farm households in the area. All 5 groups have been monitored throughout the 1980/81 season.

TABLE 4

Distribution of Average Cash Income by Source for a Sample of Pelotshetlha Households

Household Category	Average Income P	Source of Income: Arable %	Livestock %	Off-farm %
Inadequate draught power (n = 8)	750	5	26	69
Adequate oxen draught power (n = 25)	1 380	28	42	30
Adequate donkey draught power (n = 7)	1 070	22	34	44
Tractor Users (n= 8)	1 130	-a)	63	37
Cross-section of households b) (n = 11)	565	19	31	50

Source: IFPP Preliminary Report, 1980/81 Season

a) Average arable income for tractor owners was negative because the high cost of running tractors exceeded the income from crop production. The sale of livestock off-set the deficit of the arable sector.

b) This category represents a separate sample and is not derived from an average of the previous 4 categories.

Remittances from off-farm workers can account for up to 69% of household income especially in households which own less than 10 cattle (inadequate draught category). Households with large cattle holdings have, on average, a much smaller proportion (30%) of their income derived from off-farm sources, while a larger proportion comes from livestock sales (42%). Tractor users, on average, have a slightly smaller net cash income than "adequate oxen" households due to the costs incurred for operating and maintaining a tractor. Although this supports the belief that tractor usage is not economically feasible on this small scale, it does not seem to deter farmers from hiring or purchasing them. Basically, tractor ploughing is regarded as a fast and labour saving option and those households with the financial resources will make use of them, especially when there is a shortage of available farm labour.

III. DRAUGHT POWER AND ANIMAL FEEDING PROBLEM

Cattle Ownership

National figures for Botswana indicate that approximately 33% of the total population do not own cattle, whereas in this particular area only about 10% of the population do not own any cattle. Total number of cattle in Pelotshetlha are in the region

of 12 000 to 15 000 head with an approximate distribution shown in Table 6 below.

TABLE 6

Distribution of Cattle Ownership by Household

Herd Size	% Households owning
1 - 10	20
11 - 20	30
21 - 30	15
31 - 40	15
41 - 50	5
51 - 60	5
61 - 100	5
100+	5

Source: IFPP, Provisional Figures, 1982/83

Fifty per cent of the households own 20 or less cattle and the Animal Production Research Unit has calculated that the herd size must be larger than 20 in order to have a workable number (4) of draught oxen (pers. comm.). Therefore, half the households can be classified as having inadequate draught power.

Oxen holdings in Pelotshetlha are revealed in Table 7 below.

TABLE 7

Distribution of Oxen Ownership by Household

Number of Oxen	% Households Owning
0	8
1 - 2	25
3 - 4	20
5 - 6	15
7 - 8	10
9 - 10	10
11 - 12	10
13+	2

Source: IFPP Provisional Figures, 1982/83

Oxen ownership figures reveal that 47% of the households have at least 5 oxen which are seen as sufficient for draught purposes.

Cattle Uses

Cattle have traditionally been acquired as a store of wealth and for ceremonial purposes. They also provide draught power for transport and farming activities; milk - which is predominantly used for home consumption while only a small portion is sold (in April 1982 91% of farmers were milking cows in Pelotshetlha), and meat. Tribal land farmers provide about 31% of the total cattle to the Botswana Meat Commission for slaughter and beef production purposes (Ministry of Finance and Development Planning, 1980:

147). Cattle can easily be sold when a household is in need of cash. Those farmers with oxen tend to sell them to the Botswana Meat Commission when they reach the optimum age of 6 years. After this age the oxen tend to devalue. This causes a fairly high turnover of oxen in particular, which is the main category featuring in cattle sales since they bring the highest returns. In general, marketing of cattle is a more lucrative enterprise than sale of crops (IFPP, pers. comm.).

Land Preparations

The extent and intensity of land preparations are dependent on climatic conditions, availability of draught power and equipment, availability of labour and financial resources. Rainfall is one of the crucial factors in farming activity because it softens the ground, making it suitable for ploughing and it also rejuvenates the grazing land to nourish cattle and build up their strength for ploughing activity. When rains are late or insufficient, preparation activities are delayed or totally abandoned for that season. Those farmers with insufficient draught power and/or insufficient labour must rely on family or neighbours to assist them (through loan or hire) and often this means waiting until the latter's land preparation activities are completed before work starts on their own fields. This is another cause of delay. If there is a shortage of draught power or labour, an alternative is to hire a tractor to accomplish ploughing activities provided the household has sufficient cash resources. There are approximately 20 privately owned tractors in Pelotshetlha and pressure on these at ploughing time is yet another cause for delay in accomplishing land preparation activities. Because of the various factors which can delay land preparation activities and hence delay planting, farmers seek the least time-consuming practices in order to accomplish these tasks.

The most common practice in Botswana is to broadcast seed on to unprepared land and just plough it in - all in one operation; however, emphasis here has been on encouraging farmers to adopt other techniques which are seen to be more productive, but are also more time and labour consuming.

Many farmers use a variety of land preparation and planting techniques on their fields, depending on how much time is available and the appropriateness of weather conditions. Although winter ploughing is not common because families are usually in the process of returning to the village compound, it is being adopted by a small portion of farmers here. Table 8 provides a breakdown of techniques used by a sample of 60 Pelotshetlha farmers.

TABLE 8

Land Preparation and Planting Techniques
of a Sample of Pelotshetlha Farmers (n = 60)

Land Preparation and Planting Technique	% of Sample(*)
Ploughing	88
Double Ploughing	22
Broadcasting on First Ploughing	83
Broadcasting on Second Ploughing	40
Harrowing	13
Row Planting	58

(*) The percent exceeds 100 because farmers may use more than one technique on their fields. Of the sample of 60, 7 did not plant in the 1982/83 season.

Source: IFPP, pers. comm.

The incidence of row planting is particularly high here due to the encouragement of the project and the monitoring of productivity of different row planters. The project loans row planters to farmers free of charge. Row planting usually requires a certain degree of land preparation, i.e., ploughing, double ploughing and/or harrowing, which can be very time-consuming, before planting can begin. Those farmers who complete land preparations and begin row planting may sometimes find that planting time is running out and they will switch to broadcasting seed over the remainder of their prepared fields and either plough or harrow seed in. Certain seeds are not conducive to planting with row planters, i.e., certain legumes and pumpkin, hence farmers broadcast those while row planting sorghum, maize and beans.

In terms of number of days spent on preparation and planting activities, the minimum recorded was 3 to 4 days for broadcasting and ox-ploughing while keen farmers spend an average of 25 days on land preparation and planting activities. The draught team can work for only 4 - 6 hours per day, and can give an average of about 35 days of ploughing a year.

Focusing on the draught power situation, the normal ploughing team for this area consists of 8 to 10 cattle, with some farmers occasionally using 6 and even fewer using 12 or more animals. Planting with a row planter requires 2 oxen and ox-drawn cultivators also require a minimum of 2 oxen. Only 13% use ox-drawn cultivators. Harrowing, like ploughing commonly involves 8 to 10 cattle. The average plough team usually consists of a mixture of oxen (75%); tollies, i.e., castrated males under 5 years, (13%); cows (10%) and heifers, i.e., females under 3 years, (2%).

The Evaluation of Farming Systems and Agricultural Implements Project (EFSAIP) of the Ministry of Agriculture's Research Division is heavily involved with improving farming implements (especially ox-drawn equipment) and reducing the size of the

draught animal team through the use of more adequate equipment. One of the implements currently being perfected is a plough/planter which enables a farmer to plough his field and row plant seeds at the same time. This would allow farmers to accomplish planting in a one-step process but replaces broadcasting with row planting which is more efficient and usually produces higher yields. This particular implement is planned to be available in the 1983/84 season for farmers' use.

Farmer Strategies

Those farmers with insufficient draught power, i.e., those with 20 or fewer cattle, either have to borrow or hire cattle to complete their span. Of a sample of 53 Pelotshetlha households, 85% used cattle at some time in the 1982/83 season, of which 28% used borrowed cattle and 8% used hired cattle. Occasionally, when sufficient cattle are not available households use donkeys for land preparation and planting activities, either incorporating them into the cattle span or using an entire team of donkeys. 13% of the sample households used donkeys at some time during the 1982/83 season. When cash resources are available, a household with insufficient draught power can opt for hiring a tractor to accomplish land preparation and planting. Depending on the time and resources available, the household can either broadcast seed and tractor plough it in, or hire the tractor just for ploughing purposes then use an ox-drawn planter for seeding the fields. 32% of the sample used tractors at some time in the 1982/83 season.

Those farmers with adequate draught teams, i.e., those holding more than 20 head of cattle with at least 4 oxen, can encounter the problem of weak animals at ploughing time due to lack of feed. In some cases these farmers will hire a tractor in order to accomplish timely ploughing and use their draught team for further land preparation, i.e., double ploughing or harrowing, and planting later in the season when oxen have recouped their strength.

Of the tractor owners, only 2 have the tractor planting attachment which is rather costly. Therefore, most tractor owners use oxen to plant their fields which are almost as effective as a tractor planter but incur no variable costs.

Although most households in this area theoretically have either direct or indirect access (through kinship ties) to draught power (pers. comm.), the problem is mainly the timeliness of the access and availability of labour. Because of the time factor, the tendency to hire draught power has increased as financial resources of households have improved. 25% of sample households used some hired draught power while 47% used a combination of borrowed and hired draught power. The hire fees vary substantially depending on what is hired. Tractor hire fees average P25 an acre (P60 per hectare) while an oxen draught team, consisting of oxen and tollies but no females, costs from P5 - P10 per oxen day, i.e., the period of 4 - 6 hours that an ox-team can work per day. 21% of the sample hired tractors indicating the availability of and access to cash resources to cover this

expense, while only 8% hired cattle, the less costly but more labour intensive alternative.

Dry Season Cattle Feed

Communal grazing land provides the main source of cattle feed all year round, but especially during the rainy season. This source, however, is sub-optimal and unlikely to improve without remedial action. In Pelotshetlha, a perimeter drift fence demarks where the arable zone ends and the grazing area begins. Cattle herding follows a migratory pattern: during the rainy season, November to April, cattle are removed from the arable zone to the cattle posts in the grazing zone with a male herder. Those animals used for draught purposes remain in the lands area until their services are no longer needed. Some dairy cattle also remain in the arable area right through the season. Once harvesting has been completed cattle return to the arable zone to graze on crop residues and the grasses on disused fields. They can remain in the arable area throughout the winter but some farmers with large herds (over 50 head) keep their cattle at the cattle post all year round rather than trekking them back and forth.

Feed is not purchased, nor is there a tradition of growing specific fodder crops for cattle. However, experiments and trials are under way (Edwards, 1983; Chandler, 1983) here to identify suitable fodder crops which yield well under the local conditions. In the 1982/83 season about 30 farmers expressed interest and requested assistance in introducing fodder crops. Investigations are also under way to examine better ways of preserving crop residues which can be used as cattle feed during the dry season. It is understandable that as food cropping is such a precarious venture, little attention has been given to the production of animal fodders which would be in direct competition for land and labour to food crops since they have overlapping growing seasons.

Summary

Agro-climatic conditions of Botswana are not optimal for cropping activities and there is a high level of uncertainty in arable cropping. Climatic conditions prohibit winter cropping but there is potential for more intensive summer cropping which will increase overall production and better meet subsistence needs.

Examining the particular situation in this area reveals that population density and pressure on arable land are both low with the result that not all the allocated arable area is cleared and being used for cropping activity. In spite of the fact that winter cropping is not possible, there is potential for more intensive and larger scale summer cropping in the region although the population is not currently exploiting this potential. The adoption of some improved technology does increase the crop yield per hectare but requires more labour input than the traditional broadcasting and ploughing routine. Although off-farm employment contributes a significant portion of the cash income to the household, and its returns are higher than for agricultural activity, the job opportunities are limited and

the majority of households (90%) still make a concerted effort to continue with cropping activities each season.

Access to draught power is a problem in this area, but it is not as severe as in other parts of Botswana. Borrowing arrangements to acquire adequate draught power feature quite high while there is an increasing tendency to hire draught animals and especially tractors to accomplish agricultural tasks. The usual draught team consists of 8 to 10 cattle.

Although the general tendency to low labour intensity for land preparation and planting predominates, the IFPP has succeeded in encouraging a number of farmers to adopt more labour intensive practices which result in higher yields. Work on fodder crop production and crop residue preservation are still at the experimental stage and although potential exists, it is more a matter of how labour intensive and economically feasible such practices would be.

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LESOTHO

Leribe and Butha-Buthe: Block I Lowlands

I. LOCATION AND PHYSICAL CHARACTERISTICS

The Basic Agricultural Services Programme (BASP)[1] area which has been chosen for this study is Block I located in the Leribe and Butha-Buthe districts in north-western Lesotho. This region covers a total area of 521 000 hectares which is classified into arable and grazing land as shown in Table 1.

TABLE 1

BASP Block I Total Land Area and Distribution by Category and District

District	Total Area (ha.)	Arable	Grazing	Mixed
Leribe	339 000	67 800 (20%)	206 790 (61%)	64 410 (19%)
Butha-Buthe	182 000	18 200 (10%)	143 780 (79%)	20 020 (11%)
TOTAL	521 000	86 000	350 570	84 430

Source: Leribe District Agricultural Office (DAO)

Although Block 1 includes area in both the lowlands and foothills geographic zones, our focus will be on the lowlands which ranges in altitude from 1 600 to 1 800 metres above sea level and has distinct climatic and physical differences from the foothills zone. The lowlands are relatively flat, cut by occasional rivers with a number of sandstone outcrops abruptly jutting upwards, and it is in this region that Lesotho's best arable land is situated.

There are 2 main seasons in Lesotho, the cold winter months from April to September when snow and frosts occur and the warmer summer months, October to March when 80% of the rain falls. During the winter months the lowlands climate is less severe than the higher altitude zones (although frost does occasionally occur), making this an area suitable for winter cultivation.

Precipitation in Leribe and in northern Lesotho in general tends to be higher than in the south of the country with an average of approximately 700 - 800mm per annum. Recent monthly rainfall figures for the Leribe lowlands are shown in Table 2 while the long term monthly average precipitation for stations around the country are presented in Table 3. Rainfall tends to be short and heavy causing high surface run-offs which aggravate the erosion problem and hail is frequent and often causes serious crop damage.

TABLE 2

Monthly Rainfall Figures for the Leribe Block I Lowlands 1980 - 1983 (Hlotse Raingauge)

Month	1980 mm	1981 mm	1982 mm	1983 mm
January	96	273	96	39
February	146	81	79	61
March	63	85	56	55
April	23	46	188	38
May	6.4	12	11	15
June	0	23	19	19
July	1.2	0	9	
August	0	43	0	
September	108	15	14	
October	12	27	141	
November	126	89	104	
December	67	114	91	
TOTAL	648	808	808	

Source: Hlotse Raingauge, Leribe District Agriculture Office

The marked variation in monthly precipitation from year to year is immediately apparent in Table 2. The low figures from January 1983 onward reflect the recent drought conditions prevailing in Lesotho, especially when comparing them to the long-term monthly average figures for Leribe on Table ..

TABLE 3

Average Monthly Precipitation (mm)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	TOTAL	6 Months Winter Amt	6 Months Winter %	6 Months Summer Amt	6 Months Summer %
Lowlands																	
Butha-Buthe (28° 46'S 28°15'E 1770m)	12	14	27	78	99	110	127	107	105	58	30	13	780	154	20	626	80
Leribe (28° 53'S 28° 03'E 1740m)	13	13	30	76	104	117	132	115	112	60	34	13	819	163	20	656	80
Teyateyaneng (29° 09'S 27° 44'E 1750m)	11	12	22	68	90	93	111	93	99	57	31	11	698	144	21	554	79
Maseru (29° 17'S 27° 30'E 1530m)	12	13	21	61	88	89	108	91	99	60	29	11	682	146	21	536	79
Wepener, RSA (29° 44'S 27° 0[illegible]'E 1400m)	12	12	18	49	66	70	85	89	96	56	26	13	592	137	23	455	77
Mafeteng (29° 49'S 27° 15'E 1610m)	12	15	26	59	82	88	104	106	107	66	33	13	711	165	23	546	77
Mohale's Hoek (30° 00'S 27° 28'E 1600m)	14	15	26	62	86	95	113	101	106	61	37	15	731	168	23	563	77
Quthing (30° 25'S 27° 43'E 1740m)	14	17	34	64	83	98	101	93	102	67	37	15	725	184	25	541	75
Mountains																	
Mokhotlong (29° 17'S 29° 05'E 2200m)	9	14	23	57	78	90	105	78	66	36	21	9	586	112	19	474	81
Thaba Tseka (29° 30'S 28° 37'E 2160m)	11	14	22	59	67	86	96	72	74	39	27	8	575	121	21	454	79
Qacha's Nek (30° 07'S 28° 42'E 1970m)	13	19	39	66	103	147	163	140	120	46	26	18	900	161	18	739	82

Source: Hydro Survey, 1971 Period of record 50 years, 1920 - 1970 except Quthing (47 years to 1970); Mokhotlong (40 years to 1970) and Thaba Tseka (approx. 30 years of broken record to 1970)

The lowlands contain Lesotho's most suitable soil for agricultural activities and the following soil associations are found there:

(a) Khabos-Bela-Berea: Found in the valley bottoms composed of black alluvial soils which are very fertile, though some can have a lot of clay making them difficult to till. These are distributed over a small area.

(b) Leribe-Berea-Sephula: The predominant association occurring in this area is composed of a deep red moist soil high in potassium with a low pH. It is easy to till and produces a

good crop.

(c) Berea-Matela-Ntsi: Occurring on top of the occasional sandstone outcrops of the lowlands and composed of a yellow-grey poor soil.

(d) Sephula-Maseru-Berea: Gullied land located in the south-western section of Block I composed of duplex soils: a poor, sandy loam on top to a depth of 60cm under which lies a rich clay. This association causes some tillage problems but does produce a good fodder crop in winter because the clay holds the moisture.

(Source: Conservation Division, 1979)

With the exception of the alluvial soils, a few generalizations can be made of the rest of the soils in the lowlands. They have low nitrogen and phosphorus levels, low organic matter content and a low pH. With proper fertiliser applications, these deficiencies can be corrected which will improve yields.

The lowlands region has a longer growing season than the other zones in Lesotho and can support certain crops during the winter season whereas the foothills and mountains are usually covered with snow and, therefore, are too cold to support winter crops. The table below lists the major crops and the range of dates for planting and harvesting.

TABLE 4

Cropping Guidelines for the Block I Lowlands

Crop	Planting Time	Harvest
Maize	September - December	Mid-April - July
Sorghum	September - December	April - May
Beans (Haricot)	Mid-October - Mid-December	April
Potatoes	Mid-October - Mid-December	April - July
Annual Fodder	February - May	September - November
Peas	Mid-March - Mid-April	October - Mid-November
Wheat (winter)	Mid-March - Mid-April	November - December

Due to the currently prevailing drier weather conditions, the Ministry of Agriculture through extension activities in this area, has been trying to encourage farmers to adopt technology that will minimise their losses and make better use of rainfall when it does occur. The following practices are being encouraged in Block I:

(a) moisture conserving tillage techniques, such as winter ploughing;

(b) the use of drought tolerant seed varieties, such as maize;

(c) the use of drought tolerant crops (sorghum, groundnut, lentils);

(d) the use of plant populations that will minimise losses in low rainfall years;

(e) better weed control (Russell, 1982)

Through the adoption of the above techniques, farmers in this region should be able to maintain a reasonable output in spite of adverse weather conditions.

