ZAMBIAN AGRICULTURE — WITH EMPHASIS ON FERTILIZER USAGE

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Introduction

Lying in the heart of the African continent between the 8th and 16th degrees of latitude south, is the land-locked country of Zambia. A large portion of the total area of 752,614 square kilometres lies on a fairly uniform plateau at an altitude of between 1 000 and 1 300 metres, thus enjoying temperate rather than tropical climatic conditions. A normally very reliable summer rainfall varying between 600 and 1 000 mm falls from November to April, which together with the high temperatures (30°C) lends itself to agricultural production on the large tracts of suitable land. However poor communications and a sparse population of only seven inhabitants per square kilometre has resulted in large areas of the country remaining undeveloped. The recently completed new road and railway line to Dar-es-Salaam in Tanzania could however lead to the development of large areas of very suitable agricultural land in the North Eastern provinces.

Unfortunately, Zambia has in the past based her economy almost entirely on the high grade copper ore mined in the famous Copperbelt, and agricultural development for export has never been achieved. Recent world financial trends and the sharp decline in copper prices has resulted in a serious balance of payment deficits and in a bid to alleviate the situation, government are doing their utmost to encourage agricultural development with increased pre-planting producer prices and also fertilizer, seed and fuel subsidies. Unfortunately their effort is rather belated and is meeting with varying success. Although some 60 per cent of the population is rural and derives a living from agriculture, the majority of their production is for self-sufficiency of the family unit. With increased industrialisation the population has tended to drift from the rural areas towards the cities, but as unemployment increases, government is trying to attract people back to the land in a bid to attain nation-wide self sufficiency in agricultural production. Their efforts are meeting with certain resistance, so results at present are limited.

Agricultural area

The construction of the railway line from Livingstone to the Copperbelt in the early part of this century tended to follow the watershed, thereby also passing through good agricultural land. The principal soil types along this 'line of rail' are basically well to moderately drained red clays and sandy clay loams over limestone and other basic rocks. The second major soil type is the sandveld soils which vary significantly in type and depth, but are basically well to moderately well drained, depending on the depth of the gravel layer in the subsoil. Both classes of agricultural soil are relatively neutral in their virgin state; but the sands which tend to predominate in the northern areas where rainfall exceeds 1 000 mm, tend to be strongly leached and very acid.

Naturally it was along this line of rail that early commercial agricultural development by white farmers began. There was a narrow band up to 200 kilometres in width of commercial farming settlement along the railway, interspersed with native reserves where subsistence agriculture predominated. There was another commercial agricultural settlement at Fort Jameson (Chipata) near the Malawi border, but due to marketing difficulties in the days of the defunct Central African Federation, this area was almost entirely evacuated by white farmers. However, with the completion of a fully bituminised road, this area is developing again.

Production

At the time of independence in 1964, the commercial (white) farmers numbered some 1 200, and over the years has dwindled to a meagre 400. However, agricultural production with the exception of tobacco and groundnuts has increased dramatically. This has been brought about by

1. Improved farming techniques and management.
2. General use of improved seed varieties.
3. Increase in fertilizer applications.
4. Farmers increasing the size of their properties.
5. Africans entering commercial agriculture in increasing numbers.
6. Government or large companies entering into agriculture.

The main crops grown are

1. Maize.
2. Tobacco.
3. Sugar.
4. Seed maize.
5. Oil seed crops. (Groundnuts, sunflower and soya beans).
6. Cotton

Number of commercial producers

		African	*Non-African*	*Companies*
Maize	1964	15	547	6
Maize	1974	338	272	89
Tobacco	1964	Nil	350	2
Tobacco	1974	285	64	5

Production of major crops

Year	*Maize*	*Tobacco*	*Sugar*	*Seed maize*	*Ground-nuts*	*Cotton*
1964	2,35 m bags	11,0 m kg	Nil	3,337 pkts	55,933 bags	2,10 m kg
1974	6,53 m bags	7,0 m kg	85 000 tonnes	125 000 pkts	43 708 bags	5,25 m kg

Sunflower production has increased dramatically during the last three years and soya beans are gaining in popularity, as it fits very well into a rotation with winter wheat under irrigation. The almost frost-free winters make double cropping a feasible proposition.

