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Cattle Numbers, Biomass, Productivity, and Land Degradation in the Commercial Farming Sector of Namibia, 1915 to 1995

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Abstract

A Natural Resource Accounting project is currently underway to document the status of the nation's resources and their current economic use. Accounts for livestock and land feature prominently in this project; they are being used to address issues related to livestock and land use by analysing the relationship between numbers of livestock, rainfall, land degradation, and economic and policy variables over the past 25 years. This paper reports the preliminary results of a part of this work, an investigation into trends in cattle numbers, changes in cattle biomass, annual beef production, and the productivity of livestock in commercial areas over the past 30 years. Livestock numbers increased till 1960, and have steadily declined since then. In the case of cattle, this decline has been accompanied by deliberate de-stocking by farmers while herd productivity has increased. The evidence suggests that beef production per unit of land has not declined but that productivity is significantly lower than potential industry standards. Range degradation (bush encroachment) and changes in rainfall may have contributed to this. More research is needed to quantify the effects of these factors. This investigation has implications for our understanding of long-term carrying capacity, land degradation, and rangeland management, and for agricultural development policies.

ACKNOWLEDGEMENTS

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1. Introduction

The Namibian Natural Resource Accounts

Namibia is a Southern African country highly dependent on its natural resource base: mining, agriculture, fishing, and wildlife-based tourism. At Independence in 1990, Namibian society was marked by vast inequalities of income , wealth, and access to natural resources. In the past, natural resources were exploited with little thought for the provision of future income. The Government of Namibia has now undertaken the construction of Natural Resource Accounts (NRA) as a step toward sustainable management of its resources. The Namibian NRA generally follow the UN's SEEA (System of Integrated Environmental and Economic Accounts) approach (UN, 1993), though strongly influenced by the Norwegian system (Alfsen, 1996; Alfsen et al., 1987) with its emphasis on compilation of a detailed physical database and the integration of NRA with economic models for policy analysis. In addition to livestock, the NRA constructed for Namibia include water, fisheries, land, land degradation, wildlife, and minerals.

Accounts for livestock include cattle, goats, sheep, horses and donkeys for two systems of land tenure for 39 geographic districts over the years 1970 to 1995. Additional information is available for the commercial sector for earlier years, but not disaggregated by district. Accounts are constructed for stock (herds) and for annual offtake. Livestock are measured in two ways, numbers of animals and animal biomass measured in Large Stock Unit (LSU) equivalents which is equal to 450 kg (Meissner, 1982). This paper addresses one part of the livestock accounts, cattle in the commercial sector. The investigation reported here was undertaken to address two issues: first, to determine whether there been a change over time in the average size of animals (becoming larger or smaller than 450 kg), which would require an adjustment to the biomass accounts; secondly, in the absence of reliable data about land degradation for the land accounts of the NRA, to determine whether changes in stock and annual offtake shed any light on the extent of land degradation.

Livestock in the Namibian Economy

Agriculture, primarily extensive livestock farming where livestock subsist off natural rangelands, is the primary source of livelihood for most of Namibia's rural population. Roughly 75% of the land area of the country is used for extensive livestock ranching. Livestock and related industries accounted for roughly 9% of GDP and 16% of exports in 1995 (CSO, 1996). Two very different livestock sectors exist: the commercial sector on large, freehold properties historically controlled by a small minority and oriented toward production for the market, and the so-called communal livestock sector where subsistence pastoralism and agro-pastoralism are practice under traditional forms of land tenure. The total agricultural land area is split roughly in half between these two systems of livestock management. Commercial areas support a very small number of farmers while the communal areas support nearly 70% of Namibia's human population. Commercial areas generally occupy drier land than communal areas, but have better access to markets and infrastructure. Broadly speaking, the northern half of the commercial land is less dry and covered with a savanna type vegetation, while the southern half is drier and covered with open karroid shrub lands.

Virtually all livestock production recorded in economic accounts is provided by the commercial sector; as recently as 1994, only 4% of marketed livestock originated in communal areas (Meat

Board of Namibia, 1995). Livestock in the communal sector provide many non-marketed products and services such as draught power for crop farming, milk, hides, manure, and a form of savings for a community not served by credit facilities (Benhke and Scoones, 1992), but the value of these products is not fully represented in the national economic accounts.

