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Relationship Between Annual Rainfall Oscillations and Mohair Production in Lesotho Between 1935 and 1996

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Abstract: This study was conducted to determine trends in annual rainfall oscillations and mohair production in Lesotho between 1935 and 1996. An exponential regression equation of the form LnY = LnA + bx was used to estimate trends. Between 1935 and 1965 Angora goat numbers, mohair production and mohair yield per goat increased ($p<0.01$) at annual rates of 1.1, 1.9 and 1.1%, respectively. During years of independence (1966-1996) annual goat numbers remained, largely, stagnant ($p>0.05$) at around one million animals. Mohair yield per goat declined ($p<0.01$) at an annual rate of 1.2% to around 0.85 kg in 1996. Similarly, mohair production declined ($p<0.01$) at an annual rate of 1.2% to 970,000 kg in 1996. A long-term (1935-1996) annual rainfall mean of 700 mm was calculated. There were recurrent wet (rainfall above long-term mean) and dry (rainfall below long-term mean) years. However, no clear alternate rainfall oscillations of wet and dry years were observed. It was, thus, difficult to predict years of drought (rainfall below long-term mean) from alternate annual rainfall oscillations. A positive but non-significant ($p>0.05$) relationship between annual mohair yield per goat (kg) and rainfall (mm) was observed. Policy implications of the results on drought preparedness are discussed.

Key words: Rainfall oscillations, mohair production trends, Lesotho

INTRODUCTION

The agricultural sector is the largest single sector in the economy of Lesotho. It contributes to income and employment for >85% of the population (Eckert and Nobe, 1982; Bureau of Statistics, 2000). In 2005, agriculture contributed 23.9% of the Gross National Product. Seventy five percent of this contribution came from the livestock sector (Bureau of Statistics, 2005).

Angora goats have played an important role in the economy of Lesotho for a long time. They provide an important source of cash income through the sale of their mohair, their meat or the animals themselves. In the food system, Angora goats provide meat which is a high quality protein food for Basotho people (Phororo, 1979; Lawry, 1986; Hunter, 1987). Mohair sales contribute between 14 and 20% of the total income generated by the livestock sector in Lesotho (Hunter, 1987; Bureau of Statistics, 2005). In 2000 more than R16 million was realized from mohair sales (Bureau of Statistics, 2001). However, most studies indicate that annual mohair production, mohair yield per goat and Angora goat numbers have declined since independence in 1966 (Uys, 1977; Wyeth *et al*., 1983; Hunter, 1987; Belete *et al*., 1994). These studies listed poor nutrition as being the most important cause of low annual mohair production, mohair yield per goat and Angora goat numbers.

Communal rangelands play an important role in the livestock production systems in Lesotho (Phororo, 1979). Thus, Angora goats depend, mainly, on natural pastures in these rangelands for their nutritional requirements. These natural pastures, in turn, depend on rainfall for their growth. Reduced amounts of rainfall or droughts have a negative effect on pasture growth, resulting in less food for the animals and hence low mohair yield per goat (Hunter, 1987). Thus, each time there is drought farmers in Lesotho lose a lot in terms of declines in annual mohair yield per animal and deaths of animals. Knowledge of rainfall oscillations and the relationship between rainfall and mohair production in Lesotho would help farmers prepare themselves for drought years. The objectives of this study were:

- To determine trends in Angora goat numbers, mohair production and mohair yield per goat in Lesotho between 1935 and 1996
- To determine the annual rainfall oscillations in Lesotho between 1935 and 1996 and estimate their possible impact on mohair production

MATERIALS AND METHODS

This study was carried out in Lesotho. Lesotho is a semi-temperate country with cold winter and warm summer months. The temperature may range from -20 to 15.9°C in winter and from 24-36°C in summer. The average annual rainfall is between 600 and 1775 mm, with most of the rain falling in summer (Bureau of Statistics, 1987; 2005). Owing to its mountainous character, much of Lesotho is well suited for Angora goat and sheep production (Hunter, 1987).