Zambia's agricultural potential is fantastic, but as yet we have barely scratched the surface. With her favourable environment there is no reason why, in time, she should not become the granary of Central Africa. But in order to achieve this, government must continue to pursue a policy of agricultural encouragement to the full.

Two examples of Zambia's potential are

1 The fantastic increase of sugar cultivation from nothing in 1964 to 8 500 hectares of irrigated sugar cane in 1975, with raw sugar production totalling 85 000 tonnes to satisfy the domestic market. The hectarage will be expanded to 11 500 by 1980, when annual raw sugar output should be 150 000 tonnes.

2 Seed maize production has increased from 100 hectares in 1964 to 2 400 hectares in 1975 yielding 125 000 pockets and production continues to increase. The most popular variety is the well-known and extremely adaptable single hybrid SR 52, which has boosted the country's commercial maize production and responds well to high rates of fertilization.

Fertilizer supplies

Prior to independence in 1964, Zambia relied on Rhodesia for its supplies of fertilizers, which were marketed through the three commercial companies, Fison's, Rodia and Windmill. Maize and tobacco mixtures and straights were imported directly from the south at competitive prices. The range of mixtures was large in keeping with Rhodesian practice. In line with government policy the three companies were nationalised in 1968 and the National Agricultural Marketing Board became the sole supplier to the farmer of imported fertilizers.

As a result of Rhodesia's UDI, alternate supplies were sought in Europe, the Middle East and South Africa. In order to simplify distribution the number of mixtures was cut considerably, but I feel the range is still adequate for our requirements.

The current range is

Mixture	*N*	*P_2O_5*	*K_2O*	*S%*		*Boron*	
A	2	18	15	10		0,1%	) Tobacco
C	6	18	12	10		0,1%	) mixture
V	4	18	15	10		0,1%	
D	10	20	10	10	)		
R	20	20	0	10	) Maize) mixtures		
X	20	10	5	10	)		
Ammonium nitrate	34	–	–	–			
Sulphate of ammonia	21	–	–	24			
Urea	46	–	–	–			
Nitrate of soda	16	–	–	–			
Single super phosphate	–	19	–	–			
Triple super phosphate	–	44	–	–			
Potassium chloride	–	–	60	–			
Potassium sulphate	–	–	50	–			

There is very little demand for superphosphates except by the sugar estates who presently require 2 000 tonnes of triple superphosphate annually. Similarly only small amounts of potassium chloride, potassium sulphate and nitrate of soda are sold. Tobacco farmers prefer to use the latter for top-dressing.

Consumption of fertilizer has more than doubled in ten years, from 38 000 tonnes of mixtures to 80 000 tonnes in 1974. The estimated demand for 1976, which has already been ordered is

Mixture	A		2 000	tonnes
	C		10 000	"
	V		10 000	"
	D		30 000	"
	R		20 000	"
	X		20 000	"
		Total	92 000	" mixtures
Urea			50 000	"
Ammonium nitrate		10 000		
Triple superphosphate		3 000		
		Grand total	155 000	tonnes

The ammonium nitrate is produced locally by Nitrogen Chemicals of Zambia factory at Kafue. Annual production is running in the region of 25 000 tonnes of explosive grade ammonium nitrate of which 40—50 per cent is utilised for agricultural purposes and the balance for explosives on the mines. The remainder of the fertilizer requirement is imported in pre-packed form.

