PN-ABA-649
ISN 57488

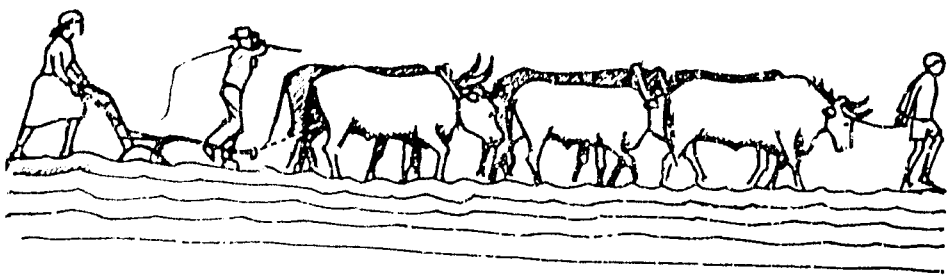
AGRICULTURAL TECHNOLOGY IMPROVEMENT PROJECT (ATIP)

AGRICULTURAL DEVELOPMENT SETTING IN BOTSWANA

NUMBER: ATIP WP - 15

BY

DOYLE BAKER



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AGRICULTURAL TECHNOLOGY IMPROVEMENT PROJECT

(ATIP)

WORKING PAPER

AGRICULTURAL DEVELOPMENT SETTING IN BOTSWANA

NUMBER: ATIP WP-15

BY

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MID-AMERICA INTERNATIONAL
AGRICULTURAL CONSORTIUM
(MIAC)

JULY 1988

PRINTED: 20/07/88

ADDRESSES:

P/BAG 0033
GABORONE

P. O. BOX 10
MAHALAPYE

P.O. BOX 10275
TATITOWN (FRANCISTOWN)

ATIP WORKING PAPERS CONSIST OF METHODOLOGICAL AND EMPIRICAL MATERIAL WHICH HAS BEEN REVIEWED INTERNALLY BY ATIP BUT DOES NOT NECESSARILY REFLECT THE VIEWS OF THE DEPARTMENT OF AGRICULTURAL RESEARCH, MINISTRY OF AGRICULTURE, BOTSWANA

PREFACE

ATIP working papers consist of methodological and empirical material which has been reviewed internally by ATIP. Working papers are prepared and circulated to make ATIP research findings easily available to GOB personnel and researchers interested in Botswana farming systems. The viewpoints expressed do not necessarily reflect the views of the Department of Agricultural Research, USAID or Kansas State University.

This paper gives background information on the setting for agricultural development in Botswana. The paper covers the technical environment, sector structure, production trends, production practices, agricultural institutions, relationships between agriculture and the macro economy, and national priorities for agricultural development and food security. Most of the information is based on secondary sources.

The paper is being distributed because of the importance of external (or exogenous) factors affecting technology research and development priorities. It is hoped that a synthesis of information on the agricultural development setting will contribute to better problem definition and priorities setting in DAR and throughout the Ministry. A second objective is to make it clear that there are a wide range of factors affecting increased production besides the success of on-farm research teams in developing improved production technologies.

ACKNOWLEDGEMENTS

David Norman (DAR, ATIP) made helpful comments on an earlier draft of the paper.

AGRICULTURAL DEVELOPMENT SETTING IN BOTSWANA

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BOTSWANA ABBREVIATIONS

AD, Agricultural Demonstrator
ADNP, Agricultural Development Ngamiland Project
ALDEP, Arable Lands Development Programme
APRU, Animal Production Research Unit
ARAP, Accelerated Rainfed Arable Production
ARS, Agricultural Research Service
ASU, Agricultural Statistics Unit
ATIP, Agricultural Technology Improvement Project
BAC, Botswana Agricultural College
BAMB, Botswana Agricultural Marketing Board
BDC, Botswana Development Corporation
BLDC, Botswana Livestock Development Corporation
BMC, Botswana Meat Commission
BVI, Botswana Vaccine Institute
CSO, Central Statistics Office
DAFS, Department of Agricultural Field Services
DAR, Department of Agricultural Research
DLFRS, Dryland Farming Research Scheme
DPS, Division of Planning and Statistics
EFSAIP, Evaluation of Farming Systems and Implements Project
FWE, Family Welfare Educator
IFPP, Integrated Farming Pilot Project
LDP, Livestock Development Plan
MOA, Ministry of Agriculture
MFDP, Ministry of Finance and Development Planning
NDB, National Development Bank
NDP, National Development Plan
NFS, National Food Strategy
PSU, Planning and Statistics Unit
RDC, Rural Development Council
TGLP, Tribal Grazing Lands Policy
VET, Village Extension Team

1. INTRODUCTION

On-farm research is a small part of a large and complex agricultural development and planning process in Botswana. Although on-farm research priorities are in part determined from farm-level diagnosis, priorities are not determined in a vacuum. On-farm research teams in Botswana, as elsewhere, are assigned mandates stemming from national and agricultural development goals. Moreover, the mandates are determined in relation to the mandates and performance of other research, planning, marketing and extension institutions.

The success of on-farm research programmes also depends on complementarities with other agricultural institutions, policies and programmes. For example, successful on-farm research requires a reasonable backlog of technological alternatives generated through on-station research. Also, the adoption of promising technologies is highly dependent on the incentives farmers face. If farmers are offered low prices or pay high prices for inputs, they obviously will be less inclined to invest in agricultural production than if product prices are high and inputs are subsidized.

In addition to the human environment, the priorities for and contributions of on-farm research are subject to limitations posed by the technical environment. The harsher the environment, the less likely it is that on-farm experiments will reveal technological alternatives which can lead to substantial improvements in productivity. This particularly is true in situations, such as Botswana, where most farmers continue to rely on traditional production practices.

Because of the importance of the above relationships, farm-level researchers need to have an adequate knowledge of the technical, institutional and policy environment in Botswana. This holds as well for on-station researchers, regional and district extension officers, and planning officers. Unfortunately, the information necessary to gain an understanding of the technical, institutional and planning environment in Botswana is spread across a large number of sources. The agriculture chapter of the recent National Development Plan [MFDP, 1985] is perhaps the best single source, particularly for a summary of agricultural programmes and policies. The agriculture chapter, however, does not provide background information on the technical environment, linkages with the macro economy, agricultural production trends and practices, or the recent focus of agricultural research.

This paper gives a synthesis of information on the setting for agricultural development in Botswana. The paper begins with a review of the important features of the technical environment affecting farm management, including rainfall patterns, temperature, soils, and vegetation. This is followed by an overview of the agricultural sector, including a characterization of the sector structure and a profile of agricultural production trends and practices. The next section characterizes the most important institutions affecting agriculture in Botswana. The single most important institution is the Ministry of Agriculture, but there are also several parastatals and non-governmental organizations which impact on agricultural development. The fourth section characterizes the macro/economic circumstances affecting agricultural development priorities and food security in Botswana. The final section summarizes national priorities and strategies for agricultural development, food security and drought relief.

The paper has two interrelated objectives. The first is to provide a reference document for current and future agricultural researchers, extension officers and consultants. Hopefully, increased awareness of the

research and development setting will help with problem definition and priorities setting. The second is to highlight the range of factors which affect the success of on-farm research, or any agricultural research for that matter. As the Ministry of Agriculture tries to promote agricultural development, more and more attention will have to be given to the complementarities between various efforts and to the linkages between different research, extension and planning processes.

2. TECHNICAL ENVIRONMENT

Botswana is a lightly populated, land locked country. More than two-thirds of its 582,000 square kilometres, somewhat larger than France, are covered by the desert and semi-desert sands of the Kalahari. Consequently, most of the population of just over one million are concentrated on the eastern border of the country, in the Limpopo catchment area.

A number of assessments have been made of the influence of the technical environment on agricultural potential in Botswana. Pike [1971] prepared the first overall agroclimatological study of Botswana, drawing primarily on data from the South Africa Weather Bureau. Siderius [1972] reviewed soil forming factors in Botswana, developed a soil classification scheme related to agricultural production potential and presented a complete series description for the major soils. Sivakumar and Virmani [n.d.] prepared an analysis of the long term probabilities of rainfall occurrences and probabilities associated with different levels of rainfall. Bhalotra [1984; 1985] reviewed recent climatological data and analysed patterns of drought. Siebert [ATIP, 1986] prepared an overview of rainfall probabilities, soils and vegetation for around Mahalapye, where one DAR/ATIP on-farm research team has been active since 1982. Selected findings from these sources are presented below.

2.1 RAINFALL

Rainfall is the single most important factor affecting agriculture in Botswana. In eastern Botswana, where most arable production takes place, rainfall is derived almost entirely from masses of moist air from the east and northeast. The average elevation in Botswana is around 1,000 metres and no hills exceed 1,500 metres. As a result, there are no barriers to the flow of moist air which might contribute to the formation of clouds and precipitation.

Average annual rainfall declines in a diagonal transect from 600 mm in the northeast to 250 mm in the southwest. Most of the annual rainfall is received during the summer rainy period, generally beginning in late October or November and continuing to March. However, the beginning of the rains is often late, there is a high frequency of prolonged dry spells during the growing season, and rainfall tends to be localised.

Most rainfall analyses have focused on inter- and intra-annual patterns for different areas of the country, to evaluate agricultural potential or predict patterns. All the available analyses have shown that rainfall is erratic. Several attempts have been made to identify correlations between years and between periods within seasons. No significant correlations have been found. Dyer and Tyson [1977] have identified a twenty year cycle, ten years of wet and ten dry, for the South African sub-continent but it has too much annual variability to be of use in prediction for any given year. The 1970s were accurately predicted to be above average rainfall years while the 1980s were predicted to have below average rainfall.

