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Agricultural development in the Western Province of Zambia, with special reference to rice cultivation

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Summary

The Western Province with its traditional subsistence agriculture is one of the less developed regions of Zambia. Climate and soil conditions and inadequate support services are the main constraints to agricultural development. Farming mainly consists of wet season food production. Cassava and millet are grown on upland soils and maize and sorghum on the lower slopes of depressions (dambos). Part of the farmers grow rice as a cash crop on the lower slopes. Some farmers are engaged in extensive cattle raising. The agricultural potential of the region and the possibilities of improved family farming are insufficiently known but there are good prospects for an increase in animal and rice production. The rice area and rice yields can be increased by improved, site-specific cultivation practices and increased availability and use of draught animals.

Agricultural development in the Western Province requires long-term planning, adaptive research with a farming systems approach and adequate marketing and credit facilities.

Introduction

Zambia, a land-locked country located in southern Central Africa, covers 753 000 km^2 and has about 6 million people. Zambia has a gently undulating topography between 1000 and 1400 m altitude and a moderate tropical climate. Population density is relatively low but average growth rate is over 3 %. The country has several mineral resources and, except for the western part, good agricultural soils.

Zambia is an underdeveloped nation with an economy based on agriculture but still mainly dependent on the copper market. The land-locked position and the political situation in southern Africa greatly affect the country's economy. Since independence in 1964, the development of agriculture and industry have been emphasized by the Government but so far these efforts have not produced satisfactory results.

Declining copper prices forced the Government to give increased attention to agricultural development. Commercial farming was initially encouraged at the cost of family farming. A recent change in policy involved the promotion of smallholders' farming and rural development (Anon., 1982; van Beuningen et al., 1983).

Environment and upland crop cultivation in the Western Province

Socio-economic situation

The Western Province is one of the less developed regions in Zambia. The region has a population of about 490 000 people of which 87 % live in the rural areas, against 57 % for the whole country. Most of the people belong to the Lozi, a farming and cattle-raising tribe. Their villages are spread in a scattered way, and are located mainly between low plains and upland zones. Population density is only 6 persons per km^2. Growth rate is 1.6 %, against the national average of 3.1 %.

A significant part of the young male population works elsewhere in the country, mainly as paid labourers in the copper mines. About 25 % of the rural households are female-headed. Average household size is 4.5. Mortality rate, health and nutrition standards compare favourably with the average national situation. Schooling facilities are relatively good. Existing feeder roads are in a bad condition. Rural transport is conducted mainly by sledges pulled by oxen.

Climate, topography and soils

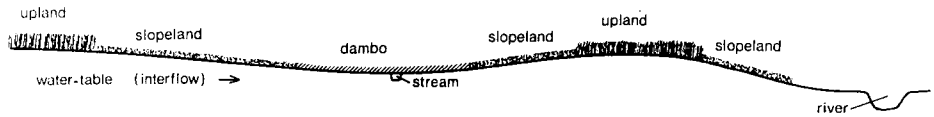
The climate of the Western Province is characterized by a distinct wet and dry season. Average annual rainfall is 1145 mm in the north and less than 760 mm in the south. The rainy season lasts from November to April and the dry season from May to October. January has a rainfall peak of over 200 mm. The chance of occurrence of a drought in the middle of the wet season is greatest in the south.

The south-western part has the largest range of maximum and minimum temperatures. Average minimum temperature is lowest and frost incidence greatest in the south-west. Average climatological data for Mongu, located in the central part of the province, have been summarized in Table 1.

The landscape consists of upland zones sloping gently into depressions and valleys with lowland partly subjected to river flooding (Fig. 1). Depressions (called dambos*), often remaining wet for a long period of the year due to seepage from the uplands, are part of a natural drainage system. The annual flooding of the Zambezi river affects surface and groundwater levels throughout the year and has a very great effect upon the life of large numbers of people and their cattle.

Soils are classified according to their topographical position in upland soils, slope land soils, dambo soils and river flood-affected lowland soils. The very sandy upland soils are sedentary in origin and have a woodland-savanah type of vegeta-

* Dambo has been defined as an area where the phreatic surface is coincidental with the ground level (Windram, 1983), and as a shallow grassy valley formation between wooded areas (Perera, 1982).