Fertilizer prices

In 1971 government introduced large fertilizer subsidies in a bid to increase agricultural production, which had immediate effect. However, the bulk of this subsidy has recently been removed resulting in up to 70 per cent increases in one year. A comparison of Southern African prices per tonne for 1976 is

	Zambia	*Rhodesia*	*South Africa*
Ammonium nitrate	K120-00	$ 116—40	R 114-00
Urea	K135-00	N/A	R 163-00
(A)2N, 1P_2O_5,15 K_2O	K120-00	$ 110-80	N/A
(V)4N, 1P_2O_5,15 K_2O	K140-00	$ 113-40	N/A

Zambian kwacha = Rhodesian $ 0,96

Zambian kwacha = SA rand 1,37

Price increases are summarised below in kwacha

	1970	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*
Ammonium nitrate	69-20	48-50	59-00	76-00	76-00	76-00	120-00
Urea	83-80	56-00	71-00	81-00	81-00	81-00	135-00
Mixture "V"	74-40	49-50	63-00	78-00	78-00	78-00	140-00

Future supplies

In a bid to save foreign exchange, increasing the capacity of the nitrogen factory is of utmost importance and tenders have been awarded to double the capacity to 50 000 tonnes a year. Likewise a mixing complex with a capacity of 100 000 tonnes is due for completion in 1980.

There is still indecision at this stage on the source of phosphates and potash, but I understand that the system will be flexible. There are local supplies of low-grade phosphates available, but I think initially it is intended to import the ingredients and mix with locally-produced nitrogen. Consideration has also been given to utilising phosphoric acid.

Soil analysis

Unfortunately with National Agricultural Marketing Board having the monopoly for fertilizer supplies, there are very few agronomists visiting commercial farms, who were so helpful in earlier days. However we still have a very efficient soil chemist and modern laboratory for soil analysis. Their recommendations are based on fertilizer trials run by Research Branch and repeated throughout the country. Most commercial farmers base their application rates on the soil chemist's recommendations from analysis.

Acidity and deficiencies

In their virgin state the heavy red clays are fairly neutral with pH (Ca CL_2) ranging from 5,0—6,0, and the heavily leached sands in the high-rainfall areas averaging 4;5. Application of agricultural lime on the commercial farms has been gaining in popularity recently, but is virtually unheard of in rural areas. Heavy applications of lime are not recommended and where used have brought about an incidence of zinc and boron deficiency. Maintenance dressings of 1 000—2 000 kg per hectare are recommended to maintain pH at a satisfactory level. The varieties of maize and tobacco planted are extremely tolerant to acid conditions and 4,4—4,8 is regarded as maize threshold pH. With continual high applications of urea, liming must become part and parcel of normal farm management. No ill effects of low pH as yet have been detected in tobacco.

In groundnuts, however, the level is more critical and a pH of 5,0 must be maintained as the high-yielding local variety Makulu Red is particularly susceptible to pops in acid soils.

Sulphur

Sulphur deficiencies are endemic to Zambia and tremendous response is achieved from its use. An increase from 10 to 50 bags per hectare was purely attributed to the application of 25 kg per hectare of sulphur. As a result all mixtures must have at least 10 per cent sulphur content and I believe Zambia is one of the few countries in Africa to legislate on sulphur content, which must also be printed on the bag.

Boron

Likewise we were also the first country in Africa to discover boron deficiency in cotton and routine applications of 2 kg per hectare of boron in the form of Solubor are recommended. 0,1 per cent boron is included in all

tobacco mixtures and it is also thought that sunflower may be susceptible.

Molybdenum

Deficiencies have appeared in maize grown in acid soils utilizing high fertilizer rates. Symptoms normally appear during long hot, dry periods in early stages of growth. The crop usually recovers naturally but applications of 70–100 grammes per hectare of sodium molybdate has proved beneficial for both a deficiency and fertilizer burn.

Zinc

Deficiencies do occur with overcast conditions in early stages of the maize plant's life, but the plant tends to grow out of it. Zinc application is only advocated on maize at our chief research station where soil pH is as high as 6,5 due to its close proximity to a cement factory. Remedial dressings of 30–50 kg of zinc sulphate are broadcast.

