Production systems

Plant production : Range grazing

The principal agro-ecological units within South Africa are illustrated by a generalised image of the Acocks (Acocks, 1953) map of the Veld Types of South Africa. Acocks (Acocks, 1953) provided a unique perspective on the classification and distribution of the agro-economic divisions of vegetation in South Africa. This map serves to illustrate the broad floristic diversity of the vegetation, and continues to remain an important classification for graziers. There are 70 Veld Types, with a primary focus on those types most useful for livestock production. In Namibia, the work of Geiss (1971) provided the first detailed vegetation map which defined agro-ecological units. Similar surveys of Zimbabwe are provided by a map for rangeland planning.

In the arid and semi-arid rangelands of southern Africa, rainfall is the primary determinant of forage production, and a number of production models have been developed for predicting the above ground primary production in natural rangeland in southern Africa. Coe *et al*., (1976) demonstrate a linear relationships between annual rainfall and primary production for conservation areas in southern Africa. These predictions are regarded as conservative by commercial graziers, many of whom suggest that production for livestock can be optimized by rotational grazing (Danckwerts and Teague, 1989). In an effort to test the sustainable production of grasslands in the Eastern Cape Province, Danckwerts (pers. comm.) designed a grazing trial to evaluate the impact of animal type (cattle or sheep), number (light, moderate and heavy stocking rate) and duration (rotation versus continuous), on rangeland condition and animal production. Preliminary results suggest that continuous grazing under moderate stocking rate (that recommended by the National Department of Agriculture) yields the best livestock mass gain. However, no significant changes in species composition are obvious, and the period of the trial (10y) is insufficient to make conclusions on system run-down. Using SPUR2, (Wight and Skiles JW, 1987) Palmer, Ainslie & Hoffman (Palmer *et al*, 1999) simulated a 50 year beef operation under continuous grazing for a site receiving 500mm per annum. The “recommended stocking rate”, determined by the National Department

of Agriculture and Land Affairs, was 8 ha LSU^{-1}. At 4 ha LSU^{-1}, the system appeared to still be sustainable. Only when the stocking rate was increased dramatically to 2 ha LSU^{-1} did the system run down within the 50y simulation period. These results suggest that for grassland systems, the recommended stocking rates are well below those which are likely to lead to system run-down.

In order to present a perspective of the production across the entire region, we have prepared a mean NDVI from the NOAA AVHRR sensor (Plate 18). This data set has only recently been released after calibration of the various sensors on each of the satellites. The resultant image, of the mean annual maximum NDVI for the period 1985-2001, is provided. This shows clearly those areas with the highest and lowest livestock production potential. With the exception of some areas where livestock production is limited due to the presence of tsetse fly and in conservation areas, livestock are kept throughout the region.

Production relationships can be simplified to straightforward expressions of kg DM production of forage per millimetre of annual rainfall (Le Houreou, 1984). An above-ground biomass production model based on the concept of rain-use-efficiency has been developed (Palmer, 1998) and applied to rangeland. The resultant maps for commercial production are provided for South Africa and Namibia. The production may be converted to carrying capacity for cattle by assuming a daily requirement of 11.25 kg dry matter per large stock unit, and a use factor of 0.4 (Le Houerou, personal communication). The use factor may decline to 0.2 in mesic grasslands with high C:N ratios.

Pastures: Introduced legumes and fodders

A number of sub-tropical pasture legumes and fodder plants have been screened at various sites from 100–700 mm annual rainfall. Probably the most successful example of introduced legumes has been the use of lucerne (*Medicago sativa*), annual medics (*M. polymorpha* and *A truncatula*) and annual clover (*Trifolium* sp.) into the grain production systems of the Western Cape. Here the commercial grain producers (wheat, barley, oats) use these species as lay crops to

elevate soil nitrogen every 2-3 years. These crops reduce risks inherent in grain production, and at the same time provide forage for the small stock industry.