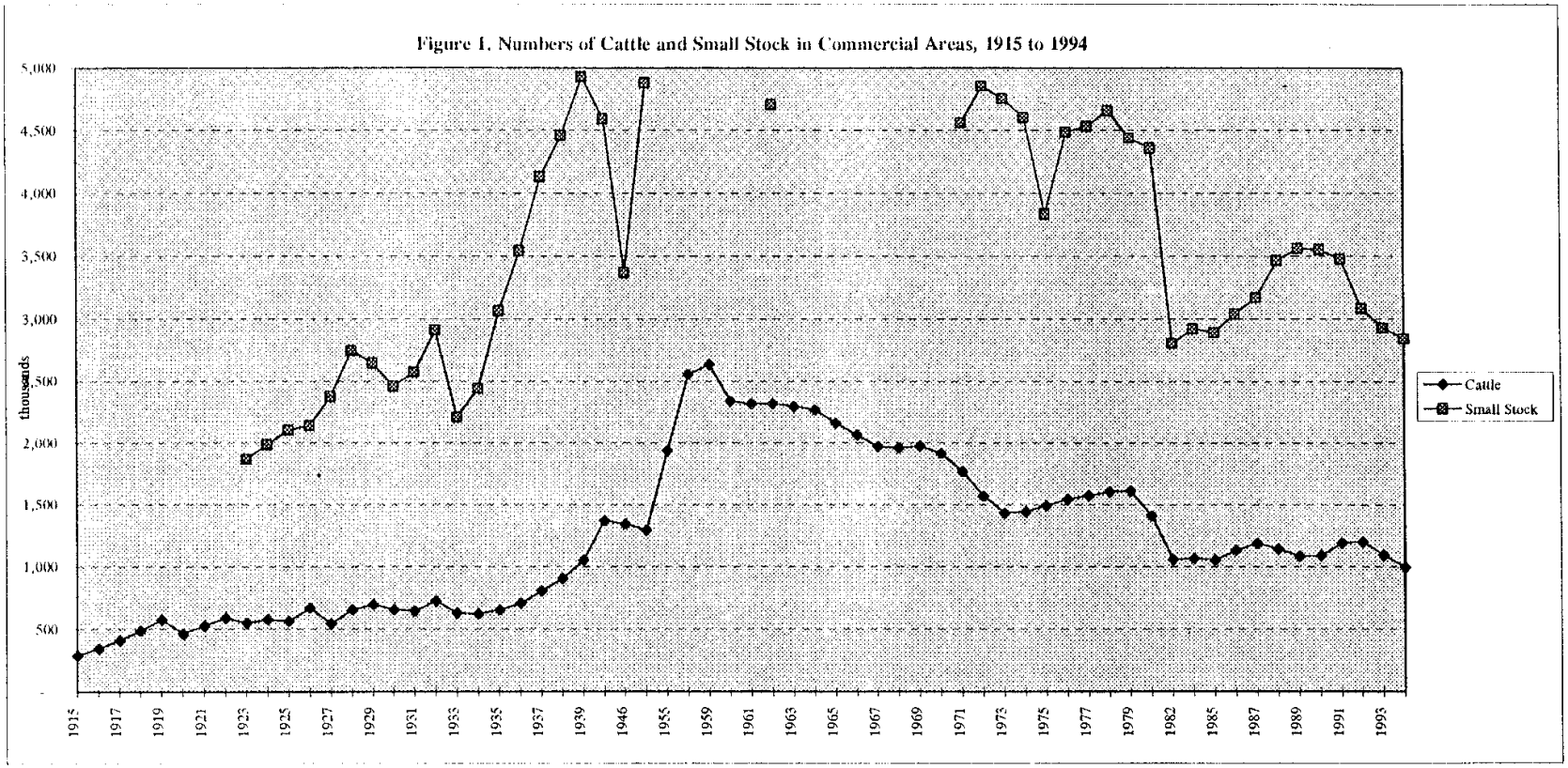
Namibia's farmers are subject to severe pressure from environmental conditions as well as from changing economic conditions. The extremely dry and erratic climate makes farming a difficult and risky business. Rangeland degradation is a major concern with implications not only for the profitability of individual farmers, but also for related issues like land reform and long-term drought policy (see for example, Adams and Werner, 1990; Brown, 1994; Directorate of Environmental Affairs, 1994; Moorsom, 1995; Quan et al. 1994). There is general agreement that some forms of land degradation are occurring, most notably bush encroachment in the north, but little systematic information has been collected to quantify this problem. Consequently, there is a great deal of controversy about the extent of degradation, its economic impact, and what should be done about it. In the absence of explicit data, an investigation into trends in livestock productivity may shed some light on the extent to which land degradation may be occurring.

