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Climate Variability and Food Production Nexus in Lesotho, 2001 - 2007

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ABSTRACT In the recent times, due to the increasing rate of global warming, the Southern African region, especially, Lesotho has been experiencing continuous climatic change characterized by drastic reduction in rainfall, increase in the rate of dryness and heat, with depletion of the amount of water, flora and fauna resources. The situation has been so for years without many questions and answers with regard to how it affects food production and security in the country. Against this background, this paper investigates the chain of interactions between climatic change, expressed in the rate of rainfall and drought condition, the indigenous adaptation mechanisms and food production in Lesotho. The paper addresses the estimate of drought condition in Lesotho, Southern Africa, the nature of food production activities in the area and the extent to which continuous climatic change has affected the state of food production.

INTRODUCTION

The environment provides all the necessary life support systems, which include air, water and land as well as other materials for fulfilling all developmental aspirations of man and animal. The suitability of the environment to provide these basic supports to life is a function of stability of the climate within a continuous homeostatic range. However, climatic homeostasis is a condition that is realistically unachievable for a long period of time as the climate keeps undergoing constant changes. According to the Intergovernmental Panel on Climate Change (IPCC), World Meteorological Organization (NMO) and United Nations Environment Programme (UNEP), the world has gone through series of climate epochs, which include the ice age and ice recessions in the recent times, occasioned by warmer atmosphere over the last century. The average surface temperature of the earth has increased during the twentieth century by about 0.6±0.2 C, as it is believed to be warmer presently around the world than at any time during the past 1000 years.

Compared with other regions of the world, Africa, especially, the sub-Saharan region is the second region adversely affected by drought condition and other hydro-meteorological natural disasters after Asia (Table 1). As in most other countries of the world, Lesotho's environment presents varied environmental problems. Each district of the country suffers from one form of environmental problem or the other in varying degrees. For instance, observation reveals that while most part of the northern and central areas suffer from soil erosion caused by rain, the southern fringes of the country is continuously being threatened by excessive dryness, soil erosion and abrasion (emphasis, mine).

In recognition that Lesotho is confronted by major environmental problems, of which drought is one of the most serious one. Drought is an insidious hazard of nature that originates from a deficiency of precipitation over a long extended period of time, usually a season or more, which results in water shortage in the environment (Okorie 2003). Hypothetically and to a large extent, scientifically proven, drought occurs whenever the supply of moisture from precipitation or moisture stored in the soil is insufficient to fulfill the optimum water needs of plants, which can be identified into four types1. Drought should be considered relative to some long-term average condition of balance between precipitation and evapo-transpiration (evaporation

Table 1: Effects of drought on population

Region	*Total number affected, 1975-2001(millions)*	*No. of people affected per occurrence (millions)*
Africa	222.1	0.87
Asia	1095.83	9.36
Latin America	47.89	0.72
Oceania	8.65	0.39
Europe	6	0.27
North America	0.03	0.0025

Source: Underlying data from Reuveny 2005

+ transpiration). It is also somewhat related to the timing and effectiveness of rains from the perspective of principal season of occurrence, delays in the start of rainy season and occurrence of rains in relation to principal crop growth stages. More importantly, rainfall intensity and number of rainfall events are important benchmarks for ascertaining drought in an environment. Drought as defined above may be perceived from discipline-wise perspective, namely meteorological, agricultural or hydrological with particular reference to its manifestation and impact.

The case of drought condition in Lesotho is quite specific and relates to what is described as Contingent Drought, which occurs as a result of irregular and variable rainfall, when the rain fails to fall over a period of time. Besides, it could also be perceived as Meteorological Drought, which is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period and Agricultural drought which links various characteristics of meteorological (or Hydro logical) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evopo-transpiration, soil water deficits, reduced ground water of reservoir levels and so forth.

Climate variability resulting in drought incidence is not new to Lesotho, considering the fact that some of the regions, especially the south, is susceptible to less rainfall regimes. These regions of the country, specifically in Mafeteng and Mohale's Hoek area are increasingly becoming very dry at a very fast rate, occasioned by fast depletion on the amount of surface water, flora and fauna resources on the land. The consistent reduction in rainfall leads to a corresponding reduction in the natural regeneration rate of land resources, which presents a chain of causal reaction that, makes people to exploit more vigorously than previously done. Soil erosion is quite severe in some districts like Maseru, Berea, Mafeteng and Mohale's Hoek as a result of sharp contract between wet and dry conditions in the areas, after the soil has lost its strength. This stems from natural condition as the soils of the south lowlands derive mainly from the underlying sandstone.

At present time, studies on the interrelationship between climate change, especially drought conditions and food production and security are growing rapidly. This is due to the importance of stable climate conditions for increased food production. Studies and references from other parts of sub-Saharan Africa indicate that drought condition as a result of decreasing rate of precipitation has led to unprecedented food crises in some countries such as Eritrea, Niger Republic and Ethiopia (see Catholic Relief Services 2005; Meron Tesfa Michael 2006; Obioha 2007; Obioha 2008). An attempt to relate the ongoing debate to the situation in Lesotho forms the focus of this discourse as little is know about the country in this regard.

Against this background, this discourse explicates the chain of interactions between change in climatic condition, expressed as decline in the rate of rainfall (drought condition) and food production in Lesotho. The paper addresses the estimate of drought condition in Lesotho, the nature of food production activities in the area and the extent to which continuous climatic change has affected the state of food production in the country from 2001 to 2007.

