

CHAPTER 4

A REVIEW OF DEVELOPMENTS IN AGRICULTURAL MECHANIZATION IN BOTSWANA

by

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INTRODUCTION

Botswana is in the Southern half of Africa with the Tropic of Capricorn dividing the country into about two equal halves. Total land area is about 60 million hectares with only about 5.3 million hectares being suitable for agriculture (Table 3). The larger part of the country is a semi desert with annual rainfall of less than 300mm. The total population is estimated at 1.3 million in 1990 and growing at about 3.7% per annum. Rainfall is unimodal falling between October-March. Over 90% of the country receives less than 600 mm rainfall, and chances of crop failure due to drought are quite high. Up to 1976 the economy was dominated by beef exports to the EEC, but after this year, diamonds and other minerals have dominated the economy. Botswana has registered a real GDP growth of over 10% per annum over the past 10 years and has built up impressive foreign currency reserves (over US\$2.0 billion by 1988). The livestock population is estimated at 2.8 million cattle and 1.5 million sheep and goats. Over 80% of the population live in the south and eastern parts of the country which have better rainfall. The country borders South Africa and Zimbabwe and a significant proportion of its trade is with these two countries. About 70% of the population derive their livelihood from agriculture (livestock and subsistence crop production) (GOB - 1989) (Table 3).

The demographic pattern shows disturbing trends. Close to 50% of the population in Botswana is in the dependent age group (i.e. children under 15 years and aged people over 65 years old). In addition a significant proportion of rural households are headed by women. The urban population is expected to increase to about 70% of the total population of Botswana by the year 2010 AD (Table 4). The implication of this trend is that there will be more urban dwellers in 2010 AD than Botswana's total population in the 1990. This means therefore that the rural population with only about 54% of them being economically active will be required to produce enough food to feed not only the numerically increased rural population but also the urban population which is increasing at an even faster rate. Even more serious is the fact that those who migrate to urban areas are the younger members of the population (less than 30 years) and in most cases the educated, thus depleting the agricultural and/or rural sector of its most economically active population group. Indeed the average age of the rural population has been progressively

increasing (ATIP (1988)) and this trend will undoubtedly have serious implications on the food and overall agricultural production and productivity if current levels of mechanization are maintained.

TABLE 3: Agricultural Statistics for Botswana

1. Total Area x 10 ³ ha.	60,037
2. Total Land Area x 10 ³ ha.	58,537
3. Potential Agricultural Area x 10 ³ ha.	5,330
4. Cultivated Area x 10 ³ ha. (including ranches)	1,330
5. Forests, Deserts and others x 10 ³ ha.	53,207
6. Cultivated Land under	
(a) Large Scale farms x 10 ³ ha. (% of cultivated area)	330(25%)
(b) Small scale/peasant farms x 10 ³ ha. (% of cult.area)	1,000(75%)
7. Irrigated Land Area x 10 ³ ha.	3
8. % of Total Agric. Area Cultivated	25%
9. % of Cultivated Area Irrigated	=0%
10. Methods of Land Preparation	
(a) Handtool Technology % Cultivated Area	20%
(b) Animal Draft Power % Cultivated Area	40%
(c) Mechanical Power (tractor) Cultivated Area	40%
11. % Agriculture to GDP	6%
12. % Agriculture to Exports	5%
13. Per Capita GDP (1987) US\$2,000	2,000
14. % Food Imports to total consumed	80%
15. Principal Export Crops	Diamonds, Copper, Nickel, Beef

SOURCE: World Bank (1987), Economic Statistics (SADCC) 1988, FAO (1986), GoB (1989),