– *upland:*	– deep sandy soils
	– woodland savannah vegetation
	– average watertable depth: 2 m
– *slopeland:*	– sandy to loamy-sand soil types
	– grassy vegetation type
	– average watertable depth: 1.50-0.20 m
– *dambo:*	– varying soil types
	– grassy/marshy vegetation
	– phreatic surface coincidental with ground level
– *river flood-affected lowland:*	– alluvial/organic soil types
	– grassy/marshy vegetation

Fig. 1. Section topography – soil types Western Province, Zambia.

tion. They have a low chemical fertility (e.g. low pH and cation exchange capacity and low mineral reserves) and a low waterholding capacity.

From the upland downwards to the depressions slopeland soils are found. They are less sandy and have a higher water-table, which makes these soils more suitable for crop cultivation. The dambo soils vary greatly in texture and may mainly consist of peat. They have grass or marsh vegetation. The river flood-affected soils have a clayey texture and sometimes a very high clay content. They have to be reclaimed before they can be used for agriculture. The ecological impact of reclamation and the agricultural potential of the reclaimed land are not yet known.

Present state of agriculture

Farm size. Agriculture in the Western Province is of the subsistence type. Shifting cultivation is common. Farms are small, ranging from 1 to 5 ha cultivated area per household. Farmland belongs to the community. Land is allotted by the chief through the village headman.

Major crops

Major food crops are cassava and maize. In the local diet, maize is preferred to cassava. Sorghum and millet are mainly grown for beer brewing. Rice, introduced in the early 1950's, is the only cash crop grown by about 1.5 % of the farm families. Cashew, introduced at the same time, has not yet been accepted as a crop.

Land use

The deep sandy soils of the uplands, having the water-table at around 2 m depth, are mainly used for the cultivation of cassava and millet. The sandy soils of the upper slopes, with a water-table 1 to 0.5 m deep are cropped to cassava, millet, mango, citrus and, when manured, to maize. Early maize, vegetables, upland rice

Table 1. Climatological summary for Mongu, Western Province, Zambia.

	Number of years recording	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	Apr	May	June	Year
Pressure (08h00)	17	901.9	899.8	897.8	896.6	896.6	895.9	895.6	895.4	896.4	897.9	899.6	901.4	897.7
Thermograph mean temp. (°C)	18	16.9	19.8	23.7	25.2	23.1	22.3	22.4	22.4	22.3	21.8	19.6	16.5	21.3
Mean maximum temp. (°C)	18	26.6	29.6	29.6	33.0	33.9	30.6	38.8	38.4	27.9	28.6	29.5	28.2	29.3
Abs. maximum temp. (°C)	18	31.7	34.4	37.8	37.8	37.8	35.6	34.4	33.3	32.8	34.4	32.8	31.1	37.8
Mean of abs. maximum temperature (°C)	18	29.6	33.3	35.9	37.2	35.6	33.0	32.2	31.3	31.4	32.1	30.4	29.2	32.6
Mean minimum temp. (°C)	17	8.5	11.8	15.3	17.2	17.7	18.3	18.4	18.6	18.1	16.1	11.5	8.4	15.0
Abs. minimum temp. (°C)	18	−2.2	1.7	7.2	7.2	11.1	12.8	12.8	13.9	12.2	7.2	2.2	−1.6	−2.2
Mean of abs. minimum temperature (°C)	18	3.5	5.0	10.3	12.3	14.3	16.0	15.9	16.1	14.7	11.3	5.3	3.3	10.7
Dew point (°C)	18	4	5	7	11	16	18	18	18	17	16	11	6	12
Rel. humidity (%)	18	43	36	33	42	66	76	79	79	75	67	55	51	58
Sunshine (hours per day	30	9.8	9.9	9.4	8.2	6.6	5.6	5.6	5.9	7.0	9.0	9.8	9.7	8.0
Wind speed (knots)	8	6.5	6.8	7.6	9.4	3.5	2.8	4.3	4.3	4.4	4.9	5.9	5.8	5.1
Evaporation (mm)		184	212	282	267	257	154	161	143	173	171	172	156	2.232
Rainfall, total (mm)	17	0	0	1	28	122	213	223	218	147	46	2	1	1.001
Rain days >0.25 mm	17	0	0	1	5	15	20	21	18	15	6	1	0	101
Rain days >1 mm	8	0	0	0	3	9	18	18	15	10	4	0	0	77
Rain days >10 mm	8	0	0	0	1	3	5	6	5	4	2	0	0	26
Frost days	3	0	0	0	0	0	0	0	0	0	0	0	3	3
Radiation (langleys)	30	492	549	591	594	544	511	518	511	528	550	513	477	–