THE STUDY AREA: LAND AND CLIMATE

Completely encircled by the Republic of South Africa but separated from it by mountain ranges, the country forms an enclave within South Africa, bordering on three of the latter's provinces-KwaZulu-Natal, Free State, and Eastern Cape. Two-thirds of Lesotho consists of mountains. The highest peak, Mount Ntlenyana, is 11,424 feet (3,482 metres) above sea level. The Drakensberg range forms the eastern boundary with KwaZulu-Natal. The Maloti spurs of the Drakensberg, running north and south, join the main range in the north, forming a plateau from 9,000 to 10,500 feet (2,700 to 3,200 metres) in elevation. This plateau, the centre of the cattle-raising and agricultural industries, is the source of South Africa's two largest rivers-the eastward-flowing Tugela and the westward-flowing Orange-as well as tributaries of the Caledon (Mohokare). Three other important rivers in Lesotho are the Senqunyane in the centre of the country, the Kometspruit in the south-west, and the Matsoku in the north-east. The foothills, with elevations averaging between 6,000 and 7,000 feet (1,800 and 2,100 metres), descend in undulating slopes to the west, where the lowlands bordering Free State rise to elevations of 5,000 to 6,000 feet (1,500 to 1,800 metres).

Lesotho is largely covered in grasses, although trees also appear on the landscape. Indigenous trees include Cape willows, cheche bush (used for fuel), and wild olives. Other willows and white poplars have been introduced into the country. There are numerous indigenous species of aloes, which are commonly found in the cooler, wet areas. Overgrazing, over utilization, and soil erosion have drastically depleted and altered the grasslands, reed beds, and woody bush on the slopes. Reforestation schemes have been attempted but have met with limited success.

Although only one-tenth of the country is arable, the majority of the rural population is involved with subsistence agriculture. Agriculture was frequently a major contributor to the gross domestic product (GDP), but drought, especially in the 1990s and in the early 21st century, has drastically reduced its contribution to the GDP. The most important crops are corn (maize), sorghum, wheat, beans, and peas. Cattle products have been exported, and wool and mohair are produced and exported. Foodstuffs must be imported, as droughts have largely destroyed summer harvests and livestock. Agricultural development projects are funded by a wide range of agencies, including the World Bank. None, however, have been able to reverse the steady decline in agricultural production since the mid-1960s. Timber cutting is largely for fuel. Fishing (from inland waters) of the common carp, rainbow trout, and catfish also is practiced on a small scale (Retrieved on 14th June 2008, from Lesotho at http://www.britanica.com/EBchecked/topic/337126/Lesotho/43915/Climate#)

As arable land is scarce and badly eroded, there is very little domestic industry. The nation's economy is primarily based on livestock, agriculture, and production of tribal crafts, construction (primarily a major water project which exports water to South Africa) and the export of labor. The country is poor. Most of the people live on money sent home by the thousands of Basotho-60 percent of the country's male work force-who labour in South Africa.

Precipitation, brought by the prevailing winds, occurs mostly between October and April and is variable; the annual average is about 28 inches (710 mm), with amounts decreasing from east to west. Hail is a frequent summer hazard. Temperatures in the lowlands reach as high as 90 °F (32 °C) in the summer and plunge to 20 °F (-7°C) in the winter. In the highlands, the temperature range is much wider, and readings below 0°F (-18°C) are not unusual. Frost occurs widely in the winter, when the Maloti Mountains are usually snowcapped.

SCOPE OF THE STUDY AND METHODOLOGY

This article covers period 2001-2007; however, there may be no restriction on discussion to this specific period where there are data that cover longer or shorter time frame. Essentially, the aim of the study is to demonstrate the interface between climate variability proxy (declining rainfall) and food production, and how the populations cope with the condition. With respect to the space, the study covers the whole country of Lesotho with monolithic reference on food production. However, for the climate estimates, more emphasis and attention is focused on the southern lowland districts, specifically *Mohale's Hoek*, but over all country wide weather estimate is used where available.

Even though some primary information were generated through Key informant interviews with stake holders, mainly in the farming communities about various indigenous coping mechanisms, the discourse relies mainly on secondary data that were generated by relevant government and non-governmental agencies as the main sources of data for the analysis and discussions. From these sources, both quantitative and qualitative information were collected depending on the immediate importance. Data related to climate, population, food production, food security were sought. For food production, to be more specific, grains and cereals that are predominantly grown in the country were the selected crops, while their production was used as the indicator for food production. These secondary sources include Statistics from Statistics Office, Meteorological Office and Ministry of Agriculture in Maseru. Data pertaining to food production were derived from the Bureau of Statistics Office, Lesotho

OBSERVATIONS AND DISCUSSION

Synthesis of Agro-climatic Conditions and Changes in Lesotho 2000 - 2007

The Kingdom of Lesotho is divided into four main agro-ecological zones: lowlands, foothills, mountains and the Senqu River Valley. Lesotho's

weather is extremely variable, ranging from drought to heavy rainfalls, frosts, snow and hailstorms. Normal seasonal cumulative rainfall in most areas of the country is too marginal for good maize production. The exception is the northern lowlands, where soils show a higher water-holding capacity.

