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Maize production in Zimbabwe. Coping with drought stress in the marginal agroecological zones

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Maize is the major staple food crop of many countries of Sub-Saharan Africa. However, its more widespread cultivation is currently hampered by environmental and human constraints such as drought, pests and diseases, soil infertility, inadequate investment in agricultural development services, etc., and the ever-increasing population counters any progress in food production. As a result many countries are currently facing severe food shortages [1].

Based on the database compiled by CIMMYT [2] and Diallo *et al* [3] on maize production constraints in Sub-Saharan Africa, drought is by far the major limiting constraint. Diallo *et al* [3] further point out that almost all ecologies in which maize is grown in Sub-Saharan Africa are characterised by unpredictable dry periods of 1-3 weeks duration, whose effects on the crop are exacerbated by the relatively small amount of crop-available water commonly found in many African soils. According to Manyowa and Muchena [1], a large proportion of the arable land in Sub-Saharan Africa has marginal rainfall, and even in areas where rainfall is generally considered adequate, the rainfall pattern varies from year to year and droughts are often experienced. While supplementary irrigation increases yields in all areas of marginal rainfall, more often this cannot be done because of the high cost of irrigation, limited water supply and the relatively low income of

most African farmers. Thus the majority of African farmers will no doubt continue to depend solely on natural rain for many years to come.

This paper addresses ways in which researchers, policy makers, extension workers, farmers, etc. in Sub-Saharan Africa could alleviate or minimize drought stress effects on maize productivity in the region. The paper is based on Zimbabwe's experience in coping with drought in the marginal agroecological zones.

The drought environment in Zimbabwe. Rainfall pattern and distribution

In general the rainy season in the cropping areas of Zimbabwe extends over the period October to April. The cropping area can be divided into five agroecological zones primarily based on the rainy pentad analysis [4]. Figure 1 and table 1 respectively show the rainfall pattern and distribution, composition of rainfall amounts and crop requirements in the five agroecological regions in an average and low rainfall season. From both figure 1 and table 1 it is apparent that water deficit is a serious constraint to crop production in the agroecological zones III, IV and V. Both the amount and distribution of rainfall vary greatly from season to season and from one part of the country to another. In addition a large proportion of the soils in regions III, IV and V are course-grained sands derived from granite, generally deficient in N, P and S, and have a low organic matter content [5-7]. Consequently the soils have a poor physical structure and water-holding capacity.

Table I. Composition of rainfall amounts and crop requirements in the five agroecological regions in an average and low rainfall season [8].

Agro-ecological region	Crop water Requirement mm	Average year		1982-1983	
		Rainfall mm	Water balance	Rainfall mm	Water balance
I	700	1 000	+ 300	800	+ 100
IIa	700	850	+ 150	562	– 138
IIb	700	850	+ 150	428	– 272
III	700	725	+ 25	350	– 350
IV	700	550	- 150	433	– 267
V	700	450	- 250	217	– 482

Figure 2 further illustrates the rainfall pattern in (i) zones I and II, good rainfall areas (depicted by Karoi, a station in zone II) and (ii) zones III, IV and V (depicted by Kadoma, a station in zone III). Comparing the reliability of rainfall for Karoi and Kadoma, it is clear that cropping conditions at Kadoma are poorer and more erratic. The mid-season "drought" at Kadoma (mid- to late January) is common throughout zones III, IV and V. The break in