STRUCTURE OF THE AGRICULTURAL SECTOR

As in many countries in Eastern and Southern Africa, the agricultural sector in Botswana is characterized by the diversity of farm sizes and farming enterprises. The sector can be broadly divided into four groups of farmers. The

first group are the Peasant Subsistence Farmers (PSF) who practise subsistence agriculture - growing mostly sorghum, millet and pulses. They do not own cattle and in many cases do hire draught power from their neighbours if it is available. Their agricultural practices are usually very traditional - broadcasting of seeds; little or no weeding and the yields are quite low usually in the region of 10 or 20 kg per hectare. This group cultivates about 20% of the cultivated land in Botswana and constitute about 49% of the farm holdings. The average farm size is in the region of 1-2 hectares. Next to the PSF's are the Small Scale Farmers (SSF) who produce food crops for subsistence and cash (or food) crops for the market. In Botswana such farmers would have livestock as their main cash crop (usually less than 40 animals) and for agricultural field operations they have their own draught oxen. The offtake levels from their livestock enterprise is low (usually less than 10%) and they grow sorghum and other drought resistant cereals. A few may venture into horticultural production. Their agricultural practices are at a higher level than those of the PSF's, although by modern scientific standards they are still low, e.g. yields are still in the region 200-300 kg/ha. The SSF cultivate about 48% of the cultivated land (average land holdings 5-15 ha) in Botswana and constitute about 41% of the farming families. The third group are the Middle Scale Farmers (MSF) who produce both cash and food crops for the export and internal market. In the Botswana case these tend to be local merchants, retired civil servants, or Government officials who decide to invest their savings in agriculture. This group can normally obtain credit from the credit institutions, and use both divisible and indivisible inputs. Many of them own several pairs of draught oxen, and a few own tractors. They cultivate about 20% of the cultivated land and in many cases they employ extra labour from neighbourhood villages. The fourth group are the Large Scale Farmers (LSF). Their land holdings are usually quite large (sometimes over 1000 ha.). A number of the large scale farms in Botswana are owned by the state (BDC farms) although there are quite a number of private large scale farmers (e.g. Barolong farms, Pandamatenga farms, etc.). The Government has in recent years allocated land on 99 years lease in blocks of 500ha. in the Pandamatenga area. They grow cereal grains (sorghum, millet, maize), and a few have invested in irrigation. Most of their field operations are mechanized. They cultivate about 20% of the cultivated land in Botswana. There are also quite a large number of livestock farmers who do not grow any crops and concentrate only on livestock ranching for beef production.

The above structure of the agricultural sector in Botswana has, by and large, remained the same over the past 3 decades, with some of the farmers moving from PSF to SSF, SSF to MSF and MSF to LSF. Due to the semi arid nature of the climate (rainfall in the region of 250-600 mm) the country has been unable in quite a number of years to produce enough food to feed her growing population (in extreme dry years upto 80% of the cereal grains consumed is imported while in good years 20% is imported). However with expansion of the area under cultivation she could produce internally a higher percentage of her food requirements even in the extreme dry years. Given her

low population and the large areas which have to be cultivated to meet her food needs, to increase food production then an extensive type of agriculture has to be practised. The semi arid nature of the climate limits any intensive type of agriculture to a few areas in the country, and to areas which can be irrigated. To cultivate large areas Botswana will have to mechanize her agriculture. Agricultural mechanization will therefore play a crucial role in enabling the country to meet her food and agricultural production challenges over the next 2 decades. In the subsequent sections we shall review the agricultural mechanization policies and strategies in Botswana over the past 3 decades.

TABLE 4: **Population: (in thousands)**

Year	Total Population	Rural Population	% of Total	Urban Population	% Total
1960	507	498	98%	9	2%
1970	622	570	92%	52	8%
1980	807	569	71%	238	29%
1990	1300	614	49%	686	51%
2000 (projected)	1634	650	40%	984	60%
2010	2378	720	30%	1658	70%

AGRIC. MECHANIZATION POLICIES AND STRATEGIES

Three factors have significantly influenced the pace of agricultural mechanization in Botswana. These are first her livestock industry and tradition of keeping livestock by most Batswana; second her proximity to South Africa which has led to her, together with South Africa, Lesotho, Namibia and Swaziland being members of the Southern Africa Customs Union (SACU) and third the semi arid nature of the climate. These three factors have influenced the pace and rate of adoption of some mechanization technologies especially draught animal cultivation. Compared to other African countries, Botswana has a large percentage of her cultivated land ploughed by draught animals and tractors (40% for each category). The Batswana traditionally maintain three homes - a permanent home in the village (some villages have populations of over 40,000); a hut in the lands (where most of the crop production is undertaken) and this may be up to 10kms from the village home; and a cattle post - where the livestock are kept and graze in the communal grazing lands. During the crop growing season, nearly the whole family moves to the lands

and stays there until when planting is completed and they return again during bird scaring and harvesting period.