Secondary data on annual rainfall, Angora goat numbers, mohair production and mohair yield per goat in Lesotho were used in this study. Major sources of this data were government reports, annual statistical bulletins, published research articles and books. The data collected covered the period between 1935 and 1996. However, trends in the above factors were calculated for the colonial period (1935-1965) and years of independence (1966-1996). These are distinct periods in terms of government policies, management practices and livestock production systems (Hunter, 1987). An exponential regression equation of the form LnY = LnA + bx (SAS, 2000) was used to estimate trends in annual Angora goat numbers, mohair production and mohair yield per goat. In this equation 'LnA' is the intercept, 'b' is the slope and 'x' is the time indexed to 1, 2, up to 31. Correlation analysis was used to estimate the relationships (r) between the above production parameters.

Mean annual rainfall between 1935 and 1996 was calculated. Annual rainfall data was then calculated as deviations above or below the 62 year mean. This data was plotted on a graph paper to observe variations above and below the long-term mean. A ten-year weighted moving average was used as a simple smoothing and generalizing device (Dyer and Tyson, 1977; Eckert and Nobe, 1982). Patterns of wet (annual rainfall above long-term mean) and dry (annual rainfall below long-term mean) years were determined.

RESULTS

Between 1935 and 1965 Angora goat population in Lesotho increased ($p<0.01$) from 501,000-1,018,000 at an annual rate of 1% (Table 1). Mohair production and mohair yield per goat increased at annual rates of 1.9 and 1.1%, respectively ($p<0.01$). There was some significant ($p<0.01$) indication that during that period growth in mohair production depended on annual growth in both Angora goat numbers and mohair yield per goat (Table 2).

During years of independence (1966-1996) annual goat numbers remained, largely, stagnant ($p>0.05$) (Table 3). However, during this period mohair yield per goat declined at an annual rate of 1.2% to a value of around 0.85 kg ($p<0.01$). The end result was a decline in mohair production at an annual rate of 1.2% to 970,000 kg in 1996 ($p<0.05$). There were some significant ($p<0.05$) relationships between the decline in annual mohair production and the decline in both annual goat numbers and mohair yield per goat (Table 4).

Figure 1 presents graphical display of the annual rainfall results. Annual rainfall is shown as deviation above or below the 62 year mean of 700±113 mm (±SD). The data show that there were dry (rainfall below long-term mean) and wet (rainfall above long-term mean) years. However, no clear alternate oscillations of wet and dry

Table 1: Regression model for annual Angora goat numbers, mohair production and mohair yield per goat in Lesotho between 1935 and 1965

Variable	Parameter (LnY = LnA + bx)	Growth rates (%)
Angora goat numbers ('000)	A = 588	
	b = 0.01	1.0
	r = 0.62	
	P = 0.00	
Mohair production ('000kg)	A = 43	
	b = 0.02	1.9
	r = 0.61	
	P = 0.00	
Mohair yield/goat (kg)	A = 66	
	b = 0.01	1.1
	r = 0.53	
	P = 0.00	

r = Correlation co-efficient, P = Probability value, A = Intercept, b = Slope or growth rate

Table 2: Relationship between annual Angora goat numbers and mohair production and between annual mohair yield per goat and mohair production in Lesotho between 1935 and 1965

Variables	Relationship
Annual goat number and mohair production	r = 0.73
	p = 0.01
Annual mohair yield/goat and mohair production	r = 0.70
	p = 0.01

r = Correlation co-efficient, P = Probability value

Table 3: Regression model for annual Angora goat numbers, mohair production and mohair yield per goat in Lesotho between 1966 and 1996