In addition to environmental concerns, the domestic and international economic conditions under which farmers, especially commercial farmers, operate have recently changed or are likely to change in the near future. These changes include the substantial reduction or even elimination of long-established drought relief programs for commercial farmers, the eventual end of Namibia's preferential access to European Union markets, and the liberalization of trade between South Africa and the European Union, threatening Namibia's export market in South Africa. Low (1994) found that implementation of the General Agreement on Tariffs and Trade (GATT) would most likely reduce prices for livestock products in Namibia by some 20 percent. These new economic conditions bring added urgency to improved understanding of the changing environmental conditions faced by farmers. This report focuses on the commercial livestock sector because extensive information is only available for the commercial sector. Future work will address the communal livestock sector.

2. Declining Numbers of Cattle

The number of cattle on commercial farms grew rapidly during the first half of this century, peaked in the late 1950's at 2.6 million head, and has steadily declined since then to roughly half of the peak, 1.2 million in 1994; numbers of small stock show a parallel trend (Directorate of Veterinary Services, various years; Meat Board of Namibia, various years; Rawlinson, 1994. See figure 1). Rawlinson (1994) attributes the dramatic increase in the early period mainly to the development of watering points and camps in commercial areas which opened up new grazing land. Figure 2 does show a rapid increase in the number of boreholes established between 1945 and 1959 (DWA, 1996). The equally dramatic decline in cattle numbers since 1959 -- all the more puzzling because of improvements in veterinary services, farm infrastructure, medicine and marketing facilities -- is not so easily explained. For example, records indicate that the drilling of new boreholes on commercial land continued throughout the 1970's and 1980's (Figure 2).

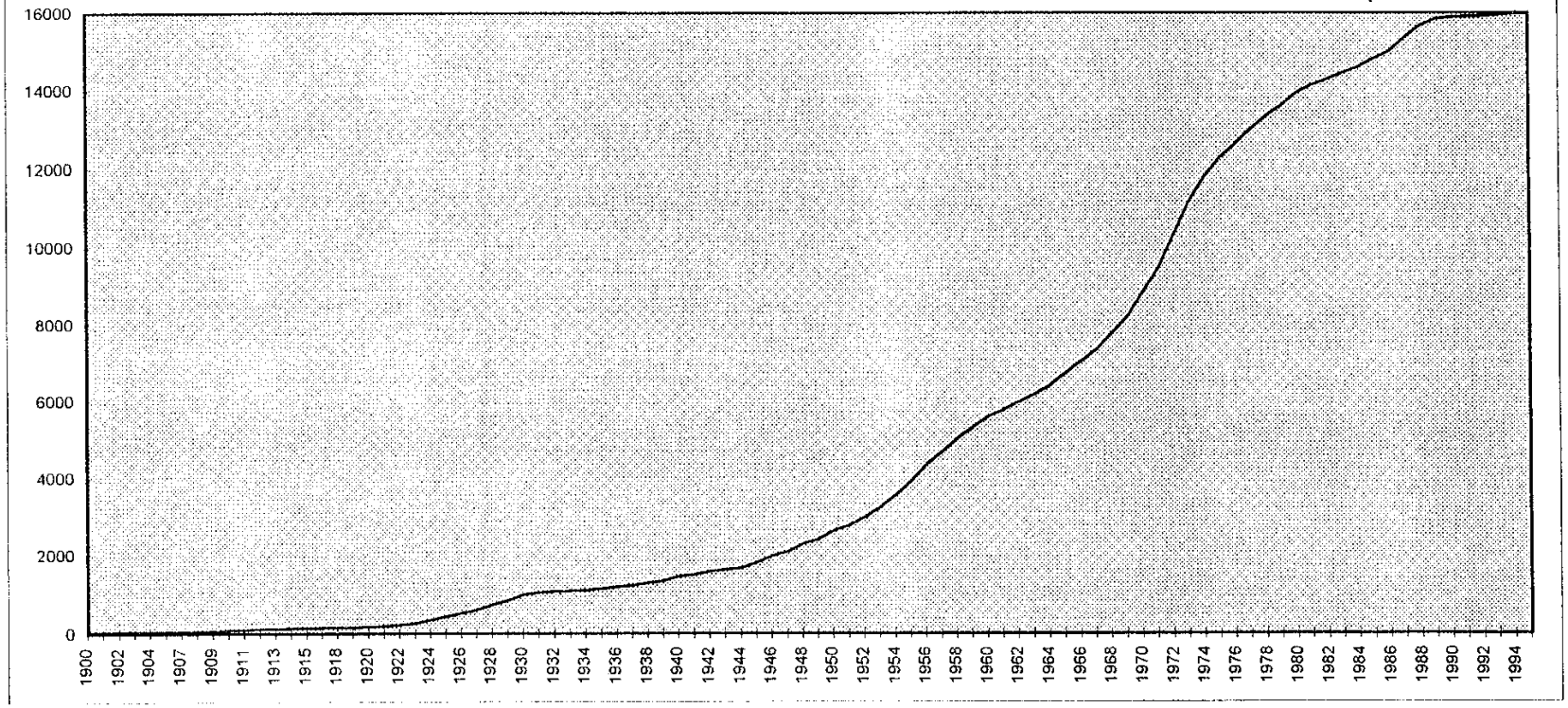
Figure 1. Numbers of Cattle and Small Stock in Commercial Areas, 1915 to 1994