During the colonial period, Botswana - then known as Bechuanaland Protectorate had her capital in Mafeking - in South Africa and British Resident Commissioner had his offices there. A lot of economic activities in the territory therefore were linked to South Africa. A large number of Batswana worked in the mines in South Africa and indeed their repatriations formed a major part of the national income in the early days after independence. There was free flow of people and goods between South Africa and the Bechuanaland Protectorate. A number of South African and other white farmers settled in Botswana. These farmers, together with the Batswana migrant workers when they returned home brought with them into the country the technology of draught animal ploughing and transport. Given that the Batswana were already livestock keepers, and the arid nature of the climate which necessitated that each family had to plough relatively large areas in order to obtain enough sorghum and millet for subsistence, this made the adoption of the draught animal technology quite easy by most Batswana. Thus the animals were used for ploughing, transport - to collect water and movement of the family to and from the cattle posts and the lands. A few large scale farms were opened up in the Tuli Block, Pandamatenga and Barolong, but these concentrated mostly on ranching. Arable agriculture remained mostly for subsistence, and during drought years, grain could always be imported from South Africa and the then Rhodesia.

TABLE 5: **Tractors in use in Botswana**

<u>Year</u>	<u>No. of Tractors</u>
1950	45
1955	74
1960	107
1965	200
1970	790
1975	1859
1980	2123
1985	2155

FAO Production Yearbooks: Vol. 13, 24, 29, 36, 42;

* Tractors - include both crawler & four wheel tractors but excludes 2 wheel tractors.

The total number of tractors in the country was quite low and upto 1965 (on advent of independence) there were only 200 tractors (both crawler and four wheeled) and most of these were used in the large farms and for public works. A review of agricultural research on cultivation techniques (1947-59), shows that the Agricultural Research Station did not use any mechanical implements in its experiments, and relied on mules/horses/donkeys/oxen and handtool technology (ARS-1978). After independence in 1965, the Government encouraged investment in agriculture

(both livestock and arable). The arable agriculture was mostly for internal food self sufficiency and a number of large scale commercial farms were started in the areas where it was feasible to grow crops. In particular in this regard, a number of freehold large farms were started through private investment, and some of these specialized in cattle while others raised both cattle and food crops. Most of the agricultural machinery in the country then was owned by these freehold farmers (Table 5). Thus the number of tractors in the country gradually increased to about 790 and 1850 by 1970 and 1975 respectively. Most of these were on the 360 large scale commercial farms. The peasant subsistence farmers, small scale farmers (SSF) and medium scale farmers (MSF) relied on draft oxen for their field operations. (ARS (1978); IBRD (1986), GoB (1985, 86).

The opening up of the mining industry from the mid 1970s and the resulting substantial increment in Government and the country's revenue, through royalties, taxes, and foreign exchange earnings, enabled the country to provide more assistance to the arable crop production sector and as a consequence led to higher levels of mechanization (NDPIV, NDPV, NDPVI - (GoB; 1974, 1979, 1985). Initially Government efforts were directed at assisting those farmers who could start arable crop production by provision of inputs - draught implements, seeds and fertilizers and low interest loans through the National Development Bank. For the traditional farmers, Government efforts were directed at provision of assistance through various drought relief programmes. It was realized by the Government that given Botswana's climate and soils the potential for dryland farming was limited (IBRD 1986, ARS 1978) given the technology available then. The Government, through its own funds and donor assistance invested a lot of money in research and development with the objective of developing a technology which could increase arable crop production given the limitations of climate and soils (Gibbon *et.al.* (1974); EFSAIP (1984); DLFRS (1985, a,b)). It was then felt, in Government and research circles, that a tillage technology could be developed which reduced draught power requirements (Batswana farmers use 3-4 pairs of draught oxen for ploughing); ensure timeliness of ploughing and planting (the short rainy season is a major problem in crop production) and conserve soil and water for crop growth and production. Researchers were therefore imported to develop this tillage technology.