Source: Rice Resuscitation Project/WP Mongu, Zambia 4th Quarterly and Annual Report, 1981.

and sometimes wheat are grown on the lower slopes. Water-saturated or seasonally flooded soils of the depressions are cropped with lowland rice and also with maize and vegetables; during the dry season these areas are used for cattle grazing.

Cultivation practices

Cultivation practices are traditional and labour-intensive. Crop yields are low. On the uplands, cassava is frequently interplanted with millet. Maize growing is most intensive. Maize land is manured by kraaling cattle and the crop is often interplanted with sorghum, sweet potatoes or pumpkins.

Women supply most of the farm labour. Men do the field clearing, handle the plough, manage and sell the cash crops and perform activities such as herding, milking, manuring, fishing and hunting.

Farm labour supply is a problem. The growing season is short, many young men go elsewhere to work as paid labourers, and there is a shortage of draught animals. Conflicting interests within households exist in labour supply. When labour becomes a limiting factor, women give priority to food crops over cash crops. Peak labour periods occur at planting, weeding and harvesting.

Certain agricultural practices have risk-reducing features. Farmers may have a rice plot next to a maize plot; in case of rainfall above normal the rice crop succeeds and maize fails and the reverse occurs when rainfall falls short. For the same reasons farmers may have two plots of rice, one under upland and the other under lowland conditions.

Animal production. Cattle raising is important. Small livestock is scarce. Cattle means status, wealth and security. It also is important as a source of manure, milk and meat. Oxen are used for draught purposes. Since the 1950's the number of cattle has decreased due to uncontrolled diseases. Cattle ownership seems to be in the hands of a limited number of families. Many families do not possess a pair of draught animals, which is a major constraint to increase of agricultural production. The reasons are not fully understood. Fishing mainly is a minor seasonal activity.

Agricultural support services

Facilities for agricultural research, extension, veterinary services, marketing and credit are poor. The needs of the rural population, the appropriate technology required for higher production and the possibilities of the diversification of agriculture are insufficiently known. Marketing is seriously constrained by high transport handling costs.

Zambia has recently introduced Adaptive Research Planning Teams (ARPTs) to complement Commodity and Specialist Research Teams. The ARPTs operate in all five provinces of Zambia. In the Western Province a moderate start has been made to improve agricultural credit and marketing facilities and with the conduct of a socio-economic survey or baseline study and a study on the introduction of the cultivation of cashew and wheat.

Constraints to and potential for agriculture

Physical constraints to agricultural production, especially of annual crops, are low chemical fertility and the sandy texture of the upland soils and the distribution and variability of the rainfall. The long dry season limits the growing season on the upland soils to four months. Late and unreliable rainfall at the beginning of the wet season hampers crop establishment while dry spells at critical stages of crop development reduce yields. On soils with a water-table within the reach of plant roots dry-season cropping is limited by low temperatures and risk of frost. Other constraints are lack of human labour and animal power, limited public resources and lack of agricultural support services.

The sandy upland soils are best suited for cultivation of drought-tolerant crops such as cassave and millet, while the middle and lower slopes are likely to be suitable for wet season cultivation of maize, sorghum, rice and vegetables. During the dry season wheat and eventually rye, triticale and certain grain legumes could be grown on slopes on land with a permanent water-table in the rooting zone. Cashew appears to be a suitable cash crop for the region but its potential is still uncertain (van Beuningen et al., 1983). There are good prospects for increased animal production which is likely to contribute to the development of mixed family farms.

An important resource to agricultural progress is the development and implementation of an effective research programme aimed at improvement of cropping practices, crop diversification and the integration of arable cropping and livestock keeping. This programme should be based on a proper understanding of the existing farming system, its physical and socio-economic environment and the objectives and resources of the farmers. The farming systems' approach adopted by the ARPTs is a first step to ensure that appropriate research findings will become available to the small farmers of the Western Province.