Magnesium

No deficiencies have as yet been detected, even on light textured sandy soils where high potassium dressings have been given to tobacco crops.

Rates of application

The accompanying table shows average fertilizer requirements of the more common crops with top management, in kilogrammes per hectare.

Crop	*N*	P_2O_5	K_2O
Maize	120–180	50– 80	30– 50
Tobacco	20– 70	110–140	50–100
Sugar	150–250	60–100	–
Soya beans	30– 40	60– 80	30– 40
Sunflowers	30– 50	40– 60	20–300
Cotton	60– 90	30– 60	30– 50
Wheat	120–150	60– 80	30– 40

Method of application

Commercial farmers, particularly on the heavy soils, have tended to broadcast and incorporate the bulk if not all of the fertilizer before planting the maize crop. This method facilitates the operation and lends itself to faster planting, but I am sure we are not obtaining the most benefit from the nutrients, as surely large amounts of nitrogen are lost through leaching. With relatively cheap fertilizer in the past, farmers tended to do away with topdressings, but with increased prices, efficiency of nutrient uptake must be the criterion.

Urea has been our chief form of nitrogen supply and efficient incorporation is not always possible, so losses to the atmosphere could be considerable. Topdressing with anhydrous ammonia is almost universal in North America, but unfortunately we do not have such a service. Aerial topdressing with ammonium nitrate before tasseling is bound to increase in popularity in order to obtain maximum nutrient utilisation, particularly on sandveld farms in the higher-rainfall areas.

Efficient application of fertilizers, be it broadcast, banded or side-dressed, is only possible with good management and efficient equipment. I read with interest recently of a service run by a UK fertilizer company, which checked and repaired fertilizer spreaders on the farm. It was surprising the state in which they found some of the machines and the variations in spread pattern. Maybe such a service is available in South Africa already?

Other forms of fertilizer

In recent years the Zambian maize industry has tended to follow a monoculture pattern rather than a legume or green crop rotation. This naturally requires larger applications of fertilizer, but legumes, particularly soya beans, are becoming increasingly more popular, in a bid to cut the fertilizer bill. Likewise in pastures, we have experienced some very promising results with Australian tropical legumes.

Increasing use is also being made of farm manure and slurry and although the actual amount is relatively small, those farmers who have a source of supply cannot afford not to utilise it.

Livestock production

I have concentrated on Zambian agricultural production in the true sense of the word, ie 'cultivation of the soil', but I feel that mention must be made of animal production briefly to complete the picture. Zambia is self sufficient in poultry and pork products, but is still a large importer of beef, mutton and dairy products.

The poultry industry in particular has made tremendous strides since independence as the rural farmers' production has increased out of all proportion, so the figures shown below are probably far from accurate. Production of table birds has increased from 2 155 000 in 1967 to 9 508 000 in 1974. Egg production has increased proportionately, so has day-old chick production to the stage where large exports are made weekly to neighbouring countries.

Likewise the total slaughterings of pigs has doubled in ten years from 16 228 to 30 483 carcases in 1974. Rural farmers' production of pork is rapidly increasing as like poultry, both are ideally suited to small-scale farmers.

However, the same cannot be said for dairy products as production of whole milk has dropped by 50 per cent in

eight years due to low prices and the decrease in the number of commercial farmers. To-day we are a large importer of all dairy products.

There are large numbers of cattle in the rural areas, but the farmers are reluctant to sell even with greatly increased prices, so that it is necessary to import approximately 25 000 head of cattle annually from Botswana. Although the number of cattle in rural areas has increased from 1,07 million in 1964 to 1,80 million in 1974, total slaughterings has only increased from 72 000 to 88 000 in the same period. The bulk red meat production is still by the commercial farmer. Although the rural farmer may have fought his personal inflation problems by keeping his cattle, it certainly does not help the country's financial situation.

In closing I can only reiterate how vast the potential is for Zambian agricultural development and only hope that the 'Agrarian Revolution' which the country has recently embarked on will yield the necessary results.