The first attempts at developing this tillage technology were simultaneously initiated in 1971 by an NGO in Mochudi district - Mochudi Farmers Brigade and Department of Agricultural Research in Sebele. The former developed a tool carrier which they called "*Makgonatsotlhe*" - and popularly known in the profession as Mochudi tool carrier which was launched in 1973. It was made from imported components and fabricated steel and by 1975 production started in a workshop in Mochudi. The Agricultural Research Station through an ODA-UK funded project - called the Dryland Farming Research System Project (DLFRS) designed and developed their own tool carrier - at Sebele which they called *Versatool*. Essentially it had more or less the same features as the Mochudi tool carrier only that it was more

sophisticated (Gibbon *et.al.* 1974; DLFRS (1985) EFSAIP (1977; 1978; 1979; 1980). This was tested mostly on station and there was no attempt at starting manufacturing. A lot of things were claimed of these two tool carriers, and some prototypes were shipped as far north as Tanzania and Kenya for testing. About 150 Mochudi tool carriers were manufactured between 1973-1980 and several were bought by Government departments and loaned to farmers for testing. There was however little coordination of the research and development efforts between the Mochudi and Versatool developers despite being 30kms from each other.

It is perhaps because of the enthusiasm shown by the two groups, and what appeared to be promising developments, that the Government signed a memorandum with ODA, starting up another project, known as Evaluation of Farming Systems and Agricultural Implements Project (EFSAIP). The principle objective of this project was to, among other things, evaluate the whole animal draught minimum tillage system, following on the earlier results obtained from tests on the Versatool. This project started in 1976, and a number of scientists and research students from UK were seconded to the Agricultural Research Station. It would seem that the EFSAIP team had better agricultural engineers, (at least one Ph.D was completed in the field of Agricultural Engineering) and it became quite apparent to the team that the tine cultivation system used on the Versatool and Mochudi tool carrier had a number of teething problems, especially when used on farmer's fields. They therefore concentrated on the Mochudi tool carrier, fitted with a standard mouldboard plough for primary tillage and they also developed a planter and plow-planter to go with it. However when an economic analysis was undertaken it became apparent that this was going to be too costly and the trials were abandoned in 1984 and the project terminated (Horspool 1988). The Agricultural Research Station however decided to establish a Farm Machinery Development Unit (FMDU) to continue with limited research on the other implements. This was however very understaffed (only 1 agricultural engineer) and the unit has, by and large, done limited development work since then.

Following the termination of the ODA funded EFSAIP Project in 1984, the Ministry of Agriculture appears to have adopted a two pronged approach in so far as mechanization was concerned. It was decided then to continue with the research work and a new project, this time funded by USAID was started - ATIP - Agricultural Technology Improvement Project. This project which was implemented under contract by a consortium of USA Land Grant Universities (MIAC - Midwest International Agriculture Consortium) was supposed to come up with, among other things, new and better tillage technologies. The basic approach was the Farming Systems approach. ATIP has generated a lot of socio-economic data so far, through its numerous Working Papers (ATIP-WP-1-20). There has not however, been any major breakthrough in so far as either tillage methods are concerned or new implements for tillage. It would seem ATIP has concentrated on evaluating current tillage practices and trying to identify the farmers constraints in this

regard (Baker, 1988). The project is currently in the process of being wound up and is expected to end by 1991. Two things may have affected ATIP's ability in developing new technologies for tillage. First the country was hit by a severe drought lasting for seven years from 1981/1987, and the severity of the drought was such that any new tillage technology which ATIP would have developed during this period would have had marginal effect on productivity and production. Secondly, Government assistance programmes, which provided farmers with assistance in tillage, during a larger part of ATIP's existence would have, in our opinion, made it uneconomical for ATIP to try to develop any new implements.