Lesotho Meteorological Services (2000, 2001, 2002, 2003, 2004, 2005, 2006) reported the rainfall situation in Lesotho for the periods/years indicated above. On a cumulative basis, rainfall shows normal conditions for the 2000/01 season, however, far below normal rainfall was recorded in most reporting stations in the country, except for a few stations that reported normal to above normal rainfall (Mohale's Hoek, Mokhotlong and Thaba-Tseka). Few isolated showers were received, thus considerably reducing soil moisture reserves. On day-to-day basis extremely high temperatures were registered, which accelerated evaporation with prevalence of dry conditions and hot weather persisting for most period. This dry and concurrent heat wave seriously hit crops. Localized hailstorms and frost in some mountain areas exacerbated the negative impact of the dry spell.

There was a record of erratic and unsustainable rain, but more of dryness for the period 2001/2002. For instance, there was an unexpected heavy rain in late August 2001 over most areas of the country, which resulted in very wet conditions through October and December. In contrast, February 2002 was generally dry throughout the country with erratic rainfall. Generally, rainfall was above normal for the 2001/02 season, but quantities and distribution were erratic, evident in contrasting very wet and dry conditions in different periods. A widespread frost in March severely affected crops in most districts, and localized hailstorms exacerbated the problem.

In general, in 2003 the distribution of rains was generally better in the north as compared to the south of the country (Agro Met). The onset of the rains was in October with considerable amount of rainfall in most areas. November was a dry month throughout the country with most stations receiving only a third of their normal rainfall. The remainder of the rainy season was erratic and the distribution uneven, particularly in southern districts of the country. Rainfall patterns indicate that the 2004 season began poorly and that with inadequate rain. Mid-season rainfall was barely adequate, while in December, rainfall was highly variable: some areas received adequate quantities but most areas did not.

Generally, throughout the country the rain season for 2005 started late. Rainfall estimates for 2005 show that in the central region (Berea, Butha-Buthe, Leribe and Maseru) cumulative rainfall was above last year but below average. In the southern region the rainfall was below average. In the mountain region rainfall was normal throughout the season. These data are consistent with those of Lesotho Meteorological Services. Thus, overall, Lesotho's rainfall situation in 2005 was generally favourable for crop production, although less than satisfactory in the central region, the country's breadbasket. Moreover, there were no major incidences of early frost and dry spells. The 2006/07 season was characterized by the most severe droughts in recent years. The amount of rainfall was well below normal and temperatures were higher than the average of the last five years. Precipitation in the month of February 2007 was the lowest recorded over the past 30 years. In the supposed rainy months (January, February and March 2007) were found to be very dry months.

Comparative Analysis of year 2007 Rain Estimates With Previous Years, 2000 - 2006

In the last eight years, there have been seasons where there have been remarkable droughts. Cumulative rainfall for the 2007 so far was very low compared with previous years (Fig. 1) in which water availability in Maseru and the rest of the country has been affected by recurrent droughts. While other years had normal to above normal rainfall during January - April, the years 2001 and 2003 were at cumulative rainfall deficits. The drought of the year 2003 became prominent in spring but the rain season of the year 2007 was far drier than all the years since the year 2000. The preceding two years and the year 2000 received good amounts of rainfall which were well above normal for large part of the season. The good rains that fell during these wet years recharged underground water resources and improved water tables. Torrential rains that fell in the years 2005 and 2006 destroyed bridge structures in some roads of the country (Lesotho Meteorological Services 2007).

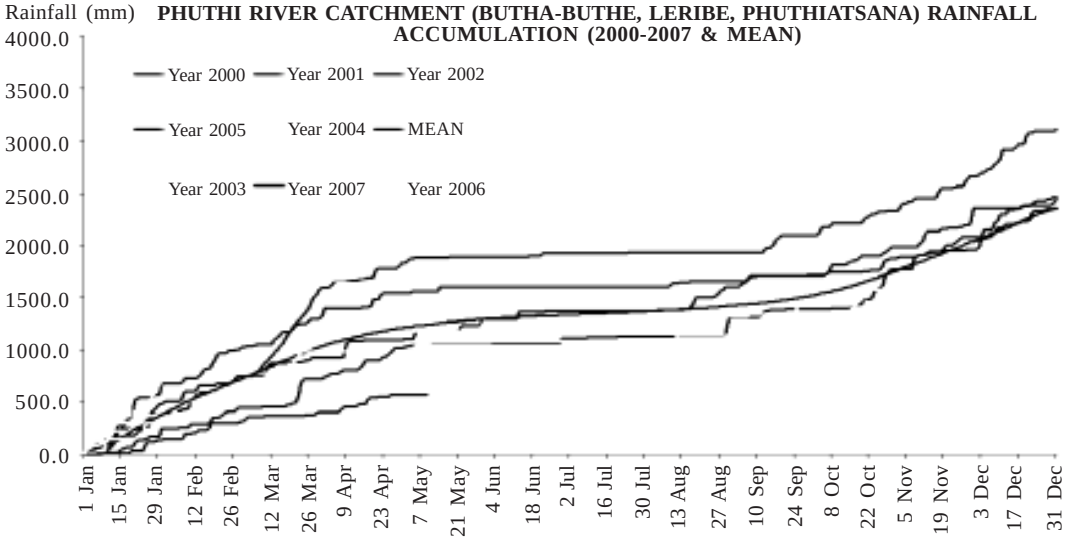

Fig. 1. Trend of rain estimates 2000 - 2007 around Phuthi river catchment areas
Source: Lesotho Meteorological Services 2007

Human Livelihood and Food Production Activities in Lesotho

Crop production is virtually all rain fed. The most important crops are maize, sorghum and wheat, which occupy about 60 percent, 20 percent and 10 percent of the cropped area respectively. Other important field crops are beans and peas. Maize, sorghum and beans are mostly grown using the summer rains, whilst wheat and peas are winter crops, usually grown in late rains or residual moisture. Crop production in winter is dependent on good end-of-summer rainfall. The summer cereals are mostly grown in pure stands, but maize is also either intercropped with sorghum or beans and sorghum is also grown in mixture with beans. Mono-cropping predominates in all the agricultural regions and accounts for about 90 percent of areas planted with cereals. Sharecropping is practiced to offset the constraints related to access to land, labour and farm inputs. Most households plant a small home garden area with summer and winter vegetables, especially those who have access to water (Food and Agricultural Organization 2007).