Pike [1971] and Bhalotra [1984] both reported that there appears to be three sub-periods within the rainy season, but they do not cite the same peaks. Pike identified isolated thunderstorms in November as the first peak. After a two to three week gap, the most steady and general rains usually take place in December, extending to early January. The last sub-peak seemingly takes place in late January to mid-February. Bhalotra, using more recent data, identified peaks (using five day intervals) in the third week of December, second week of January, and the beginning of March. Unfortunately, these observations are of little value (besides not being in agreement) since the presence or absence of rain at a given time cannot be used to predict rainfall in subsequent periods. If there are no rains until January, the rest of the year might still be above average and a good yield could be produced. Conversely, good early rains can stop completely.

With reference to the Mahalapye area, Siebert calculated an average annual rainfall of 464 mm over a 73 year period, with more than 80 percent of the total expected from November through March. In an analysis of intra-seasonal rainfall, he found no significant correlations between: (a) July-December and January-June, (b) four periods sub-dividing the traditional tillage-planting months, (c) months, or even (d) two week intervals within months. He also showed that the probabilities for a rain sufficient to begin ploughing (estimated to be 20 mm) do not reach 50 percent until the second week of November. Even if there is a good rain in October, there is only a 0.36 probability of a second 20 mm rain within two weeks. Siebert concluded that farmers are faced with a narrow rainfall/soil moisture window for tillage-planting operations. This leads to high opportunity costs in terms loss of area ploughed if farmers were to shift to multiple tillage-planting systems.

2.2 TEMPERATURE AND EVAPORATION

Climatological studies generally point out two crop production problems in Botswana caused by temperatures. First, during December and January, the period with the highest probability and lowest coefficient of variability for rain, it is hot. Daily maximum air temperatures average 33 degrees celsius, and can reach 40 degrees or more. This can lead to soil surface temperatures of as much as 60 degrees celsius. Siebert pointed out that the cardinal temperature for sorghum seedling viability is somewhere between 40 and 47 degrees [ATIP, 1986]. Thus, temperatures alone can have a detrimental effect on seedling establishment when there is rapid surface drying even if there is otherwise sufficient soil moisture.

The second problem is the onset of cool nights at the end of the season. Ground frosts can occur during the coldest period, late June through July. But long before that period, nighttime temperatures drop low enough to inhibit the maturation process of sorghum. The cardinal temperature for sorghum maturation is around 15 degrees celsius. This temperature is commonly reached at night beginning in April. As a result, February plantings often will not reach harvest stage before the maturation process is slowed. If there are even short drought periods, during which sorghum stops growing, even January plantings may not mature. In principle, it can still be possible to wait for the slowed maturation process to be completed but the resulting grain yield is often small enough to not be worth the wait.

High temperatures, along with radiation and wind, lead to another problem -- high evaporation and evapotranspiration rates. Evaporation rates have been estimated to be around 1.7 to 1.9 metres per year. Evapotranspiration rates

are around 1.4 metres per year, with daily rates exceeding 5 mm. In every month of the growing season, these rates exceed expected rainfall.

2.3 SOILS

Eighty-five percent of Botswana is covered by Kalahari sands. Most of the arable soils are located along the eastern side of the country. All assessments of the soils in the "arable" part agree that the soils are not good for arable farming, but there is not complete consensus that they are uniformly bad.

Siderius [1972] reported that the arable part of Botswana is covered by ferruginous tropical soils with either sandy parent material or granitic rock. Many soils are shallow and have low water holding capacity. Most soils are weakly developed, consisting of medium to coarse grained sands and sandy loams. In many places, the soils are subject to crusting following heavy rains. Most soils are deficient in phosphorus, have generally low (but variable) levels of mineral nitrogen, and are very low in organic matter and cation exchange capacity.

Siebert [ATIP, 1986] presented a detailed assessment of soils in the Mahalapye area. He noted there is considerable variability in soil types but said, in general, that the soils are characterized by a high sand content and little silt. Most cultivation takes place on light sand and sandy loam soils, although some heavy clays soils are found in places. Based on an analysis of soil samples from 41 fields in three villages where the Mahalapye team has conducted research, Siebert found that most soils were high in coarse grained sands (sand being more than 50 percent of the soil mass) with a sandy loam to sandy texture. These soils are more easily ploughed than are the sandy clay loam soils in the area but their pH values are low for sorghum production, phosphorus is very low, organic matter is almost not present and the total base saturation is low. The study also revealed there is tremendous within field variability, some of which is significantly associated with micro-topography.

2.4 VEGETATION

Various tree savanna zones cover most of the arable parts of the country. The savanna zones are dominated by various Acacia, with different species dominating depending on local conditions. Several species of Acacia are bushes which encroach in areas with sandy loam soils, particularly where there has been overgrazing or heavy cultivation. There commonly is noted to be a strong association between vegetation and soil types.

Siebert [ATIP, 1986] reported that most arable activity in the Central Agricultural Region takes place on two hardveld vegetation zones. Arable activity in the southern part of the Region is mainly carried out in woodlands (or tree savanna) dominated by Combretum apiculatum and Acacia nigrescens. These woodlands give away in the northern part of the Region to Colophospermum mopane bushveld. The transition in vegetation from south to north is accompanied by an increase in soil clay content and alkalinity. There is variability of vegetation types within localities due to soil texture, soil reaction, topography and land use.

3. AGRICULTURAL SECTOR OVERVIEW

This section describes the structure of the agricultural sector, production trends since independence, and current production practices.

3.1 SECTOR STRUCTURE

Two subdivisions usually are made when characterizing the agricultural sector in Botswana: livestock and arable farming, or traditional and freehold. The sub-division of the sector into traditional versus freehold is based on a special tenure arrangement made for the white minority. Selected characteristics of the freehold and traditional sectors, as of 1986 (the last year for which data are available), are presented in Table 1.

TABLE 1: FARM STRUCTURE: TRADITIONAL VERSUS FREEHOLD, 1986

	TRADITIONAL	FREEHOLD	BOTH
Total Farms	83,300	540	83,840
Farms with Land	62,200	220	62,420
Crops:			
Farms planting crops	56,800	160	56,960
Hectares planted per crop farm	4.1	80.6	4.3
MT cereals produced per crop farm	0.3	39.7	0.4
Cattle:			
Farms having cattle	52,900	510	53,410
Cattle per cattle farm	37	741	44
Goats:			
Farms having goats	57,900	300	58,200
Goats per goat farm	22	119	23
Sheep:			
Farms having sheep	13,350	250	13,800
Sheep per sheep farm	15	121	17
Donkeys:			
Farms having donkeys	27,450	150	27,600
Donkeys per donkey farm	5	13	5
Chickens:			
Farms having chickens	63,600	200	63,800
Chickens per chicken farm	11	2,246	18

Source: 1986 Botswana Agricultural Statistics, Ministry of Agriculture, Agricultural Statistics Unit, Gaborone, 1987.

The small freehold sector, which in 1986 comprised 540 farms, accounts for a disproportionate share of area cultivated, total food crop production and cattle offtake. For example, in 1986, the freehold farms accounted for 45 percent of cattle sales and provided 30 percent of the output of sorghum, maize, millet and beans/pulses. Most of the freehold farms specialize in cattle.

Historically, little attention has been given to differences among farmers within the traditional sector. However, the Sixth National Development Plan [MFDP, 1985] identifies two sub-groups within the traditional arable farming

sector. One group is comprised of "intermediate" farmers who own above average cattle herds and aim to produce a surplus to market. These farmers generally cultivate over ten hectares. In 1983, the farmers cultivating over ten hectares accounted for 73 percent of total cereal production from the traditional sector even though they represented just 6.3 percent of the traditional farms. The second group is generally characterized as having no cattle and not being able to grow enough sorghum to cover subsistence requirements. There is not a hard distinction between the resource poor group and the intermediate farmers but it is significant that the government has started to distinguish among traditional dryland farmers.

Dryland farming, whether traditional or freehold tenure, is now also being distinguished from two systems not so reliant on rainfall. One is irrigated farming. There are only about 1,000 hectares under irrigation in Botswana, nearly all of it on the freehold farms. There is a small irrigation project, focused on rice production, in the northwest. Also, in the northwest, there is traditional system of "melapo" farming. Melapo are flood recession fields in which crop establishment and development mostly takes place on residual soil moisture.

A newly established tenure category has created yet another relevant sub-division of the agricultural sector. Traditional lands historically were held communally under tribal authority. After independence, the government institutionalised the land allocation process through which traditional farmers can receive permanent use rights to land. Land allocations can be passed on from generation to generation but technically land is not owned. Under the Tribal Grazing Lands Policy (TGLP), established in 1975, leasehold tenure was created in the tribal territories. Through the TGLP, groups or individuals are given exclusive land rights for fifty years. Only eighty ranches were established through 1984. Beginning in 1985, the leasehold concept was extended to arable production in an attempt to encourage large scale, commercial farming without having to expand the area under freehold tenure.

3.2 PRODUCTION TRENDS

The 1960s were dominated by drought, good rainfall was received through most of the 1970s, and a drought again started during the 1981-82 season. During the droughts, the national cattle herd has decreased, due to higher death and offtake rates. Smallstock inventories generally have not been as seriously affected by drought as have cattle inventories. Both the area cultivated and yields have fallen during drought years, leading to four and five fold differences in food grain production between good years and bad years.