Variables	Parameter (LnY = LnA + bx)	Growth rates (%)
Angora goat numbers ('000)	A = 950	
	b = 0.01	-0.05
	r = 0.26	
	P = 0.16	
Wool production ('000 kg)	A = 836	
	b = -0.01	-1.2
	r = -0.56	
	P = 0.39	
Wool yield/goat (kg)	A = 1.09	
	b = -0.01	-1.2
	r = 0.50	
	P = 0.00	

r = Correlation co-efficient, P = Probability value, A = Intercept, b = Slope or growth rate

Table 4: Relationship between annual Angora goat numbers and mohair production and between annual mohair yield per goat and mohair production in Lesotho between 1966 and 1996

Variables	Relationship
Annual goat number and mohair production	r = 0.66
	p = 0.01
Annual mohair yield per goat and mohair production	r = 0.45
	p = 0.05

r = Correlation co-efficient, P = Probability value

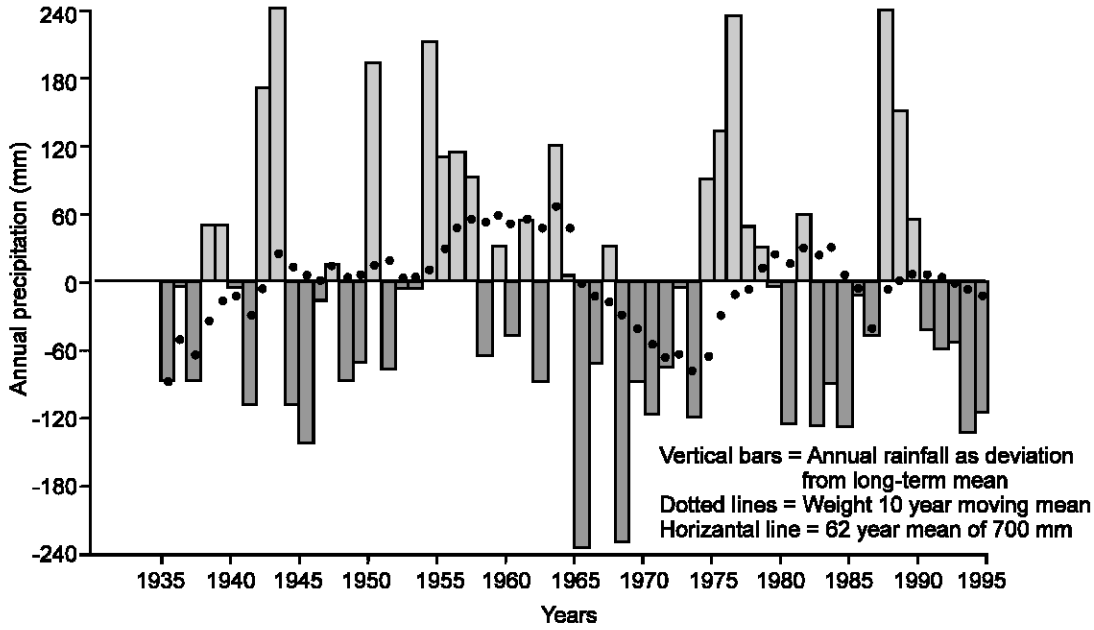

Fig. 1: Annual rainfall deviations from long-term mean of 700 mm in Lesotho between 1935 and 1996

Table 5: Relationship between annual mohair yield per goat (kg) and annual rainfall (mm) in Lesotho for the period 1935-1996

Variables	Relationship
Annual mohair yield and annual rainfall	r = 0.26
	p = 0.38

r = Correlation co-efficient, P = Probability value

years were observed. A positive but non-significant (p>0.05) relationship between annual rainfall and annual mohair yield per goat was observed (Table 5).