Fifty- seven percent of the domestic labour force of Lesotho is involved in agriculture, with the majority employed in subsistence farming. Most of the good farming land lay in the Lowlands, around the Maseru, Leribe and Butha-Buthe districts. Much of the rest of the country is either too mountainous or normally too dry to produce high yields of cereal crops. In addition, many of these areas are characterized by fragile soils, where the pressures of increasing farming and grazing have led to degradation of fields and pastures (Food and Agricultural Organization 2001).

The livestock sector continues to provide a significant source of rural income, with cattle, sheep and goats being equally important. Besides meat, wool and mohair are important sources of revenue. Herd sizes do not appear to be shrinking drastically at present, despite pasture degradation and drought. The majority of rural households (perhaps over 80 percent) own livestock, mainly cattle, sheep and goats. Many also have a horse, two or more donkeys and chickens. Highland Maseru probably has the highest concentration of livestock in the country. Large herds of cattle and flocks of sheep and goats were observed. Theft of livestock is a serious problem which negatively affects household food security and planting areas (Food and Agricultural Organization 2001, 2002, 2003, 2004, 2005, 2007).

Estimates of Area and Yield in Major Crops (Maize, Wheat and Sorghum), 2000 - 2007

In 2001 season, yields per hectare were highly variable between districts. The estimated national

Table 2: Area and production of wheat, maize and sorghum in 2001, by district

District	*Wheat*			*Maize*			*Sorghum*		
	Area '000 ha	*Yield kg/ha*	*Prod. '000tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*
Butha-Buthe	0.3	440	0.1	6.7	400	2.7	1.3	400	0.5
Leribe	1.2	440	0.5	28.8	600	17.3	3.7	500	1.9
Berea	0.0	0	0.0	24.3	400	9.7	4.3	500	2.2
Maseru	1.9	320	0.6	24.6	500	12.3	4.2	440	1.8
Mafeteng	0.2	550	0.1	15.5	350	5.4	4.5	550	2.5
Mohale's Hoek	0.1	400	0.0	11.2	300	3.4	0.5	550	0.3
Quthing	1.9	660	1.3	8.5	350	3.0	1.9	700	1.3
Qacha's Nek	0.8	350	0.3	4.4	300	1.3	0.4	400	0.2
Mokhotlong	2.8	500	1.4	3.7	200	0.7	0.2	200	0.0
Thaba-Tseka	2.7	320	0.9	10.6	200	2.1	1.0	300	0.3
Lesotho	11.9	438	5.2	138.3	419	57.9	22.0	495	10.9

Source: Department of Crops and Mission estimates 2001; Bureau of Statistics, Lesotho 2001; FAO 2001

average yield for sorghum was significantly higher than that of maize (Table 2), where the national average yields for maize and sorghum were estimated at 419 kg/ha and 495 kg/ha, respectively. Summer wheat yields are estimated at around 438 kg/ha.

In the year 2002, yields per hectare were universally poor but highly variable between districts (Table 3). In many areas of these districts, the crops produced no grain at all and were being harvested as fodder for livestock. Northern districts (Berea, Leribe, Butha-Buthe and Mokhotlong) were relatively less affected by the disasters and yields were slightly better. National average yields of maize and sorghum are estimated at 378 kg/ha and 388 kg/ha, respectively. Combined summer and winter wheat average yields are estimated at around 488 kg/ha.

Table 4 provides the area and yield estimates of cereal production in 2003. Yields per hectare at the national level were higher than last year but remained highly variable between districts. Southern lowland districts of Mafeteng, Mohale's Hoek and Quthing were worst affected and in many areas will produce no grain at all for the second consecutive year. Northern lowland districts of Berea, Leribe, and Butha-Buthe were relatively less affected and yields were slightly better. All foothill and mountain areas although variable even within districts showed the best potential. National average yields of maize and sorghum are estimated at 414 kg/ha and 466 kg/ha, respectively. Combined summer and winter wheat average yields are estimated at around 1 075 kg/ha.

Crop yields throughout Lesotho were poor during the 2004 season. Much of the south suffered large areas of total crop failure as the maize crop withered in the field. The situation in the mountain areas was somewhat better, but yields were also well below normal and even below those of last year. The high production areas of the northeast, as a whole, also had well-

Table 3: Area and production of wheat, maize and sorghum in 2002, by district

District	*Wheat*			*Maize*			*Sorghum*		
	Area '000 ha	*Yield kg/ha*	*Prod. '000tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*
Butha-Buthe	1.1	440	0.5	3.0	450	1.4	0.3	400	0.1
Leribe	2.6	750	2.0	16.4	500	8.2	2.2	450	1.0
Berea	2.2	700	1.5	15.6	500	7.8	2.3	450	1.0
Maseru	4.2	500	2.1	16.3	400	6.5	2.4	400	1.0
Mafeteng	2.5	470	1.2	13.6	300	4.1	1.9	350	0.7
Mohale's Hoek	3.0	400	1.2	9.0	250	2.3	1.5	350	0.5
Quthing	2.2	400	0.9	7.2	250	1.8	1.3	300	0.4
Qacha's Nek	1.4	350	0.5	3.5	200	0.7	0.2	300	0.06
Mokhotlong	4.9	500	2.5	1.2	250	0.3	0.1	200	0.02
Thaba-Tseka	4.8	350	1.7	5.5	250	1.4	1.2	300	0.4
Lesotho	28.9	488	14.1	91.3	378	34.5	13.4	388	5.2