Between the 1967/68 and 1974/75 season, the area planted to sorghum ranged from a low of 57,000 hectares up to 180,000. The average area planted was 124,000. The area planted to maize averaged just under 50,000 hectares during this same period, but increased tremendously (to more than 100,000) during the good rainfall years at the end of the sequence. Yields for sorghum ranged from 65 kilograms per hectare up to 455 kilograms per hectare, averaging 278 kilograms. Maize yields were quite similar.

Data from the mid-1970s (1974/75 season), show that approximately 75 percent of agricultural households grew sorghum and maize, 32 percent grew millet and 68 percent grew beans/pulses [PSU, 1978]. These figures have remained about the same over time, with some annual variation. During the drought of the 1980s, a greater share of households have grown sorghum, the proportions growing maize and millet have fallen slightly, and the proportion growing

beans has fallen to around 55 percent.

With reference to cattle, the mid-1970s figures show that 54 percent of the agricultural households held cattle. Data from the 1980s indicated that around 70 percent of agricultural households held cattle. This difference does not correspond well with the common observation that both the size of cattle herds and the numbers of households owning cattle declined from the mid-1970s to the mid-1980s.

Summary data for the 1981-1986 period are presented in Table 2, for crop production trends, and Table 3 for livestock.

TABLE 2: AREA AND PRODUCTION TRENDS OF MAJOR CROPS: TRADITIONAL SECTOR, 1980-1986

	% OF FARMS GROWING	HARVESTED AS % OF PLANTED AREA	PRODUCTION TOTAL (M.Tons)	PRODUCTION PER FARM (Kgs.)	YIELD PER HECTARE PLANTED (Kgs.)	YIELD PER HECTARE HARVESTED (Kgs.)
Sorghum:						
1980	88	89	27,170	471	191	215
1981	88	87	26,500	440	195	224
1982	84	40	3,700	77	41	103
1983	90	27	4,445	102	35	131
1984	90	42	5,170	113	48	114
1985	90	61	11,785	234	99	151
1986	93	59	11,330	215	74	125
Maize:						
1980	75	55	6,885	141	92	167
1981	72	66	16,415	334	202	306
1982	65	24	3,500	95	67	282
1983	68	27	4,005	123	70	257
1984	70	3	100	3	2	67
1985	76	14	735	17	15	113
1986	54	18	1,910	62	46	251
Millet:						
1980	29	85	2,270	152	134	159
1981	27	64	1,820	97	92	144
1982	25	21	450	32	28	132
1983	21	38	435	44	27	69
1984	26	50	715	53	43	86
1985	28	62	1,830	115	119	191
1986	29	58	1,290	78	74	128
Beans:						
1980	51	53	1,780	53	76	144
1981	55	56	2,550	68	98	176
1982	58	17	400	12	20	118
1983	56	14	190	15	9	64
1984	49	15	335	13	21	135
1985	56	17	300	10	19	111
1986	47	29	490	18	31	107

Source: Ministry of Agriculture, Agricultural Statistics Unit.

The sequence of seasons in Table 2 shows the susceptibility of crop production to poor rains. Total production of the major food grains was extremely low and a small percentage of the area planted was harvested. Even in the best year of the seven presented, 1981, total production of sorghum, maize, millet and beans combined was under 50 kilograms per person. This is only one-fourth the approximately 200 kgs per person needed to make a household self-sufficient in grain consumption.

TABLE 3: LIVESTOCK INVENTORY TRENDS, TRADITIONAL SECTOR, 1981-1986

	1981	1982	1983	1984	1985	1986
CATTLE:						
Average Inventory/a	2495	2504	2407	2306	2092	1954
Additions:						
Births	586	604	521	502	477	467
Purchases	33	53	37	31	33	41
Deletions/b:						
Deaths	340	425	429	445	493	454
Sales	194	205	205	169	201	177
Home slaughter	19	25	26	39	48	35
Change Rates (pct):						
Birth rate/c	58	59	51	53	54	56
Death rate	14	17	18	19	24	23
Offtake rate	9	9	10	9	12	11
SMALLSTOCK:						
Average Inventory	724	733	902	1009	1280	1495
Additions:						
Births	309	306	390	414	507	597
Purchases	11	17	19	20	31	26
Deletions:						
Deaths	224	214	202	254	254	262
Sales	27	30	24	35	49	49
Home slaughter	37	47	52	59	66	68
Change Rates (pct.):						
Death rate	31	29	22	25	20	18
Offtake rate	9	11	9	9	9	8

Source: Ministry of Agriculture, Agricultural Statistics Unit.
a. All numbers are expressed in ,000s.
b. Does not include losses of animals, which have been quite large during the drought.
c. Based on ratio of calves to cows.

The cattle herd figures in Table 3 show a decrease in the national herd since the mid-1970s. Deaths and home slaughter both gradually increased during the drought. Sales increased from 1981 to 1982 and 1983, and then dropped off as the drought continued. In each year just over half the cows gave birth, a proportion which surprisingly did not decline more during the drought. Death rates were around twice the combined offtake rate for sales and home slaughter.

The national figures for smallstock appear suspect. Data from the 1970s

showed there were as many smallstock as there were cattle. Equally important, most people familiar with Botswana would agree that birthrates and offtake rates are higher for smallstock than for cattle, while the death rate (particularly for goats) is much lower during drought conditions. The national figures do depict a downward trend in death rates, and an increase in the number of births, and a resulting overall growth of the national inventory of smallstock.

It can be seen in Table 3 that sales accounted for around 90 percent of the offtake of cattle while a majority of smallstock were home slaughtered. However, national accounts data show that the value of home use production for cattle, primarily milk consumption and meat from deceased animals, was higher than the value of cattle sales until the beef prices were increased significantly during the mid-1970s [MFDF, 1985: 169].

3.3 CROPPING PRACTICES

Beginning in the late-1970s, increased attention was given to documenting the use of selected cropping practices in the national agricultural survey. From the recent surveys, data are available on traction use, draught ownership, planting methods, month ploughing started, seeding rates, fertiliser use, and number of weedings.

Cropping practices are quite similar through out Botswana, although there is enough variation to be taken into account in the Ministry of Agriculture's research and extension programmes. Still, the problem appears to be more one of finding any alternative sets of practices, rather than the location specific adaptation of technologies.

Table 4 shows that sorghum is the most important crop in four of five of the major agricultural regions, with Maun being the exception. The Maun Region, in the northwest of the country, has greater rainfall and is ecologically more similar to southern Zimbabwe and Zambia than it is the rest of Botswana. Maize and millet are of above average importance in the Francistown Region, also reflecting an influence from Zimbabwe (and preferences of the Kalanga). Cowpeas are an important intercrop throughout the country.

Promotion of animal traction is not an issue in Botswana, as it is in many other African countries. Nearly all land is mechanically ploughed and has been since the mouldboard plough was introduced at the end of the last century. Historically, most draught power has been provided by cattle, usually teams of six to eight oxen. Tractor and donkey traction rapidly have become major sources of draught power, particularly in the Gaborone and Central Agricultural Regions. In fact, in 1986, tractor traction was used by as many households as used cattle. Private contract services account for most of the tractor traction used. Despite limited importance nationwide, donkeys have nearly completely supplanted cattle traction in 10-15 percent of villages. The whole farm system implications of shifts in draught power is an important area of research.

A majority of farms relied on traction they owned until the drought started but by 1986 more households hired draught than used their own draught power. Ownership is important since non-owners generally cannot control the timeliness of ploughing vis-a-vis planting rains. Most recommended changes in cropping practices derived from experiment station research have required that farmers have control over draught resources. Research on solutions for non-owners has only been considered to be important in the last seven years. The extension service has yet to made a reorientation toward non-owners.

TABLE 4: CROPPING PRACTICES BY AGRICULTURAL REGION: TRADITIONAL SECTOR, 1986

	SOUTHERN	GABORONE	CENTRAL	FRANCIS.	MAUN	WESTERN	ALL
Crop Farms/a	7,900	14,400	16,600	10,400	5,800	700	56,800
Percent Growing:							
Sorghum	94	100	99	98	57	71	93
Maize	39	51	49	70	60	86	54
Millet	1	21	13	79	46	<1	29
Beans	25	55	55	59	12	71	47
Ha. Per Farm Growing:							
Sorghum	4.4	3.3	2.8	2.1	1.1	0.8	2.9
Maize	2.0	1.4	1.3	1.4	1.1	0.7	1.4
Millet	2.0	1.1	1.0	1.0	1.2	<0.1	1.0
Beans	1.1	0.6	0.7	0.4	0.3	0.4	0.6
Pct. Area Planted Sole:							
Sorghum	85	25	38	11	24	<1	40
Maize	60	10	12	<1	73	<1	22
Millet	<1	6	19	2	54	<1	16
Beans	42	7	11	<1	<1	<1	13
Pct. Ploughing With:							
Cattle	38	19	24	75	65	29	39
Donkeys	11	8	26	5	16	43	15
Tractors	44	64	47	14	5	7	39
Multiple types	7	9	3	6	14	21	7
Pct. Get Draught By:							
Owning	27	16	33	48	44	64	32
Hiring	55	68	53	19	16	14	46
Other/b	18	16	14	33	40	22	22
Pct. Planting By:							
Broadcast	54	91	97	97	78	86	87
Row plant	42	6	3	1	19	14	11
Both	4	3	<1	2	3	<1	2
Pct. Having Wire Fencing	15	15	36	45	19	14	27
Pct. Using Fert. or Manure	15	7	4	11	2	7	7
Pct. Weeding:							
Not at all	29	15	23	6	17	22	16
Once	67	83	73	85	47	64	74
More than once	4	2	4	9	36	14	10

Source: ASU [1987].
a. Crop farms which planted crops in 1983.
b. Includes mafisa, borrowing, and cooperative agreements.