The second prong of the Ministry's approach was to initiate programmes which assist farmers (in particular the poorer ones) to get, among other things, mechanization inputs at highly subsidized rates or even free. Among the programmes introduced then is ALDEP - Arable Lands Development Programme, which was introduced in 1982 through a loan from the African Development Bank and IFAD and FAO providing technical assistance and through which the Government is removing some of the constraints facing the poorer traditional farmers. These farmers are defined as those with less than 10ha. of land and owning less than 40 herd of cattle and the potential maximum assistance one could get through ALDEP initially was P2,000.00 (then equivalent to US\$2,000.00). This figure has been progressively reviewed upwards in Pula terms although in US dollar terms it has remained at around US\$2,000.00. The package provided up to now includes - agricultural implements up to 15% of maximum grant, fencing materials 25%, animal draught power (oxen & donkeys) 45%, water tanks 15%. From this it is apparent that animal draught power and implements account for about 60% of the maximum assistance. To be able to qualify however the farmer has to put up about 15% of the amount he is requesting. The programme is administered by the extension services of the Ministry of Agriculture. Over US\$30 million has been given in the last 6 years (Mokoene & Sebolai (1989)). This programme which is still being implemented was directed mostly at the small farmers and has focused principally at provision of draught animal power and implements. These farmers would not have been able to undertake such on farm investments without this programme. It was however launched in the middle of a prolonged drought cycle, and it is difficult to isolate its impact on productivity and overall production in view of other programmes which started at the same time.

A second programme - which has had a profound impact on mechanization was the Accelerated Rainfed Arable Programme (ARAP) which was started in 1985/86 as a five years project, with an estimated total operational budget of P29 million (then about US\$22 million). The programme was launched to assist all farmers (irrespective of size of land holding) and included the following components: ploughing P70.00 (US\$36.00) per hectare up to a maximum 10 hectares; P20.00 per ha for planting up to a maximum of 10ha.; free seeds to plant 10 hectares (equivalent to 8kg/ha); land clearing

through destumping grants, fencing grants, water development in the lands area (upto a maximum of P20,000 (US\$10,500.00)). The programme was administered by the extension services of the Ministry of Agriculture. Over US\$30 million has been spent in this programme over the past five years and the programme is being phased out w.e.f. 1990/91 financial year. This programme has had a significant impact on the level of tractor mechanization as quite a number of farmers, merchants, and civil servants, borrowed money from the National Development Bank (at low interest rates) to purchase tractors which they hired out to plough land for the small farmers as they were assured of payment. (The commercial cost of ploughing one hectare is about P70.00). Whether these small scale farmers will be able to continue to afford hiring such tractors, without the Government grant remains to be seen. There are also a number of other programmes which assist farmers - in particular women farmers (AE10 - for horticultural projects, etc.); Financial Assistance Policy - for commercial farming enterprises, etc.

A recent study by two consultants, on the relative economics of different draught power sources in Botswana has advised against Government subsidy on tractors (MoA-GoB 1989). In its recent review of agricultural policy, the Ministry of Agriculture has recommended that Government assistance should continue to be provided to procure draught animal power for both efficiency and equity considerations (MoA-GoB-1989,1990) and farmers who wish to get tractors should apply for loans from the commercial banks at full market prices. Also in the last 3 years, a small engineering firm in Gaborone, has started to assemble Yugoslavian manufactured tractors under licence from the main Yugoslavian company IMT. Although the tractors carry local names like Tshukudu, they are essentially a copy of the Yugoslavian tractors as they are assembled from SKD parts with no modification to suit local conditions. About 250 of these tractors have been assembled locally over the past 3 years and it is claimed a few have been exported to other SADCC countries. Also in 1990, a high powered study team, has been sent to some Asian countries (Japan, South Korea, etc.), to study the mechanization programmes of these countries. However recommendations emanating from this mission have yet to be considered by the Government. The major makes of tractors in the market are Ford, Massey Ferguson, Deutz, and the locally assembled Tshukudu, (which is essentially a variant of MF 300 series). Spare parts are not difficult to get as Botswana is linked with South Africa through the customs union, and all the major manufacturers have assembly factories in South Africa manufacturing from CKD components with 30-40% local content.