Source: Department of Crops and Mission estimates 2002

Table 4: Area and production of wheat, maize and sorghum in 2003, by district

District	*Wheat*			*Maize*			*Sorghum*		
	Area '000 ha	*Yield kg/ha*	*Prod. '000tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*
Butha-Buthe	1.1	500	0.6	4.3	450	1.9	0.2	300	0.1
Leribe	3.5	1 700	6.0	19.5	500	9.8	-	-	-
Berea	1.4	1 700	2.4	40.2	500	20.1	0.1	500	0.1
Maseru	1.2	1 450	1.7	32.2	400	12.9	1.4	450	0.6
Mafeteng	3.4	1 500	5.1	17.0	250	4.3	0.4	450	0.2
Mohale's Hoek	1.5	1 000	1.5	11.1	300	3.3	4.6	450	2.1
Quthing	0.4	1 000	0.4	8.6	300	2.6	0.4	450	0.2
Qacha's Nek	1.2	350	0.4	3.1	300	0.9	-	-	-
Mokhotlong	4.5	1 050	4.7	3.8	350	1.3	-	-	-
Thaba-Tseka	4.4	350	1.5	8.6	500	4.3	0.2	300	0.1
Lesotho	22.6	1 075	24.3	148.4	414	61.4	7.3	466	3.4

Source: Department of Crops and Mission estimates 2003

Table 5: Area and production of wheat, maize and sorghum in 2004, by district

District	*Wheat*			*Maize*			*Sorghum*		
	Area '000 ha	*Yield kg/ha*	*Prod. '000tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*
Butha-Buthe	1.1	440	0.5	5.8	293	1.7	1.3	77	0.1
Leribe	3.5	1 229	4.3	23.0	565	13.0	3.4	147	0.5
Berea	1.4	714	1.0	11.9	630	7.5	2.7	111	0.3
Maseru	1.2	500	0.6	10.9	340	3.7	1.9	105	0.2
Mafeteng	3.4	470	1.6	21.3	80	1.7	6.0	83	0.5
Mohale's Hoek	1.5	400	0.6	7.0	87	0.6	4.5	67	0.3
Quthing	0.4	500	0.2	6.0	133	0.8	2.5	80	0.2
Qacha's Nek	1.2	333	0.4	0.7	286	0.2	0.0	-	0.0
Mokhotlong	4.5	511	2.3	8.1	198	1.6	0.2	500	0.1
Thaba-Tseka	4.4	341	1.5	10.7	300	3.2	1.7	118	0.2
Lesotho	22.6	500	13.0	105.4	323	34.0	24.2	100	2.4

Source: Bureau of Statistics and CFSAM estimates 2004.

Table 6: Area and production of wheat, maize and sorghum in 2005, by district

District	*Maize*			*Sorghum*			*Wheat*		
	Area '000 ha	*Yield kg/ha*	*Prod. '000tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*
Butha-Buthe	7 492.3	0.57	4 270.6	1 422.5	0.47	668.6	172.0	0.70	120.4
Leribe	26 204.6	0.82	21 487.8	4 118.0	0.52	2 141.4	140.0	0.80	112.0
Berea	23 959.7	0.35	8 385.9	5 784.5	0.40	2 313.8	0.0	0.00	0.0
Maseru	22 877.2	0.85	19 445.6	5 099.0	0.53	2 702.5	2 221.0	0.70	1 554.7
Mafeteng	22 276.9	0.40	8 910.8	6 290.0	0.55	3 459.5	253.0	0.40	101.2
Mohale's Hoek	17 043.1	0.35	5 965.1	6 312.1	0.40	2 524.8	833.0	0.65	541.5
Quthing	9 802.4	0.30	2 940.7	3 308.0	0.30	992.4	927.0	0.60	556.2
Qacha's Nek	4 485.0	0.41	1 838.9	2 125.6	0.35	744.0	1 201.0	1.30	1 561.3
Mokhotlong	7 064.2	0.65	4 591.7	37.0	0.30	11.1	3 429.0	1.30	4 457.7
Thaba-Tseka	20 417.1	0.70	14 292.0	1 607.3	0.55	884.0	1 334.0	1.00	1 334.0
Lesotho	161 559.5		92 129.1	36 104.0		16 442.0	10 510.0		10 339.0

Source: Bureau of Statistics and CFSAM estimates

below-average yields, with some patches of near-normal yields. Data indicate that maize yields, nationally, are on the order of 50 percent of normal and 69 percent of last year's yield.

The maize yields provided in table 5 indicate the difficulties that were faced by farmers in the southern and far western districts of Mafeteng, Mohale's Hoek, Quthing, Qacha's Nek and Mokhotlong. Though normally not major maize-producing areas, yields this year were

significantly lower than normal and even less than the poor 2003 season. Sorghum yields in Lesotho were generally low in 2004 because sorghum is relegated to marginal, drought-prone lands of the country. Although many sorghum fields produced a crop in 2004, even when neighbouring maize fields were wiped out by the drought, the yields were still lower than normal.