Having assessed the agricultural potential of the Block I Lowlands which is very high, focus will now turn to the socio-economic conditions prevailing in this region and a close look at what is actually happening within the farm household. Specific household data presented below is derived from the BASF Baseline Survey (Winch 1981) undertaken in 1979/80 which included a sample of 250 Block I lowlands households.

II. SOCIO-ECONOMIC ENVIRONMENT AND DESCRIPTION OF FARMING SYSTEM

Population Density

The average population density for Lesotho is 44 persons per km^2 but the majority of the population is concentrated in the western lowlands. This could be a result of its agro-climatic suitability and its proximity to the urban centres. Density figures for Leribe and Butha-Buthe are provided in Table 5. Although overall population density in Butha-Buthe is comparable with the country as a whole, the density on arable land is particularly high at 771 persons per km^2, basically because only 10% of its area is classified as arable. The high population density on arable land indicates the pressure that exists on these areas and makes land a limiting factor in agricultural activity.

TABLE 5

Population Density per km^2 and per km^2 on Arable Land

	Overall Population Density (persons per km^2)	Population Density on Arable Land (persons per km^2)
Lesotho (entire country)	44	343.2
Leribe District	72	453
Butha-Buthe District	48	771

Source: Annual Statistical Bulletin, 1981

In Lesotho, land tenure is complex with individual ownership traditionally impossible. Male heads of households are awarded use rights to arable land by the chief acting on behalf of the

King who holds all land in trust for the people. Land holdings are, on average, small (see Table 7) and about 15% of rural households are estimated to have no land allocation at all (Cobbe, 1982: 27).

Household Size and Land Allocation

According to recent estimates the total number of households in Block I is approximately 50 000 (pers. comm.) with an average household size in the lowlands of 6.2 persons (see Table 6) while 80% of households have 8 persons or less.

TABLE 6

Frequency Distribution of Household Size in the Block 1 Lowlands

No. of persons per household	% of households (n = 250)
1 - 2	11.2
3 - 5	33.6
6 - 8	35.2
9 - 11	14.8
12 - 14	4.0
15 - 16	1.2

Average 6.2 persons per household

Source: Steele and Winch, 1981: 15

Landholdings are determined by both the number of fields and the land area per household and this information for the sample of Block I lowlands is shown in Table 7.

TABLE 7

Frequency Distribution of Number of Fields and Land Area per Household in the Block I Lowlands

No. of Fields	No. of homesteads (n = 250)	%	Land Area per household (ha.)	No. of households (n = 176)(*)	%
1	139	56	less than .5	18	10
2	68	27	.5 - 1.0	46	26
3	31	12	1.1 - 1.5	45	26
4	6	2	1.6 - 2.0	21	12
5	2	1	2.1 - 2.5	15	8
6	2	1	2.6 - 3.0	12	7
7	1	1	3.1 and larger	19	11

mean 1.69 fields mean 1.61 ha.

(*) Only 176 farms were actually measured during survey

Source: Steele & Winch, 1981a: 20

As shown above, the average number of fields per household is

1.69 while 17% of the households own 3 or more fields. When considering the land area per household, the average is only 1.61 ha. with 74% of the households owning 2 hectares or less. These figures serve to confirm the pressure on arable land and the current belief that the majority of the holdings are of insufficient size to provide a reasonable standard of living for the families running them especially at the present level of cropping intensity (Steele & Winch, 1981a: 19).

Cropping Activity

The main dryland food crops grown in Lesotho are the staples, maize and sorghum, while beans, peas and wheat are grown on a smaller scale for home consumption and cash sale. Although these 5 crops tend to dominate the farming system, fruit trees and garden crops constitute an integral part of the system, especially in terms of helping generate some income.

In the Block 1 Lowlands maize is the most common crop followed by sorghum, beans, peas and finally wheat. Table 8 indicates the distribution of households growing these 5 crops.

TABLE 8

Number of Lowlands Households producing 5 Basic Crops

Crop	No. of Households	%
Maize	188	75
Sorghum	144	58
Beans	30	12
Peas	6	2
Wheat	2	1
	228(*)	

(*) Not all sample households were actually growing crops in 1979/80 season

Source: Steele & Winch 1981a: 24

The mean number of crops planted was 1.6 which is a direct result of the small land area and number of fields available to the households. In the sample, 44% of farmers planted only 1 crop and a similar percentage planted 2 crops, while only 2 cases were recorded where farmers planted 4 crops (Steele & Winch, 1981a: 24).

It is a common practice to mix crops within a field, with maize/sorghum being the most popular combination. This basic mix may be combined with legumes and sometimes pumpkins. Table 9 shows the cropping pattern of lowlands farmers and provides data on mean total yields from the 1978/79 season. Output figures were included in this table to provide some indication of average household production and these have been divided into two categores: output of entire lowlands sample and output of top producers. This latter group included the top 10% of households

with the highest output levels in the area and allows for a comparison to be made between the average smallholder and the top producers. However, the yield figures refer to total mean output and do not take into account the size of the area cultivated. It has been shown that top producers have on average twice as much arable land at their disposal (Winch, 1981: 168) but even taking this into consideration, the average yields are 2 to 4 times higher probably indicating more intensive cropping activity amongst the top producers.

TABLE 9

Percentage of Farmers Growing on a Field Basis Sole Crops and Crop Mixtures with Mean Output by Category of Producer

Crop Mix	% Farmers Growing	Mean Output entire Lowlands Sample (kg)	Mean Output Top Lowlands Producers (kg)
Maize only	30	531	2 355
Sorghum only	14	551	2 085
Beans only	1	-	-
Maize/sorghum	41	1 154	2 775
Maize/sorghum/legume	7	1 227	2 277
Maize/legume	5	624	1 920
Sorghum/legume	1	969	-
Wheat only	1	-	2 100

Source: Steele & Winch, 1981a: 25 and Winch 1981: 167

The percentage of farmers growing wheat is very low for several reasons:

(a) ox-drawn planers cannot be used to plant wheat, so the alternatives are broadcasting or using a tractor planter, of which there are few;

(b) winter wheat planting season can overlap with harvesting of summer crops, and fields may not be ready in time;

(c) wheat harvesting clashes with maize weeding time;

(d) thrashing without a machine is very laborious;

(e) yields and therefore profits are low in most years (Russell, 1982: 8)

Only those farmers with access to tractors and combine harvesters tend to become involved with wheat production.

Comparing the list of common crops grown with the planting guidelines (Table 4) reveals the predominance of summer crops being grown with little attention paid to any winter cultivation. Although the potential exists for a 2 season crop year, few farmers are actually taking advantage of the opportunity. The main reasons for not taking up winter cropping are:

(a) there is a great demand to allow livestock to graze the summer crop residues left in arable fields during the winter;

(b) it is difficult to prepare and cultivate the dry, hardened fields in April and May due to the onset of the dry season.

It was revealed, however, that winter cropping was proportionately more important to those farmers classified as top producers and contributed significantly to their producing more (Steele & Winch, 1981a: 31).

One factor promoting winter cropping has been the Food Self-Sufficiency Programme* which came into operation in a portion of Block I Lowlands in 1980. This scheme operated on the consolidated fields of entire consenting villages, using an intensive inputs and mechanization regime for growing maize during the summer months and wheat in winter. Farmers only needed to provide the land, all labour was mechanised and inputs were provided by the programme. A portion of the harvest was retained by the scheme to cover its costs while the rest went to each participating household to do with as they pleased.

Crop Value and Sources of Farm Income

The total value of crop production in the lowlands averaged M137 (M = Maloti, which is on a par with the South African Rand) per household with the majority of lowland farmers (89%) producing under M200 of crops, indicating that the level of production is very low (Steele & Winch, 1981a: 28). When considering only the top producers, their average total crop value was M397. Sale of farm crops, however, plays a minor role in income generation and the main staples, maize and sorghum, are predominantly kept for home consumption. The average value of crops sold was M43 while for the top producers the average value of crops sold was M103 (Winch, 1981: 172). It is important to note that 71% of the lowlands farmers did not sell any crops from the 1978/79 season (Winch, 1981: 91) which could indicate that they had insufficient yields to meet their own requirements. Indeed, they may have had to supplement their production with purchased food commodities.

Farm income can be derived from the sales of fruit from the household's fruit trees and also from the sale of garden produce. Only 16% of the lowlands households do not have any fruit trees while 84% own an average of 11 peach trees - the most common type (Winch, 1981: 92). The 1982 Farm Management Monitoring Survey revealed 22% of the sample of 114 sold fruit (Steele 1983: Table 2: 11) although no precise income from this source was reported.

Three to four garden crops are grown on average per lowlands household with the most frequent types being sepaile (a vegetable green), pumpkin, cabbage, maize, potato and tomato. Up to 29% of the households sold a portion of what they produced while the bulk of this production is consumed at home (Winch, 1981: 96).

The sale of livestock is not a regular practice and of those

households owning cattle 76% responded that they do not sell cattle mainly because they have too few but 36% said they would sell an animal if they needed cash quickly. Hence, cattle sale does not feature as a regular source of farm income but is resorted to in an emergency.

Although no precise figures have been reported, "on average, rural homesteads derive only about 20% of their total income from agricultural activities" (Cobbe, 1982: 27).

Non-Farm Income

Non-farm activities provide a source of income for households in the area, especially female headed households. Such activities include beer brewing and sale, collection of firewood for sale, small scale handicraft production, preparation of food for sale, domestic services or wage labour for other households. A few rural households have more substantial non-farm enterprises which include retail trade, cafes, beer houses, transport and construction (Cobbe, 1982: 32). No figures were available, however, to indicate the percentage of annual income provided by these activities or the number of households involved with them.

Off-Farm Income

Off-farm income is an important cash source for lowlands households. The Baseline Survey revealed that 57% of the households had 1 or more members away from the farm for an average of 7 months, engaged in off-farm employment (Winch, 1981: 55). Forty-six percent of adult males who are not household heads are employed in the Republic of South Africa while 40% of male household heads are also employed there (Winch, 1981: 21). The majority of females (81%) are permanently at home engaged in farming and domestic activities with only a small portion working off-farm.

In 1980, the poverty datum line was estimated at about M1 000 per annum for an average household, whereas the average annual income for households without access to migrant earnings in 1980 was less than M400. For those households with access to migrant remittances the average annual income was estimated at M1 500 in 1980 (Kingdom of Lesotho, 1981: 20). The difference between households with and without access to remittances is very significant and these figures make clear the fact that agriculture alone, especially on the small scale in which most households are involved, cannot sufficiently support the family. In general, remittances form the largest single source of income for many of the households in this particular lowlands region (Leribe DAO, pers. comm.).

III. THE DRAUGHT POWER AND ANIMAL FEEDING PROBLEM

Nature and Extent of Draught Access

In October 1982 a Farm Management Monitoring Survey (Steele, 1983) was undertaken in the BASF Block 1 area which provides updated data on livestock holdings. Of a sample of 170 households in the area, 112 (66%) own a total of 569 cattle and of those cattle owners only 5 do not have female cattle. Table 10 presents a breakdown of cattle ownership by type and average number held by households owning cattle.

TABLE 10

Cattle Ownership by Category in Block 1 Lowlands

Category of Cattle	% Households owning	Average Number held
Milk Cows	46	2.0
Breed Cows	11	1.4
Oxen	33	2.3
Bulls	18	1.1

Source: Farm Management Survey, 1983: Table 2.8

The average number of cattle per owner is 5.0 while the average number of oxen per holder is only 2.3 and only 33% of the households actually own oxen. These figures are very comparable to results of the Baseline Survey where 35% of lowlands households were recorded as owning an average of 2.5 oxen (Winch, 1981: 64) and only 12% of the household owned 4 or more oxen (Steele & Winch, 1981a: 23).

As the normal ploughing team consists of 4 to 6 oxen and as 52% of the lowlands farmers depend on oxen to plough their land (Winch, 1981: 73) it suggests that there must be a great deal of borrowing or hiring of oxen among households. Further, only 35% of the lowland farmers own their own ploughs and only 24% own their own planters (Winch, 1981: 64), indicating that not only animals but also equipment must be hired or borrowed, demonstrating the extent of the problem farmers have to tackle.

Uses of Cattle

Apart from draught, which was the main purpose stated for keeping oxen, households retain cattle for the following main reasons: milk production (mostly for home consumption), breeding, bohali (bride price) and meat. Table 11 provides a detailed breakdown of cattle uses and the interesting point to note is that all categories of cattle are used for draught purposes, not just oxen.

TABLE 11

Purpose of Raising Cattle by Category in the Northern Lowlands

Purpose	Oxen	Cows <24 mos	Bulls <6 mos	Heifers 7 - 24 mos	Calves 6 mos
	%	%	%	%	%
Draught	70.0	22.8	35.4	29.5	32.2
Meat	3.8	7.0	11.8	4.3	5.9
Milk	2.7*)	36.8	-	14.3	2.5
General	8.5	2.9	3.6	9.0	12.7
Sale	1.5	3.4	8.2	4.8	8.5
Bohali	3.8	6.0	12.8	6.2	10.2
Transport	0.4	-	2.1	-	0.8
Breeding	1.9	13.0	21.0	22.9	16.9
Multiple	5.5	6.5	4.0	7.3	9.2
Other	-	0.9	0.6	-	0.3
No Response	1.9	0.7	0.5	1.9	0.8

*) An obvious enumeration or punching error

Source: Winch, 1981: 66

The underlying reason for acquiring cattle in the first place continues to be ascribed to their cultural and social significance and as a store of wealth. The latter was emphasised by the sharp increase in cattle numbers and imports during the mid-1970s which can be correlated with the escalation of off-farm earnings due to the increase in mine wages (Eckert, 1982: 153-155). (Recently imports have been reduced due to restrictions on bringing cattle into the country because of pressure on grazing and the high mortality rate amongst imported cattle due to the severe climatic conditions.)

Household Response to the Draught Problem

Ploughing: As previously indicated, 52% of households use draught power for ploughing but only about 35% actually have their own oxen. Many farmers overcome the problem of a shortage of oxen by using a mixture of male and female cattle or old and young beasts while there is a less common practice of using donkeys to complete the draught team. In the Block 1 area, however, there seems to be a strong tendency for the draught team to consist of only 2 animals rather than the more common 4 or 6. Various reasons have been given to explain why only 2 animals are used for ploughing:

(a) Due to the low number of cattle per household and in the area in general, farmers use what is immediately accessible to them.

(b) The animals are stronger because more feed is available to them so only 2 are necessary to do the job.

(c) The soil is better quality and easier to work so a small

team is adequate for ploughing.

(d) Some use two, then set them to graze and hook up a fresh team of two and continue ploughing longer, rather than tiring out 4 animals at once.

Other alternatives available to overcome the draught problem include:

(a) borrowing oxen and/or equipment from extended family;

(b) hiring oxen and/or equipment;

(c) hiring a tractor.

Table 12 indicates the proportion of households using the various power sources to accomplish ploughing. The majority (52%) use oxen, either their own (which includes those borrowed from their extended family without charge) or hired, or a combination of both their own and hired oxen, while 39.1% use tractors only. 9.2% use a combination of oxen and a tractor to accomplish their ploughing activity.

TABLE 12

Power Source for Ploughing for a Sample of Lowlands Households

(n = 750)

Power Source	No. of households	% of households	
Own oxen	212	30.5)	
Hired oxen	142	20.4)	52%
Own and Hired Oxen	5	0.7)	
Own Tractor	10	1.4)	
Hired Tractor	262	37.7)	39.1%
Own Oxen-hired Tractor	30	4.3)	
Hired Oxen and Tractor	34	4.9)	9.2%
	---	-----	
	695	100.0	
No Response	55		

TOTAL	750		

Source: Winch, 1981: 74

As shown in Table 12, 62% of households accomplished land preparations with equipment entirely their own while the remainder had to hire some portion of their power source. Those hiring oxen and/or equipment from their neighbours or other contractors can pay for the service in a variety of ways, either through a cash settlement based on time and area worked or a sharecropping* arrangement. 30% of the farmers here were involved with sharecropping and it was indicated that this was a common form of repayment for draught power assistance (Leribe

DOA, pers. comm.). Tractor hiring usually requires cash payment which indicates the dependence on off-farm resources in order to complete initial land preparation. The hire rate for tractors during the 1982/83 season was in the region of M16 per .5 hectare, making the charge for ploughing the average sized field about M50.

The interest in tractor as opposed to ox draught power could stem from:

(a) the relatively high number (45%) of female headed households and the fact that women don't operate ox-drawn ploughs;

(b) the lack of draught animals and difficulty in arranging timely draught hire;

(c) the poor condition of draught animals and broken draught equipment;

(d) the speed at which tractor ploughing can be completed;

(e) shortage of farm labour and availability of cash for hiring a tractor;

(f) the more adequate ploughing job done by tractors compared with existing ox-drawn equipment.

Households in this area perceived their main ploughing problems as: lack of tractors available for ploughing (19%); lack of oxen (13%); lack of money to hire oxen (13%); lack of money to hire tractors (12%); weak oxen (7%); while 29% of the sample households stated they had no problems. Those farmers specifically using oxen and ox-drawn equipment stated their main problem was the weak condition of oxen, usually due to poor feeding and/or health problems. Another common problem was broken draught equipment. The BASP Mobile Repair Teams" were created specifically to deal with this latter problem (Steele & Winch, 1981b: 6-7).

Planting: Planting in this area tends to be done with ox-drawn planters rather than by hand or tractor planters. An ox-drawn planter only requires 2 draught animals as the operation and equipment are relatively light. It is common to find women operating ox-drawn planters whereas it is still uncommon to find women operating ox-drawn ploughs. In general, most seed is planted with the aid of an ox-drawn planter but only 24% of the sampled farmers own ox-drawn planters (Steele & Winch,1981: 23) and therefore the majority of farmers have to rent or borrow this implement. While 39% of the lowland farmers identified no planting problems, 21% said they lacked money to hire planters, 10% lacked seed or fertilizer, 9% said there was a shortage of planters for hire, 8% said price of inputs was too high, and 5% lacked oxen (Steele & Winch, 1981b: 10). Most of the above-mentioned problems could be solved with cash.

Although there are currently 350 privately owned tractors in the area covered by Block I, only a small number of owners actually own tractor planting attachments, the reason being that this piece of equipment is very costly and not economically viable for the small size of fields generally found in this area (Leribe

DAO, pers. comm.)

Weeding: Approximately 38% of the households in this region owned an ox-drawn cultivator which requires 2 oxen to pull it. Few farmers expressed problems with weeding and of those that did, 10% stated lack of money to hire a cultivator while 9% stated lack of money to hire labour to weed. As most crops are row planted rather than broadcast, the possibility of using a cultivator is high but there were no figures collected on the percentage of households actually using them.

Extent of Purchase of Draught Reducing Inputs

According to the Baseline Survey, 48% of lowlands farmers used a tractor for their land preparation activities in the 1979/80 season (see Table 9) and the overwhelming majority of these farmers were hiring those tractors. However, the Baseline Survey only included 3 or 4 tractor owners in its sample whereas there are now about 350 private tractors in Block I and it is believed that about 77% of the lowlands farmers use tractors for ploughing (Leribe DAO, pers. comm.) The high number of private tractors and the high proportion of farmers resorting to this means of land preparation indicate its popularity in this region and the financial resources of the community. Many of the private tractor owners use their tractors only 2 or 3 months of the year on agricultural activities while the rest of the year they are used as a form of public transport, thereby providing an additional income for the household (Leribe DAO, pers. comm.)

Nature and Extent of Dry Season Cattle Feed Problem

Current Sources of Dry Season Cattle Feed: The communal nature of pasture use rights (also a feature of Botswana and Swaziland) serves to maintain the low input expenditure characteristic of livestock ownership. Due to this factor, those with the financial means tend to invest in cattle regardless of the immediate land (arable) resources available to them. However, in recent years, due to severe overstocking the communal areas are insufficient to support the large herds especially during the dry season.