Nearly all crops are broadcasted and most seed is planted in mixtures. The dominance of broadcasting can be contrasted to extension efforts for over thirty years [ARS, 1978] to encourage farmers to row plant. Row planting has made the greatest inroads in the Southern Agricultural Region, where more than half the farmers row plant the major cereal grains. Hand row planting is rare except in the Maun Region, where most row planting is done by hand. Improvement in planting methods remains a top priority for research and extension officers.

Very few farmers use fertilisers, either manure or chemical. Usage is greatest in the Southern Region, reflecting the overall progressiveness of farmers in that region and the fact that the south receives more rainfall on average. Manure application is an extension recommendation but is not considered to be a top priority. Most cattle in Botswana are kept on communal grazing areas, often some distance from farmers' fields, and it is not considered practical to collect and apply the quantities of manure necessary to achieve a significant response on a whole field basis.

Few Batswana farmers weed more than once and many farmers will not bother to do a single weeding unless a sufficiently promising plant stand is achieved. The amount of weeding done is a classic case of farmers making intra-seasonal adjustments to anticipated cropping outcomes.

3.4 LIVESTOCK HUSBANDRY

Livestock husbandry and management practices differ greatly between the freehold and traditional sectors but are fairly similar throughout the communal areas. In communal areas, cattle generally are allowed to graze freely near the cattle posts or lands of their owners [Carl Bro International, 1982]. However, it is a standard practice to have at least one kraal (corral) and associated calf pen. Lactating cows are often penned part of the time for milking. Calves generally are penned for the first several months of their lives [Grey, 1986].

General herding is done only occasionally, most commonly when there are crops being grown or there is a long distance to water. The standard practice for avoiding crop damage is to maintain a separate residence where cattle can be kept, a cattle post, which can be quite a distant from both the village and the lands areas. Since there are few permanent water sources in Botswana, livestock are usually watered at boreholes or open wells during the dry season. When there are rains, dams and pans become the main source of water. Watering is generally done daily, although some herders only water every second day if there is a long distance to water.

The most common husbandry practices are vaccination, deticking, castration, and dehorning [ATIP, 1986]. Most herd owners see that their cattle are vaccinated. The Department of Animal Health provides free vaccinations against anthrax, quarter evil and brucellosis. External parasites usually are controlled on an ad hoc basis through the hand application of "tick grease." Castration generally is carried out at three to four months using a burdizzo. Approximately half the cattle are dehorned.

Few farmers yet attempt to regulate the breeding of their animals. Bulls nearly always are allowed to graze with the cows. Nevertheless, there is a distinct calving season, with most calves being born during the rainy season. Most bulls are selected from within the herd. If owners become worried about inbreeding, they usually will obtain a new bull through purchases or exchanges with neighbours. In few cases do herd owners seek out improved breeds to upgrade their herds.

4. AGRICULTURAL INSTITUTIONS

Primary responsibility for development of the agricultural sector in Botswana rests with the Ministry of Agriculture. A number of parastatals have been created to supplement private channels for credit, input supply, marketing and trade. At the local level, several groups play an active role in coordinating (and initiating) development activities.

4.1 MINISTRY OF AGRICULTURE

The organization of the Ministry of Agriculture has undergone many changes over the years. Prior to independence, all agricultural research and extension activities were centred in Mahalapye. Until the 1930s, investigations consisted of trials and demonstrations on farmers' fields in the Mahalapye area. During the 1930s, a crops experiment station was established in Mahalapye and livestock research was initiated at the Morale Pasture Station (just outside Mahalapye). In 1947, the first systematic experiments and trials on arable crops commenced at the experiment station in Mahalapye [DAR, 1969].

Over the next three decades, additional staff members were appointed and agricultural services were expanded. By the mid-1960s, several sections had been established, relating to: (a) research and experiments, (b) seed multiplication, (c) resettlement, (d) farm management, (e) soil and water conservation, (f) agricultural information distribution, (g) farmer training, (h) agricultural agent training, and (i) agricultural extension. The main experiment station was still at Mahalapye but research activities were decentralised, with eight experimental unit fields distributed from Goodhope in the south to Moshu (near Maun) in the north. Similarly, extension personnel were posted to twelve district offices.

In 1966, the Ministry was moved to Gaborone. Research and most training activities moved to Sebele, 10 kilometres north of Gaborone in 1967. In 1975, after an exhaustive study of the Ministry structure, functions, and activities, especially extension, the Ministry was reorganized into its current structure.

Since 1975, the Ministry of Agriculture has had four departments: Animal Veterinary Services, Agricultural Research, Agricultural Field Services, and Cooperative Development. The major units responsible for research and extension activities are the Departments of Agricultural Research (DAR) and Agricultural Field Services (DAFS), respectively. DAFS is the largest department, followed by Veterinary Services.

4.1.1 Department of Agricultural Research

The function of the Department of Agricultural Research (DAR) is to provide information so agricultural production in Botswana can be increased and become more reliable. An explicit objective is to provide information and new technology to planners and the staff of the Department of Agricultural Field Services, to enable them to achieve the agricultural objectives of the National Development Plans. The DAR consists of a Division of Arable Research, an Animal Production Research Unit, an Estate Management Unit, and a Laboratory Services Unit. The Division of Arable Research is responsible for a Seed Multiplication Unit.

Since 1967, the primary location for field research has been the Content Farm at Sebele. Until recently, sub-stations were located at Goodhope, Mahalapye, Motopi, and Moshu. Research at Sebele has included trials on dryland crop varieties (including cotton, sorghum, millet, maize, legumes, sunflower, wheat and barley), fertilisers, soil fertility, crop rotations, tillage systems, and horticulture crops. Plant pathology and entomological investigations have addressed (among others) the American bollworm, sorghum stalk-borer, sorghum midge, soil pests, and weed control.

Much of the arable crops research in Botswana during the 1970s and 1980s has been conducted through donor funded projects, including the following:

(a).The FAO funded a fertiliser project, which conducted a number of fertiliser trials on farmers' fields between 1969-75. These trials were carried out collaboratively with agricultural demonstrators from the Department of Agricultural Field Services.

(b).The British sponsored the Dryland Farming Research Scheme (DLFRS), which was was the backbone of arable research activities in Botswana between 1971 and 1983. The objectives of DLFRS were to study factors limiting arable food crop production and to investigate means of making crop production more reliable. Studies were made of tillage methods, planting dates and plant populations, moisture conservation, crop physiology, crop protection, and implement design and construction. The project officially terminated in 1985.

(c).The British Ministry for Overseas Development sponsored a Bird Pest Research Project between 1972 and 1978.

(d).UNDP/FAO sponsored a study on the swamp and dryland soils of the Okavango, which ended in 1981. During 1982, the investigations were continued through temporary funding from the FAO Technical Cooperation Programme. Beginning in early 1984, the Molapo Development Project, funded by the Federal Republic of Germany, was started to continue research on molapo farming.

(e).The U.S. funded a Crop Improvement Research Project, focused on sorghum, maize and millet. This project was based at the Sebele Content farm in the 1970s. It primarily involved a provision of technical assistance to the ongoing varietal research programmes.

(f).The British supported the Evaluation of Farming Systems and Implements Project (EFSAIP), which extended from 1975 to 1984. EFSAIP was the first multidisciplinary project specifically mandated to test agricultural production technologies on farmers' fields. The original objectives were to test an animal draught minimum tillage system, based on a tool carrier developed by DLFRS, and an associated cropping system. After it became clear that neither the tool carrier nor the system worked well, the project shifted to developing alternative systems and testing them in farmers' fields [EFSAIP, 1985]. During the last few years of the project, emphasis was given to assessing the techniques farmers were using, as an input to developing improved farming systems.

(g).The British also sponsored the Integrated Farming Pilot Project. IFPP actually was a combined agricultural research and integrated rural development programme and, as such, was administratively located in the Department of Agricultural Field Services. In principle, IFPP was to provide the extension situation under which the technologies developed and screened by DLFRS and EFSAIP could be tested under farmers' conditions with farmers' management, as well as on farmers' fields. IFPP also found that the proposed practices showed little, if any, benefit when managed by farmers. As a result, there was a substantial reorientation of the project during the second phase, which began in 1982. Descriptive and diagnostic research received much increased priority, farmer participation was expanded, and implements and crop production systems testing were de-emphasized in favour of communal area livestock research. When IFPP ended in 1985, three positions were institutionalised under the regional agricultural

office for the Southern Region. IFPP was renamed as Farming Systems Southern Region (FSSR).

(h). International Voluntary Services supported the country's main research horticulturalist between 1978 and 1987.

(i). The Swedish (SAREC) supported the Agricultural Development Ngamiland Project (ADNP), which began in 1979. ADNP was the first project in Botswana to be established as a farming systems project. The first phase, which lasted until 1981, focused on systems description and diagnosis. Since 1982, ADNP has focused on production systems for both dryland and molapo farming.

(j). USAID supported the Agricultural Technology Improvement Project, which was initiated in 1982 with a mandate to improve the capacity of the Ministry of Agriculture to develop and extend technologies relevant to the needs of resource poor farmers. There have been four main components to the project: an agricultural economist has been based at Sebele to provide leadership for on-farm research, an agronomist has held the position of Research-Extension Liaison Officer, long and short term training was provided to Ministry officers, and on-farm research teams were established in the Central Agricultural Region and in the Tutume District of the Francistown Agricultural Region.