The year 2005 season was better than 2004 and yields were also better, although there were marked variations by district and agro-ecological zone, according to data in table 6.

Observation of the year 2007's overall productivity of main cereal crops indicated that the yield and output for these crops have significantly decreased. The overall crop yield performance of the 2007 cereal crops (Table 7) was lower than the already low yields of 2005. The average yields of maize, sorghum and wheat in the cropping season 2007 were estimated at 0.43, 0.42, and 0.52 tonnes/ha respectively.

Compared to the previous year's cropping season, yields have decreased dramatically by 42 percent and 25 percent for maize and sorghum respectively, and by 4 percent for wheat.

Trends and Comparisons in Cereal Production, 2001 - 2007

In 2001, as revealed in Figure 2, the aggregate cereal production was estimated at 176.6 000 tonnes and declined to 134.6 000 in 2002. It further declined to 118.9 000 and 104.1 000 in 2003 and 2004 respectively. The production rose to 119 000 tonnes in 2005 and further to 126.2 000 tonnes in 2006. In 2007 a drastic decline was recorded.

In Figure 3, data strongly indicate a continuous downward trend in the productions of the cereals, especially in 2004, when the total production hit the lowest ebb compared to other years. The production rose to 14 percent in 2005 and further to 6.1 percent in 2006. The year 2007 as compared to the previous year and the past five-year average (2002 - 2006) experienced a drastic drop ever recorded in any of the years under consideration. The national cereal production estimated at about 67 000 tonnes represents a substantial decline of 47 percent as compared to 2006 and 44 percent with respect to the five-year average. Further analysis of the decadal trend from 1996 to 2007 (Fig. 4), also revealed a downward curve where 2007 manifested as the year with least food production in Lesotho.

In the Kingdom of Lesotho, a lot of factors have been identified by previous authors to be related to the apparent decline in food production in the country. A combination of lack of arable land, soil erosion, the country's mountainous terrain, overgrazing by the cattle, population pressure and increasing HIV/AIDS rates have caused the country's national crop production to decline steadily over the past three years (FAO 2004). Besides, agricultural production is burdened by other difficulties, such as erratic rains and recurrent droughts, lack of sustainable land management practices and dependency on one single crop, mono-cropping of maize, which makes household farmers very vulnerable, especially those who live in the marginal and drought prone areas of the country (FAO 2007). However, the extent and the measure to which each of these factors contribute to the declining

Table 7: Area and production of wheat, maize and sorghum in 2007, by district

District	*Maize*			*Sorghum*			*Wheat*		
	Area '000 ha	*Yield kg/ha*	*Prod. '000tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*	*Area '000 ha*	*Yield kg/ha*	*Prod. '000 tons*
Butha Buthe	6 620	0.7	4 634	1 600	0.4	640	163	0.8	130
Leribe	19 009	0.6	10 645	2 141	0.4	856	126	0.5	63
Berea	15 479	0.6	8 668	4 180	0.4	1 756	0	0	0
Maseru	13 361	0.6	8 017	3 254	0.4	1 302	2 110	0.7	1 477
Mafeteng	19 607	0.3	5 882	6 430	0.6	3 601	240	0.3	72
Mohale's Hoek	6 834	0.4	2 734	3 169	0.4	1 268	791	0.4	277
Quthing	8 008	0.3	2 402	2 640	0.4	1 056	881	0.4	335
Quacha's Nek	4 138	0.4	1 655	1 858	0.2	372	1 231	0.5	616
Mokhotlong	8 255	0.2	1 651	30	0.3	8	3 515	0.5	1 758
Thaba-Tseka	18 147	0.3	4 537	1 298	0.3	325	1 367	0.5	684
Lesotho	119 458	0.4	50 825	26 600	0.4	11 182	10 424	0.5	5 411

Sources: Area data based on DAOs; Yield and production for 2007 are mission estimates