The livestock feeding pattern characteristic of this lowlands region is of a migratory nature. During the cropping season (summer months October to March) most cattle are trekked to communal cattle posts in the foothills and mountains where they remain until the winter months. A small number of cattle will remain behind kraaled at the homestead for draught purposes or milk production. Once harvesting is under way, cattle return to the lowlands where they remain for the duration of the dry season (winter is too severe for cattle to remain in the mountains), feeding on crop residues, mainly maize stover, and on the local communal grazing areas.

As the recent drought conditions have caused poor harvests and slow rejuvenation of natural pastures, sources of dry season feed are severely reduced. Even in years with adequate rainfall and

good harvests, crop residues and natural pastures are not sufficient. There are some farmers who purchase lucerne and bran cattle feed from the Republic of South Africa. Unfortunately, little of this feed is produced currently in Lesotho, and the high cost and logistics of transporting this material from South Africa significantly reduces the number of purchasers from this area (Leribe DAO, pers. comm.)

Potential Sources of Dry Season Cattle Feed: As revealed in the Crops section, the lowlands climate is suitable for the production of winter fodder crops and as the land is usually left fallow, this practice would make more intensive use of the land while helping solve a feeding problem at the same time. The Ministry of Agriculture has made a large effort to encourage farmers to grow fodder crops (see Component Research section) and has identified particular species that are good yielders under the local conditions.

Some farmers are experimenting by growing small areas of winter fodder crops on enclosed (fenced) fields to prevent cattle damage to the crop. The labour effort is no more intensive than that for maize or sorghum and depending on the type of crop, it can either be harvested and stored or grazed straight from the field. In comparison with the exorbitant current cost of purchasing feed from South Africa, winter forage production seems to present an economically feasible alternative source of feed. It remains to be seen, however, whether households have the labour and time to devote to winter cropping, considering the already high opportunity cost of agricultural activities compared with off-farm employment. This production is being encouraged amongst non-cattle owners as well, in terms of fodder being seen as a cash crop which could provide a source of income especially considering the potential market within Lesotho itself (Ministry of Agriculture, pers. comm.)

Summary

The physical and climatic conditions of the Block I Lowlands make it an area very suitable for agricultural activity. It is significant to add that the lowlands are the only geographic zone within the country conducive to large scale agricultural mechanization while the rolling hills and steep slopes of the foothills and mountains prohibit tractor usages on a large or economically viable scale. This factor has certain implications for draught power.

The cropping guidelines indicate that there is scope for planting crops during winter months without interfering with the main summer plantings. Because the lowlands climate is conducive to a winter growing season, there is potential for fairly intensive land use in the area.

However, in spite of the seemingly high population density, the practice of more intensive land use through winter cropping is not being adopted on any considerable scale by lowlands farmers. The reason for the lack of uptake is the high labour demands and relatively low returns which cropping activity provides. The

high economic returns from off-farm wage employment, particularly in the South African mines, indicates that the opportunity cost of farming is very high and thus accounts for the diversion of manpower from domestic agriculture to the off-farm sector. Until the wage or income earning gap is reduced, farm development and smallholder production and income will continue to be depressed.

It is apparent that in the Block I lowlands, access to ox-draught power and the complementary equipment has been and continues to be a problem for most farmers. For those few not encountering an access problem, the scarcity of dry season cattle feed at the end of winter is a main factor causing the poor condition of oxen when their energy and services are most needed for ploughing. It is interesting to note that in this lowlands area the average plough team is usually composed of only two oxen. There has been an increasing tendency, however, to turn to an alternative power source - the tractor - particularly in order to do ploughing, while the operations of planting and weeding are still the main domain of draught power. The prevalence of tractor usage indicates the financial resources available to a high portion of the households, usually originating from off-farm wage employment. There is potential, through the adoption and intensification of winter cropping, for the production of fodder crops which would help overcome the problem of the poor condition of draught animals at ploughing time.

NOTES

1 The Basic Agricultural Services Programme (BASP), established in Lesotho in 1978 was designed to contribute to a long term agricultural development strategy over a 5 year period. Its goal was to provide a physical and institutional infrastructure for agricultural services in the lowlands and foothills situated along the western edge of Lesotho and to promote production of the 5 major food crops - maize, sorghum, wheat, beans and peas. The region was divided into 5 blocks each with its own supporting infrastructure. Creation of an inputs and marketing network in the form of stores and roads as well as agricultural extension services, mobile implement repair teams and training services were considered as priority tasks of the programme. Although officially reaching the end of its term in April 1983, some of the infrastructures created through BASP continue to operate under direct government or Co-operative Lesotho supervision.

2 In the 1980/81 summer season the Food Self-Sufficiency Programme was established by a Chinese Agricultural Mission under the auspices of the Prime Minister's Office. The Technical Operations Units (TOU), Ministry of Agriculture, has become the over-seer of this programme which is an attempt to become self-sufficient in maize. TOU provides the inputs (seed, fertilizer, herbicides, pesticides) and undertakes all the agricultural operations - ploughing, planting, spraying and harvesting - while selected lowland farmers provide their arable fields for the scheme. The objective was to intensify cropping and increase yields while freeing farmers to engage in other farm activities which would be more lucrative such as vegetable production, dairying and small livestock raising all of which would provide a source of income to the farm household. A preliminary evaluation of this scheme, however, indicates that farmers have not diversified in spite of this scheme.

3 Sharecropping is an arrangement by which a farmer, in return for some goods or services provided to him, will share out either a portion of his harvest or a portion of his land to the person to whom he is indebted.

Example: Farmer A "hires" the oxen and draught equipment from Farmer B to plough his field, the payment of which will be made at harvest time when Farmer A will give Farmer B an agreed portion of his harvested crop: or Farmer A will permit Farmer B to use some of his arable land for cropping that season.

4 The Mobile Repair Teams consisted of trained farm-machinery mechanics who travelled from village to village repairing broken ox-drawn equipment. Gradually they became more involved in helping to teach farmers proper usage and maintenance of draught equipment, thus becoming more extension oriented. Currently 3 teams are still operating, one each in Leribe, Butha-Buthe and Teyateyaneng.

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LESOTHO

Nyakosoba Prototype Area - Central Foothills

I. LOCATION AND PHYSICAL CHARACTERISTICS

The Nyakosoba prototype area is one of 3 areas which was chosen in 1980 by the Ministry of Agriculture's Farming Systems Research Project (Research Division) for intensive study and monitoring. It is located in the Central Foothills of Maseru District, south-east of Roma and approximately 40 km south-east of MASERU, the capital. The altitude ranges from 2000 - 2900 metres and the total study area encompasses 5 950 hectares of which about one-third is considered arable and the rest grazing land. Approximately 1044 (1980 estimate) households live in this zone. There is one major river valley, the Makhalaneng, occupying the western third of the region while the eastern two-thirds is mountainous with elevations greater than 2200 metres. Most of the cropped land lies below 2300 metres (Mack, 1981: 13.).

Average annual precipitation ranges from 800 - 1000 mm while monthly rainfall figures collected from the Nyakosoba rain gauge are presented in table 1 below. The main rains are concentrated during the months of October to March which corresponds to the summer growing season.

TABLE 1

Monthly Rainfall for Nyakosoba Prototype Area
November 1980 to May 1983

Month	1980	1981	1982	1983
January		278	46	50.5
February		206	101	70.5
March		No record	107	No record
April		85	171	36.25
May		60	10.5	32.75
June		21	18	28.25
July		No record	26.5	
August		79	0	
September		13	34	
October		50	209	
November	112	144	107	
December	63	128	No record	
		1 084	829	

(Source: Agriculture Research Division: Nyakosoba File)

Rainfall is one of the crucial determinants in land preparation, time of planting, quality and density of crops during the growing period, the final yield and the time of harvest. The heavily defined and sometimes erratic seasonal distribution of rain is also a key factor affecting the varying condition of draught

animals: i.e., they are in their worst condition at ploughing and sowing time and in their best condition just after harvest and at the beginning of the long fallow period, during which time they are least used. Improved farm management, however, can significantly contribute to reducing the detrimental effects of low rainfall on crop yields. (Eckert, 1980: 90)

Approximately one-quarter to one-third of the area of Nyakosoba is considered arable while the rest is communal grazing land. The arable soils are deep, dark, highly organic loams with reasonable drainage and a neutral pH. The grazing area is characterised by moderate to steep slopes and shallow soils overlying bedrock (for more detailed description see Mack, 1981).

The geographic location of Nyakosoba in the foothills zone limits the possibility of a winter cropping season because the climate is too severe, with frost and snow common occurrences. The summer season extends from October to May with the ploughing, planting and harvesting schedule for the main crops elaborated in Table 2.

TABLE 2

Foothills Cropping Guidelines

Crop	Range of Months for: Ploughing	Planting	Harvesting
Maize	Sept. - Nov.	Oct. - Nov.	March - May
Sorghum	Oct. - Nov.	Oct. - Nov.	March - May
Beans	Sept. - Nov.	Oct. - Dec.	Feb. - May
Peas	Feb. - March	April - May	Aug. - Sept.
Wheat (spring)	July - Sept.	July - Sept.	Dec. - Feb.
Wheat (winter)	Jan. - March	April - June	Sept. - Nov.

(Source: Ministry of Agriculture, Crops Division)

II. SOCIO-ECONOMIC ENVIRONMENT AND DESCRIPTION OF FARMING SYSTEM

The overall population density in this area is estimated to be approximately 70 persons per km², with approximately 247 persons per km² of arable land. These density figures are not particularly high compared to other areas of the country, i.e., Leribe and Butha Buthe. The average household size is 3.7 persons (Plath, 1982: 4) and the average land area is 1.9 hectares per household, with an average of 2.2 fields (Plath, 1982: 9).

As in Botswana and Swaziland, land is not privately owned by the family but the use rights to a piece of land are allocated to the household by the chief. Of a sample of 153 Nyakosoba households, 28% (43) had no land allocations, while 66% had from 1 to 3 fields (Holland, 1983: 6). Land distribution of a smaller sample (n = 28) of Nyakosoba farmers is shown in Table 3. Usually fields are sub-divided into 2 or more parcels, as a measure to

control erosion on the sloping land. Each parcel is usually devoted to a single crop (Plath, 1982: 14).

TABLE 3

Distribution of Land in Nyakosoba by
Number of Fields and Area
(1980/81 Season)

(n = 28)(*)

No. of Fields	% of households	Land Area (ha.)	% households
1	17.9	less than 1 ha.	28.6
2	57.1	1 - 2 ha.	50.0
3	25.0	2 - 3 ha.	17.9
more than 3	0.0	3 - 4 ha.	0.0
		4 - 5 ha.	3.6
Average		more than 5 ha.	0.0
2.2 fields		Average 1.9 ha.	

(Source: Plath, 1982: Table V-2)

(*) This sample excluded all households who did not own fields

The average area cropped per household in the 1980/81 season was 1.7 hectares, while 94% of the total arable area in Nyakosoba was in crops and 6% of arable land remained fallow (Plath, 1982: 15). This indicates a fairly intensive use of land allocated to the household. As farm sizes tend to be small, households attempt to make the utmost use of what is available to them in order to meet their subsistence needs.

The main crops grown here are the staple grains: maize, wheat and sorghum and the pulses: beans and peas which are regarded as "cash" crops because a higher percentage of these are sold. In the 1980/81 season maize was the most popular crop here covering 54% of the land and grown by 89% of farmers. Ranked in terms of land use, maize was followed by wheat (15%), sorghum (10%), fallow (6%) and beans (5%). In terms of farmers growing each crop, peas came second (39%), followed by sorghum (36%), wheat (32%) and beans (29%) (Plath, 1982:20). The majority of the cultivated land was planted to the basic staple grains implying the basic concern of farmers to grow part of their basic food requirements. On average the number of crops planted per household is 2.8.

A rough estimate of the average yields achieved for the main crops grown in Nyakosoba are presented in Table 4. These figures represent the average output for Maseru district, in which Nyakosoba is located, and further discussion revealed that, in fact, Nyakosoba's yields are somewhat lower than these averages indicate.

TABLE 4

Average Crop Yields (Maseru District)

Crop	Average Yield kg/ha(*)
Maize	863
Sorghum	904
Wheat	1 298
Beans	552
Peas	963

(*) Yields are based on output of the 1973/74 to 1977/78 season for the entire Maseru District where Nyakosoba is located and therefore provide only a rough guide.

(Source: Plath, 1982: 21)

There is potential, however, for higher yields to be achieved in Nyakosoba through improved land management practices, which would provide a surplus above the household subsistence needs. This surplus could be used to feed livestock, to sell and/or to trade (Plath, 1982: 22). The use of commercial fertilizer on fields is extremely low, only 1 farmer in a sample of 28 said he purchased and used it. None of the 28 sample farmers used commercial herbicide to control weeds (Holland, 1983: 16).

Cash Income and Sources

The major source of cash income for Nyakosoba households is off-farm work: 86% of the households receive the majority of their income from wages while 14% of the households receive the majority of their income from the sale of farm produce (Holland, 1983: 18, 20). 46% of the Nyakosoba households have at least one adult (aged 17 to 64 years) working away while 14% of households have more than one adult working away (Plath, 1982: 5). 80% of the Nyakosoba males reside away from their households for more than 6 months of the year. This high number of males residing away could limit the ability of households to perform agricultural tasks that require physical strength (i.e. ploughing) or that have traditionally been performed by men (care of livestock). This lack of male farm labour could also account for the failure of some households to prepare and plant all the land available to them (Plath, 1982: 5). On the other hand, cash received by the household from off-farm wage earners could be used to purchase needed equipment or hire equipment and/or labour in order to accomplish agricultural tasks in a timely manner. On average the available farm workforce is 2.6 people, these predominantly being women (Plath, 1982: 6).

Turning to crop sales, the amount that is sold is very small as shown in Table 5 which provides information on crop sales from the 1980/81 season.

TABLE 5

Sale of Major Food Crops for a Sample of Nyakosoba Households (1980/81 Season)

(n = 21)

Crop	No. of farmers selling	% of sample	Total Product sold (tins)
Maize	8	38	119
Sorghum	1	5	4
Beans	4	19	10
Wheat	7	33	73
Peas	1	5	6

(Source: Holland, 1983: Table 12)

Few farmers were engaged in crop sales during that particular season and no cash figures were collected by the survey to indicate the actual amount received by households from the sale of crops. Most farmers have to struggle to produce their subsistence needs accounting for the low number of surplus producers.

Income derived from livestock sale is small and can be erratic, depending on the needs of the household. In the 1980/81 season only 10.5% of Nyakosoba farmers out of a sample of 152 sold animals, mostly sheep and chickens while only 7 cattle were reported sold by the sampled population. Some households sold livestock products such as wool (15.1% of households); mohair (11.8%); milk (1.3%); eggs (3.9%) and meat (2%) (Hoisterman, 1987: 16). In general, however, these percentages are low and account for only a minor part of household income. When examining household expenditure on livestock products for home consumption, survey data indicates that the majority of households buy most or all of their needs rather than producing them (see Table 6).

TABLE 6

Source of Household Needs for Livestock Products in Nyakosoba

(n = 153)

Product	% of households
Eggs - Buy most or all	32.0
- Produce most or all	38.6
- Neither produce nor buy	29.4
Milk - Buy most or all	45.1
- Produce most or all	28.8
- Neither produce nor buy	26.1
Meat - Buy most or all	71.9
- Produce most or all	12.4
- Neither produce nor buy	15.0

(Source: Klosterman, 1982: Table 9)

The high household dependence on purchases indicates their reliance on cash to meet their needs.

III. DRAUGHT POWER AND ANIMAL FEEDING

Cattle Holdings

Data from the Baseline Survey in 1981 of a sample of 153 Nyakosoba households revealed that 56.2% of the sample manage (own or mafisa'd in) cattle with a mean number of 7.7 head per household. The estimated total number of cattle in this area is 4414 and the range in number per household is 1 to 43 (Klosterman, 1982: 8).

Focusing specifically on draught animals, 51% of the sample manage them (38% actually own them while 13% mafisa'd in) with a mean number of 4.5 head per household, and a range of 1 to 13. The estimated total number of draught animals in the area is 2341 (Klosterman, 1982: 8).

When only examining those households owning oxen as opposed to those who manage others' oxen, the following distribution of oxen per household is revealed (see Table 7).

TABLE 7

Distribution of Oxen owned in Nyakosoba

(n = 153)

Number of oxen owned per household	% of household
0	62
1	12
2	11
3	5
4	5
more than 4	5
Mean ownership per household	.9
% households owning oxen	38
% households owning at least 1 pair oxen (planting, cultivating team)	26
% households owning 2 pairs (plough team)	10

Source: Holland, 1983b: Table 7

The above figures indicate that the draught power situation in Nyakosoba is a considerable problem, which is only somewhat alleviated by the "mafisa" systems which provides 13% more households with some draught power.

The custom of "mafisa" is a fairly common practice in Nyakosoba whereby animals (usually cattle) are loaned or shared with others for a variety of reasons. This practice can benefit both the owner and the recipient in different ways. For owners, this is a means of obtaining access to herders or better grazing while the recipient obtains the use of the animal and certain limited products (i.e., draught power, milk, fuel) (Klosterman, 1982: 4). In Nyakosoba, 20% of households mafisa'd in cattle while 16% mafisa'd out cattle.

Cattle Uses

The reasons for keeping cattle vary and are somewhat influenced by the geographic area and attitude of the household. In the foothills, cattle are the main source of draught power due to the steep slope of most fields and this usage features highly. The use of cattle for traditional practices, particularly lobola is still fairly common in the foothills and mountains where adherence to tradition is strong indicating another important reason for acquiring cattle. Less prominent, though still important uses of cattle are for milk production, for meat production (especially for large feasts and celebrations), as a store of wealth (especially in more remote areas), and cattle dung provides an important source of fuel due to the scarcity of wood.

Draught Equipment Holdings

Before discussing the draught problem faced by Nyakosoba farmers, a brief presentation of draught equipment ownership is made.

None of the farmers in Nyakosoba own tractors, primarily because of field slope and field access problems. Table 8 below provides details of ox-drawn equipment ownership for a sample of 153 Nyakosoba households.

TABLE 8

Ownership of Usable Ox-drawn Equipment
Nyakosoba Sample

(n = 153)

Implement	No. of households	% of households
Plough		
none	63	41.2
1 or more	90	58.8
Cultivator		
none	130	85
1 or more	23	15
Planter		
none	139	90.8
1 or more	13	9.2
Harrow		
none	133	86.9
1 or more	20	13.1
Cart		
none	148	96.7
1 or more	5	3.3
Sledge		
none	116	75.8
1 or more	37	24.2
Yokes		
none	62	40.5
1 or more	91	59.5

Source: Holland, 1983: 8

From the ownership figures above it is evident that few families own a basic complement of tillage equipment. Close to two-thirds of sample households own yokes and ploughs but only a small percentage (9 - 15%) own planters, cultivators and harrows, which are necessary to perform a typical sequence of tillage operations. When comparing the ownership percentages of basic ox-drawn equipment and animal power, more households lack the latter (62% of the household do not own oxen but 14% of these mafisa'd in draught oxen). However, scarcity of either or both ox power and equipment presents severe production constraints and exerts pressure on the limited available resources during the optimum ploughing period, resulting in untimely or inadequate land preparation. The low ownership of carts and sledges means farmers must have their oxen drag the equipment to and from the fields and that which cannot be dragged must be carried by people or tied to the back of animals. The dragging of equipment, etc., by oxen drains their much needed strength even before they start on agricultural operations and also increases the wear on equipment and the likelihood of its breaking.