(k). The U.S. also funded the Collaborative Research Support Programme (CRSP) for cowpea improvement, based at Sebele, from 1982 until 1986. The cowpea programme was broadly focused, addressing varietal selection and screening, agronomy, entomology and pathology.

(l). IRHO (Paris) has supported a "oils crop agronomist" research officer, who initiated a groundnut research programme with an emphasis on germplasm evaluation and basic seed production in 1983.

(m). Since, 1983, the U.S. has sponsored an INSORMIL sorghum agronomy programme based at Sebele. INSORMIL has been emphasizing crop rotations, soil moisture monitoring and variety by environment trials.

Livestock research has been conducted under auspices of the Animal Production Research Unit (APRU) since 1970. While a limited programme of range management research had been conducted since the 1930s, there was little information at independence in 1966 on which to base extension advice for the country's livestock sector [APRU, 1980]. APRU conducts research on 16 MOA ranches spread throughout the country. APRU's first priority has been improvement of beef production through breeding. Its general emphasis has been development of a technical basis for commercialization of the beef industry. Range management, range improvement, beef cattle nutrition, and beef cattle reproductive physiology have been the major areas of investigation. Some attention has been given to dairy and smallstock production, but research has not addressed herd owner objectives, communal area management practices or motivations in livestock raising [Behnke, 1982]. Since 1982, APRU has attempted to modify its commercial orientation and now devotes more resources to communal area investigations.

There has been project support for livestock research, analogous to that received for arable farming research. This has included the following:

(a). During the 1970s, the UNDP (FAO) supported the range and animal production research coordinator position and funded two positions in a Range Research Project. During much of the 1980s, the UNDP has supported research on range management, animal nutrition and

pasture/fodder agronomy.

(b).The World Bank and SIDA (Swedish aid) both provided funds for the First Livestock Development Project, which included a research component.

(c).During the late 1970s and early 1980s, information on communal area livestock management and production was generated through a multi-year study supported in part by the European Development Fund [Carl Bro., 1982]. Responsibility for the livestock management and herd management surveys, which were initiated by the Livestock Evaluation Unit, has been assumed by the Division of Planning and Statistics.

(d).ILCA has repeatedly provided assistance. In 1978, ILCA sponsored the development of a cattle production model. Later, in the 1980s, ILCA funded and provided technical assistance for rangeland monitoring, and helped develop livestock-focused library materials.

(e).Since 1985, IDRC has supported a smallholder dairy project.

4.1.2 Department of Agricultural Field Services

The Department of Agricultural Field Services (DAFS) contains four major Divisions: Animal Production, Crop Production, Land Utilization, and Agricultural Management Associations. An Agricultural Information Section, servicing the entire MOA, and a Field Section are also included. The latter is the major field operations unit in the Department. The above divisions and sections of DAFS, particularly the Field Section, are responsible for most direct farmer contacts by the MOA, except those by the Department of Veterinary Services.

There are four levels of staff in DAFS: (a) administrators and subject matter specialists at headquarters, (b) agricultural officers and specialist officers in the six regions (specialists are responsible administratively to the regional agricultural officers, but are responsible technically to their division chiefs), (c) agricultural officers and supervisors in the 22 agricultural districts, and (d) agricultural demonstrators in the 225 agricultural extension areas.

Extension work is funnelled through the agricultural demonstrators. Technical information is in principle provided to ADs by the regional specialists. The main activities of ADs include demonstrations, coordination of village group activities, coordination of local development schemes (such as dam construction), and handling of loan and grant applications for Ministry programmes.

4.1.3 Other Departments and Units

The Department of Veterinary Services is responsible for disease prevention and control, meat inspection, tsetse fly control, administration of livestock advisory services (mainly input distribution), trek route supervision, operation of a diagnostic laboratory, and veterinary research. The function of the Department of Cooperative Development is to promote cooperative formation and provide technical assistance to existing cooperatives.

The Ministry also includes the Division of Planning and Statistics and the Botswana Agricultural College. The Division of Planning and Statistics

(DPS) is responsible for agricultural sector planning, the annual agricultural survey, an ongoing farm management economics survey, and rural sociology research. The DPS is administratively attached to the office of the Deputy Permanent Secretary.

In the annual agricultural survey, data on crop and livestock production patterns and practices in Botswana are collected on an annual basis through a large sample agricultural survey. Some type of annual agricultural survey has been conducted since independence in 1966. During the first decade, the data were of variable quality. Area and yield estimates for crop production were reasonably good but most data on cattle were based on estimated relationships between sales and formal sector slaughters (for which data existed) and herd sizes, using two baseline sample surveys conducted in 1972 and 1972. Over that first decade, sampling and enumeration procedures were improved and figures for the last decade are considered to be quite good. The annual survey is now conducted by the Agricultural Statistics Unit of DPS, in conjunction with Central Statistics Office of the Ministry of Finance and Development Planning.

Botswana Agricultural College provides training in technical agriculture through the diploma level. BAC has trained most of the agricultural demonstrators in Botswana. In 1987, the University of Botswana created a Faculty of Agriculture and BAC will eventually be folded into the University.

4.2 INPUT SUPPLY, CREDIT AND MARKETING AGENCIES

Several governmental and parastatal agencies have been created to promote development of the agricultural sector. Most have focused on commercial production, with a particular emphasis on nurturing the important export beef market.

The most important agency is the Botswana Meat Commission (BMC), which is the cornerstone of the cattle industry in Botswana [MFDP, 1985]. BMC has a statutory monopoly over all exports of meat and meat products and accounts for four-fifths of all cattle slaughtered in Botswana. BMC was established in its present form just before independence, in 1965. BMC has two abattoirs, one of which is the largest single manufacturing enterprise in the country. A third abattoir is under construction. BMC provides government revenues through a turnover tax. Prices are set for different classes and change over the year to encourage sales outside of the peak April to June sales period.

There are two additional agencies which directly serve the livestock sector. One is the Botswana Livestock Development Corporation (BLDC), which is a parastatal formed in 1973 to buy cattle not yet ready for slaughter. BLDC is specifically targeted to serve remote area purchases, where competition among the cattle agents which serve BMC is the weakest. BLDC has attempted to develop ranches for fattening before selling cattle to BMC for slaughter. The Botswana Vaccine Institute (BVI) was set-up on a temporary basis to produce an effective foot and mount disease vaccine. A permanent facility was finished in 1981 which is capable of an annual production of more than 20 million doses [MFDP, 1985].

The most important agency affecting arable farming is the Botswana Agricultural Marketing Board (BAMB), established in 1974. BAMB has three basic functions: (a) to provide guaranteed, equitable prices, (b) to purchase enough domestic produce to meet emergency demand requirements (if possible), and (c) to provide necessary seed and chemical inputs to farmers.

BAMB has marketing facilities at 26 locations and a storage capacity of 55,100 tons. BAMB played a major role during the 1980s drought in purchasing seed internationally.

Two organizations which have broad economic development responsibilities, extending beyond agriculture, provide credit and support services to both traditional and large scale commercial operations. These include the National Development Bank (NDB), established in 1964, and the Botswana Development Corporation (BDC). The NDB is the major source of credit for farmers seeking to upgrade their operations through capital investments. NDB currently provides more than half of all lending to the agricultural sector [MFDP, 1985]. The BDC promotes and assists commercial operations and, in agriculture, has concentrated on irrigation and dairy farming. BDC freehold farms account for the largest irrigated area in Botswana.

4.3 LOCAL GOVERNMENT AND VOLUNTARY ORGANIZATIONS

Since independence, traditional authority for village government, vested in a headman and village meetings (kgotlas), has been subsumed into the local governmental structure. Village leaders are responsible to District Councils. District Councils are under jurisdiction of the Ministry of Local Government and Lands. Land Boards under authority of the district councils have been given authority to allocate tribal lands.

Village Development Committees have been created under the authority of District Councils as the executive authority in charge of development at the village level. A village may also have a village extension team (VET) comprised of the AD, the assistant community development officer (village representative of the social and community development departments of the Ministry of Local Government and Lands), a family welfare educator (FWE) and the head teachers of the local schools. In some villages, the veterinary assistant (extension agent of the Department of Veterinary Services), might also participate in the VET.

In addition to local governmental institutions, most villages have one or more Farmers Committees which work together with the ADs to implement various Ministry projects. Villages also have several special purpose groups (for example, borehole syndicates, spray race groups, smallstock groups, fencing groups), and often have local chapters of 4-B clubs, YWCA, PTA and the Botswana Women's Council.

Local branches of various types of cooperatives can be found in many of the larger villages. Consumer cooperatives play a major role in creating retail outlets for consumer goods while various marketing and multi-purpose cooperatives are involved in providing farm inputs, selling consumer goods, and purchasing livestock and farm produce. Cooperatives are often the sole source of agricultural implements in the medium and small villages. Local cooperatives are supported through two secondary societies, the Botswana Cooperative Bank and the Botswana Cooperative Union, and by the Ministry of Agriculture's Department of Cooperative Development.

5. MACRO ECONOMY

When Botswana became independent in 1966, it was one of the poorest countries in Africa and was in a life threatening drought. There had been little institutional, infrastructural or industrial development. Livestock and remittances from mine labourers working in South Africa were the major sources of rural household and national income.

Between independence in 1966 and the 1988, several key circumstances have radically altered the the macro economy affecting agriculture in Botswana. Four of the most important occurred in the 1970s.