Range reinforcement is conducted on a large scale in the commercial dairy regions of the country. Favoured grass species include *Pennisetum clandestinum* (kikuyu), *Panicum maximum, Digitaria eriantha*, while the legumes such as silver leaf (*Desmodium* spp) are oversown into natural rangeland. Foggage production in South Africa is important in commercial beef and dairy production systems. Graziers use a wide range of commercially available local and imported grasses and legumes. The performance of growing beef steers grazing foggaged dryland *Pennisetum clandestinum* pastures and given limited access (3 hd^{-1}) to *Leucaena leucocephala* cv. Cunningham (Zacharias *et al*., 1991) was better than that of steers grazing only kikuyu foggage during autumn and early winter Zacharias *et al*., (1991). Animals grazing leucaena performed better and gained 24.8 kg per animal more, over 90 days, than those on kikuyu alone. There is concern about the risk of leucaena becoming an invasive alien in the humid coast, and further encouragement of the use of this and other potentially aggressive species (e.g. *Lespedeza sericea*) has been discouraged until further evaluation has been carried out. Investigations to determine whether frosted Kikuyu could supply quality foggage than natural pasturage in sourveld area during the winter months revealed that this grass was characterised by a crude protein content of 8 - 10% in the winter months. The performance of animals grazing such frosted Kikuyu was highly satisfactory Rethman and Gouws, (1973). Sheep performance and patterns of herbage utilization were determined in two grazing trials involving different amounts and quality of kikuyu foggage. Wether lambs maintained livemass whereas dry ewes and wether lambs both lost 8-10% of their initial mass, irrespective of differences in foggage quality. Grazing capacity was proportional to the yield of foggage and some 50% of the total herbage was utilized. The estimates of quality indicated that a higher level of utilization would have resulted in poorer sheep performance. Barnes and Dempsey, (1993).

Dryland fodder

Dryland fodder production is only possible in the higher rainfall regions of South Africa. The principal form of dryland fodder is cereal crop residues, and these make an important contribution to livestock diets in communal areas during the dry season. Some communal area farmers collect and store at least part of their residues to feed to selected animals such as milk cows and draft oxen, but most of the fodder is utilised *in situ*. The cultivation of rainfed crops in South Africa is widespread, occurring in both commercial and communal land-use systems. The most significant commercial grain producing areas are the "maize triangle" of the central highveld, the wheat growing region of the south western Cape and the maize growing regions of central Kwa-Zulu Natal. Maize is widely preferred as the staple food in the communal areas, but millet and sorghum are more reliable crops except in the highest rainfall zones. National cereal production (roughly 80% maize, 16% wheat and 4% other including millet and sorghum) fluctuates considerably from year to year according to rainfall. Production has varied from a low of 5 044 000 million tons in the drought year of 1991/92 to a record high of 15 966 000 million tons in 1993/94.

In the drier central and western areas, farmers commonly have small areas of drought tolerant fodder crops (Table 1) as drought reserve for exceptional circumstances.

Table 1:

Botanical name	Common name	Uses
Agave americana	American aloe	Drought fodder in arid and semi-arid regions
Anthephora pubescens	Wool grass	Spring and summer grazing
Atriplex mueleri	Australian saltbush	Drought fodder
Atriplex nummalaria	Old Man Saltbush	Drought fodder
Atriplex semibaccata	Creeping saltbush	Drought fodder
Cenchrus ciliaris	Blue buffalo grass	Tufted perennial; spring, summer and autumn grazing
Opuntia spp.	Spineless cactus	Live fencing and drought fodder
Opuntia ficus-indica	Prickly pear	Live fencing and drought fodder
Vigna unguiculata	Cowpea	Undersowing maize, millet or sorghum

Irrigated fodder

There are some eighty species of commercially available species and cultivars which are used in South Africa (Klug and Arnott, 2000). Lucerne (*Medicago sativa*) is the main purpose- grown irrigated fodder in South Africa, and is grown under irrigation throughout the country. Ryegrass (*Lolium multiflorum* and L. *perenne*) is cultivated on a large

scale for pastures in the dairy industry. Many other species and numerous cultivars are available commercially and are provided in detail by Bartholomew (Bartholomew, 2000).

Imported fodder

In times of drought, the South African government traditionally assisted farmers in obtaining fodder by providing subsidies. According to the new drought policy (Anonymous, 1996), the fodder subsidies have been terminated in order to encourage farmers to build up their own forage reserves and to discourage them from retaining excessive stock numbers. Nonetheless, it is likely that some commercial farmers, and probably the government, will continue to import fodder in extreme drought conditions.

Animal production : Feedlots

Probably the largest contribution to improving beef and mutton production comes from the intensive feedlot systems which exist throughout southern Africa. There are approximately 12 large (>20000 animals) feedlots currently operating in South Africa, with fewer in Namibia, Botswana and Zimbabwe. At any moment, there are approximately 420000 head of cattle in the South African feedlots, with three cycles per annum. There are 1,26 million animals per annum or 9% of the national beef herd being prepared for the market each year. The feedlots achieve conversion rates of approximately 1 kg live weight to 6 kg dry concentrate provided.