Land Preparation and Planting

The average plough team consists of 4 draught animals, usually both oxen and cows, but can also include bulls, horses and donkeys when sufficient oxen are not available. However, the team may occasionally be comprised of 6 or 8 animals depending on their condition and strength. Planting and cultivating with ox-drawn implements requires a minimum of 2 oxen but can have 4 involved. It is estimated that a span of 4 oxen can plough approximately 700 sq. meters in an hour and that a span works about 3 hours per day (Guma, 1977: 5). It would then take a 4 ox-span 4.76 days to plough one hectare, or about 6.2 days for the average field of 1.3 ha. to be ploughed.

The normal sequence of preparation activities for the majority of households without ox-drawn planters is:

(a) plough - broadcast seed - harrow seed in; or

(b) plough - harrow - broadcast seed - harrow seed in, which is the better technique because it breaks up soil more adequately.

For those using ox-drawn planters, the normal routine is to plough, harrow and then use the planter. When there is no harrow available, the land can be ploughed and then re-ploughed to break up large soil clumps, and then seed is planted using either broadcasting or row planters depending on what is available to the household.

Winter ploughing is a practice which is being adopted by some farmers in this area through the encouragement of agricultural officers. This practice helps increase soil moisture penetration and reduces the weed population as well as reducing pressure on draught animals for spring ploughing by spreading tillage operations over a longer period.

Farmer Strategies to Overcome Draught Problem

As has already been revealed, almost half (49%) the Nyakosoba households do not own or manage draught power and about a third lack yokes and ox-drawn ploughs indicating the degree of the draught power problem in this area. Farmers obtain access to these resources through a variety of means:

(a) hiring;
(b) pooling resources and sharing;
(c) sharecropping;
(d) borrowing from family.

For all of these strategies, no statistics were available to indicate what percentage of the households resorted to them.

Hiring draught power and equipment requires that the households have access to cash resources. In general, households prefer to conduct agricultural activities with the minimum of cash expenditure (Holland, 1983b: 15) and, therefore, they would probably seek other means to gain access to draught before

resorting to hiring. No figures were available on the number of households hiring draught power.

The pooling of resources is a common practice to gain access to draught power. Two or more households will combine draught animals and equipment to make a complete span for ploughing and then proceed to work on the various fields of the farmers involved. This arrangement does not involve any cash expenditure for draught.

Sharecropping is another practice found in Nyakosoba and in the 1981 season 10.5% of sample households (n = 153) sharecropped out fields. In sharecropping, the landholder who is unable to work all his land himself will allow another farmer or landless household to prepare and crop a certain portion of his land. In return, that farmer or household will be able to keep half of the harvest produced on that particular piece of land. Another variation of sharecropping, although much less common, involves the landholder allowing a certain portion of his land to be used by another farmer for a season in exchange for access to the latter's draught power and/or equipment.

Another strategy to obtain access to draught power is borrowing from family or friends. Certain family relationships require that members be looked after and assisted in various tasks and there is an inherent obligation to do so (i.e., elderly parents are assisted by sons, widowed daughter assisted by brothers, etc.). Other borrowing arrangements are between neighbours and friends and all of them do not involve a reciprocal exchange.

In all the above mentioned strategies, however, the household in need has to wait until the draught power they are seeking has completed its owners' tasks. This can cause a delay in timely land preparation and planting which, in turn, can affect output, and is one of the main drawbacks of not having one's own draught power.

Another common problem faced by households with their own draught power is the weak condition of animals in the spring due to lack of adequate winter feed. This problem is one receiving much attention in Lesotho and is further discussed in the section on Dry Season Feed, below.

In an attempt to help alleviate the draught problem the Ministry of Agriculture has been investigating the possibility of using horses as draught animals (Matobo, 1982). Horses are traditionally used for riding, coping well with the rugged Lesotho terrain and are looked upon as a status symbol and mark of social prestige for the owner. Limited experimentation has revealed that horses are stronger, can work longer and work faster than oxen as draught animals and once agricultural tasks are completed the horses can still be used for riding. Only 2 horses are needed for ploughing while planting and cultivating only require one horse. Another important factor weighing in favour of horses is that they are easier to feed than oxen. Uptake of this alternative form of draught power will be slow and will require appropriate introduction of this technique to the

population as well as sufficient horses and training to accustom horses to the harness and working with agricultural implements.

Another area of concern of the Ministry of Agriculture is the improvement of draught equipment which will improve preparation and planting and make the draught procedure less strenuous on both people and animals. On-farm trials are currently underway demonstrating the ox-drawn Ariana tool bar and its various attachments including a plough, planter and cultivator, and comparing its efficiency to the Safim equipment which has been and is commonly used in Lesotho. Modification of various implements has also been undertaken in order to improve them.

Dry Season Cattle Feed

The usual practice of livestock feeding follows a somewhat migratory pattern. About 50% of Nyakosoba households send their cattle to graze at cattle posts up in the mountain areas from November to March, after which time they return to the village for the winter months (Klosterman, 1982: 4-5). From April to November, cattle graze on the communal range located in and around Nyakosoba and they also graze on the crop residues (mainly maize stover) on arable fields once harvesting is completed.

Few households actually grow fodder for animals and few purchase animal feeds, almost all of which are imported from South Africa. Hominy chop, a by-product from the grinding of maize, is locally produced at the Maputsoe mill and one of the cheapest sources of animal feed purchasable in Lesotho. Efforts are being made to introduce farmers to this product and demonstrate its benefits when fed to cattle during the dry season as a supplementary feed (Klosterman, 1983: 10).

Although 23% of Nyakosoba households indicated they had a problem with the poor condition of their draught animals at ploughing time only 3% said they gave their draught animals special supplementary feed which consisted of fodders, crop residues, barley, lucerne and/or maize (Klosterman, 1982: 3).

The shortage of range and feed for cattle is a widely recognised problem in Lesotho and one to which much research is devoted. The Ministry of Agriculture is promoting research on identifying the most suitable fodder species for various geographic zones of Lesotho (see component research). On-farm trials are underway, both for summer and winter cropping - where possible, to demonstrate to farmers the advantages of growing and storing fodder for dry season feed. Its potential as a cash crop is also being investigated in certain parts of the country.

The Range Management Division of the Ministry is also involved with the cattle feed problem and is establishing a fencing and rotation system on communal grazing land as well as improving natural pastures through seeding schemes.

The whole issue of the animal feeding problem is receiving quite high priority attention in Lesotho. The matter remains as to how successful the uptake of growing fodder crops will be.

Considering that households on average have relatively small plots available to them, and only a small percentage of the area lies fallow, emphasis is on promoting annual fodders which would not compete with summer food crop production.

Summary

The Nyakosoba prototype area exhibits suitable agro-climatic conditions for summer cropping activity with a possible potential for winter cropping currently being investigated. The introduction of improved short-term seed varieties to complement the common long-term varieties could improve production especially amongst those farmers who are, for whatever reason, delayed and late in their land preparation and planting.

It is important to note that the geographic location is not particularly conducive to tractor usage due to the steepness of some of the fields.

Currently, "on-farm trials" are under way to examine the possibilities of growing food and fodder crops on the lower reaches of the foothills during the winter in an attempt to increase cropping intensity (pers. comm. and component research).
Nyakosoba is relatively densely populated and almost all of the available arable land is cultivated during the summer growing season. Output, however, varies considerably due to the degree and intensity of labour and cropping inputs, as well as being affected by climatic factors. Most households are dependent on cash income from off-farm wage employment rather than income derived from cropping activities. Returns for labour are much higher in wage employment than farming explaining the decision of households to divert labour to the off-farm sector.

Access to draught power and equipment is a problem for at least half the Nyakosoba population. Although off-farm earnings contribute significantly to household incomes, these earnings do not appear to be diverted to agricultural inputs and activities, judging by the low agricultural equipment ownership levels. Arrangements for access to draught power and labour also tend to be based on non-cash agreements indicating that earnings are not being used here.

In Nyakosoba, the average draught team consists of 4 oxen - or a combination of oxen and cows, with teams of 6 or 8 draught animals being very uncommon. This contrasts with the Leribe lowlands area of Lesotho where draught teams tend to be composed of only 2 oxen.

One of the main problems facing cattle owners is the inadequacy of dry season cattle feed causing animals to be in a weak condition when their strength for ploughing is most needed. Efforts are under way to introduce households to suitable fodder crops and to encourage farmers to start planting them. Improvement of communal range management practices are also being examined in order to prevent further deterioration of natural grazing land.

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SWAZILAND

Southern Rural Development Area

I. LOCATION AND PHYSICAL DESCRIPTION

Southern Rural Development Area (RDA), the second region designated under the Swaziland RDA Programme(1), was established in 1972 and is located in the southern Swaziland district of Shiselweni. It lies south-east of Hlatikulu in the upper Ngwavuma valley (see map), in the middleveld zone and ranges in altitude from 760 to 1 060 metres above sea level.

The valley floors which are surrounded by steep, rolling hills are comprised of large areas of gently undulating land containing red, loamy soils suitable for arable cultivation.

The total area of the RDA is 11 295 ha. of which 3 075 ha. are arable and 8 220 are for grazing. The major rivers are the Ngwavuma and the Muwemi.

The Southern RDA Project Centre located at Ntonga monitors the rainfall for the area which averages 800mm per annum. The monthly rainfall figures are shown in table 1 below.

TABLE 1

Monthly Rainfall Southern RDA, 1980-1983 and Kubuta Longterm Average(*)

	1980	1981	1982	1983	Kubuta Longterm Average
January		140,4	58,8	105,0	121,5
February		118,0	24,2	17,0	117,7
March		20,0	27,0	50,0	97,0
April		9,0	160,0	51,5	53,1
May		92,0	4,0	108,0	21,8
June		23,2	0,0	14,0	17,4
July		0,0	0,0	12,0	13,9
August	18,5	30,5	0,0		17,4
September	92,0	91,5	19,0		39,9
October	35,7	71,5	86,0		67,7
November	109,0	26,0	72,0		112,7
December	160,7	114,5	116,4		120,4

Note: (*) Kubuta is the nearest hydrological station with longterm monthly average rainfall figures, included in this table for comparative purposes

Source: Southern RDA Project Centre records and Annual Statistical Bulletin, 1981

The red, loamy soils of the area are not heavy but when they are dry, land preparation is very difficult. Emphasis has been placed on winter ploughing as well as timely spring ploughing which is encouraged as soon as the rains begin.

The main planting season occurs from September to February while harvesting extends from February to June. Table 2 elaborates the crop calendar for the crops commonly grown in this region.

TABLE 2

Crop Calendar

Crop	Sowing Period	Harvesting Period
Beans: rain grown	January-February throughout winter, best in March	May - June
irrigated		September-October
Cotton	usually early Oct.	March - June
Groundnuts	October-November	February-April
Maize	September-November	March-May
Potatoes	September-December	December-February
Sorghum	September-October	April-June
Sweet Potatoes	March	May-June
	September-December	January-March
Tobacco	October	January-March

Source: Annual Statistical Bulletin, 1981

Although the main planting season falls during the summer months (September to February), winter cropping is also possible on irrigated land. Presently, 22.5 ha. of land is under irrigation in Southern RDA and 50 farmers participate in this irrigation scheme located at Mapateni. Crops grown include garden vegetables (tomatoes, spinach, carrots and cabbage) and green maize, all of which are sold in the market. Summer production on the irrigated fields, however, is low due to farmers' attention being focused on field crops, which are primarily for home consumption rather than for selling.

Although not very far from Bulawayo and Nkulumane, which offer only limited employment prospects, Southern RDA is situated approximately 80 km from the Mangwe/Matsapha belt and its numerous employment opportunities. This location qualifies it as a rural RDA rather than a peri-urban one and accounts for some noticeable differences between it and Central RDA - which is considered peri-urban (i.e. Central RDA has a larger number of persons per homestead, high rate of off-farm employment, more homesteads without cattle).

II. FARM HOUSEHOLD SITUATION

Population Density

In 1981 the Southern RDA population estimates stood at approximately 9 804 giving an overall density of 87 persons per km² (RDA Management, 1981: 9), while the average density on arable land was calculated at 319 persons per km². The total number of homesteads in this area is estimated to be 1 323 (ibid: 9) with an average membership of 7,4 persons per homestead. The average farm size is 1,7 ha., with 58% occupying more than 1,5 ha., and the average cropped area is 1,33 ha. (RDA MEU, 1982: 3).

Farm Crops

The main crops grown here include maize, both local and hybrid varieties, groundnuts, jugo beans, tobacco, cotton, with some sorghum and potatoes.

TABLE 3

Southern RDA Farm Crops

Crop	Total No. of growers (*)	% of households growing (**)	Average ha. per household growing (**)
Maize: local	740	77,9	0,83
hybrid	518	54,5	0,91
Groundnuts	210	22,1	0,26
Beans	185	19,5	0,23
Sorghum	37	3,9	0,19
Tobacco	111	11,7	0,22
Potatoes	12	1,3	0,04
Garden	12	1,3	0,03
Cotton	37	3,9	1,05

(*) estimate of total number of farmers growing each crop during 1978/79 season

(**) figures based on data from sample survey of 79 Southern RDA households during 1978/79 season

Source: RDA MEU, 1982: Table 1a

Maize constitutes 87% of the total farm area cultivated and is the staple food, while jugo beans and groundnuts are the next most common crops and important components of the Swazi diet. Tobacco and cotton are both grown as cash crops in Southern RDA, but only occupy 5% of the total cropped area. Although more households are actually involved in growing tobacco than cotton, the farmer covers a smaller total cropped area than the latter.

It is interesting to note that 24% of arable land is left fallow which is attributed to lack of money to purchase inputs, lack of time, and lack of adequate labour (personal communication, Project Director, Southern RDA).

The average yields achieved for the main crops of maize and beans are as follows:

local maize	1 010 kg/ha.
hybrid maize	1 198 kg/ha.
beans	724 kg/ha.
sorghum	411 kg/ha.

Comparing these figures with average yields from Central RDA reveals that maize productivity is higher in Central while bean productivity is higher in Southern RDA. These differences are due to variations in climatic and soil conditions as well as the type of land preparation activities (discussed in section III).

The planting of fodder crops is limited to those 12 farmers with dairy cattle. They grow perennial grasses and prepare maize silage in order to feed these dairy animals during the dry season. Due to the small numbers involved, fodder crop production is negligible in this area and indeed in the country as a whole.

Farm Household Work Force: Income and Expenditure

In Southern RDA, 57% of the population is aged between 15 and 64 years, comprising the effective farm workforce. The average potential labour force in this age range is 5,1 persons per homestead, of which 18,5% are actually engaged in off-farm wage employment (RDA MEU, 1982: 4) and therefore not available as farm labour. Presumably cash remittances would be received by the homesteads from these off-farm workers, although no data was specifically available on this aspect in the 1978/79 survey.

Average income from farm sources - both cropping and livestock - combined gave a negative balance of E24,64, in other words, more was spent than was earned from these combined activities. Table 4 elaborates the average income and expenditure of the household.

TABLE 4

Average Homestead Farm Income and Expenditure

	Income	Expenditure	Balance
Crops	22,52	61,56	-39,04
Livestock	17,50	3,10	14,30
Combined	40,02	64,66	-24,64

Source: RDA MEU, 1982: Table 2p

Crop production requires a considerable expenditure on inputs

(seed, fertilizer, pesticides, equipment hire, etc.) and little of the harvested crop appears to be sold, rather it is used for home consumption, accounting for the low income derived from crops. Livestock, on the other hand, requires little in the way of input expenditure, due to communal grazing rights, and the returns from livestock sales are high, thus giving a positive balance in that category. This factor makes cattle an attractive enterprise in which to invest. However, the sale of livestock tends to be reserved for special needs and does not necessarily occur on a regular basis, accounting for the apparently low average income received from it.

The average homestead non-farm income amounts to a total of E90,80 and is derived from the following sources illustrated in Table 5.

TABLE 5

Average Homestead Non-Farm Income by Source
(in Emalangeni)

Source	Income
Labour	0,80
Handicrafts	7,60
Marketing	6,00
Beer marketing	12,70
Other (includes remittances)	63,70
TOTAL	E90,80

Only 22% of the homesteads in the sample of 77 were not involved in some sort of non-farm income generating activity. Beer marketing appears to be the largest single source of non-farm income (apart from the "other" category) and is a task predominantly controlled by women. The "other" category includes cash remittances from off-farm wage earners, though no further details on this source were available.

Average household non-farm expenditure is itemized in Table 6 below, with food purchases featuring as the highest expenditure category.

TABLE 6

Average Household Non-Farm Expenditure

	Expenditure (E)
Food	105,10
Clothing	28,40
School	38,40
Medical Expenses	11,30
Fuel	6,60
Household Goods	46,20
Tobacco/Alcohol	13,40
Transport	23,40
Material for brewing, marketing handicrafts	5,60
Credit received	1,90
Other	0,70
Gifts given	0,40
TOTAL non-farm expenditure	E281,40

Source: RDA MEU, 1982: Table 2m

The overall average farm and non-farm household income amounts to E130,82 while overall average household expenditure amounts to E346,06 giving a negative balance of E215,24. It is likely this deficit was supplemented by remittances received from off-farm wage earners working in South Africa or elsewhere within Swaziland.

In general, the majority of homesteads in this RDA are not self-supporting through on-farm activities. As already shown, crop farming requires a considerable expenditure on inputs while little of the output is sold. However, the size of the harvest will determine how much cash will be spent later in the year on food purchases - which is one of a homestead's main non-farm expenditures. Those homesteads involved in cash cropping of tobacco (11,7%) or cotton (3,9%) would, in good harvest years, receive a substantial income from such cropping activities, but these only involve a small portion of the homesteads in Southern RDA. Non-farm activities, including remittances, form the major contribution to the homestead income and indeed keep it solvent. As Southern RDA is in a rural situation with limited off-farm employment opportunities, many off-farm wage earners live away from the homestead.

III. DRAUGHT POWER AND ANIMAL FEEDING PROBLEMS

Cattle Ownership

According to estimates, 62% of the Southern RDA homesteads own a total of 8 525 cattle (RDA MEU, 1982), with an average herd size of 11 head per homestead. The distribution of herd size by homestead is presented in Table 7.

TABLE 7

Frequency Distribution of Cattle Herd Size by Homestead

Cattle Herd Size	No. of Homesteads	% of Households
0	30	39
1 - 5	3	4
6 - 10	9	12
11 - 20	23	30
21 - 30	11	14
31+	0	0
TOTAL Sample	76	

Source: RDA MEU, 1982: Table 2k

A more detailed examination of homestead cattle holdings reveals the composition of the herd by category, which is presented in Table 8.

TABLE 8

Average Cattle Ownership by Category of Stock

Stock Category	# Cattle per owner	# cattle per household (*)	% households owning
Cows	4,63	2,77	60
Heifters under 3 years	3,30	1,71	52
Males under 3 years	2,82	1,43	51
Bulls	1,83	0,69	38
Oxen	4,16	2,38	57

(*) All 77 sample households were included in this grouping, but not all of them actually own cattle

Source: RDA MEU, 1982: Table 2h

Cows (4.63) are the largest category of cattle held by homesteads followed by oxen (4.16). Due to their reproductive ability, cows serve to increase the herd size as well as supplying fresh milk. Oxen provide a source of draught power and after a number of years in this capacity, they can be sold to the Swaziland Meat Corporation for beef production.

Cattle numbers in Southern RDA have been on the increase until recently. In the period April 1980 to March 1981, there was an overall increase of 550 cattle while in the April 1981 to March 1982 period the increase stood at 146. There was a marked reduction in the size of the increase figures from 1980/81 to 1981/82, partly due to the prevailing drier climatic conditions which caused more deaths and also encouraged more farmers to slaughter animals due to the lack of adequate feed. Monthly cattle figures for 1983 indicate that the cattle population in

this area is stabilizing, with more deaths and slaughters than births occurring, again predominantly a result of the drought conditions which have prevailed in this area and the country as a whole.