(a).Botswana was found to possess mineral wealth on a large scale. There is copper, nickel, coal, iron ore, manganese and two massive diamond mines. Diamonds alone now account for two-thirds of the value of exports [MFDP, 1985].

(b).The Lome Agreement with the EEC provided Botswana with access to the European beef market at no or reduced tariffs, enabling the Botswana Meat Commission to greatly increase producer prices.

(c).The Southern African Customs Union Agreement was renegotiated to allocate Botswana a larger share of customs union revenues.

(d).The drought of the 1960s was followed by several years of good rainfall, allowing a tremendous expansion of the national cattle herd.

This section identifies relationships between these events and the development of the Botswana economy, as it currently affects planning for agricultural development and food security.

5.1 FIRST DECADE

Dahl [1981] provided a valuable historical profile on the significance of diamond and beef exports, and increased customs union revenues on economic development in Botswana from independence through 1978. Dahl pointed out that the combined effect of these events was to create a large increase in earnings (including rural earnings) and a rapid expansion of overall demand in the economy, particularly demand for imports. As a result, imports rose by around 400 percent during the decade following independence. During the early phase of the expansion growth was led by construction and other fixed capital formation related to bringing the various mines on line and other rural infrastructure projects. This was closely followed by an expansion of the various service sectors, including trade, transport, business and household services and utilities.

An early turning point was reached in 1973, when construction value added peaked. Real economic growth slowed, resulting in falling imports and a reduction in import duties. The temporary slowing of the economy was soon offset by increasing mineral output, leading to a phase of "diamond-dependent" development with its associated risks [Lewis, 1981]. While diamonds produced much government revenue, relatively little employment was generated. Equally important, strong export demand for diamonds increased the value of the Pula, after it was introduced in 1976, making food grain imports less expensive. This has had beneficial effects due to the deficit food production position of Botswana but has made it difficult for the government to guarantee prices to farmers which are high enough to stimulate commercial investments in arable farming.

The government has continued to play an active role in the economy. In addition to the customs union revenues, the government has shared the revenues from the mines. As a result, recurrent government revenues grew from 6.2 million Pula during 1966-7 to 72.7 million during 1975-6. During this same period the government development budget grew from 3.7 million Pula to 44.4 million and the value added contribution of government programmes increased between 20 and 50 percent per year [Dahl, 1981]. By

1973, British grants-in-aid were phased out and budgetary self-sufficiency was achieved [Lewis, 1981].

The government also has played a key role in setting employment and pricing policies. In 1972, the government adopted an explicit policy of being the wage/salary leader in the economy [Lewis, 1981]. Between 1969 and 1978, the private sector minimum wage was increased from 6.3 (U.S.) cents to 29 cents, and the public sector minimum wage went from 9.8 to 43.7 cents (Lipton [1978] cited in Lewis [1981]). In addition, the private sector was cautioned to use government wages as the standard for setting wages for private sector professionals.

Creation of employment opportunities became a major priority of the government during the 1970s. The population of Botswana is small relative to the land area but is growing in excess of three percent a year. There has been rapid urbanization as well, with the percent of the population in townships increasing from just over two percent in 1964 to over fifteen percent in 1978 [Dahl, 1981]. During the 1970s, there was a large expansion of formal sector employment, but it was much less than the rate of growth of value added and it was offset by the increasing number of job seekers. In rural areas, there was a problem of underemployment. Lipton [1978] estimated that nearly half the potential labour time was not being used. To address the need for employment generation, the government looked to the agricultural sector. A major issue faced by the government was whether to increase producer prices or subsidize producers to make agricultural production more attractive.

As stated above, the main government instruments for pricing policies are BMC, for livestock prices, and BAMB, for crop prices. In the 1970s, BMC was able to take advantage of EEC prices, which were 60 percent higher than alternative export markets, to approximately double the prices they were able to offer farmers [Jones, 1981]. Through most of the 1970s, BAMB was not able to offer comparably high prices to crop producers. Because of concerns over smuggling and the legal ramifications of the customs union agreement, BAMB set prices which were only a few percentage points above prices in South Africa [Jones, 1981]. The gap between Botswana and South African prices was substantially increased in 1979, to about 20 percent, but this was still below the transport and handling costs of private sector traders. The government made a commitment in 1978 to emphasize subsidies on agricultural infrastructure and inputs, rather than have BAMB pay high prices and compensate consumers. The government also rejected the alternative of a devaluation since it would hurt consumers and tend to worsen income distribution [Jones, 1981].

5.2 SECOND DECADE

The trends set during the first post-independence decade continued into the second decade. A second diamond mine made up revenue lost from declining export demand for copper-nickel, the government continued to play a major role in shaping national development through redistribution of mineral rents and customs union revenues, and a drought accelerated the relative decline of the agricultural domestic product. The gross domestic product (GDP) grew at an average annual rate of 12.4 percent between 1978 and 1983, resulting in an average annual growth of 13 percent since independence [MFDP, 1985]. Despite rapid population growth, the GDP per capita reached nearly $1,000 in 1983 (but this included expatriate earnings, which were nearly 25 percent of all formal sector earnings).

The structure of the Botswana economy was strikingly different in the

mid-1980s than it had been at independence or even in the mid-1970s. Table 5 shows the sectoral contributions to the GDP in 1966, 1972, 1976, and 1983. The percentage contributions of government, trade and hotels, and manufacturing have remained about the same. The most dramatic changes have been for agricultural and mining. Agriculture fell from 39 percent in 1966 to 7.4 percent in 1983. By 1983, the contribution of agriculture to GDP was outstripped by mining, manufacturing, trade and hotels, services and government.

The Botswana economy continued its strong performance during the second post-independence decade but three interrelated macro economic problems have continued to cause concern to government planners: (a) the vulnerability of the economy to shifts in export demand, (b) insufficient employment generation, and (c) poor performance of the agricultural sector. Each of these problems has been aggravated since the onset of drought. Together, the problems pose a major challenge with respect to national food security.

The vulnerability of the economy stems from its pattern of growth and proximity to the the large and highly developed economy of South Africa [MFDP, 1985]. The rapid growth of the Botswana economy has continued to stimulate demand for imports, mostly goods and services from South Africa.

TABLE 5: GROSS DOMESTIC PRODUCT, 1966-1983 (SELECTED YEARS)

	1966		1972		1976		1978	
	P m/a	Pct/b	P m	Pct	P m	Pct	P m	Pct
Agriculture	14.5	39.4	33.1	32.3	65.7	31.5	73.5	7.4
Mining	----	----	11.2	10.9	33.6	16.1	286.3	28.7
Manufacturing	2.9	7.9	5.1	5.0	20.9	10.0	81.7	8.2
Water & Electricity	0.3	0.8	1.3	1.3	11.1	5.3	29.5	3.0
Construction	2.1	5.7	10.0	9.7	18.8	9.0	43.2	4.3
Trade and Hotels	6.8	18.5	17.5	17.0	42.5	20.4	223.5	22.4
Transport	3.0	8.1	3.8	3.7	12.5	6.0	29.8	3.0
Services	2.4	6.5	8.8	8.6	28.6	13.7	82.2	8.2
Government	4.9	13.3	11.8	11.5	36.1	17.3	147.4	14.8
GDP (current)	36.8		102.6		269.8		997.1	
GDP (1979/80)	129.0		287.0		446.0		968.9	

Source: CSO National Accounts [MFDP, 1985: 14].
a. P m = million Pula
b. Pct = percentage

To pay for the imports, Botswana has relied on a few commodities, primarily diamonds and beef. Diamonds alone accounted for two-thirds of the value of exports in 1983. The vulnerability of reliance on diamonds and beef exports was made clear when, during the late 1970s, Botswana beef was temporarily banned from the EEC due to an outbreak of Foot and Mouth Disease and, during the early 1980s, when the export demand for diamonds dropped. Moreover, both diamond and beef exports are denominated in Dollars, which dampened demand for Botswana's exports as the dollar rose.

The net effect has been rapid swings in balance of payments and a reliance on capital inflows. For example, during the period 1978-1983, the balance on goods and services was always negative (157 million Pula annual deficit

on average). The negative balance on goods and services was overcome by substantial positive net transfers in three of the six years but the current account balance still averaged a negative 29.5 million Pula over the period (primarily due to deficit of 171 million Pula in 1981). However, in every year but 1981 the negative current account balance was overcome by a positive capital account balance (which averaged 91.8 million Pula annually) so the overall balance was positive in 5 of 6 years. The average balance of payments was a 55.5 million surplus. (All figures are current prices based on national accounts, cited in MFDP [1985]. Inflation averaged around 11 percent over the period.)

The employment problem is basically the same as that faced in the 1970s. Because there are few linkages from diamond led growth to the rest of the economy, employment in the formal sector has been growing at only 60 percent of the rate of the economy. Meanwhile, the demand for formal sector employment has increased rapidly due to an urban growth rate exceeding 15 percent and a rapid decline in mine employment opportunities. Employment in South Africa fell from a peak of 40,000 in 1976 to only 17,800 in 1983 [MFDP, 1985].

Poor agricultural sector performance, especially during the drought of the 1980s, has stimulated an exodus from rural areas while reducing rural employment opportunities. Between the 1977/78 season and the 1982/83 season the agricultural GDP fell 33.6 percent and food grain production fell to 10,000 tons. During the drought there has been a drop of between twenty to thirty percent in the number of households which have been planting and, as a result, estimated employment in arable agriculture has dropped from around 250,000 in the mid-1970s to 190,000 in the early 1980s [RDC, 1985]. There has also been a major loss in productive assets, particularly cattle. The drought has further affected employment due to reduced income and demand for goods and services.