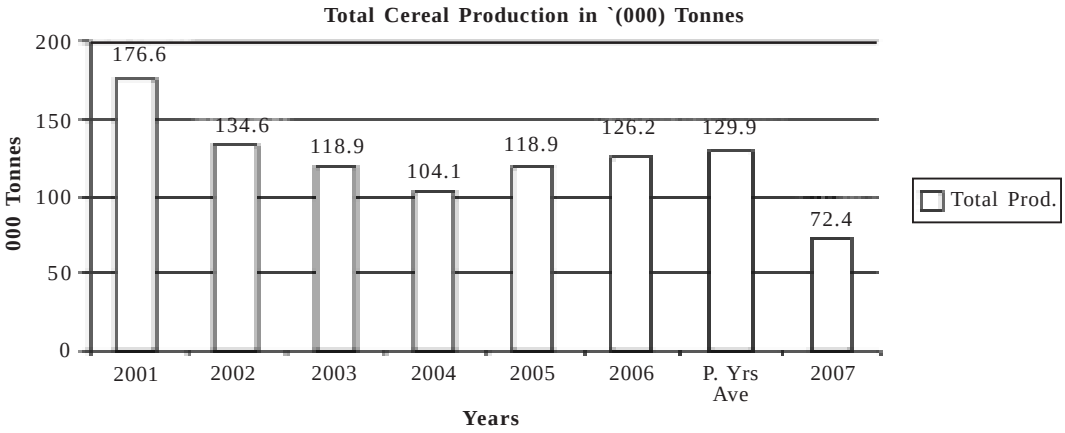

Fig. 2. Trend in cereal production, 2001-2007

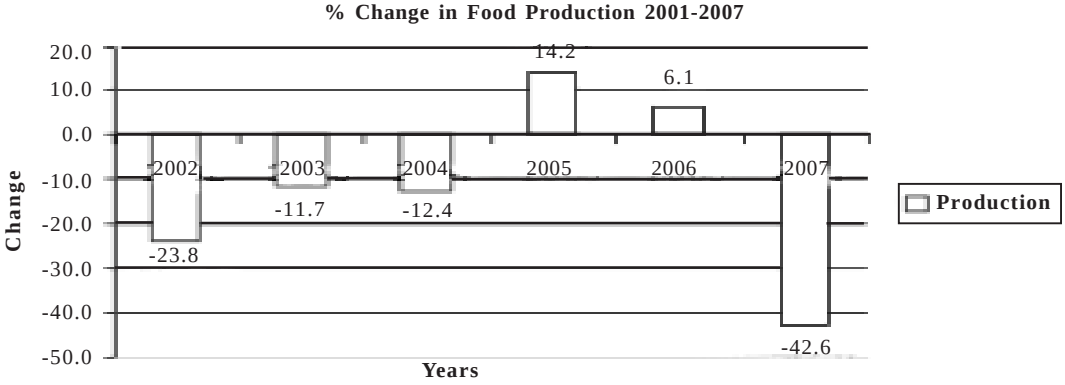

Fig. 3. Percentage change in the trend of cereal production, 2001-2007

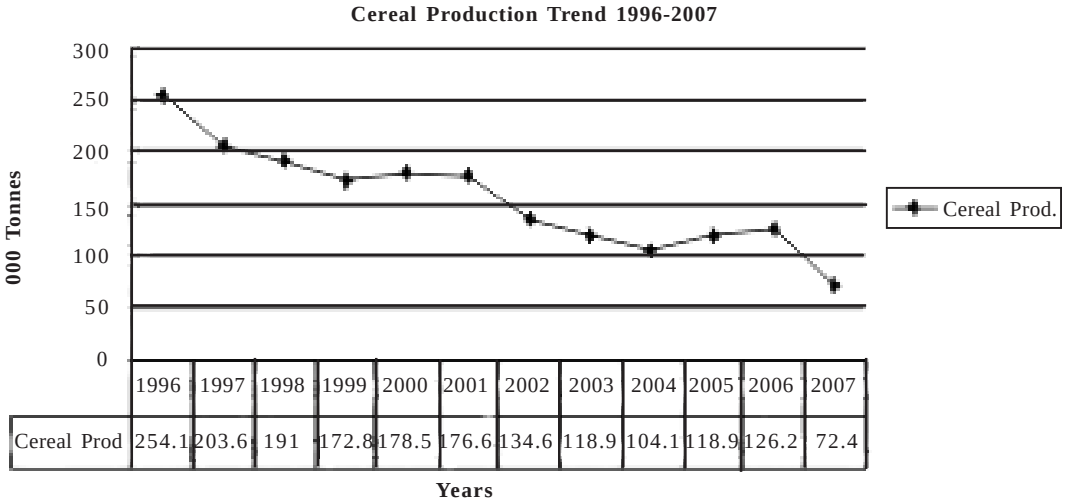

Fig. 4. Decadal trend in cereal production, 1996-2007

trend in food production in Lesotho may vary significantly, depending on the years of analysis. As this paper had spelt out in its aims and objectives, the extent to which climate variability or change, estimated in the rate of rain fall as the proxy for drought affect the situation is explained herein. Evidence from previous studies from other countries even in the sub-Saharan Africa consistently implicated climate variability, descriptive of drought as one of the major causes of declining food production in the continent (Obioha 2006b; Obioha 2007) coupled with other factors such as conflict situations (Obioha 2005; Obioha 2008) and adverse land policies (Obioha 2004; Obioha 2006a; Obioha and Molapo 2007)

As described in one of the previous sections on weather and climate variability, rainfall shows normal conditions at a maximum of about 2000mm for the 2001 season, but the dry spell and the concurrent heat wave in January seriously hit crops. The drought was exacerbated by extremely high temperatures, which accelerated evapo-transpiration. Maize among other crops like sorghum and wheat suffered more from the drought compared to the sorghum, which made the estimated national average yield for sorghum significantly higher than that of maize. This somewhat conforms to the agro- climatic notion, where sorghum is believed to be more drought resistant compared to maize. Generally, the crop yield was very poor at 419 kg/ha and 495 kg/ha, 438 kg/ha for maize, sorghum and wheat in that order, compared to normal situation. Observation shows that hail, frost and drought were the main causes of the poor crop yields for the year, as the total cereal yield for the year was estimated at 177,000 tonnes, which was less than the record of the previous year 2000 and the least production rate in the previous five years, 1995-1999.

The succeeding year, 2002 was generally dry throughout the country, with erratic rainfall in February, which is supposed to be one of the raining months. However, rainfall was believed to be above normal for the season, at a maximum of about 2000mm, though with higher monthly records compared to the previous year, but quantities and distribution were erratic and delayed planting of crops. Yields per hectare were universally poor but highly variable between districts. National average yields of maize and sorghum were estimated at 378 kg/ha and 388 kg/ha, respectively and 488 kg/ha for wheat crop. This aggregate cereal production in the year was 137,000 tonnes, which was far less than that of year 2001, at 177,000 tonnes, which also was a poor harvest. The main reason for this decline could be associated with dryness after very wet period. It was established that late planting because of waterlogged fields, widespread early frost and hail were the main causes of the poor crop yields (FAO 2002).