Note: Livestock numbers not available for all years in the 1940s and 1950s.

Source: Cattle numbers for 1915-1992 from (Rawlinson, 1994) Tables 9 and 12, pp. 64 and 68. Cattle numbers for 1993 and 1994 from Meat Board.

Figure 2. Cumulative Number of Boreholes Established in Commercial Farming Areas, 1900 to 1995



Note: Out of approximately 100,000 currently registered boreholes, location and date of establishment were only available for about 16,000.

Source: unpublished data from the Directorate of Water Affairs.

Several explanations for the decline in cattle numbers have been suggested. The relatively simple explanations include possible inaccuracy of data, the substitution of small stock or wildlife for cattle, and a reduction of land area used for grazing. Other suggested explanations include fundamental changes in farm management practices by which herd numbers are deliberately reduced below ecological carrying capacity in order to increase herd productivity, or worsening of environmental conditions which has reduced the carrying capacity of the land. The former may include an increase in the average size of cattle through selective breeding so that the declining number of cattle is offset by increased individual animal weight. The latter includes both a decline in rainfall over the past 40 years and land degradation, notably bush encroachment. Dean and Macdonald (1994) examined livestock numbers between 1911 and 1981 in the semi-arid and arid parts of South Africa's Northern Cape, Western Cape, Eastern Cape and North West Provinces, regions which include savanna and karroid biomes very similar to those in Namibia. They found that stock numbers had declined in all biomes and attributed this to rangeland degradation.

This paper will review the evidence for each explanation in an attempt to determine the extent to which each of these factors may have contributed to the present state of the commercial livestock sector in Namibia. The relatively simple explanations are addressed first in the remainder of this section. While it has not been suggested that these factors account for all of the decline, if any one of them contributes substantially to the decline, the remaining factors become less significant. Factors related to farm management and environmental conditions are explored in the following sections.

Reliability of the Data. The decline in recorded numbers of cattle is unlikely to be the result of poor data; the data about numbers of livestock on commercial farms are considered fairly reliable since all farmers must register in order to market their cattle. Any error is expected to result in an **underestimate** of the numbers of cattle in earlier periods when reporting and veterinary monitoring may have been less thorough. Consequently, even if the data were significantly inaccurate, the direction of expected error would increase the already precipitous decline in cattle numbers after 1960 observed in figure 1.

Numbers of Small Stock and Wildlife. The decline in cattle numbers cannot be attributed to a substitution of small stock for cattle because, as Figure 1 indicates, small stock also declined over this period.[1] The amount of wildlife on commercial farms has increased as farmers have looked for ways to diversify their incomes through game ranching or mixed livestock with game ranching (Barnes and de Jager, 1996), but the numbers are not significant enough to account for the decline in cattle. Based on self-administered surveys of commercial farmers conducted in 1972, 1982, and 1992, the amount of wildlife increased by 77% over the 20 year period and the proportion of animal biomass (measured in large stock unit equivalents or LSU) consisting of wildlife, grew from 8% to 18% of the total. This increase is too small to account for the drop of livestock numbers of more than 50%. In any case, there would not be a clear one to one replacement of

[1] Developments in the small stock sector are not specifically addressed in this paper. Preliminary evidence indicates that some of the trends are similar for cattle and for small stock, but there are additional factors unique to small stock, notably the decline of the karakul sheep industry.

cattle by wildlife since some wildlife species utilise slightly different feeding niches from those of cattle.