Considering that the optimum stocking rate is assumed to be 2,65 ha. per livestock unit and the actual stocking rate is less than 1 ha. per livestock unit, there is a severe overstocking problem, causing extreme pressure on grazing land. The situation is even more severe than calculated because the latter overstocking figure did not take into account the presence of a large but unknown number of goats and sheep.

Cattle Uses

Traditionally, cattle were, and still are, regarded as a status symbol and store of wealth - the more the better. They play a significant role in traditional ceremonies including betrothal, marriage, kingship and Incwala. Hides and tails are used in traditional and ceremonial dress. Cattle dung is still used in the traditional construction of house floors. Although these uses may not be as widespread today they still are practised by a substantial portion of the Swazi population. The use of cattle for draught, milk and meat production, however, is increasing. The function of cattle as a store of wealth is probably the major factor accounting for the severe overstocking problem in the country today. Once purchased, the cost of maintaining the herd is minimal due to the communal grazing rights and an animal can easily be sold for cash when the need arises.

Land Preparation Activities

The average ploughing team consists of from 4 to 6 oxen, but according to Table 8 it appears that there are many households who do not own a full complement of 6 oxen. Due to this, draught teams are often composed of a mixture of oxen and cows or young animals.

For the tasks of planting and cultivating with ox-drawn equipment, at least 2 oxen are required. However, if the animals are weak, the team size may be increased to 4 but not usually more than that. Harrowing commonly requires at least 4 animals but larger teams are possible, depending on the size and weight of the harrow being used.

A sample survey of 77 Southern RDA homesteads revealed that almost all of them rely on oxen power and traditional hand methods for land preparation activities rather than mechanised (tractor) means. Table 9 below illustrates this point.

TABLE 9

Per Farm Labour Hours by Operational Category and Number of Sample using each Method

Operation	Average Labour hours	# sample homesteads using this method	% of sample homesteads
Traditional ploughing and harrowing	51	75	97
Mechanised (tractor) ploughing and harrowing	24	44	57
Handsow, ox-sow, traditional fertilizer	69	76	99
Mechanised sowing, mechanised fertilizing	8	8	10
Hand weeding, ox-weeding, thinning, spraying	106	76	99
Mechanised weeding and spraying	50	42	55
Harvesting, processing, storage, scaring	149	75	97
Transport, trucking, marketing, purchasing	9	19	25
Herding	351	53	69
Milking	20	49	64
Slaughtering and skimming	11	71	91
TOTAL		77 farms	

Source: RDA MEU, 1982: Table 2j

It was revealed that a number of homesteads (57%) with the financial means will hire tractors for ploughing fields only, instead of using their own draught power. This practice is resorted to because of the weak condition of cattle at the optimum ploughing time at the start of the rainy season. Farmers prefer to reserve whatever draught power they possess for the lighter tasks of planting and cultivation (weeding). A tractor can prepare the fields more quickly than oxen, enabling the farmer to begin planting at the best opportunity using an ox-drawn planter which only requires 2 animals to pull it. In the RDA there is a tractor hire pool (with 3 tractors) providing low cost hire (E16 per hour), as well as private tractor owners in the area who hire out their tractors at similar prices.

Due to the availability of cash in the homestead and the number of absentee homestead members working away (therefore not able to assist in farm tasks), there is much competition and pressure on tractor hire services at the start of the rainy season. For those families without the means to hire tractors, and with a shortage of male labour, women are forced to participate in ox-drawn ploughing activities which were once the sole domain of men.

Once ploughing and harrowing are completed, planting is done predominantly through the use of ox-drawn planters and hand sowing (99%). Only 10% of the sample homesteads did tractor planting. Weeding also is predominantly done by hand or ox-drawn cultivators (99%) but a considerable number of homesteads (55%) indicated they used mechanical weeding or spraying methods on some of their fields.

As maize is the national staple food and most common crop grown, it is a feasible crop to examine in more detail in order to obtain a better idea of land preparation and sowing methods in Southern RDA. In the 1982/83 season, 59% of the maize crop was sown by hand while 40% was sown by planters. In both cases, land preparation was predominantly done by ox-drawn ploughs with tractors ranking as the second means of land preparation. Less than 3% of the crop was planted in land prepared by hand (Agricultural Extension Service, 1983). When these figures are compared with those from Central RDA, there is quite a startling difference - only 14% of maize was sown by hand while 86% was sown by planter.

It appears that Southern RDA was less mechanised than Central RDA with most crop operations being carried out by hand or with ox-drawn implements. It should be kept in mind, however, that the 1982/83 season was not typical - firstly, because of the mourning period after the death of King Sobhuza II, land preparation activities were delayed until 1st November; and, secondly, the late rains contributed to the weak condition of cattle which further delayed land preparation and caused subsequent low harvests.

The high degree of hand sowing in Southern RDA could indicate:

(a) the low number of ox-drawn planters available in the area (Central RDA has twice as many as Southern RDA);

(b) the decision to accomplish ploughing and planting in one time-saving process (plough/planting) due to the late start in agricultural activities due to King Sobhuza II's death;

(c) pressure on the fixed number of draught teams, forcing farmers to accomplish ploughing and planting quickly especially when borrowing draught power.

Farmers' Strategies in coping with the Draught Problem

As has already been revealed, approximately 38% of the homesteads do not own cattle in Southern RDA while ox-drawn implements are the type most commonly used by most homesteads to accomplish their ploughing and planting. Farmers with no oxen or insufficient numbers of oxen are forced to seek an alternative source of power in order to accomplish their land preparation activities. It has also been revealed that farmers who do have sufficient oxen for a plough team will sometimes use an alternative method for ploughing - usually hiring a tractor - because their animals are in poor condition.

Farmers resort to a variety of strategies in order to accomplish ploughing, depending on the financial resources available to them, which include:

(a) borrowing draught animals from a neighbour;

(b) hiring draught team;

(c) operating a "sisa"[2] arrangement with someone in order to have access to draught power;

(d) hiring tractor.

No statistics were available to quantify the extent of farmer reliance on these various alternatives although discussion (pers. comm. Project Director, Southern RDA) revealed that the "sisa" arrangement was common in this area, as was the informal sharing or borrowing of draught animals or equipment from a neighbour. Financial constraints heavily determine the strategy which a homestead will choose in order to accomplish their land preparation activities. Recent drought conditions are responsible for severely weakening the cattle which has affected their draught power capacity. This has led to increased demand for access to tractors in order to plough the fields.

The RDA tractor pool operates throughout the year and reduced hire rates are charged in off-peak periods (May - August) in order to encourage farmers to practice winter ploughing. Not only does this help alleviate pressure for tractors during peak ploughing time, but it also has benefits for the soil: reduced weed population and better rain penetration. About 25% of the farmers now undertake winter ploughing and the campaign to encourage more to adopt this practice continues.

Another attraction influencing farmers to use tractors has been the labour factor. Tractor ploughing only requires one person - to drive the tractor while ox-drawn ploughing requires at least 2 or 3 people in the field at a time manipulating the plough and guiding the oxen.

Cattle Feed

The aspect of improving animal performance especially during drought through supplementary feeding has not been practised here. Cattle owners rely almost entirely on communal grazing areas for cattle feed, with the exception of dairy farmers - who do grow and purchase fodder in order to maintain a relatively constant supply of dairy products. As there is an overstocking problem in Swaziland, communal grazing areas are overgrazed and are not able to sufficiently recover, which has encouraged sheet and gully erosion. This has resulted in reduced grazing area which is under extreme pressure. The RDA programme has been emphasizing range management activities amongst farmers as well as trying to encourage farmers to grow fodder crops. A fencing programme is also under way in order to help control grazing and allow fields to rejuvenate.

Cattle do graze on crop residues once the harvest is complete but there is no organised collection and storage of these for use at the most critical time during the height of the dry season.

Summary

The agronomic potential of Southern RDA is reasonably good with the possibility of both summer cropping and irrigated winter

cropping. Due to its location, Southern RDA is classed as a rural RDA and there are fewer opportunities for homestead members to find off-farm wage employment locally, as compared with Central RDA.

This area is fairly densely populated and although it has good agricultural potential most farmers only practise sub-subsistence production. This is due to the lack of resources - both labour and cash for farm inputs, and occasional climatic variations which cause poor yields. The balance of food requirements are purchased, usually with cash obtained from non-farm and off-farm income generating activities. In spite of its rural location, homestead members seek off-farm wage employment because of the higher financial returns it offers.

Over one-third of the Southern RDA population does not own cattle and, therefore, has a problem of access to draught power. For those households with sufficient draught, there is a feeding problem at the end of the dry season. Due to the presence of the subsidized tractor hire pool, some farmers have been encouraged to adopt a low time-labour input to cultivation by tractor ploughing and ox-drawn row planting. The reliance on tractors for ploughing seems to be more favoured than the time-consuming alternative of producing cattle fodder, and because of the low labour input of mechanised ploughing, farm labour is freed to seek off-farm wage employment where returns are higher. For those homesteads without the financial means to hire a tractor, non-cash arrangements for obtaining draught power and equipment are most common. The average draught team is comprised of 4 to 6 oxen. Improved animal feeding practices and fodder crop production could help alleviate some of the problems experienced by farmers at the optimum ploughing time but the task remains to convince farmers that such practices are worth their time and effort.

Notes:

(1) The Rural Development Areas Programme of Swaziland was formally established in 1970 with 4 areas identified as maximum input areas to receive an intensive development effort in agricultural extension services, natural resource conservation and infrastructural improvements (roads, fencing, market facilities). Initial funding was provided by the United Kingdom Overseas Development Ministry. As results from the initial 4 areas were encouraging, the Swazi Government expanded the programme in 1976 with the creation of 14 more RDAs. 18 RDAs currently exist covering some 531,000 hectares of Swazi Nation Land and include 55% of the rural population. The main aim was to improve the level of crop production which would raise the incomes and living standards of rural Swazis.

(2) A "sisa" arrangement is one whereby a farmer feeds and maintains some or all of someone else's cattle for some

arranged period in return for milk and draught power and occasionally the offspring. The owner solves the problem of someone to herd and look after his beasts while the recipient has access to cattle he does not actually own but has a right to use for certain tasks.

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CENTRAL RURAL DEVELOPMENT AREA

I. LOCATION AND PHYSICAL CHARACTERISTICS

Initiated in 1975, Central Rural Development Area (RDA) is situated in the middleveld in Manzini district adjacent to Manzini township and Matsapha industrial estate. It comprises the headwater catchment area of the Umtilane river system and a small portion of the Little Usutu River. Bounded to the west by the Mdimba escarpment, to the north by Sigombeni block (title deed farms), to the east by Manzini township and to the south by the main Mbabane/Manzini/Siteki road it covers a total area of approximately 20 129 hectares (5 729 ha. arable, 14 400 ha. grazing), all of which is Swazi Nation land.

Topographically in the middleveld, the altitude ranges from 610 - 1 070 metres above sea level. The southern area is composed of broad, gently sloping, undulating ridges changing to narrow, sloping ridges with deeply incised valleys to the north. Rainfall in this area tends to be reasonably high, compared with other areas in the country, with an annual average of approximately 900mm. The bulk of the rain falls in the warm summer months, October - March. Monthly rainfall figures for Central RDA are presented in Table 1 below, along with the long-term monthly average rainfall for Matsapha station, for comparative purposes.

TABLE 1

Monthly Rainfall Figures - Central RDA 1980 - 1983 and Long-Term Monthly Average

Month	1980	1981	1982	1983	Matsapha Long-Term Monthly Average
January		122,6	187	94,5	131,6
February		302,5	26,8	32	132,9
March		102	56	86	114,2
April		8,8	172	32	69,4
May		34	-	35	24,5
June		-	-	-	2,4
July		-	-	12,3	9,2
August	60	10	-	69	23,8
September	143	94,1	18,9	Record	68,7
October	30	47,9	18,9	ends	107,9
November	139,2	136,2	93,3	here	141,6
December	194	145,7	45		114,8

Source: RDA Rainfall 1980/81
Central RDA Annual Report 1982
Annual Statistical Bulletin 1981

The soil is generally considered to be acid and of the five groups of soil identified in the Central RDA region only three have been classed as arable:

1. deep red loams - further sub-divided as deep red sandy loam and deep reddish-brown clay loam;

2. gravelly clay loams - arable but with low moisture-holding ability;

3. alluvial soils - deep brown loamy sands which are arable but require irrigation because of permeability and low moisture-holding capacity;

4. shallow grey loamy sands - non-arable;

5. wet and poorly drained soils - non-arable.

Due to its close proximity to the Mbabane-Matsapha-Manzini corridor Central RDA is classified as peri-urban, and its situation accounts for the substantial number of adults who have migrated to and settled in this area in search of urban employment. Of the sample population, 58% fall into the work-force category (aged 15 - 64 years) (MEU, 1979: 1) and 75% of the homesteads were supported from income derived from off-farm activities, emphasizing the peri-urban nature of this particular RDA.

In spite of its peri-urban location, Central RDA has the chartacteristic mixed economy common in this region, with homesteads practising both crop-growing and livestock rearing. In Swaziland cattle are based at the homestead year round, unlike in Botswana and Lesotho where they migrate to grazing areas during the growing season. At night, cattle are placed in the kraal and in the morning they are released and lead to the nearby grazing area where they remain until late afternoon, at which time they are lead back to the kraal.

The main cropping season for this middleveld region runs from October to March, the summer months. The months of April to September fall in the winter season when rainfall and temperatures are considerably lower. Frost is not common during the winter but it has been known to occur. The main constraint of winter cropping activity is the low rainfall. In order to overcome this problem, an irrigation scheme has been set up for growing winter vegetables and summer maize, covering an area of approximately 12 hectares with 25 participating farmers. Summer production of vegetables on the irrigated fields, however, is low because farmers concentrate on dryland grain and legume cropping during these months, thus severely reducing the range of vegetables available to the urban markets and reducing their potential income from vegetable sales.

Table 2 indicates the planting and harvesting period for the country's major crops.

TABLE 2

Crop Calendar -
Range of Months for Establishment and Harvest in the Middleveld

Crop		Sowing Period	Harvesting Period
Beans:	Rain grown	After first spring rain HV	2-3 months after sowing
	Irrigated	Jan. - Feb.	May - June
		Throughout winter - best in March	Sept. - Oct.
Cotton		Usually early in October	March - June
Groundnut		Oct. - Nov.	Feb. - April
Maize		Sept. - Nov.	March - May
Potatoes - Middleveld		Sept. - Dec.	Dec. - Feb.
Rice		Dec. - Jan.	July - August
Sorghum		Sept. - Oct.	April - June
Sweet Potatoes		March Sept. - Nov.	May - June Jan. - March
Wheat		May	October
Sugar Cane		March - May	July - August (15-18 months after planting) thereafter May - January
Tobacco		October	Jan. - March
Pineapples		March - Sept.	Mid-Jan. - April (15-18 months after planting)
Citrus crops		April - June	May - August

Source: Annual Statistical Bulletin, 1980: Table F19

Yield data for the main crops, maize and beans, provides some indication of cropping intensity in this particular area. Local maize averaged 1 264 kg/ha and ranged from 211 kg/ha to 4 590 kg/ha while hybrid maize averaged 1 604 kg/ha with a range from 377 kg/ha to 3 812 kg/ha and beans averaged 312 kg/ha.

II. THE SOCIO-ECONOMIC ENVIRONMENT AND DESCRIPTION OF FARMING SYSTEM

Population Density

Central RDA is relatively densely settled with a total population estimated to be 11 454 (RDA Management Unit, 1982: 10) and an overall population density averaging 66 persons per km². The average population density on arable land is 319 persons per km².

There are an estimated total of 1 636 (RDA Management Unit, 1982: 10) homesteads in this area with an average of 7 persons per household.

Farm Size

Average farm size is relatively small at 1,3 ha. with only 33% of the homesteads owning more than 1,5 ha. Table 3 below illustrates the arable land distribution per homestead based on a sample survey of 79 homesteads.

TABLE 3

Distribution of Arable Area Available per Household

Hectares	No. of households	% of households	
0 - 0,5	16	20,3)	
0,5 - 1,0	26	32,9)	67,1
1,0 - 1,5	11	13,9)	
1,5 - 2,0	10	12,7)	
2,0 - 2,5	6	7,6)	33,1
2,5 - 3,0	4	5,1)	
3,0 - >	6	7,7)	
Total	79		

Smallest farm: 0,22 ha.
Largest farm: 5,46 ha.
Average: 1,31 ha.

Source: RDA MEU, 1979: Table 2a

Comparing the above distribution with more recent sample surveys (RDA Management Unit, 1981a: 3) reveals that the trend still follows that about 70% of the homesteads own farms under 1,5 ha.

Crop Production

Virtually all homesteads plant something each growing season with 91% of the worked arable area devoted to maize production, 40% of which is planted to hybrid maize. The remaining 9% of cropped area is used for growing beans (5%), groundnuts (3%), pumpkins (usually intercropped with maize), sorghum (0,3%) and garden vegetables (0,8%) (RDA MEU, 1979: Table 2b).

Tobacco, in the 1981/82 season, was only grown by 40 farmers which represents less than 3% of the total homesteads and is, therefore, insignificant while no cotton figures appear at all for Central RDA during that period. On average, more attention is devoted to growing subsistence rather than cash crops.

Table 4 tabulates the average crop area cultivated per household (not all households grow each crop) and per grower.

TABLE 4 Average Crop Cultivated

Crop	% of arable area	Area per household (1977/78)	Average Area per Grower
Local Maize)	90	0,60 ha.	0,76 ha.
Hybrid Maize)		0,43	0,78
Sorghum	0,3	0,003	0,14
Groundnuts	3	0,04	0,36
Beans	5	0,05	0,33
Garden	0,8	0,01	0,23
Total Crop Area		1,14	1,15
Fallow		0,17	0,16
Total Area		1,31	1,31

Source: RDA MEU, 1979: Table 2c

The major crops are maize, beans and groundnuts, all of which are planted in the spring from October unwards depending on the rains and the timeliness of the land preparation activities.

It is interesting to note that the relatively high uptake rate of hybrid maize exceeded RDA expectations. This phenomenon can be explained by the fact that the higher yields from this variety enable homesteads to increase output without increasing the hectarage, and indeed, many homesteads can reduce hectarage and still meet their subsistence requirements. This reduction in area cropped reduces labour inputs and hence releases labour for off-farm employment.

Survey results (RDA MEU, 1979: 1) revealed that 62% of farmers do not fallow arable land, suggesting that continuous mono-cropping of cereal is practised, which most likely has adverse effects on soil nutrients. It is also worth noting that, although the RDA programme is encouraging the planting of animal fodder this practice has only been adopted by commercial dairy farmers (n = 23) who plant perennial grasses as a source of dry season feed.

Income and Expenditure

As already indicated, 75% of the households in Central RDA have members engaged in off-farm employment with about 26% of the homestead workforce (aged 15 - 64) employed outside the traditional agricultural sector.

Examining the various cash sources and needs of farm households provides insight into the economic situation and the extent of reliance on off-farm income generating activities.

The average homestead farm income and expenditure is elaborated below in Table 5.