Rice cultivation

Present state of rice cultivation

Rice-growing conditions and cultivation practices were studied in the Mongu, Kalabo and Kaoma districts during a visit in January 1983. In 1982 the rainfall in October and November was above and in December below average.

In general, rice cultivation practices are of a low standard. The present average yield is 500 to 650 kg per ha for the province as a whole and 1000 to 1500 kg per ha in southern Mongu District where cultivation practices are more developed.

Rice is usually planted in October-November on upland and slopeland soils and on soils in depressions (dambo soils) but not on the river flood-affected soils. A farmer plants on an average 0.50 to 0.75 ha with a local 150-day rice variety and uses unsoaked seeds which are sown broadcast or in lines on unbunded fields with predominantly sandy soils. Land is prepared by hand or with the use of oxen. Some farmers apply a compound fertilizer most as a basic dressing. There is considerable variation in plot size, quality of land preparation, time of planting, crop stand, de-

gree of weed infestation and labour input. Fields differ in soil type and drainage conditions which range from well-drained to water-saturated to submerged.

On several sites, rice stands were observed which were established on dry lands which became submerged later in the growing season. Rice cultivation on submerged fields was predominant in southern Mongu District while in other areas cultivation on well drained and water-saturated soils was common. Crop stands were usually irregular which is due to roughness of the seedbed and untimely drought or submergence. Some plantings had failed completely. The land was often not well prepared while the spacing was usually incorrect.

On many fields there was a serious weed problem which originates from inadequate land preparation and inadequate water control and weeding practices. Rice stands suffered also from drought and lack of nitrogen and other plant nutrients. A mild form of blast disease caused by *Pyricularia oryzae* was also common.

The impact of the extension service on rice cultivation was only apparent in southern Mongu where rice had been timely sown, usually in lines, and where the crop was well developed and free from weeds. The hydrological conditions in this area require planting in October-November so that initial growth can take place under upland conditions and later development can take place on submerged fields. The water layer, however, frequently exceeds a depth of 50 cm which is too great for optimum yields while fields cannot be drained for application of a top dressing of N fertilizer. As a result the rice plants show reduced tillering and symptoms of chlorosis.

Potential for an increased rice production

Considering the large area of land which is at present not used for crop production but which is suitable for rice, the low standard of rice cultivation on existing fields and the attractive price for rice on the domestic market, there is definitely scope for an increase in rice production. In view of the soil conditions and lack of water control only low to moderately high yields can be expected. Lack of soil moisture and low temperatures rule out double cropping. Transplanting, under the prevailing climatic conditions a good establishment method, cannot be implemented because of lack of water control and lack of labour. Given the sandy texture of soil, bunding is often of little use. The construction of even minor water control works may be beneficial to some farmers and harmful to others. Their installation and maintenance need careful planning and full cooperation of the farmers.

Under the present circumstances expansion of the rice area, aiming at moderate but stable yields with low-cost inputs, seems to be the best strategy. Increased use of draught animals will be needed to expand the area and to improve land preparation. Each farm household should at least have one pair of draught animals and a set of the implements required, and this may lay the basis of family farms with an integrated livestock and arable crop component.

Efforts to increase rice production need strong support from research and extension, which should consider rice cultivation as an integrated part of the farming activity and should evaluate the research objectives and results in terms of the farming system as a whole. Apart from land preparation weed control needs special at-

tention. Farmers need advice on site selection, field size (which should not exceed the farmer's capacity to maintain his crop adequately), row planting at proper spacing, labour-saving mechanical weed control and use of weed-free seeds. Introduction of a rotary weeder on submerged fields and a small hoe for upland fields should be considered. Farmers need also improved varieties with blast and drought tolerance and a growth duration of about 120 days to replace the present heterogeneous varieties which have a growing period of 150 days. Improved cultivation practices and new varieties need to be tested in on-farm trials to take into account soil conditions, especially water regimes, and farmers' management.

It goes without saying that the success of measures to increase the rice production in the Western Province of Zambia will largely depend on an attractive rice price and the Government's willingness to fix a minimum rice price at an acceptable level.

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