Changes in Land Area. In the early 1960's the Odendaal Commission re-assigned some land from commercial farmers to communal farmers (Adams and Werner, 1990). However, most of the re-assigned land was located in areas of extremely low agricultural potential, such as Damaraland and Namaland, so that the transfer would have had a minimal impact on the size of commercial herds. In addition, because the transfer occurred in the early 1960's, this loss of commercial rangeland would only account for a decline in cattle numbers in the early 1960's and not for the downward trend which has persisted throughout the three decades since then.

3. Average Size of Cattle and Total Cattle Biomass, 1956 to 1994

Management of commercial farms has undoubtedly improved, if unevenly, over the past 40 years, and concentrated efforts have been made to improve the herd through selective cross-breeding, including the introduction of some larger breeds. While the **numbers** of cattle have declined, the cattle **biomass** may not have declined, or not by nearly the amount suggested by cattle numbers alone, if the average size of cattle has increased -- though average cattle weight would have had to double throughout commercial areas in order for the smaller numbers to have maintained a constant biomass, a highly unlikely occurrence.

The average size of cattle and, consequently, herd biomass depends on two factors: the average weight of cattle of a given age and the age mix of the herd, with older cattle generally weighing more than younger cattle. Experiments on breeding herds at two government farms in the northern savanna areas reported live weight increases for animals of a given age of about 60% between the early 1960's and the early 1980's (Venter, undated). Anecdotal evidence for an unspecified number of farms in Otjiwarongo district indicated an increase in average cattle weight of 25% between 1967 and 1994 (Quan et al., 1994). It might seem reasonable to assume that these increases are typical for herds of the average commercial farmer since efforts were made during this period to improve the stock through breeding, especially in the 1960's, but it is not clear that this is, in fact, the case. No comprehensive data are available about the average weight of commercial herds nationwide, but information is available about the weight of annual offtake. Consequently, a methodology was developed to estimate the trend in herd biomass based on data obtained for annual offtake. The remainder of this section describes the methodology and the results of our calculations, concluding with an assessment of whether the average size of cattle produced for sale has changed and whether the trend for herd biomass differs from the observed decline in herd numbers.

Methodology for Estimating the Average Size of Cattle in Annual Production and in Herds

The average weight of cattle produced for sale is considered a good indicator of the average weight of cattle herds because both the age mix and the average size of animals of a given age are usually fairly similar for the two. Reports indicate that the average carcass weight of cattle slaughtered in Namibia has been fairly constant, or increased only slightly over the past 35 years (Office of the Administrator General, South-West Africa, 1984; Rawlinson, 1994; Meat Board of Namibia, various years). This would seem to indicate that there has been little change in the size

of animals in herds and, consequently, that herd biomass has declined in parallel with herd numbers. However, trends in the weight of animals in herds cannot be inferred solely from trends in slaughter weight because slaughter accounts for only part of Namibia's beef production.

Beef marketing in Namibia consists of two main components: domestic slaughter and live export of animals, mainly to South Africa, either for immediate slaughter or for finishing in feedlots prior to slaughter. Live exports constitute a large share of production, ranging from a peak of 90% in 1971 to a low of 41% in 1991 with an average share of 50% (Meat Board of Namibia, various years). Ideally, the weight of total beef production would be calculated as the weighted sum of the two components, domestically slaughtered cattle and live exports. Analysis of trends in total production could then be used to infer trends in herd biomass. Data are available about the weight of domestically slaughtered cattle, but not for the weight of animals produced for live export. A method was developed to estimate the weight of live exports and, combining live exports with domestic slaughter, to then estimate the weight of total production. Trends in herd biomass can be inferred from trends in total production. The rest of this section describes this methodology, after briefly discussing the problems that could arise from inferring trends in herds solely from trends in domestic slaughter.