TABLE 5

Average Homestead Farm Income and Expenditure - Central RDA

	Crop			Livestock			Combined		
	Income	Expenditure	Balance	Income	Expenditure	Balance	Income	Expenditure	Balance
Mean	17,08	35,53	-18,45	33,40	6,70	26,70	50,48	42,23	8,25

Source: RDA MEU, 1979: Table 2q

Overall, there is a positive balance of E8,25, which is maintained by the livestock sector. Homestead crop expenditure tends to exceed its income because most crops are grown for subsistence purposes and not commercial sale purposes, hence the low income received from them. On the other hand crops require a fair expenditure for inputs, regardless of where or for whom the harvest is designated. Livestock, however, requires little in the way of inputs and can bring in a substantial income - but sale of livestock is not necessarily a regular practice, rather one resorted to in times of immediate cash needs. In general, it is evident that average farm income is low.

The average homestead non-farm income stems from several activities as shown in Table 6 below.

TABLE 6

Average Homestead Non-Farm Income by Source and Average Off-Farm Earnings (Central RDA)

	Handicrafts	Marketing	Beer-Making	Total Non-Farm Income	Off-Farm Earnings
E	77,70	35,80	8,20	121,50	1 803,00

Source: RDA MEU, 1979: Table 2p

The income for handicraft production (E77.70) appears quite high (especially when compared with Southern RDA - E7,60) but is probably explained by the proximity of this area to the Mbabane-Manzini corridor and its various craft market outlets for tourists. The average income derived from marketing (mostly sale of fresh vegetables or cooked foods - E35,80) is also relatively high compared with Southern RDA (E6,00), once again due to the easy access to an urban market by this peri-urban RDA. Beer marketing income, however, is on average lower in Central RDA, probably due to the more readily available mass produced brews and greater pr ponderance of commercial licensed bars. Although data was not readily available, traditional medicine and tractor hiring also contribute to non-farm income. Before taking into account remittances and off-farm earnings, Central RDA receives considerably more income from off-farm activities than Southern RDA, which is predominantly due to its location and easy access

to a large urban population/market.

Having considered non-farm earnings, focus now turns to non-farm expenditure, elaborated in Table 7 below.

TABLE 7

Average Homestead Non-Farm Expenditure by Item - Central RDA

Item	Cost	Item	Cost
Food	273,10	Fuel	18,40
School Fees	86,20	Tobacco, Alcohol	13,90
Clothing	54,70	Materials for brewing	0,60
Household Goods	53,40	Marketing	21,70
Transport	50,80	Handicrafts	0,40
Medical Exp.	32,30	Maintenance of non-farm structures	8,60
		Loan given	3,00
		Gifts given	1,80

TOTAL: E618, 90
(adjusted to E634,63 because of purchase of a vehicle)

Source: RDA I EU. 1979: Table 20

The table above reveals that non-farm expenditure is considered high at E618,90 with food purchases the main item. This can be accounted for by the smaller area of maize cultivated, reducing the chances of meeting subsistence requirements; the easier access to retail supplies and the greater cash earnings. Taking into account the average homestead farm and non-farm income and expenditure, the overall balance is negative at E504,88.

TABLE 8

Farm and Non-Farm Income and Expenditure

	Income	Expenditure	Balance
Farm	50,48	42,23	8,25
Non-Farm	121,50	634,63	513,13
TOTAL	171,98	676,86	-504,88

This deficit was supplemented by earnings obtained from off-farm wage employment which, on average, totalled E1 803,00 per household. When only considering those households with members actually involved in off-farm employment, the average amount rose to E2 414.

It is, therefore, obvious to conclude that off-farm employment plays a major role in maintaining the homestead in this particular RDA, while non-farm income generating activities are also important.

As indicated earlier, the peri-urban nature of this RDA has lead it to become a dwelling place for off-farm workers rather than a highly intensive farming area. The inputs, especially the tractor hire service and even hybrid maize seed, help to perpetuate this area's function as a dwelling place by alleviating pressure on the farm labour requirements which release more farm workers for wage employment where financial returns are much higher. The problem lies in the fact that job opportunities are not increasing as fast as the demand for jobs and the formal sector will not be able to absorb all those seeking wage employment with the only alternative being back to the land.

III. DRAUGHT POWER AND ANIMAL FEEDING

Cattle Ownership

According to the Central RDA Farm Management Survey (RDA MEU, 1979: 1) only 47% of the surveyed farmers owned cattle with the estimated total number being 9 386. More recent farm census surveys (RDA Management Unit, 1981c) indicate that approximately 51% of the Central RDA homesteads own cattle with total number in the region of 11 084 (RDA Management Unit, 1982: 19-9) of which about 28% (3 104) are oxen. Of the homesteads with cattle, the average herd size is approximately 16 head per homestead (RDA Management Unit, 1981b). Breaking down cattle ownership by category, the average number per owner stands at: cows - 11,7; bulls - 1,4; oxen - 4,5 (for animals aged 1 year or older), based on figures in the Farmers Census (RDA Management Unit, 1981b).

A number of differences have been observed between cattle owners and non-cattle owners in this RDA. First, farmers not owning cattle tend to have smaller farms averaging 0,8 ha., whereas those with cattle have farms averaging 1,91 ha. Cattle owners have larger households, tend to own more equipment and have higher equipment depreciation costs, have a higher value of farm production, a lower percentage of workforce in off-farm employment and a larger workforce per hectare of arable land.

Although national figures indicate that cattle numbers have generally decreased, the number of livestock in this region increased during the 12 month period, April 1980 - March 1981. There was an overall cattle increase of 202 head, whereas in the period April 1981 - March 1981 the increase jumped to 961. These figures are based on births, deaths, slaughters and permits into and out of the area. The positive balance was primarily maintained by the number of cattle permits into this area from other regions that have been issued. Post March 1982 statistics (Central RDA Project Office), however, indicate that the cattle population is remaining constant, if not decreasing somewhat, due to the prevailing drought conditions which have caused cattle deaths and slaughters to increase.

Cattle Uses

The predominant reasons for keeping cattle remain the traditional ones - as a status symbol and store of wealth. Since off-farm wage employment is so high in this area, there is a high propensity to purchase cattle with a portion of earnings, while there is less need to sell cattle in order to obtain cash since there is a source of cash from off-farm employment. This is one factor which contributes to the perpetuation of high stocking rates.

Ceremonial roles of cattle, though still practised, are on the decrease, while the role of cattle in commercial enterprises, such as dairying and meat production are gradually increasing. Central RDA has 23 dairy farmers who sell a large portion (87%) of their milk (Central RDA, August 1983 Statistics). However, many homesteads only sell cattle to the Swaziland Meat Corporation when they are in need of cash for a specific purpose such as for purchasing farm inputs or for school fees. There are few commercial cattle breeders in this area.

Draught features relatively highly as a use of cattle in those homesteads with cattle. A ploughing team usually consists of 6 to 8 animals with 4 an absolute minimum, while weeding, harrowing and cultivating require a minimum of 2 animals. Due to the lack of oxen, draught teams are often comprised of a mixture of oxen and cows. It is common to occasionally see larger than average teams, which is in an effort to compensate for the fact that the team contains a mixture of animals of varying strength due to age or poor condition.

In times of drought, the weak state of draught animals requires that teams are larger in order to cope with the work load. Those land preparation and planting activities involving draught cattle are reserved for the cooler times of day, usually early morning.

Dry Season Feed

The problem of weak cattle at spring ploughing time is usually caused by the shortage of dry season feed. The severe overgrazing problem on communal land coupled with recent drought conditions has reduced natural grazing considerably. Although the growing of fodder crops is encouraged, only dairy farmers have adopted this practice, and they are also the main purchasers of feed, which is sold by the Swaziland Dairy Board. The majority of cattle-holding homesteads rely on the communal grazing range and the use of crop residues during the dry season (from May to October). About 25% of farmers make a concerted effort to gather and store crop residues which are then fed to their cattle during the months of August and September when communal grazing areas are most depleted. A range management project has recently begun in this area, consisting of fencing, bush clearing and an organised grazing rotation, with the specific aim of improving the reproductive capacity of cows (Project Manager, pers. comm.).

Land Preparation

Land preparation activities in Central RDA are characterized by the significantly high portion of homesteads (77%) using tractors (MEU, 1979: IV). Several factors are responsible for this tendency:

(a) the low percentage of homesteads with cattle, especially among the new arrivals to this area who come specifically to seek wage employment and tend not to have cattle with them;

(b) the high availability of cash from off-farm employment provides more homesteads with the means to hire tractors;

(c) the benefits of releasing labour from the farm to engage in off-farm employment providing more lucrative returns.

The commencement of land preparation activities can be as early as April with the practice of winter ploughing. About 50% of homesteads here have adopted this practice which extends from April to August and involves either ox-draught power or tractor hire. During these months the RDA tractor pool hire charges are slightly reduced, as it is a slack period. For those farmers not involved with winter ploughing, the normal spring ploughing activities begin from September and are dependent on adequate rainfall to soften the ground. The sequence of land preparation activities depends on when they begin and what form of power is used, the main variations being:

(a) winter plough with tractor + spring disc with tractor then plant with oxen and row planter;

(b) winter plough with oxen + spring plough with oxen and plant with oxen;

(c) spring plough with tractor then plant with oxen;

(d) spring plough with oxen + plant with oxen.

When virgin ground is first opened for planting, it is ploughed, then harrowed to remove weeds and finally planted.

The government operated tractor hire pool in Central RDA runs 4 tractors and spent 1 400 hours ploughing an estimated 700 ha. in the 1980/81 season. During the previous season - 1981/82, total ploughing hours reach 1 710 covering 855 ha. (RDA Management Unit, 1982: 24). The reason for the reduction in time and area covered in the 1982/83 season was due to the observance of the mourning period and also the late start of the rains. Cost of tractor hire is in the region of E14 - E18 per hour, depending on the season.

In spite of the high tractor usage, there was no significant difference in the crop areas planted using tractor preparation as opposed to ox-drawn land preparation (MEU, 1979: 12). In other words, tractors are not used in order that a larger area be cropped but rather as a labour (human and animal) saving device.

Tractors work faster than oxen and work a long period at a time. In fact, often tractors are only hired for the purpose of ploughing fields - a long and exerting task for oxen - and thereafter homesteads use their own ox-drawn planters. The process of planting only requires a minimum of 2 animals and is a relatively fast operation.

When examining figures on tractor equipment ownership as compared to draught implement ownership of a sample of 49% Central RDA households (RDA Management Unit, 1981b), the following was revealed:

TABLE 9

Private Equipment Ownership in Central RDA

# Homesteads	% sample	# tractors	# tractor ploughs	# discs	# tractor trailers	# planters
698	49	15	16	5	3	2
		# ox ploughs	# harrows	# cultivators	# carts	# planters
698	49	402	188	316	33	32[illegible]

In fact, very few tractor planters are owned, probably due to the high cost (uneconomic on small plots) and the relative ease and speed at which ox-drawn planters can be used on the small areas cropped. A high proportion of ox-drawn planters are owned by homesteads in Central RDA and those homesteads without them borrow or hire (at a cost of approximately E5 per day) planters from their neighbours. Planting is usually done with a planter (85,8%) rather than by hand (13,8%) - as revealed in the maize crop table below.

TABLE 10

Method of Land Preparation and Sowing of Maize
1982/[illegible] Season

Sown by hand - land preparation:	Tractor	6,9%)	
	Oxen	6,3%)	13,8%
	Hand	0,6%)	
Sown with planter - land preparation:	Tractor	42,4%)	
	Oxen	43,6%)	85,8%

Source: Agricultural Extension Services, 1983: Table 5

When these figures are compared with Southern RDA figures it reveals that Central RDA is much less reliant on hand operations. This could be due to the fact that more farmers have the means to purchase equipment in Central RDA, because of off-farm income.

Having established the general tendency in Central RDA of more equipment ownership, focus is now turned to labour hour requirements.

The monthly labour hours per homestead for Central RDA (Table 10) appear to be more evenly distributed than those for Southern RDA (see next Chapter), especially during the land preparation time at the beginning of the season, during September to December.

This reflects 2 factors:

(a) the rains began early that season, 1977/78, allowing ploughing activities to get underway sooner;

(b) the high proportion of hybrid maize grown in Central RDA. This variety requires timely land preparation and application of fertiliser, spreading labour over a longer period.

TABLE 11

Farm Labour Hours by Month and Type of Labour

	Mean Average Labour Hours per farm	Type of Farm Labour	Mean Average Hours
January	56	Under 10 years	24
February	33	10 - 14 years	34
March	33	Males 15 - 64	128
April	45	Females 15 - 64	159
May	91	Over 64 years	23
June	21	Community	2
July	-	Hired Seasonal	23
August	-		
September	2		
October	33		
November	41		
December	37		
TOTAL	393		

Source: RDA MEU, 1979: Table 3F

The total annual labour hours on farm are lower in Central RDA than Southern possibly resulting from:

(a) reduced area cultivated in Central (1,14 ha.);

(b) the higher reliance on tractor usage, and other farm equipment which reduces labour time.

The distribution of labour hours by operational category per

household is illustrated in Table 12.

TABLE 12

Per Farm Labour Hours by Operational Category for all Farm Work in Central RDA

	Operational Mean	Overall Mean	#fields using Method
Traditional ploughing and harrowing	33	19	45
Mechanical tractor, ploughing and harrowing	9	7	61
Traditional sowing, ox-sown and fertilising	48	41	68
Mechanical tractor, sowing and fertilising	5	2	33
Traditional weeding, thinning and spraying	91	90	78
Mechanical tractor, weeding and spraying	1	0	1
Harvesting, process, storing	94	90	76
Transport trucking, travelling, market purchase	11	0	2
Herding, dipping	247	113	36
Milking	5	1	17
Slaughtering and other animal operations	31	30	77
TOTAL	575	393	Total 79 farms

Source: RDA MEU, 1979, Table 2J

As revealed above, of the 79 farms surveyed, 61 used tractors for ploughing some of their fields while 45 used traditional hand- and ox-drawn equipment for ploughing. When it came to planting, more than twice as many used ox-drawn equipment compared to tractor planters.

Weeding is usually done with ox-drawn cultivators and by hand, but current trials are underway testing the effectiveness of certain herbicides which would further reduce labour time input.

The overall proportion of farming time devoted to livestock activities was 40% while cropping activities accounted for 60% of total farm work hours. This distribution is similar to that of Southern RDA, although the average total hours for Central RDA are considerably lower.

Summary

Central RDA with its high annual rainfall and relatively good soil exhibits fairly good agronomic potential. The average yields of the main crops are quite high although there is a considerable range in yields, suggesting that there is room for improved husbandry practices by some farmers. The climate is suitable for a double cropping season provided winter fields are irrigated. The main limiting factor is the proximity of this area to the urban centres of Manzini and Mbabane, where the opportunities for off-farm wage employment absorb a significant amount of the potential farm labour force.

Although Central RDA has a reasonably high agricultural potential, present crop production tends to remain at the sub-subsistence level with the balance of food requirements being purchased as revealed by the non-farm expenditure. Farm sizes are, on average, relatively small and cropping activity predominantly centres on subsistence production rather than cash cropping, therefore generating little or no income. This low productivity can be explained by the diversion of potential farm labour into other activities, particularly off-farm wage employment where returns are much higher. The peri-urban location of this RDA has been a significant factor which has encouraged homestead members to shift their attention from farming activities to wage employment. Analysis of homestead income and expenditure reveals that the farm and non-farm incomes are low while expenditures are very high, and in most cases off-farm wage employment provides the cash to maintain the homestead.

Although statistics indicate that over half the Central RDA homesteads own cattle, it is believed that current holdings are even higher (Project Manager, pers. comm.). In any case, draught power does present a problem for both those without cattle and those with weak or insufficient numbers of cattle. Usually the draught teams are composed of 6 - 8 oxen. The most common solution to the problem is to use a tractor for ploughing purposes, while reserving draught power for the tasks of planting and cultivating, which require only 2 oxen and are less strenuous jobs. Emphasis in this RDA is on a low labour-time input to cultivation, especially because many households have members engaged in off-farm employment, therefore reducing the labour available for agricultural activities while at the same time providing the financial means to hire a tractor.

Opportunity exists for improved animal feeding and fodder production which would help alleviate the weakness of animals at ploughing time, but this practice is likely to be most attractive to cattle owners who are the ones with the least access problem. Currently, only dairy farmers have adopted this supplementary feeding routine in order to maintain milk production, the sale of which provides them with a regular income. The time-cost factor is an important consideration when evaluating the feasibility of farmers adopting the practice of fodder production.

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SECTION TWO

Component Research

BOTSWANA

COMPONENT RESEARCH

A. MINIMUM TILLAGE RESEARCH

A.1 Testing Makgonatsotlha Tool Bar

Location of research: Pelotshetlha IFPP and EFSAIP farmers plot near Sebele

Average annual rainfall: Not applicable

General soil description: Arable sandy loam and loamy sand

Year started: 1977 - for several season till 1980/81

Researcher responsible: EFSAIP and IFPP working together

Objectives of experiments: To test Makgonatsotlha tool bar and minimum tillage equipment as well as other attachments for suitability and reduced animal draught power requirement.

If clear results obtained: Tests on farm were not successful for minimum tillage because there were too many weeds which clogged in the mechanism requiring stopping work and clearing out - too time consuming. Also, farmers were afraid this minimum tillage method would compact soil, making subsequent ploughing difficult. Planter needed modifying - too difficult to work with: also equipment very costly compared with the traditionally used implements.

Write-ups available: IFPP Annual Reports, 1979 and 1980: EFSAIP Report No. 6, 1981/82

If discontinued for what reason: Discontinued because Makgonatsotlha tool bar not well liked by farmers, not economical unless more than 10 ha. worked.

BOTSWANA

B. WINTER PLOUGHING

B.1 To allow rain to penetrate and to reduce weed population.

Location of research: Pelotshetlha lands area (Integrated Farming Pilot Project)(IFPP)

Average annual rainfall: 500 - 600mm

General soil description: Loamy sand to sandy loam

Year started: Encouraged by extension workers since 1975

Researcher responsible: Inter-disciplinary IFPP team

Objectives of experiments: To improve soil preparation, reduce weeds and allow rain to penetrate which, in turn, will help improve crop yields

If clear results obtained: Improved yields were obtained even in years when drought occurred

What write-ups available: Mentioned in IFPP Annual Reports, 1976 onwards

If discontinued for what reason: Ongoing extension advice, but difficult to practice due to low rainfall, weak animals, other labour demands

BOTSWANA

C. FORAGE LEGUME RESEARCH

C.1 Identifying suitable fodders under local agro-climatic conditions

Location of research: In several areas:

(a) Pelotshetlha - Southern District on experimental plots

(b) EFSAIP on-farm trials in Kgatleng District

Average annual rainfall: Pelotshetlha: 500 - 600mm
EFSAIP area: 500 - 550mm

General soil description: Pelotshetlha - loamy sand to sandy loam, arable areas

Year started: 1979 ongoing - at Pelotshetlha nursery various components were examined and modified each season, i.e., use of fertilizer and impact on yield

Researcher responsible: At Pelotshetlha - D. Chandler
At EFSAIP - C. Riches

Objectives of experiments: After testing for fodders suitable to soil and climate conditions, the practicability of growing fodder, the yields obtained in improved management systems, and the appropriateness of fodder crops to small scale mixed farmers is examined.

If clear results obtained: Appropriate crops have been identified for the various geo-climatic zones but now need to examine which farmers will make use of such fodders, because a number reside away from the lands area during the winter season and have no need for fodders.