In the year 2003, the distribution of rains was at a maximum of about 1500mm and was remarkably better in the north than in the south of the country. The onset of the rains was quite early in October in most areas, which facilitated early land preparation where fields had been ploughed during the winter. This ensured that the optimum planting date for maize and sorghum was achieved where machinery and physical inputs were available. November was a dry month throughout the country with most stations receiving only a third of their normal rainfall, and this resulted in delayed planting operations for farmers. The remainder of the rainy season was erratic and the distribution uneven, particularly in southern districts of the country. Yields per hectare at the national level in 2003 were higher than last year 2002 but less in terms of total cereal production at 119,000 tonnes compared to 135,000 tonnes in 2002. Southern lowland districts of Mafeteng, Mohale's Hoek and Quthing were worst affected by drought and in many areas will produce no grain at all for the second consecutive year. Northern lowland districts of Berea, Leribe, and Butha-Buthe were relatively less affected and yields were slightly better due to more ground moisture. National average yields of maize and sorghum were estimated at 414 kg/ha and 466 kg/ha, respectively, and an average yields estimate at around 1 075 kg/ha for combine summer and winter wheat.

In 2004 normal seasonal cumulative rainfall began poorly in most areas of the country and too marginal for good maize production at less than 1500mm, except in the northern low-lands, where soils show a higher water-holding capacity. The poor rain resulted in late planting, while mid-season drought in many cases devastated the maize crop. Sorghum fared somewhat better because it is more drought resistant than maize, but yields were also very low and many sorghum plantings failed as well. According to FAO (2004), the usual pattern observed was that farmers planted their maize with only minimal soil moisture available, which

in most cases was insufficient to allow for full and rapid crop emergence. As a result, maize seeds remained in the ground without germinating for up to one month and the resulting crop stands were poor. Most farmers chose not to replant, realizing that the season was late and that the risk of replanting was too great. Crop yields throughout Lesotho were poor during the 2004 season. Much of the south suffered large areas of total crop failure as the maize crop withered in the field. Even the high production areas of the northeast, as a whole, also had well-below-average yields, with some patches of near-normal yields. The maize yields in this year 2004 were significantly lower than normal and even less than the poor yields of 2003 season. Similarly, total cereal production of 104,000 tonnes was a great failure compared to previous years, specifically the preceding year 2003 with 119,000 tonnes.

Rainfall estimates for 2005 showed that in the central region (Berea, Butha-Buthe, Leribe and Maseru) cumulative rainfall was above last year. The overall Lesotho's rainfall situation in 2005 was generally favourable for crop production, although less than satisfactory in the central region, the country's breadbasket. This season was better than last year 2004 and yields were also better although, there are marked variations by district and agro-ecological zone. The estimated national cereal production for the year was about 119 000 tonnes, which is higher than last year 2004 estimate of 104,000 tonnes by about 15 percent but less than the estimate of 126,000 tonnes in 2006.

The 2006/07 cropping season was characterized by the most severe of droughts in recent years. The amount of rainfall was well below normal and temperatures were higher than the average of the last five years. In general, January, February and March 2007 were found to be very dry months causing large scale damage to growing crops. Paradoxically, seasonal rainfall started with normal conditions and allowed farmers to plant cereals on time. However, this was followed by prolonged dry spells, which continued from December 2006 up to April 2007. The absence of rains in the critical stage of the plant growth phase was greatly responsible for the irreversible damage caused to yields, with the excessive heat worsening the accentuated drought that prevailed.

The overall productivity of main cereal crops has significantly decreased during the cropping year 2007. The main factor for the reduction in yields (tonnes/ha) was lack of sufficient rain, particularly at the time of flowering and seed formation. The mid season drought caused complete loss of many crop fields through abortion of flowers before bearing seeds (FAO 2007).

The overall crop yield performance of the 2007 cereal crops was estimated to be even lower than the already low yields of 2005. The average yields of maize, sorghum and wheat in the year was estimated at 0.43, 0.42, and 0.52 tonnes/ha respectively. Compared to the 2006 cropping season, yields have decreased dramatically by 42 percent and 25 percent for maize and sorghum respectively, and by 4 percent for wheat. Total cereal production for the year was estimated at 72,000 tonnes, which was far less than 126,000 tonnes observed in the previous year 2006.

CONCLUSION

Apparently, a consistent positive association was found between the two variables (rainfall and cereal crop production). Remarkably, the years with worse or inadequate rainfall distribution had poorer production yield in cereal compared to those that had adequate and well distributed rain. For instance, the two years with least record of cereal production, 2004 and 2007 were incidentally the hardest hit by drought. Similarly, in 2006 there was higher rainfall regime, which corresponds with increase in cereal yield and production.

NOTE

1. Four types of drought can be identified: *1) Permanent Drought:* This occurs in arid areas where in all seasons, precipitation is not enough to satisfy the water needs of plants. *2) Seasonal Drought:* Occurs in areas with well- defined wet and dry seasons especially in the tropics owing to seasonal changes in the atmospheric circulation patterns. *3) Contingent Drought:* This occurs as a result of irregular and variable rainfall. This is characteristic of sub- humid and humid areas and it occurs when the rain fails to fall over a period of time. 4) Invisible Drought: Occurs any time the daily supply of moisture from the soil or falling precipitation fails to equal the daily water needs of plants

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