It cannot be assumed *a priori* that the age mix of domestic slaughter is representative of the age mix of live exports and, consequently, of total production (domestic slaughter plus live exports). The age mix can vary significantly from year to year in response to market and weather conditions, and can vary over the longer term in response to changes in marketing strategy. Evidence indicates that there has been a shift toward marketing younger cattle. Rawlinson (1994) reports that as late as 1978 the average age of cattle at slaughter was over four years of age compared to a more ideal marketing standard of two to three years. Prior to 1978, the average age was even higher though precise figures are not available (personal communication with Mr. S. van Zyl, Meat Board of Namibia). Conclusions drawn about live herds on the basis of domestic slaughter could be highly misleading if there is any difference in age mix between domestic slaughter and live exports. As discussed in a later part of this section, the age of live exports is considerably different from domestically slaughtered cattle. The degree of error is likely to be high for Namibia because live exports constitute a large share of annual production.

An estimate of average animal weight for all marketed animals, domestic slaughter plus live exports, can be developed on the basis of available information about carcass weight for different grades of slaughtered cattle[2] and about the age mix of domestic slaughter and of live exports. In order to estimate the trend in weight of total production (domestic slaughter plus live exports), the following calculations are made for each year:

1. Calculate the average slaughter weight for each age group of cattle from data published about carcass weight by grade in the *Annual Report* of the Meat Board of Namibia and convert to live weight equivalent.

2. Calculate the age distribution of total production (domestic slaughter plus live exports)

[2] Even this is not entirely satisfactory since each age group assigned at slaughter for grading purposes typically cover 2 years.

as the sum of the age distribution of slaughtered cattle plus the age distribution of live exports, each weighted by their respective shares in total annual production. For example, if

a) all domestically slaughtered cattle were four-year-old cattle and all live exports were two-year-old cattle, and
b) domestic slaughter and live exports each accounted for half of annual production (in numbers of animals marketed),

then the age mix of total production would be 50% two-year-old cattle and 50% four-year-old cattle.

3. Calculate the average weight of total production by applying the average weights for each age group (step 1) to the age mix of total production (step 2). For example, if
   a) the age mix of production is found to be half two-year old cattle and half four-year-old cattle,
   b) and the average live weight of two-year-old and four-year-old cattle was found to be 440 kg and 460 kg, respectively,

   then the average weight of total production would be 50% of the weight of two-year-old cattle and 50% of the weight of four-year-old cattle, or 450 kg.

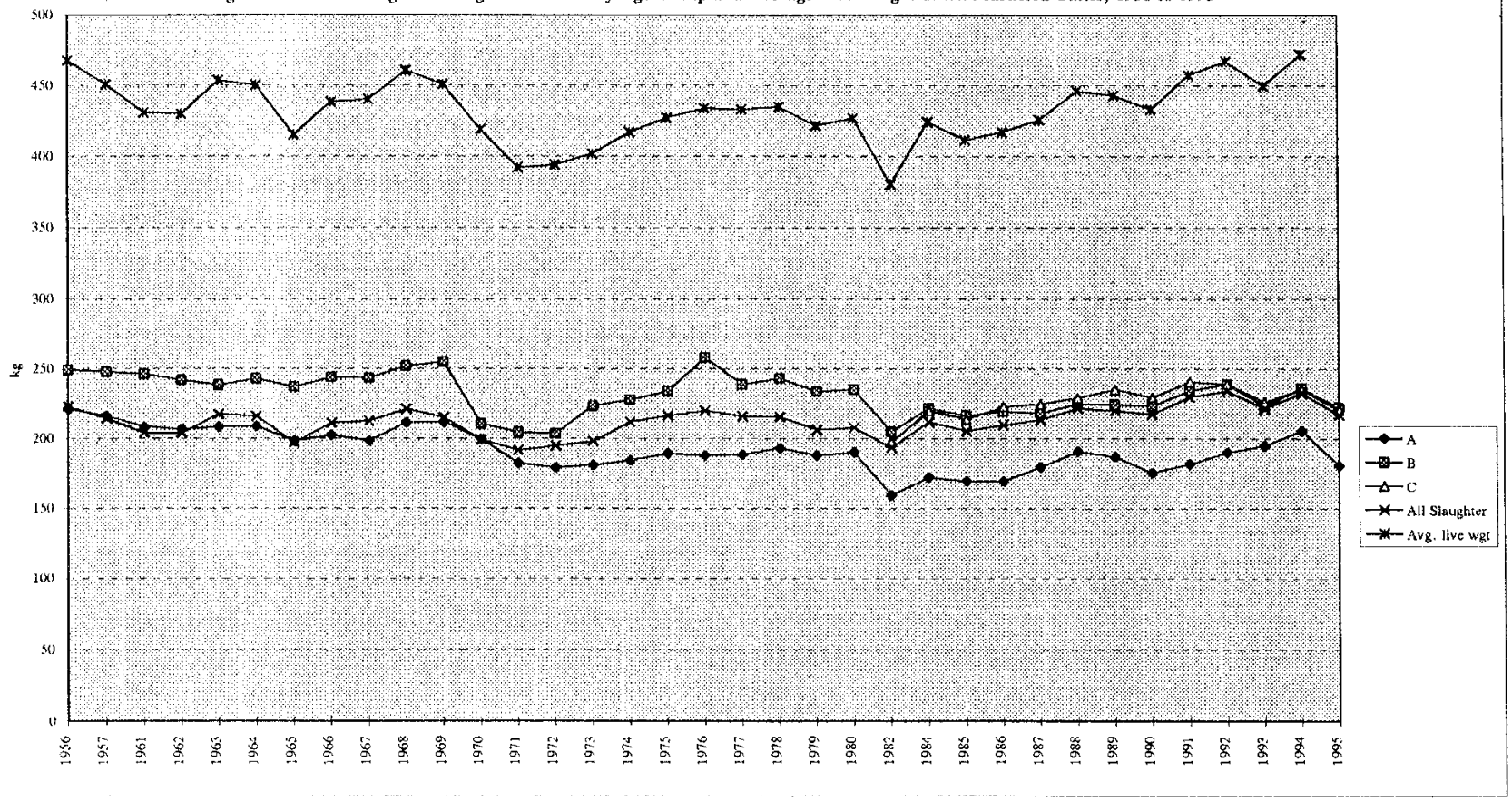
Weight of Domestically Slaughtered Cattle by Age Group, 1956 to 1994