Write-ups available: Pelotshetlha in IFPP Annual Reports, 1980, 1981/82; EFSAIP Report No. 6, 1981/82

If discontinued for what reason: Work continuing; Animal Production Research Unit also involved in this fodder research, mentioned in APRU 1980 Report

BOTSWANA

C. FORAGE LEGUME RESEARCH

C.2 Testing appropriate conservation measures to preserve forage legumes

Location of research: Pelotshetlha IFPP area Southern District; APRU Kgatleng District

Average annual rainfall: 500 - 600mm

General soil description: Arable - loamy sand to sandy loam

Year started: Since 1979/80 growing season - ongoing

Researcher responsible: Doug Chandler at IFPP/Ludwig Mayer at APRU

Objectives of experiments: Testing the conservation of grown forage legumes particularly for:

(a) optimum cutting times

(b) variability of total bulk;

(c) digestibility;

(d) nutritional value;

(e) number of cuttings possible;

(f) effects if crop left standing

If clear results obtained: Continuing work and testing more variations such as timing of various activities

Write-ups available: General mention in IFPP Annual Reports and forthcoming IFPP reports

If discontinued for what reason: Work ongoing

BOTSWANA

D. UNDERSOWING FOOD CROPS WITH FODDER

D.1 Undersowing sorghum and maize with various species of fodder

Location of research: At Pelotshetlha in Southern District on 2 ha. of project plot for testing

Average annual rainfall: 500 - 600mm per annum

General soil description: Loamy sand to sandy loam

Year started: Began 1980/81 season and ongoing

Researcher responsible: Doug Chandler in Pelotshetlha in conjunction with Bill Astle, APRU

Objectives of experiments: To identify whether various fodder legumes were suitable to the area and to see what effect they had on quality and bulk of stover produced by grain crop. Both inter-cropping/undersowing with grains and also grown on own fields to determine if suitable for those soil and climate conditions.

Another aspect of this has been overplanting late planted sorghum that will not produce harvest with legumes, to make use of land for fodder produce, having at least one crop yield in the end.

If clear results obtained: Quality of stover is improved with inter-cropping, but not bulk, and it may not be suitable to undersow with grain because of low moisture level of soil which affects the grain crop. Some suitable/adaptable fodder crops have been identified.

Write-ups available: To be included in 1981/82 and 1982/83 IFPP Annual Reports now in preparation; also mentioned in APRU 1980 report in Range Improvement section.

If discontinued for what reason: Work continuing; temporarily stopped due to drought

BOTSWANA

E. USE OF CROP RESIDUES

E.1 Encouraging the use of crop residues and the conservation of crop residues

Location of research: Pelotshetlha IFPP area Southern District

Average annual rainfall: 500 - 600mm

General soil description: On both arable and grazing areas

Year started: Since 1980 and ongoing

Researcher responsible: Doug Chandler and APRU (Animal Production Unit at Ministry of Agriculture Research Station, Gaborone)

Objectives of experiments: To encourage farmers to make optimal use of crop residues, especially by gathering them, stooking to preserve green material and racking or storing them to prevent animals trampling and subsequent loss. When left on field half is wasted due to cattle trampling it.

If clear results obtained: Some farmers have set up racks to preserve residue and feed to cattle when necessary.

Write-ups available: In APRU 1980 Report fairly good summary; and will be in 1981/82 and 1982/83 IFPP Annual Reports

If discontinued for what reason: Work continuing with experimentation on more suitable methods for storing crop residues and more extension work to encourage farmers to adopt these practices

BOTSWANA

F. PLANTED GRASSES FOR DRY SEASON FEED

F.1 Identifying suitable fodder grasses and the use of fertilizer to improve yield

Location of research: Pelotshetlha IFPP Southern District; APRU Kgatleng District

Average annual rainfall: 500 - 600mm

General soil description: Loamy sand to sandy loam

Year started: Since 1980 and expanding

Researcher responsible: Doug Chandler and APRU team

Objectives of experiments: Testing performance of various grasses in the area, as a source of fodder, and the use of fertilizer (superphosphate) to improve yield

If clear results obtained: Has expanded from test plot to farmers trials - 30 farmers volunteered last season (1982/83): 19 had crop worth harvesting, 6 were failures, rest dropped out of programme. Farmers are becoming interested, problem is now climatic (lack of rain).

Write-ups available: To be in IFPP 1982/83 Annual Report, mentioned in 1980 APRU study

If discontinued for what reason: Various grasses identified as possible to grow in those geo-climatic conditions, more varieties to be tested in coming 1983/84 season (vetches, lucerne, winter rye and radishes).

BOTSWANA

G. CATTLE REPRODUCTION AND CALF MANAGEMENT ON DRAUGHT/MILK REGIME

Location of research: Pelotshetlha - IFPP Southern District

Average annual rainfall: 500 - 600mm

General soil description: Loamy sand to sandy loam

Year started: 1982 onwards

Researcher responsible: Doug Chandler and IFPP team (Michael Flint)

Objectives of experiments: Work is under way on monitoring (through Farm Management Survey) cattle weights, milk production and fertility and related problems. Still at early stage but in time could provide some insight into effects of draught on milk production and fertility.

If clear results obtained: Too soon to say what results. Obviously draught does put stress on cows and affects both reproduction/abortion and milk production

Write-ups available: Not yet

If discontinued for what reason: Ongoing

LESOTHO

COMPONENT RESEARCH

A. NO TILLAGE RESEARCH

Location of research: Thaba Bosiu area: Only one farmer involved in current trials covering 1,25 ha.

Average annual rainfall: 700mm

General soil description: Sandy loam - Leribe series

Year started: 1979

Researcher responsible, past, present: H. W. Fausch and Farming Systems Research Team

Objectives of the experiments

(a) Erosion control - no visible erosion since experiment began;

(b) To achieve maximum production of maize possible with the "no tillage" system, using different types of planters (rotary injection, ox-drawn, etc.);

(c) Improve yields without fertilizer;

(d) Test effectiveness of herbicides, to eliminate hand weeding.

If clear results were obtained

(a) erosion controlled;

(b) productivity affected by drought;

(in first year yields doubled to 2 000 kg/ha. with good rains and hope to achieve 5 000 kg/ha.)

Write-ups available: Written up as progress report, but at end of trial, 1985, a final report will be produced.

If discontinued for what reason: Continuing until 1985

LESOTHO

B. MINIMUM AND REDUCED TILLAGE RESEARCH

B.1 Reduced tillage with low draught equipment

Location of research: Spring and summer on-farm trials at 3 proto-type areas

Siloe (lowlands) - sorghum
Nyakosoba (foothills) - maize
Molumong (highlands) - maize

Average annual rainfall: Siloe - 710mm
Nyakosoba - 800-1 000mm
Molumong - 586mm

General soil description: On arable fields with good, red, deep soils

Year started: October 1983 - March/April 1984

Researcher responsible: Multi-disciplinary: Agronomy, Farm Management and Extension Divisions

Objectives: To demonstrate the use of improved ox-drawn ploughing and planting technology in the form of Ariana plough and planter. Comparing manageability of Ariana to current Safim, and at a later phase comparing yields. Trial should demonstrate superior handling control of Ariana which helps in improving yields.

If clear results were obtained: No results yet

Write-ups available: On-farm trial description only

If discontinued for what reason: Point of handling equipment with ease was demonstrated, now need a manufacturer of this product locally.

LESOTHO

B. REDUCED AND MINIMUM TILLAGE

B.2 Improved technology in the form of Ariana or improved Safim planter. Higher yields for maize and sorghum.

Location of research

Spring-summer on-farm trials: Areas - 3 prototype areas:

Siloe - 2 trials sorghum, maize
Nyakosoba - 2 trials sorghum, maize
Molumong - 1 trial maize

Average annual rainfall: Siloe - 710mm
Nyakosoba - 800-1 000mm
Molumong - 586mm

General soil description: Arable fields with good soils

Year started: To begin October 83/84 season

Researcher responsible: Multi-disciplinary - Farm management, Extension, Agronomy staff

Objectives of the experiments: To examine 3 factors believed to be holding down yields:

(a) seedbed preparation;
(b) fertilizer/seed placement;
(c) proper seed placement in rows;

and demonstrate the need for appropriate equipment as well as demonstrating the effects of careful land preparation (i.e., harrowing). One half of field will be ploughed and planted, the other half ploughed, harrowed as many times as necessary and then planted. Designed to emphasize the importance harrowing has as a pre-planting technique.

If clear results obtained: Not yet

Write-ups available: On-farm trial description only

If discontinued for what reason: Ongoing - depending on current results

LESOTHO

C. HERBICIDE RESEARCH

C.1 Herbicide research - weed control trials - 11 trials with 11 crops in Maseru and 3 replications using selection of herbicides.

Location of research: Maseru and Leribe Agricultural Stations

Average annual rainfall: Maseru - 680mm Leribe - 800mm

General soil description: Good arable, deep soil in both areas

Year started: 1982/83 season - to go on - 3 seasons

Researcher responsible: Keith Wallace, E. Pomelo

Objectives of the experiments: Weed control trials to determine most effective chemicals to use on selected crops

If clear results were obtained: Hand-weeding is most effective but the herbicides used also gave reasonable results.

Write-ups available: For each trial a report is written, also mentioned in Research Division annual reports, Agronomy section.

If discontinued for what reason: Research work and trials continuing and expanding to other areas in the country..

LESOTHO

D. WINTER PLOUGHING AND SEEDBED PREPARATION

Location of research: Siloe (lowlands) - sorghum; Nyakosoba (foothills) - maize; one trial each method

Average annual rainfall: Siloe - 710mm
Nyakosoba - 800-1 000mm

General soil description: Good, deep, arable soils

Year started: 1983 winter to 1984 spring - limited start - Siloe tractor winter ploughing done.

Researcher responsible: Team effort - Farm Management, Agronomy and Extension

Objectives of the experiments: To illustrate the effects of one approach to reducing the tillage/oxen bottleneck that occurs in spring, by tilling in winter.

Siloe - methods:

Tractor - spring	Oxen - spring	Tractor - spring
Tractor - winter	Oxen - winter	Oxen - winter

Nyakosoba - method: (cannot use tractors)

Oxen - winter
Oxen - spring

In Siloe apart from demonstrating importance of spring vs. winter ploughing, the trial will include the advantages of tractor vs. oxen ploughing.

After preparation, crops will be planted as recommended in cropping guidelines.

If clear results obtained: Not yet, too soon

Write-ups available: On-farm description only

If discontinued for what reason: May be encouraged in other areas.

LESOTHO

E. FORAGE LEGUME RESEARCH

E.1 Undersowing fodder sorghum with cow peas (including some forage varieties). Cow peas are more drought tolerant and more acid-soil tolerant, only problem is that frost kills them.

Location of research: Leribe - Mahobong trial station area.

Average annual rainfall: 800mm

General soil description: Good, red, deep soil, high in potassium, low pH.

Year started: 1982/83 summer season

Researcher responsible: T. Russell

Objectives of experiments: To demonstrate inter-cropping of fodder grain with a legume that is predominantly used for home consumption in order to encourage fodder production to supplement animal feeding.

If clear results obtained: Results being analysed.

Write-ups available: Only briefly in annual reports

If discontinued for what reason: Continuing

LESOTHO

E. FORAGE LEGUME RESEARCH

E.2 Undersowing grains or legumes with pasture

Maize - fodder undersowing trial
Sorghum - fodder undersowing trial

Location of research: Leribe - Mahobong trial site

Average annual rainfall: See Leribe figures - 800mm

General soil description: Good, red, deep soil, high in potassium, low pH

Year started: Winter trials 1982 (May - September)

Researcher responsible: Tim Russell

Objectives of experiments: To determine if the cost of establishing a fodder crop can be covered by value of the companion maize, sorghum, wheat or pea crop (using Eragrostis C., Rye, Lucerne, Red Clover, Era and Lucerne, Rye + Radish).

If clear results obtained: Results being analysed

Write-ups available: Only in annual reports

If discontinued for what reason: Continuing

LESOTHO

E. FORAGE LEGUME RESEARCH

E.3 Chick pea accessions from ICRISAT

Location of research: Maseru Agricultural Research Station

Average annual rainfall: Not applicable

General soil description: Maseru soil series

Year started: 1981/82 summer growing season

Researcher responsible: A. Law (Agronomy)

Objectives of experiments: To determine if there are selections of chick peas which could have a place in Lesotho agriculture.

Forage yield ranged from 2 889 kg/ha. to 1 708 kg/ha.
Seed yield ranged from 668 kg/ha. to 521 kg/ha.

Time from planting to harvest = 84 days, making it possible to crop to follow winter wheat in crop rotation. Also short growing season makes crop particularly useful in areas where spring drought delays planting of maize and sorghum.

If clear results obtained: Intended to plant chick peas at Siloe and Nyakosoba areas but due to change in staff not being done, and now hoping for new accessions from ICRISAT.

Write-ups available: Only in annual reports

If discontinued for what reason: No work just now, but Crop Division would like to start again and also use soya bean.

LESOTHO

E. FORAGE LEGUME RESEARCH

E.4 Pidgeon pea trials

Location of research: Maseru - to extend to Maseru and Mafeteng

Average annual rainfall: 680mm

General soil description: Good soil in research nursery plot

Year started: Planted September 1981 and harvested January 1982 (in screening nursery)

Researcher responsible: A. Law

Objectives of experiments: Pidgeon pea accessions from ICRISAT programme in India were grown in a preliminary screening trial with best accession yielding 1 319 kg/ha. forage + 1 476 kg/ha. seed. Maturity required 132 days from planting to harvest. Best accessions should be planted in replicated trials in Maseru and Mafeteng to explore production. in trials designed to compare row spacing, fertilizer level and time of seeding.

If clear results obtained: Good - more trials were planned in Siloe and Nyalenoba, but due to change in staff not going on now.

Write-ups available: In quarterly reports: January - March 1982: April - June 1982

If discontinued for what reason: Planted but due to drought died, need new accessions from ICRISAT.

LESOTHO

F. PLANTED CROP FOR DRY SEASON FEED

F.1 Fodder species comparative productivity trial.

Location of research: In Leribe area - research trial plot Mahobong

Average annual rainfall: 800mm

General soil description: Good, red, deep soil, high potassium, low pH

Year started: 1982/83

Researcher responsible: Tim Russell

Objectives of experiments: To compare the productivity of a range of fodder crops. The seeds of all crops can, with a little effort, be purchased in the region. Crops are harvested, fresh weight taken, then sun-dried and weighed.

If clear results obtained: April planting in 1st year (1982) late; now (1983) planted earlier from February - April - results positive. Some planted alone and some mixed cropping.

Write-ups available: No formal write-up

If discontinued for what reason: Ongoing

LESOTHO

G. USE OF CROP RESIDUES AND FEEDING SUPPLEMENTS

G.1 Value of winter lick fed to cattle under Lesotho farmer conditions (Rumevite block)

Location of research: In 3 prototype areas: Siloe, Nyakosoba, Molumong

Average annual rainfall: Molumong - 586mm
Siloe - 710mm
Maseru - 680mm

General soil description: Not applicable

Year started: Fodder crops planted spring 1980; experiment ran June 1981 to December 1982, some animals in pen others on grazing land.

Researcher responsible: E. Klosterman, L. Motjope, M. Molapo.

Objectives of experiments

(a) Fodder to encourage and enable farmers to improve livestock feeding methods especially for draught animals.

(b) To compare performance of oxen fed in pens during winter period to those fed and managed in usual manner by village farmers.

(c) To determine the value of a supplemental protein and mineral lick when fed with each of the above 2 systems.

(d) To enable farmers to improve their total oxen feeding and management methods (winter feeding runs from June - October).

If clear results obtained: First winter Siloe, it was apparent that farmers did not have adequate supply of fodder to maintain weight of cattle in mid- to late winter.

Molumong - drought in summer 1981/82 season, feed supplies were scarce and there were problems getting cattle to the pen. Project became primarily one of supplying half the group with Rumevite to feed at home.

Generally, results indicate no significant difference in supply of Rumevite, basically because of shortage of crop residues to provide energy and maintain cattle weight. Showed farmers the need to provide adequate feeding and management during winter months. Winter feeding of young, reproducing animals is much more critical if production of meat and milk is expected.

Generally lacked adequate feeding. Need to meet energy needs before protein supplements are a wise investment to average farmer. When needed, if they can afford it, farmers should buy

fodders or high energy feeds such as under-grade cereal grains or hominy chop before Rumevite.

Write-ups available: Molapo, Motjope and Klosterman - 1982

If discontinued for what reason: Experiment ended

LESOTHO

G. USE OF CROP RESIDUES

G.2 Use of hominy chop produced at Lesotho Mill (at Maputsoe) as a cattle feed

Location of research

1982: Molumong (highlands) - 10 farmers (2 oxen on/2 oxen off)

1983: Siloe (lowlands) winter - 11 farmers (4 with 4 animals; 7 with 2 animals)

Average annual rainfall: Not applicable

General soil description: Not applicable for this work

Year started: July 1982 - December 1983

Researcher responsible: E. Klosterman, L. Motjope, M. Molapo

Objectives of experiments: To determine the value of hominy chop for oxen feeding, which is the cheapest source of purchasable energy available in Lesotho (also feed milk cows hominy chop and bran to help increase milk production)

If clear results obtained: All cattle lost weight: those on hominy chop lost less, but farmers worked them harder because they were stronger. Cost of meeting daily energy requirements of a 400kg ox was calculated to be M0,37 from hominy chop and M1,37 from lucerne (which is imported).

What write-ups available: None - just in annual report

If discontinued for what reason: Still ongoing - this season in Siloe

LESOTHO

H. PLANTED GRASS FOR DRY SEASON FEED

H.1 Perennial grasses for fodder in lowlands

Location of research: Maseru Research Station

Average annual rainfall: 680mm

General soil description: Deep, good soil, loamy

Year started: November 1982 - ongoing

Researcher responsible: J. Tiedeman - R.Ntsasa

Objectives of experiments: To demonstrate recommended perennial fodder varieties and monitor production under local conditions.

If clear results obtained: No results yet

Write-ups available: Written in Annual Report 1982/83

If discontinued for what reason: Ongoing

LESOTHO

H. PLANTED GRASS FOR DRY SEASON FEED

H.2 Perennial grasses under mountain conditions

Location of research: Molumong (highlands) and Libibing (highlands)

Average annual rainfall: In October/November 1980 only ¼-inch fell then drought which killed all seedlings except drought tolerant varieties. Adequate rain fell from late November to February.

General soil description: Shallow, gravelly, loamy soils on gentle slopes with little organic matter.

Year started: Planting began October 1980, 1st harvest in March 1981

Researcher responsible: J. Liedeman and K. Wieland

Objectives of experiments: To demonstrate and test yield of perennial forage grasses under mountain conditions - high altitude, climate and poor soil.

If clear results obtained: The highest yielders were:

Libibing: bookfoot, perennial rye grass, Eragrostis curvula and lucerne

Molumong: lucerne, birdsfoot trefoil and yellow sweet clover

What write-ups available: Wieland, K. G., 1981 "Forage Planting at Libibing", Research Division, Ministry of Agriculture, Lesotho, 5pp

Wieland, K. G., 1981 "Molumong Store Forage Trials Report", Research Division, Ministry of Agriculture, Lesotho, 12pp

If discontinued for what reason: Work continuing in other areas

LESOTHO

H. PLANTED GRASS FOR DRY SEASON FEED

H.3 Eragrostis curvula fertilizer x harvest x frequency x variety trials

Location of research: Matelile (Mafeteng District - foothills) - on sub-station land and research plots

Average annual rainfall: 900mm

General soil description: Deep loam, highly organic - very good soil - cooler climate

Year started: 1975 - 1983 ongoing perennial grass. 1982 stopped fertilizer but continue to harvest.

Researcher responsible: J. Tiedeman, R. Ntsasa, F. Nkuatsana

Objectives of experiments: To evaluate the effect of different nitrogen levels and cutting frequencies on performance of two varieties of Eragrostis curvula

If clear results obtained: There appears to be a significant relationship as expected between increased yields with increased fertilizer rates. Yield differences between varieties do not appear significant. The longest (12 week) harvest interval appears to be the highest yielder.