Botswana farmers do not produce enough the feed themselves or the rest of the population even in good rainfall years. In drought, Botswana produces less than ten percent of its food grain requirements. But Botswana can afford to pay for its food imports. According to the recent National Food Strategy paper [RDC, 1985], imports of food, drink and tobacco accounted for 13 to 19 percent of the value of imports during the early 1980s. Cereal imports alone were only 3.5 percent of the value of imports in 1980, increasing to 7.3 percent in 1983. In terms of the value of export revenues, the cost of the cereal imports was still only eight percent in 1983. Moreover, the percent of value of imports accounted by cereals was smaller than the percent of exports accounted for beef. So, not only can Botswana pay for its staple food grain imports, it can essentially do so by agricultural exports.

Botswana has not even had to pay for a large share of its food grain imports. Because of a stable democracy, and the international attention on African starvation and South African apartheid, Botswana has become a favourite target of international food aid. During 1980, approximately 80,000 tons of food grains was imported. This increased to 150,000 in 1983 and 180,000 in 1984 [RDC, 1985]. During the drought, food aid accounted for approximately one-third of imports.

6. NATIONAL PLANNING PRIORITIES AND STRATEGIES

This section reviews national planning priorities and strategies for national development, agricultural sector development, food security, and drought relief. The discussion of priorities and strategies discussed is based on the Sixth National Development Plan [MFDP, 1985] and the National Food Strategy paper [RDC, 1985].

6.1 NATIONAL DEVELOPMENT

At independence, the Botswana government adopted four national principles: democracy, development, self reliance, and unity. In support of the national principles, each national plan has had four planning objectives: rapid economic growth, social justice, economic independence, and sustained development.

The sixth NDP identifies two major challenges to the national planning objectives. The first is the problem of poverty. The government recognizes that the GDP per capita overstates average welfare, that income and wealth are quite skewed, and that there are limited opportunities for employment in the high-paying formal sector. The NDP also notes that since most Batswana live in rural areas, there is a particular need to increase rural employment opportunities and to increase the share of national resources in rural areas. As a result, the NDP VI declares that productive employment creation and rural development are the highest national planning priorities.

The second major challenge is the vulnerability of Botswana's economic development to external forces. Dependence on South Africa for nearly everything (including most transport and communication links with other countries), growing food deficits, and concentration on few exports are specifically identified as major sources of vulnerability.

During most of the post-independence period, the basic strategy for accomplishing national development objectives has been to achieve rapid and large returns from intensive capital investments in mining, and then to reinvest returns so as to improve the living standard of those not benefiting directly from the mining sector expansion. Botswana has thus far been quite successful in redistributing the mineral wealth and thereby minimizing many of the problems faced by other countries with similar circumstances [Lewis, 1981].

The specific components of the national planning strategy which relate to the four national planning objectives are as follows:

(a). Economic Growth. The government promotes economic growth (and growth in government revenues) through: (1) exploiting Botswana's mineral wealth, (2) seeking favourable international arrangements for exports, (3) maintaining a national solvency through sound monetary and fiscal policies, (4) providing basic social services and economic infrastructure, (5) supporting key institutions such as BMC, BAMB, NDF and BDC, and (6) investing in education and training to meet a t ained manpower scarcity.

(b). Social justice. Social justice is defined to involve fairness in redistribution of the national wealth and a minimal standard of living. Fairness is obtained through fiscal policies supporting key social services, including free primary education, health care, and drinking water. Minimum standards of living are maintained through the various drought relief and feeding programmes.

(c). Independence. There are four components of the strategy for gaining national independence: (1) increased training and rapid localisation of the many positions now held by expatriates, (2) mobilization of the various national resources, (3) diversification of the economy (including a resurgence of agriculture), and (4) diversification internationally with respect to communications, trade, investment partners, and sources of aid.

(d). Sustained development. Sustained development is being pursued through investments in education and infrastructure, and diversification of the economy. Programmes supporting the recovery of the agricultural sector are expected to play a major role.

A subtle but important shift in the role of the government in promoting national development took place in NDP VI. It was anticipated that additional growth from mineral exports will soon end and, therefore, the government's scope to expand social services and make infrastructure investments will be limited. In response, the government has made a commitment to emphasize maintaining and improving the quality of existing services and assets, rather than embarking on major new ventures. The government has also called upon the private and parastatal sectors to assume a greater burden for generating employment opportunities.

NDP VI further proposed that there should be a decentralization of responsibility for obtaining national objectives. For example, priority is placed on better integration of planning, extension and implementation capacities at the District Council level. The Plan calls on the District Councils to encourage popular participation in planning and implementation. There is also an emphasis on:

(a). Communal area planning with special attention to Community First Development Areas
(b). Improvements in the quality and effectiveness of the various national extension services
(c). Strengthening and promoting the role of village groups and leaders

6.2 AGRICULTURAL SECTOR DEVELOPMENT

The Ministry of Agriculture's strategy for improving the contribution of the agricultural sector to national development involves:

(a). Providing adequate assistance and incentives, particularly for resource poor farmers
(b). Identifying ways to improve long-term labour and land productivity in a manner which does not have detrimental effects on the environment

The guiding principle in developing policies in support of the strategy is to identify constraints faced by individual farmers and then design and implement programmes to break the constraints. The policies and programmes designed by the Ministry to implement the sectoral development strategy include:

(a). Pricing and marketing policies
(b). Provision of inputs and infrastructure
(c). Research into alternative ways of increasing dryland productivity
(d). Development of non-traditional production systems.

As mentioned above, BMC and BAMB are the main vehicles for pricing and

marketing policies. Both BAMB and BMC try to provide adequate incentives to encourage farmers to invest in agricultural production, while recognizing the limitations posed by an open economy. BAMB in principle follows a policy of pricing sorghum, maize and millet on the basis of landed cost, plus the cost of transport. However, in order to encourage production (and because of the drought), the real prices paid for food grains were increased by 60 percent between 1979 and 1985 and sorghum prices have been kept above those of maize. As of the mid-1980s, BAMB prices were somewhat above those of South Africa. Guaranteed prices are announced before the planting season in order to eliminate price risk. BMC has little flexibility in setting prices. Because of falling export prices and increasing operating cost, real beef prices have actually been falling in Botswana. BMC is nevertheless committed to keeping producer prices as high as possible.

The most important component of the Ministry's strategy is the provision of inputs and infrastructure, with the former being more important for arable production and the latter for livestock. The Arable Lands Development Programme (ALDEP), which was introduced in NDP V, is the centrepiece of efforts to assist traditional crop farmers. The purpose of ALDEP is to increase arable productivity by providing subsidized implements, fencing, water catchment tanks and draught power. ALDEP is targeted to resource poor farmers. In order to qualify, a farmer must have less than 40 cattle and cultivate less than 10 hectares. ALDEP indirectly helps farmers by assisting the extension service, and contributing to input distribution, marketing and storage facilities.

Originally, ALDEP was set-up as a subsidized loan programme, but after a poor response, it was changed to a grant approach in 1983. Under the current system, farmers pay only 15 percent for implements, fencing, and water catchment tanks, and 40 percent for draught animals. Aside from ALDEP, the Ministry has continued to concentrate on seed multiplication and distribution, both as part of the regular sector development programme and as a drought relief measure.

The development of the livestock sector has been addressed through a series of Livestock Development Projects (LDP). LDP I was launched in 1972 with funding from the World Bank and SIDA. The project had several components, including support for commercial cattle and sheep breeding ranches, cattle fattening ranches, trek route improvements, borehole maintenance, and technical studies. Closely related to the LDP, the Tribal Grazing Lands Policy (TGLP) was announced in 1975. TGLP was designed to rationalise range land use by encouraging cattle owners with large herds to develop lessehold ranches, and remove their cattle from the communal areas.

Ranch development under the TGLP was a focal point for the Second Livestock Development Project, which started in 1978. LDP II was funded by the World Bank. In addition to ranch development, LDP II had components covering:

(a).Development of communal grazing units and smallstock holding grounds
(b).Provision of credit to both communal and commercial farmers
(c).Improvement of trek routes and railway handling facilities
(d).Establishment of a ranch management training centre
(e).Creation of a monitoring and evaluation unit

LDP II gave greater emphasis to communal area improvement than did LDP I because of several criticism levelled at LDP I [Odell, 1980]. As LDP II proceeded, increasing emphasis was given to three components: ranch development, trek route improvement, and establishment of communal grazing cells. Most of the major components of LDP II were incorporated into LDP III after the former project ended in 1984. Despite the somewhat greater

emphasis on communal areas during the 1980s, maintenance and improvement of the commercial cattle industry is still the top livestock development priority. Major activities during NDP VI have included: increasing slaughter capacity, drilling more boreholes along trek routes, and expanding the cordon fence system.

The institutionalised research programmes in the Department of Agricultural Research have continued in NDP VI as in the past. During NDP V, the Ministry adopted the strategy of complementing Sebele Content farm and APRU ranch research with the farming systems approach. The FS approach is being applied by five on-farm research teams, with a particular emphasis on resource poor farmers. The NDP specifies that a major contribution of FSR will be to identify and evaluate strategies to reduce the effects of drought, such as: (a) early varieties, (b) increased soil moisture through better timing and different types of tillage, (c) appropriate plant populations, and (d) timely elimination of weeds.