A key feature of Botswana's agricultural mechanization policies and programmes, has been Government assistance for performing certain tasks (e.g. ploughing). The Government however has avoided getting involved directly in provision of these mechanization services, and has allowed the farmer to get them from whatever source and subsidized him for the work accomplished. The opening up of new lands in Pandamatenga and Barolong areas for large scale commercial crop production, and the Government assistance programme

led to a significant increment in the number of tractors in the country from under 1000 in 1970 to over 2000 by 1985 (Table 5). Further although the Government and donors have invested a lot of money in research and development efforts over the past 3 decades for appropriate mechanization implements, (over US\$50 million) these efforts would seem have not yet yielded any readily adoptable technology which meets the key criteria for tillage in such a dry country - water retention technology. On the post harvest front however, local efforts appear to have yielded a successful technology in the form of a sorghum dehuller. This dehuller, developed by a local appropriate technology group - Rural Industries Innovation Centre, (RIIC) initially with IDRC assistance, appears to be quite successful and is now widely used and a few of them have been exported to other SADCC countries (Schmidt & Bassie 1988, RIIC 1988-89). RIIC is also involved in development of other technologies in particular water lifting devices and rural transport. These are however still at developmental stage, although a few of them have reached large scale testing by farmers. Another key problem of agricultural mechanization in Botswana is the lack of manpower required at all levels - artisan, technician, managerial and professional. An important factor in Botswana, which contributes significantly to making mechanized agriculture profitable has been the price subsidy provided by the Government on important cereal crops e.g. sorghum and maize. Prices paid to farmers for their produce sold to the Botswana Agricultural Marketing Board, has been about 2-3 times the world market prices. This has made it profitable for medium and large scale farmers to embark on mechanized cereal production. The objective of the Government then in providing such a high subsidy was to attain food self sufficiency. However, the Government is currently (1990) reviewing its policy in this regard, and indications are that there will be a shift from food self sufficiency to food security. It is likely therefore, due to this shift in policy, that the subsidies will be phased out and farmers will be encouraged to grow crops which are more profitable and which do not require subsidization from the Government. What impact this will have on agricultural mechanization is difficult to predict - precisely. It is likely however that the profitability of cereal production by large scale mechanized farmers will be greatly reduced.

INSTITUTIONAL FRAMEWORK

In Botswana few institutions/Government departments have been involved with mechanization policy compared to other African countries. Policy formulation has been initiated by the Department of Planning and Statistics in the Ministry of Agriculture (e.g. programmes such as ARAP, ALDEP have been initiated in this department). For programmes which involved crop production this department normally works closely with the Department of Field Services which controls most of the extension services and is responsible for arable crop production. The draft policy paper so prepared then is considered by the policy formulation committee of the Ministry of Agriculture, which comprises of all Heads of Departments in the Ministry and is chaired by the Permanent

Secretary of the Ministry. Once a policy paper has been approved at this stage it is then sent to the Rural Development Council - which is a high level council - chaired by the Minister of Finance and Development Planning and its membership comprises of all Permanent Secretaries. If the policy document is approved at this stage, it is then sent by the ministry concerned for consideration and approval at the highest Government levels and after this the usual process of preparing budgetary estimates and getting them approved by the legislature follows.

Implementation of most programmes/projects involving mechanization has been done by two departments in Botswana - Agricultural Research Station and the department of Field Services. The department of Field Services has been involved with the implementation of such programmes as ARAP and ALDEP through its extensive network of front line extension workers - supervised at district level by District Agricultural Officers and at regional level by Regional Agricultural Officers. The front line extension workers, who work in the villages, are the ones who assist the farmers in filling the various forms required for obtaining Government assistance and pass them to the supervisors who forward them to the District Agricultural Officers for approval and payment in the case of ARAP payments and ALDEP assistance. Even in other schemes such as the Agricultural Credit Guarantee Scheme, whereby farmers can secure loans from the National Development Bank for purchasing inputs - including farm implements and machinery, the District Agricultural Officers and Regional Agricultural Officers have to be involved before the Bank can provide the assistance. Compared to other countries, the procedures for getting Government assistance under the various programmes has been quite straight forward and quite efficient. It would seem abuse of the scheme has also been minimal. The low population may well have contributed to this higher level of efficiency (Mokone & Sebolai (1989)).