DISCUSSION

Annual mohair production can be influenced by the number of goats shorn and mohair yield per goat (Drummond, 1985; Hunter, 1987). Between 1935 and 1965 annual goat numbers and mohair yield per goat increased. The overall result was that there was an increase in annual mohair production. Thus, annual mohair production depended on growth in both goat numbers and mohair yield per goat. The growth in goat numbers may have been possible during that time because the communal rangelands were still able to sustain more animals (Hunter, 1987). However, the increase in goat numbers and other livestock species resulted in overstocking and degradation of the communal rangelands (Phororo, 1979; Hunter, 1987). This, in turn, led to the communal rangelands being unable to sustain good levels of livestock production (Hunter, 1987). Thus, between 1966 and 1996 annual goat numbers remained, largely, stagnant at around one million while mohair yield per goat declined at an annual rate of 1.2%. Indeed, it could be argued that the future prospects for increasing mohair production in Lesotho may depend, mainly, on increasing the annual mohair yield per goat rather than on increasing goat numbers. The low annual mohair yield of about 0.85 kg/goat may be compared with a mean annual yield of about 4.0 kg mohair per goat (Bureau of Statistics, 2000) in South Africa. Thus, improvements of around 370% are possible.

Past Lesotho governments responded to the problems of low mohair yield per goat with a variety of policies and remedial programmes (Uys, 1977; Wyeth *et al*., 1983; Hunter, 1987). These included compulsory rotational grazing in the communal rangelands, exchange of old goats with young ones imported from South Africa, introduction of grazing fees, formation of associations, etc. However, it seems that past policies and remedial programmes did not have positive impact on annual growth of mohair yield per goat during the 1966-1996 period. It is, therefore, suggested that in future attention should be placed on increasing mohair production through improvements of mohair yield per goat. Initially, an attempt should be made to quantify the major factors that limit growth in mohair yield per goat. Then, policies and programmes putting more emphasis on those factors having higher limiting effects can be instituted.

In the present study recorded data show that there were wet (rainfall above long-term mean) and dry (rainfall below long-term mean) years. However, there were no clear alternate oscillations of wet and dry periods as suggested by Eckert and Nobe (1982). In that study, which involved data from lowland districts of Lesotho only, there was some pattern of alternate 10 year periods of below or above long-term average annual

rainfall. However, even in that study, there were a number of deviant years within wet or dry spells. It is, also, clear from the present study that drought (annual rainfall below long-term mean) was a recurrent feature in Lesotho during the period under study. This is similar to the findings of Eckert and Nobe (1982). There is, thus, a need for Angora goat farmers in Lesotho to have resources and knowledge so that they can prepare for drought and adjust their management strategies accordingly. Drought should be seen and treated as part of the whole livestock production industry and not as something which takes the country by surprise every now and then. The aim should be to minimize the impact of drought on livestock production. This will ensure the industry's sustain ability.

Angora goats in Lesotho depend, mainly, on natural pastures for their nutritional requirements. These natural pastures depend on rainfall for their moisture requirements and hence their dry matter production (Phororo, 1979; De Waal, 1994). However, the relationship between annual rainfall and annual mohair yield per goat in Lesotho was very poor. Such poor relationship may indicate that there are other major factors determining annual mohair yield per goat (Hutchings and Stewart, 1953; Eckert and Nobe, 1982; De Waal, 1994). These include the rainfall distribution within the year and any intervention by the farmers in terms of feed supplementation to the animals (Eckert and Nobe, 1982; De Waal, 1994).

Conclusion: The communal rangelands of Lesotho are not able to sustain the present Angora goat numbers, mohair yield per goat and mohair production. It is recommended that, in future, emphasis should be on increasing mohair production through improvement of mohair yield per goat. However, it is also important for Angora goat farmers to always have necessary resources and management skills for drought preparedness since drought was a recurrent feature in Lesotho. Although, the magnitude and extent of the impacts of such climatic changes on dry matter production of natural pastures and hence mohair production could not be well predicted from rainfall patterns during the period under study.

Recommendations: It is therefore recommended that more research is needed to ascertain the relationship between annual rainfall oscillations and mohair production in Lesotho between 1996 and 2008 as this will help to add more knowledge on the magnitude and extent of the impacts of such climatic changes on dry matter production of natural pastures and hence mohair production in Lesotho for the benefit of the rural Angora goat farmers.

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