The fourth component of the Ministry's strategy is to explore options for shifting away from reliance on traditional production. Investigations into the possibilities of expanding irrigated crop farming, melapo farming, and communal grazing cells have been receiving attention. The Ministry has also made a commitment to providing services to encourage large scale, leasehold arable farming and ranching.

In addition to the major elements of the agricultural sector strategy, the Ministry has smaller programmes relating to poultry, forestry, horticulture, dairies, fisheries, pig husbandry, and small dams.

6.3 NATIONAL FOOD STRATEGY

The National Food Strategy (NFS) has formed an important focus for agricultural development programmes during NDP VI. The NFS outlines an agenda for achieving improved national and household food security in Botswana. It complements the NDP by specifying the contributions of the various ministries and identifying activities not generally emphasized in the NDPs, such as institution building. The aim of the Strategy is to reduce dependence on external sources of food supplies and vulnerability to uncontrollable events. At present, the country is dependent on food imports and a majority of households are dependent on the government to make up food deficits.

The NFS represents one of the best, if not the best, governmental assessments of food security in Africa. The Strategy recognizes the complementarity between household and national food security, policy and technological change, short and long term interventions, narrowly targeted and general access programmes, and producing and buying food. The government would definitely like to achieve a greater degree of self-sufficiency but the Strategy recognizes that self-sufficiency is unlikely and that even if the country was self-sufficient it would not ensure household food security.

The plan for achieving improved food security has six components:

(a). Improvement of the database on the food economy
(b). Programmes to increase food and seed production and to reduce fluctuations in production caused by drought
(c). Strengthening of nutrition oriented and consumer programmes
(d). Improvement of drought relief planning and implementation
(e). A programme for post-drought recovery

(f). Establishment of an adequate strategic grain reserve

With respect to data requirements, the Strategy notes that available data are adequate for national-level analyses of the food economy but that "serious deficiencies" exist in information about food availability and utilization at the household level. The Strategy also says that additional knowledge is needed on household utilization of crop production, expenditures on food, and the composition of diets. In the light of data collection costs, the Strategy proposes that an attempt should be made to generate the required information through existing research and survey programmes.

The programmes to increase food and seed production are the major link between agricultural sector development and the NFS. The NFS identifies three main objectives for agricultural programmes:

(a). Drought recovery to improve rural incomes, access to food and employment, and nutrition
(b). Sustained increases in the total level of food production to reduce dependency
(c). Reduced fluctuations in year to year output caused by reliance on dryland farming

The Strategy proposes programmes for small-scale dryland, commercial dryland, irrigated, and melapo farming. Back-up research, infrastructure improvements and start-up capital are to be provided to support irrigation and the commercial farmers. The main programme for small-scale dryland and melapo farming will be to continue assistance under ALDEP. Emphasis is also being given to improved extension coverage, marketing and input supply, and the production and distribution of seeds. Agricultural research is expected to concentrate on seed varieties and tillage methods for rainfed farming under high risk conditions.

Aside from increased production, the Strategy proposes programmes to improve food access through the recovery of pre-drought income and production levels, and programmes to ensure the physical availability of food at reasonable prices. The various feeding programmes will be continued to provide a safety net. Nutrition education programmes will be enhanced to ensure that available food is used to best advantage. At the national level, the Strategy focuses on developing a strategic grain reserve and maintaining high foreign exchange reserves.

6.4 DROUGHT RELIEF

Drought relief programmes have taken precedence over longer term development programmes during most of NDP VI. The strategy for drought relief has three major components:

(a). Supplemental food is provided for preschool and primary school children, pregnant and lactating women, destitutes, TB patients, and remote area dwellers
(b). Incomes are supplemented through temporary employment generating, village-level projects (such as dam construction or fencing)
(c). Subsidies are provided for agricultural production and a recovery of productive assets

Through the 1984-85 season, the Ministry of Agriculture's Drought Relief programme includes the following:

(a). Farmers could receive 30 to 50 Pulas per hectare, up to three hectares, to destump their field or to pay another person to destump
(b). All farmers were eligible to receive 10 kilograms each of sorghum and maize seed
(c). A 85 percent subsidy was provided for the hiring of traction for up to three hectares
(d). Stock feed was available at a subsidized price
(e). A botulism vaccine was made available free of charge
(f). Cull cattle (those not good enough for BMC) were purchased at prices from P50 to P100 to distribute to schools and feeding programmes
(g). Funds were made available for village groups to build or improve water sources at the lands

Most of the drought relief programmes were developed on an ad hoc basis, in response to observed needs. In 1985, the government introduced a comprehensive drought recovery programme focused on arable production, called the Accelerated Rainfed Arable Programme. ARAP provides inputs and pays for critical fieldwork activities to encourage farmers to continue planting. Under ARAP, all farmers in the country have been eligible to receive payments of 50 Pula per hectare, up to ten hectares, to plough their field. If the field is row planted, the payment per hectare is increased by ten Pula. In addition, farmers have been able to receive five Pula per hectare for weeding. ARAP also has provided 50 Pula per hectare for destumping, seed for up to ten hectares, and fertiliser for up to three hectares. One explicit objective of ARAP is to demonstrate the importance of improved seed, fertiliser application, row planting and weeding.

7. SUMMARY AND IMPLICATIONS

Most farmers in Botswana are involved in mixed crop and livestock farming in communally owned, but privately managed, tribal areas. Unfortunately, Botswana has a harsh technical environment for agricultural production. Low average annual rainfall is far from being the only technical problem. Growing crops or even raising livestock is impossible in most of the country. Even where it is possible to grow crops, it is extremely risky. Consequently, the levels of both crop production and livestock value added fluctuate greatly, primarily as a function of the distribution of rainfall. Because of drought and the continued use of traditional production practices, the relative contribution of agricultural production to national income has declined dramatically since independence.

In the current National Development Plan (NDP), the sixth since independence, agriculture was expected to play an increasing role in national development. Unfortunately, the 1980s drought forced the government to shift attention from long term development to short term drought relief and recovery interventions.

The harsh environment and pattern of economic growth in Botswana have created a unique relationship between agricultural development, national independence and food security. The Botswana economy has had one of the fastest growth rates in the world over the last twenty years but has been unbalanced growth, with the agricultural sector stagnating in the long run and performing particularly poorly in years of recurrent drought. For now, Botswana can make up food shortfalls and pay for imports. But the country is vulnerable, particularly due to the volatile situation in South Africa.

Household food security is also vulnerable, reflected in the loss of productive assets during the drought, and dependence on remittances and government feeding programmes. For example, in 1984, more than a third of

the total population were receiving supplementary rations equivalent to 35 percent of their basic food needs [RDC, 1985]. Around sixty percent of the population were benefiting from various feeding programmes. The food provided through the various feeding programmes accounted for nearly 25 percent of the total availability of staple food in Botswana in 1984.

The development and security situation may well get worse in Botswana if, as predicted in the National Development Plan [MFDP, 1985], the growth of mine revenues begins to fall in the next few years while the growth of government expenditures increases, leading again to a government budget deficit and possibly even a balance of trade deficit. Therefore, the Ministry of Agriculture must take urgent steps to address the stagnation and erratic performance of the agricultural sector. This review of the Botswana development setting has suggested a few options which might be considered by the Ministry.

First, the majority of resource poor farmers cannot be expected to feed themselves. Therefore, instead of emphasizing poor arable farmers, the Ministry might concentrate more research resources on improving the productivity and capacity of intermediate traditional and non-traditional producers. Diversification of the agricultural sector could be assigned top priority.

Second, there has continued to be a tendency to propose general purpose programmes and general purpose interventions. Unfortunately, no programmes and interventions are likely to be useful across all environments. Therefore, an attempt should be made to develop a comprehensive strategy for targeting the Ministry's activities taking into account the diversity in resources and production practices.

Third, one of the biggest problems facing the Ministry is the seeming lack of coordination and communication between the various departments. For example, DPS develops plans based on technical assumptions which are not necessarily supported by research. DAFS promotes technologies which DAR officers feel are no better than existing practices. BAC does not provide the type of training ADs need, and DAR researchers provide little or no input into the BAC curriculum. The establishment of improved linkages also should be a top priority.

Fourth, the Division of Arable Crops Research has made a major shift in orientation during the past decade toward the testing of technologies and varieties which reflect farmers' resources and objectives. Nevertheless, most interventions being examined still will require substantial control of resources, particularly draught resources. More research resources might be used for investigating the potential for improvement though widespread adoption of better traditional practices.

Fifth, APRU has been successful in developing practices for commercial producers but has neglected practices for communal, home-use oriented producers. More attention might be given to multiple use cattle husbandry practices, with an emphasis on home milk consumption. Smallstock and poultry also might receive more attention in research.

Sixth, on-farm research will continue to be necessary in order to screen technologies for particular micro-environments and farmer circumstances. However, there appears to be a need for more national coordination of on-farm research since many of the same technical interventions are being studied by several research teams. On-farm research might give more attention to livestock and non-traditional producers, since too much is being asked of on-farm researchers by having them focus on crop production

by the poorest farmers.

Seventh, one priority for DAFS would be to increase the effectiveness of ADs to operate as agricultural change agents. Several specific issues have been identified in other ATIP working papers.

Eighth, despite the important linkages between national and agricultural development, most Ministry economists are involved in generating data, or planning and analysing various programmes and projects. The Ministry might re-allocate some of its social scientists to the policy and support systems analysis. A top priority could be to develop a realistic sectoral development strategy so that when new projects are solicited or new programmes developed, the Ministry can make sure the proposals contribute to long- and short-term sector development goals.

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