Information about the weight of domestically slaughtered cattle is published for the period 1956 to 1994 by the Meat Board of Namibia in its *Annual Report*. The annual average carcass weight was calculated for each age group (A, B, and C) and for the average of all slaughtered cattle weighted by each age group's share of total slaughter. For analytical purposes, a "mixed age" group was defined for the period prior to 1982 since the grading system used before 1982 did not allow all carcasses to be clearly assigned to a specific age group. (The definition of each age group in terms of the grades from the different classification systems used from 1956 to 1994 are given in Appendix A. The share of carcasses in each age group is given in Appendix B.) The slaughter weight is converted to live weight by a factor of 2.1 (personal communication with staff of Meat Board, 1996).

The average slaughter weight of each age group of cattle varies considerably from year to year and is strongly influenced by rainfall; weight falls during periods of drought then gradually recovers (Figure 3). The slaughter weights of the three age groups are fairly similar, with the youngest age group, Group A, averaging about 10% less than the oldest, Group C, but not more than 20% less. Group C cattle, clearly distinguished from other age groups only from 1982 onward, are virtually the same weight as Group B cattle, indicating no economic advantage from a meat production point of view in delaying slaughter beyond 4 years; the Group C animals mainly represent breeding stock.

In order to distinguish long term trends from short-term variation in cattle slaughter weight, a linear trend line was estimated for each age group and for all slaughtered cattle over the period, 1956 to 1995. The trend line indicates a small increase (6%, from 206 kg to 219 kg) in the average carcass weight of slaughtered cattle of all ages between 1956 and 1994 (Table 1, part A, columns 1-3). Trends for each age group vary. Carcass weights for A and B Group cattle declined by 15% and 9%, respectively. Group C cattle carcasses increased by 15% from 209 kg

Figure 3. Carcass Weight of Slaughtered Cattle by Age Group and Average Live Weight of All Marketed Cattle, 1956 to 1995



Note: Carcass mass converted to live weight by a constant factor of 2.1.

Source: Authors' calculations, discussed in the text, based on data obtained from the Meat Board.

Table 1. Trends in Average Weight of Marketed Cattle by Age of Cattle, 1956 to 1994

Age	1956-1994 Average Carcass Weight (in kg) Initial year	Final year	Percent change	1956-1969 Average Carcass Weight (in kg) Initial year	Final year	Percent change
A. Slaughtered Cattle						
A Group	209	177	-15	206	213	-6
B Group	244	222	-9	245	246	1
C Group (1982-1994 only)	209	241	15	na	na	na
Mixed Age Group (1956-1980 only)	212	202	-5	215	207	-4
Slaughtered Cattle of All Ages (weighted average)	206	219	6	214	212	-1
	Average Live Weight (in kg) Initial year	Final year	Percent change	**Average Live Weight (in kg)** Initial year	Final year	Percent change
B. Marketed Cattle of All Ages (weighted average, slaughter plus live exports)	432	434	0	450	440	-2

na: not available.