Livestock numbers

South Africa, with its greater surface area, is the most important livestock producer in the region, with some 13.8 million cattle, 29 million sheep and 6 million goats (Figures 7 and 8). The livestock numbers in all countries in the region have not changed significantly during the past 10 years, with the exception of sheep numbers which declined in 1992 in South Africa and in Lesotho, but now appear to have stabilized (FAO, 2002). These changes could possibly be explained by a decline in the international demand for mutton and wool.

In Nambia there are currently about 2.2 million cattle, 2.1 million sheep and 1.7 million goats. Numbers of cattle and small stock fluctuate in response to high and low rainfall years. Beef production is the most important livestock related activity, followed by small stock production, and most of the output from the livestock sector is exported. The combined livestock sector contributes 75% of total agricultural output (Sweet and Burke, 1999). Namibia also possesses a rich and diverse

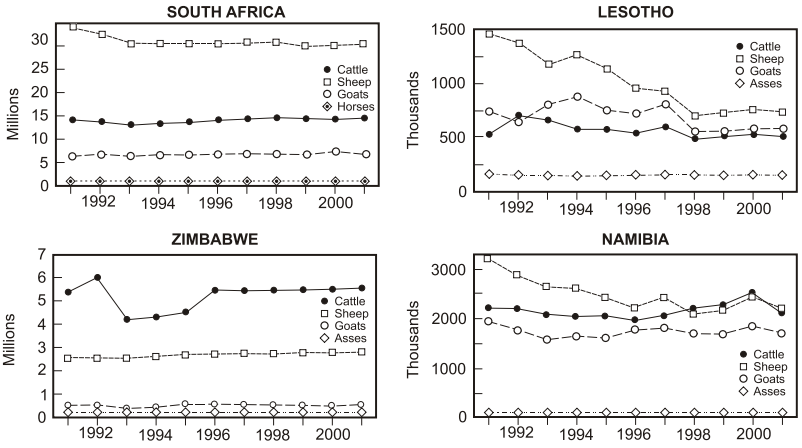

Figure 7: . Livestock numbers: a) South Africa b) Zimbabwe c) Lesotho d) Namibia

wildlife resource, and about 13% of the country is designated as National Parks, but a considerable proportion of the wildlife exists outside formally proclaimed conservation areas. Many commercial farms derive some or all of their income from hunting and/or tourism, and there is an increasing movement towards the establishment of nature conservancies in communal areas to enable local communities to benefit from their wildlife populations.

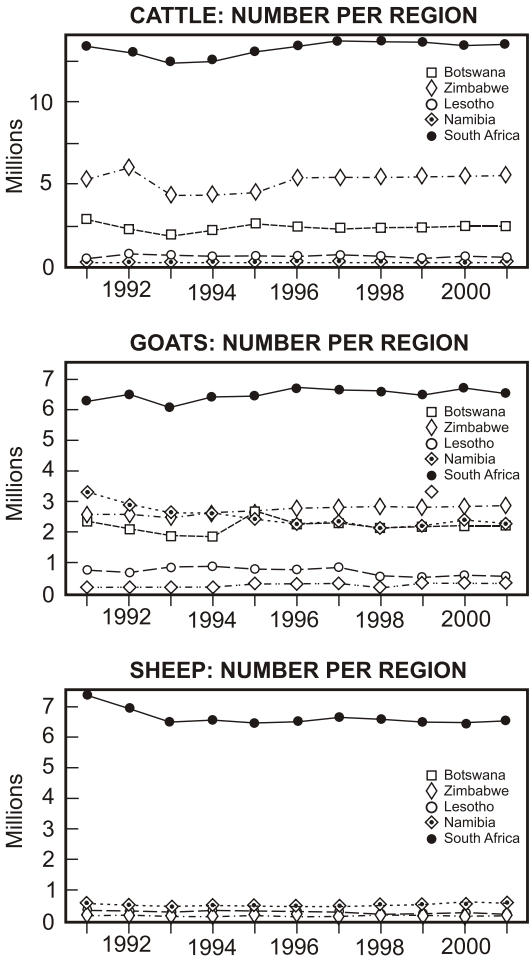

Figure 8 : Number of cattle, goats and sheep per region.