On the research side the agric. mechanization work has been undertaken mostly through donor funded projects (DRFSP, EFSAIP and ATIP). All of these projects operated as semi autonomous projects/sections within the Agricultural Research Department, with their own funding, staff and equipment. Nearly all the senior staff in these projects were/are expatriates. It is perhaps because of this type of arrangement that these projects have had little impact on the agricultural situation in Botswana as the projects were, by and large, terminated when the expatriate staff left and donor funding stopped. Further, with the exception of ATIP, these projects did little in training of national staff in the critical areas. Thus despite 15 years of project funding for tillage only 2 agric. engineers have been trained and one of them is no longer working for the Agricultural Research Station. Other institutions which have been involved in one way or another in agricultural mechanization are the NGO - Mochudi Farmers Brigade, which developed the Mochudi Tool Carrier and RIIC - Rural Industries Innovation Centre. The latter has been involved in the development of the sorghum dehuller which, as we mentioned earlier has been more widely adopted than any other mechanization technology

developed in Botswana. The Botswana Agricultural College has been indirectly involved in agric. mechanization efforts as it trains all the front line extension workers who have been involved in implementing Government assistance programmes such as ALDEP and ARAP while the Ministry of Industries has been involved in assisting in establishment of manufacturing utilities such as the Montenegeiro Engineering which is assembling tractors. Other than coordination through the Rural Development Council and its committees which coordinates activities more at policy level, there is little, it would seem, coordination at professional level.

DISCUSSION AND CONCLUSION

We have in the preceding paragraphs reviewed mechanization policies and strategies in Botswana over the past few decades. For Botswana three distinct periods can be discerned. These are the period before 1970 - when *laissez faire* - existed - oxen powered cultivation had been adopted by the Batswana farmers and the standard ox-drawn mouldboard plough was being used and there was little effort to change this type of mechanization technology. This was followed by the period between 1970-84 which may be called the period of experimentation - when there was a lot of activity on the research and development front aimed at developing better animal drawn implements which in addition to reducing the draught power requirements, would also be able to retain as much moisture as possible in the soil. Both the Botswana Government, Non Governmental Organizations and donor agencies were very active in these efforts. However despite a lot of money and manpower being devoted to these efforts, we can conclude that no such technology was developed. The period of experimentation was followed by the period of subsidization from 1984 to todote. During this period the Government has instituted a number of assistance programmes most of them with a mechanization subsidy component. The government has however, unlike in other countries avoided setting up projects/institutions to offer these services and has been content to pay for the services provided in ploughing by whatever means - tractors, animals, or human power! Given her favourable economic conditions, Botswana has been able to subsidize her agricultural production in various ways. There is however an increasing concern that the subsidization has been to much and there have been calls to reduce it. A significant proportion of the subsidy has been provided for mechanization inputs. As a large proportion of the population live in rural areas it will be difficult to phase out all the subsidies provided to crop production. Further as a % of Government expenditure, the subsidy provided to farmers is still a small amount. In addition the Government is keen to reduce rural-urban migration as its capacity to provide productive jobs in the urban areas is also limited. Consequently therefore an agricultural mechanization policy and strategy will have to be formulated which reduces the drudgery of agricultural field operations, while at the same time increases agricultural production and productivity. Given the climatic constraints, this will be difficult to achieve without some form of assistance to farmers. Perhaps what is important is to

ensure that whatever subsidy is given to farmers enables them to establish a sustainable and profitable farming enterprise which will not require continued government assistance after a few years. This will require careful selection of crops to be grown as well as judicious use of all inputs required including agricultural mechanization inputs.