Write-ups available: Briefly in Research Division annual reports

If discontinued for what reason: Fertilizer stopped, now only observation status of this perennial grass

LESOTHO

H. PLANTED GRASS FOR DRY SEASON FEED

H.4 Eragrostis curvula through Extension Service

Location of research: Butha-Buthe, Leribe, Maseru, Morija, Mafeteng - about 150 on-farm trials

Average annual rainfall: Butha-Buthe: 780mm
Leribe - 800mm
Maseru - 680mm
Mafeteng - 710mm

General soil description: Shallow to deep, level to rolling, poorly drained, largely sandstone and basalt derived loam, clay loam or clay on valley bottoms. Area is used for normal cropping but results are poor and land susceptible to erosion.

Year started: 1978 - ongoing

Researcher responsible: J. Polisane with extension staff in the above-listed districts

Objectives of experiments: To encourage conservation of soil is the main objective, as well as to provide fodder for dry season animal feed. Plan is to have perennial grass on land for 4 years, then to plant maize one year and after return to perennial grass.

If clear results obtained: It is clear that erosion is curtailed with this practice. In a good year, grass can be cut 3 times and stored or sold in bales to farmers needing fodder.

What write-ups available: Monitored in monthly and quarterly Bulletins of Conservation Division, Ministry of Agriculture, Lesotho

If discontinued for what reason: To run on the long term in the hope that more farmers adopt this practice. Until now the Ministry has provided seed, fertilizer and did the ploughing - now the shift is that farmers have to provide fertilizer and apply it after cutting the crop.

LESOTHO

H. PLANTED GRASS FOR DRY SEASON CATTLE FEED

H.5 Planting fodders to provide cattle feed and prevent erosion

Location of research: Sehlabathebe - eastern highlands; Berea and Teyateyaneng trials

Average annual rainfall: 800mm

General soil description: Marginal land - can be cropped depending on inputs

Year started: 1983/84 season, beginning with 5 year duration

Researcher responsible: H. W. Fausch and J. Polisane

Objectives of experiments: Mainly to conserve soil, prevent erosion while at the same time providing needed products, in this case animal fodder. Various varieties of forage grasses have been planted (woolly vetch, cerradela, leafy clover, birdsfoot trefoil, lucerne and Eragrostis curvula) and yields will be monitored. Approximately 1 ha. per variety is planted in each of the above 3 areas to compare yields.

If clear results obtained: As project only just begun, no results yet

What write-ups available: Only outlined in conservation and cropping programme

If discontinued for what reason: To continue for 5 years

LESOTHO

I. CONSERVING AND REJUVENATING RANGELAND

I.1 Natural grass rangeland research on rejuvenation - the effect of burning natural rangeland on various grasses and subsequent rejuvenation

Location of research: Nyakosoba foothills

Average annual rainfall: See Nyakosoba - 800 - 1 000mm

General soil description: Shallow soils on sloping hills - rangeland

Year started: 1982-1984 completed and analysed results - now only observation status

Researcher responsible: I. Monoto

Objectives of experiments: The vigour and ground cover of various grasses was being measured to determine the impact of burning natural rangeland on them. Forage samples were harvested in April to determine the effect of fire on forage production and carrying capacity.

If clear results obtained: Preliminary analysis shows that the vigour of most of the grasses measured is significantly less on burned than non-burned plots. Forage yeild was reduced by approximately 15% from burning. Results below:

	Majelefa's Burn (hyparrhenia)	Rock Rabbit (andropogon)	Gabriel's Burn
Burned	2 070 kg/ha.	1 901 kg/ha.	471 kg/ha.
Non-burned	2 706 kg/ha.	2 467 kg/ha.	687 kg/ha.

What write-ups available: Written up as a final paper by Mr. Monoto as part of degree course from University of Lesotho

If discontinued for what reason: Now only observing grass growth

SWAZILAND

COMPONENT RESEARCH

A. DRAUGHT EQUIPMENT IMPROVEMENT

A.1 Examination of commonly used draught equipment with focus on its weaknesses

Location of research: On-farm research in Malkerns-Luyengo area

Average annual rainfall: 800 - 1000mm

General soil description: Red, loamy, arable soil

Year started: 1982 until June 1984

Researcher responsible: Augustine Engoru-Ebinu

Objectives of experiments: Focus on the problems and constraints of mechanizing the small-scale farmers sector. Animal draught power proved to be the most appropriate method to use - but maintenance of draught equipment is the main constraint. Attention is now on ways of improving and modifying draught equipment.

If clear results obtained: Clear directions for improvement are being identified

Write-ups available: Progress report available from the researcher at Land Use and Mechanisation Department, UNISWA, Luyengo Campus

If discontinued for what reason: Ongoing

SWAZILAND

B. MINIMUM TILLAGE RESEARCH

B.1 Effects of reduced tillage on various soil types

Location of research: Experimental plots in Middleveld and Lowveld of Swaziland

Average annual rainfall: Lowveld: 500-800mm
Middleveld: 750-1 000mm

General soil description: Variety of arable soils in the 2 areas

Year started: 1974 until 1981

Researcher responsible: A. H. Ward, Physics Department, UNISWA, Kwaluseni, and D. Warwick, Agriculture Faculty, UNISWA, Luyengo

Objectives of experiments: To test the effects of reduced tillage and no tillage on various soils and crops in the Lowveld and Middleveld

If clear results obtained: Findings revealed:

(a) progressively improved moisture retention in no-tillage soils after the 3rd year (assuming chemical weed control);

(b) unexpectedly similar bulk densities in untilled and tilled soils

Write-ups available

Warwick, D., "Reduced tillage research with maize in Swaziland", Journal of RSSST, Vol. 1, No. 3, 1978, pp. 155-164

Ward, A. & **Warwick, D.**, "Soil temperature at Luyengo and variations caused by tillage practices", Journal of RSSST, Vol. 1, No. 3, 1978, pp. 165-173

Ward, A., "Use of radiotracers in determining maize root distribution", Journal of RSSST, Vol. 1, No. 3, 1978, pp. 174-177

Ward, A. & **Warwick, D.**, "Soil moisture measurements with neutron proble in the Middleveld", Journal of RSSST, Vol. 2, No. 1, 1979, pp. 38-42

Warwick, D., "Effects of no-tillage and mulching on soil conditions and maize yield", Journal of RSSST, Vol. 4, 1981, pp 12-20

Available at SSRU Documentation Centre

If discontinued for what reason: Experiments ended

SWAZILAND

C. PLANTED GRASS FOR DRY SEASON FEED

C.1 Test effects of fertilizer application on forage grass yields

Location of research: Malkerns Research Station - to be extended to the Rural Development Areas

Average annual rainfall: 800-1 000mm

General soil description: Un land classed as grazing and some arable (fertilizers were also used in these trials to test their effects)

Year started: 1974-1977

Researcher responsible: Ministry of Agriculture Research Station

Objectives of experiments: To test suitability and returns of various fodder grasses and the effects of NPK fertilizer treatments. Grasses included:

Eragrostis curvula
Chloris gayana
Stargrass and Kikuyu

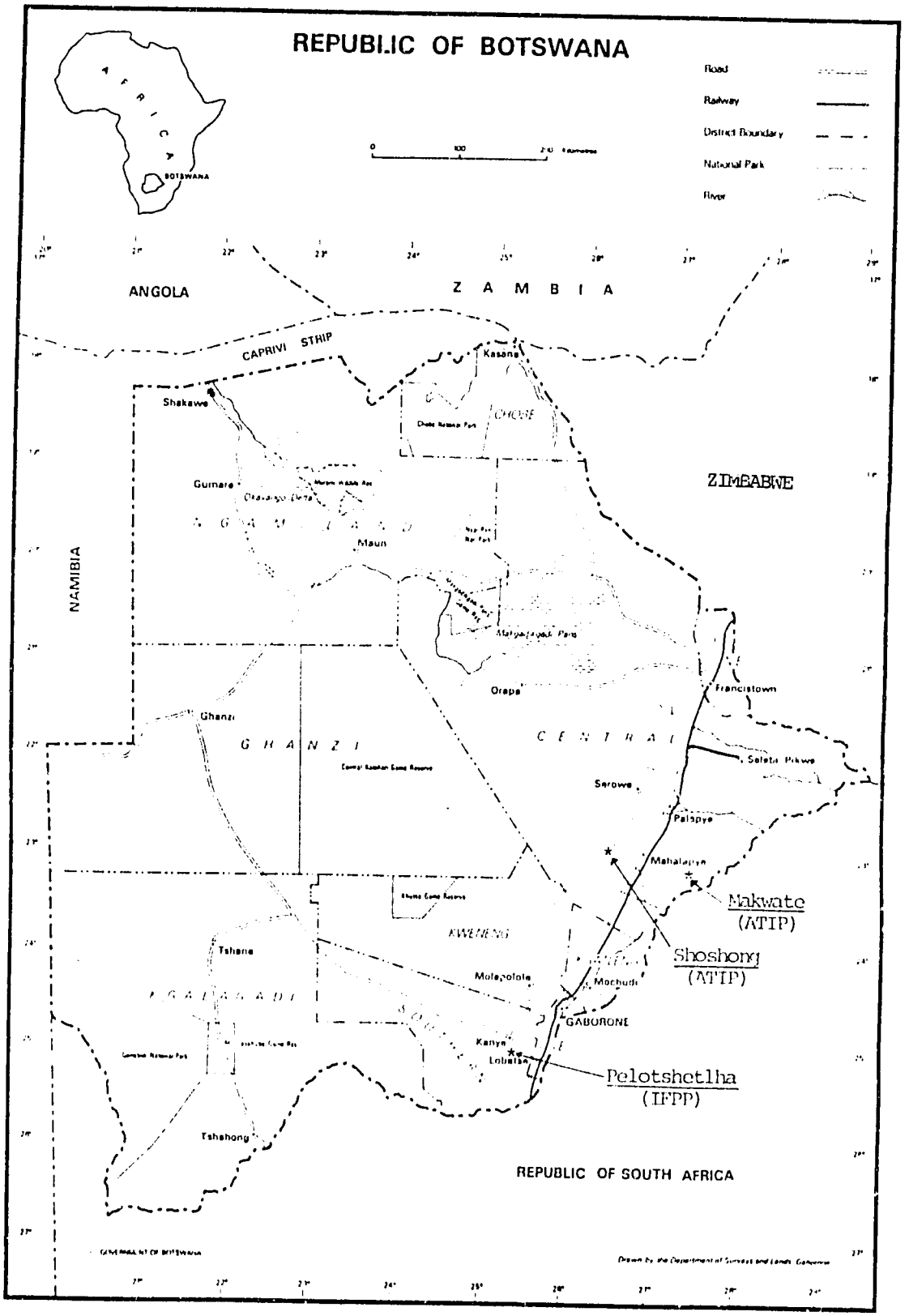
If clear results obtained: Good results on growth when nitrogen and phosphate were applied together, but question on whether cost justifies end results

Write-ups available: Ministry of Agriculture and Co-operatives, Annual Report of the Agricultural Research Division, 1977-78, pp. 9-16

If discontinued for what reason: Experiments ended when Pasture Research Officer left in 1977

COUNTRY MAPS

12/11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KWENENG
Tshane
Molepolole
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GABORONE
Kanye
Lobatse
Pelotshetlha
(IFPP)
Tshabong
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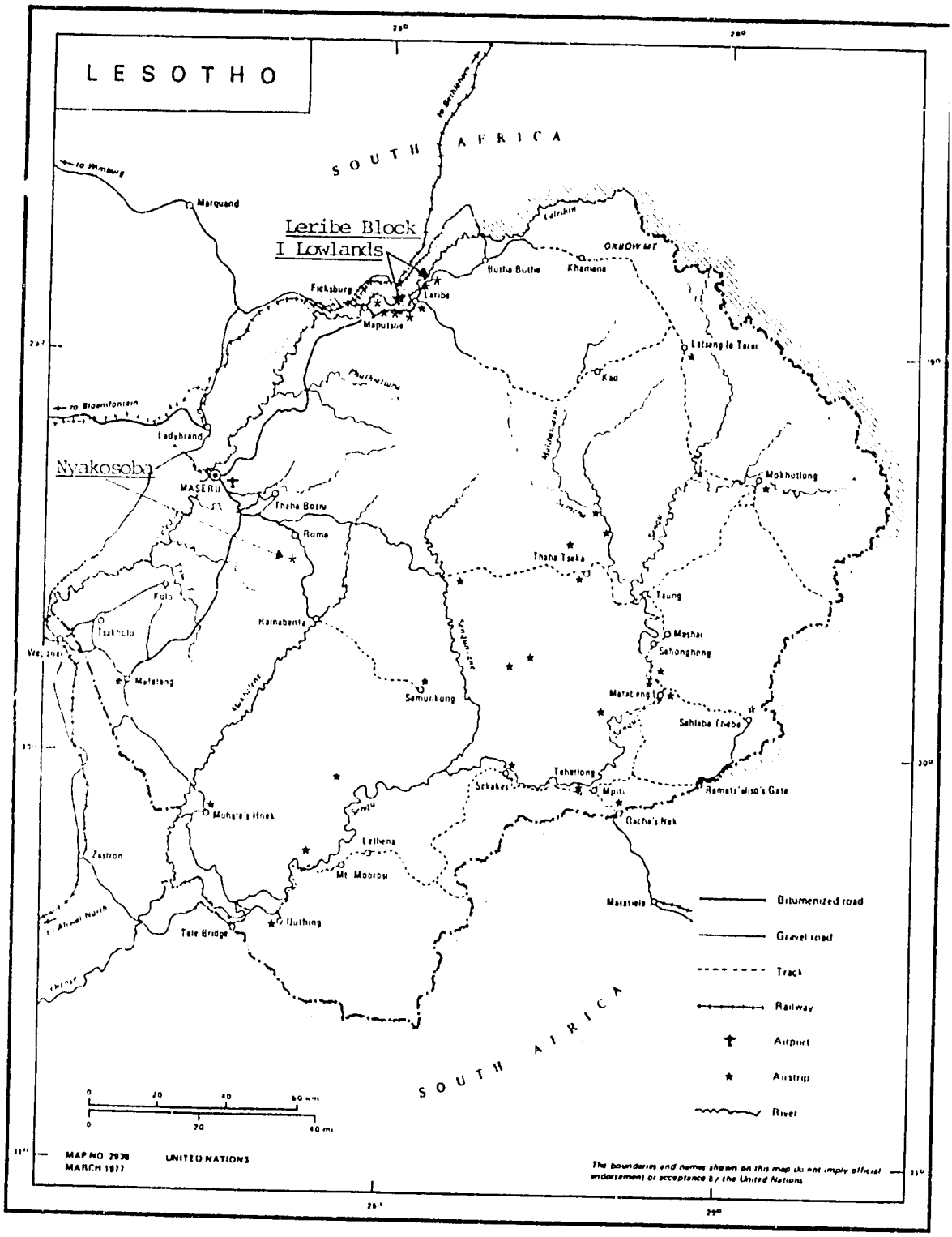
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Mokhotlong
Thaba Tseka
Tsung
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Sehonghong
Hlotse
Mafeteng
Semonkong
Mohale's Hoek
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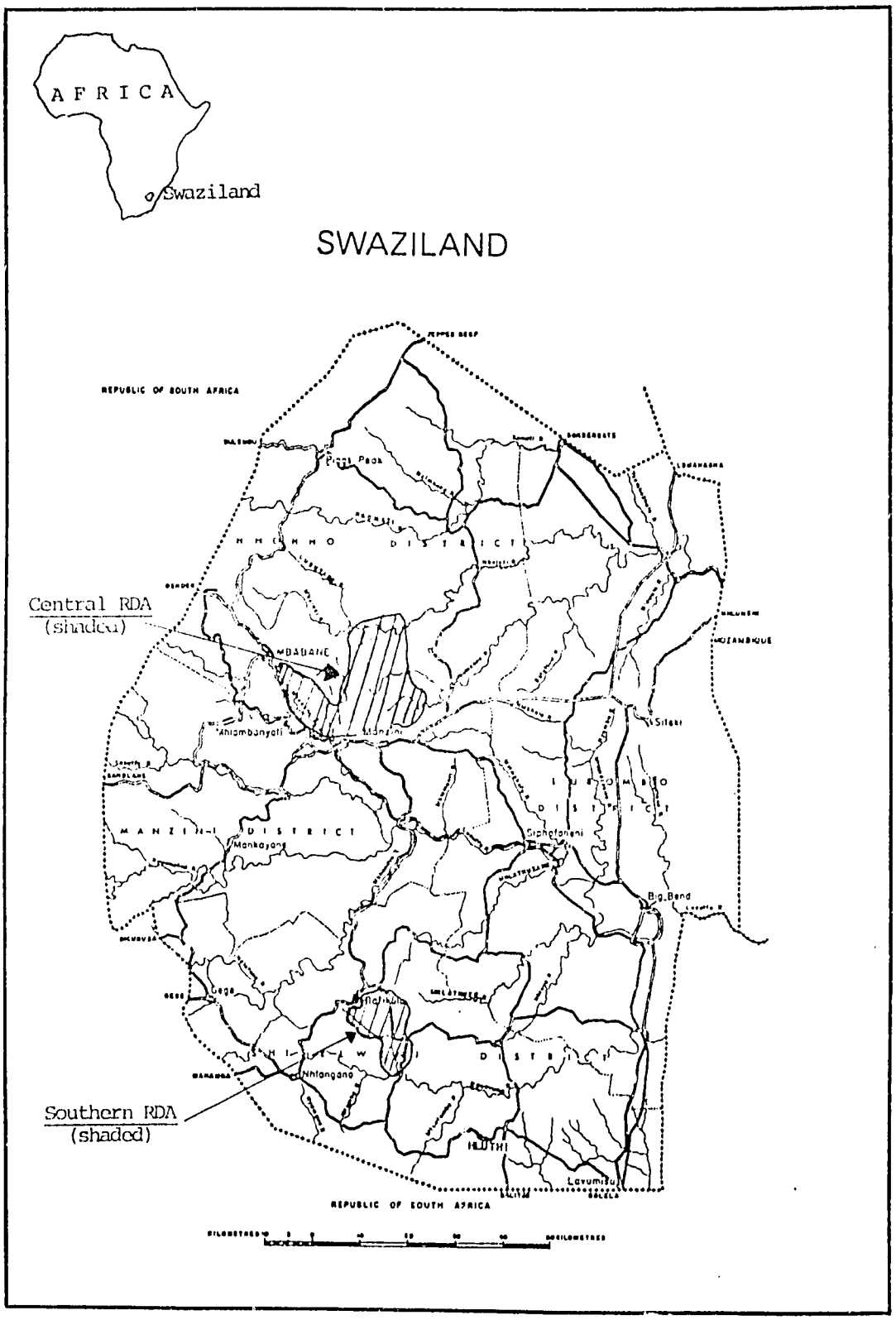
Qiuthing
Mpiti
Ramats'eliso's Gate
Bitumenized road
Gravel road
Track
Railway
Airport
Airstrip
River
MAP NO 2938
MARCH 1977
UNITED NATIONS
The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations


AFRICA
Swaziland
SWAZILAND
REPUBLIC OF SOUTH AFRICA
Pigg's Peak
HHOHHO DISTRICT
Central RDA
(shaded)
MBABANE
Ahlambanyati
MOZAMBIQUE
Siteki
LUBOMBO DISTRICT
MANZINI DISTRICT
Manzini
Mankayane
Siphofaneni
Big Bend
Gege
Nhlangano
SHISELWENI DISTRICT
Southern RDA
(shaded)
HLUTHI
Lavumisa
REPUBLIC OF SOUTH AFRICA