Note: The figures were obtained from a linear trend line of actual slaughter weights reported in Figure 3 over the periods indicated. Figures for 1981 were not available. Carcass weight was converted to live weight by a factor of 2.1. See Appendix A for definition of age groups.

Source: Authors' calculations based on annual data from the Meat Board of Namibia.

in 1982 to 241 kg in 1994. However, data about C group cattle are only available from 1982; given the typical pattern of recovery of weight after a drought, the result for C Group cattle should probably not be interpreted as a long term upward trend or a trend that extends backward in time because the initial year, 1982, is an exceptionally low slaughter-weight year for all cattle as a result of the drought. The mixed age group, compiled for the years 1956 to 1980, show a small

decline in average weight, from 212 kg to 202 kg, but it is not possible to determine the extent to which this results from a change in age mix, or a change in average weight of animals for a given age mix.

Estimation of a trend line is very sensitive to the period covered. It has been suggested that the introduction of new, sometimes larger breeds of cattle was concentrated in the 1960's and that any increase of average weight would also be especially pronounced during that period. To test whether slaughter data support the hypothesis of an increase of average weight in the 1960's, trends in slaughter weight by age group were estimated separately for the period 1956 to 1969 (Table 1, part A, columns 4-6). The results of the estimate do not indicate any significant increase in weight. Over the period 1956 to 1969, the average weight of A group cattle declined by 6%, B group cattle increased by 1%, and average carcass weight of slaughtered cattle of all ages decreased by 1%.

Weight of All Marketed Cattle by Age Group: Domestically Slaughtered Plus Live Exports

We can only assume that the average size of animals in live herds increased by an amount similar to the 6% increase in average size of slaughtered animals if the age distribution of all production (including live exports) is similar to the age distribution of slaughtered animals. However, that is not the case. Older cattle account for a disproportionate share of slaughtered animals and weaners (Group A cattle) have constituted only 10-12% of domestic slaughter over the last twenty-five years, which is much less than their share in total marketed production and in herds. By contrast, the age distribution of live exports is markedly younger: two-thirds of the live exports were weaners in 1994, a share which has been fairly constant over time (personal communication with Meat Board staff, 1996). Because live exports account for a large share, often the majority, of annual production (averaging 50% of animals marketed each year), weaners, therefore, constitute a large share of total production. The importance of weaners in production would not be evident from the figures on domestic slaughter. Inferences about trends in live herd weight can only be made on the basis of trends in weight of total production.

The average weight of **all** marketed cattle, combining both domestically slaughtered cattle and live exports, cannot be estimated directly since no information is available about the weight of live exports. However, information about the age mix of live exports is available and it is reasonable to assume that, for a given age group, average cattle weight is similar for domestically slaughtered cattle and for live exports. The calculations described earlier in the subsection on methodology were carried out in order to estimate the average weight of **all** marketed cattle which is shown in Figure 3 with carcass weight converted to live weight by a constant factor of 2.1. A trend line estimated for the average weight of all marketed cattle indicates that there has been **no** change in the average weight of marketed animals over the period 1956 to 1994 (Table 1, part B).

It can be assumed that since the marketed cattle of various ages have not grown bigger over time, the average weight of their progenitors, cattle in the live herds, will also not have grown bigger. The shift toward marketing younger cattle (see Appendix C, Table C) also results in live herds which are, on average, younger and, consequently, somewhat smaller. We must look to reasons other than change in cattle weight to explain the declining numbers of cattle supported on commercial farms.

4. Herd Management and Productivity

A 50% decline in numbers of livestock, not compensated for by an increase in the average size of cattle or an increase in herd productivity, is a potential economic disaster (the real price of beef has not increased). However, the decline may represent a deliberate attempt by farmers to increase their herd productivity and farm profitability. If the high cattle stocking rate of 1960 was close to the limit of ecological carrying capacity, then herd production potential (breeding and weight gain) would be low. Reducing stocking rates should, in theory, bring this potential toward the maximum sustainable yield of both rangelands and herd. Carew (1976) and Danckwerts and King (1984) have provided the empirical evidence that these principles apply in semi-arid savanna ranching.

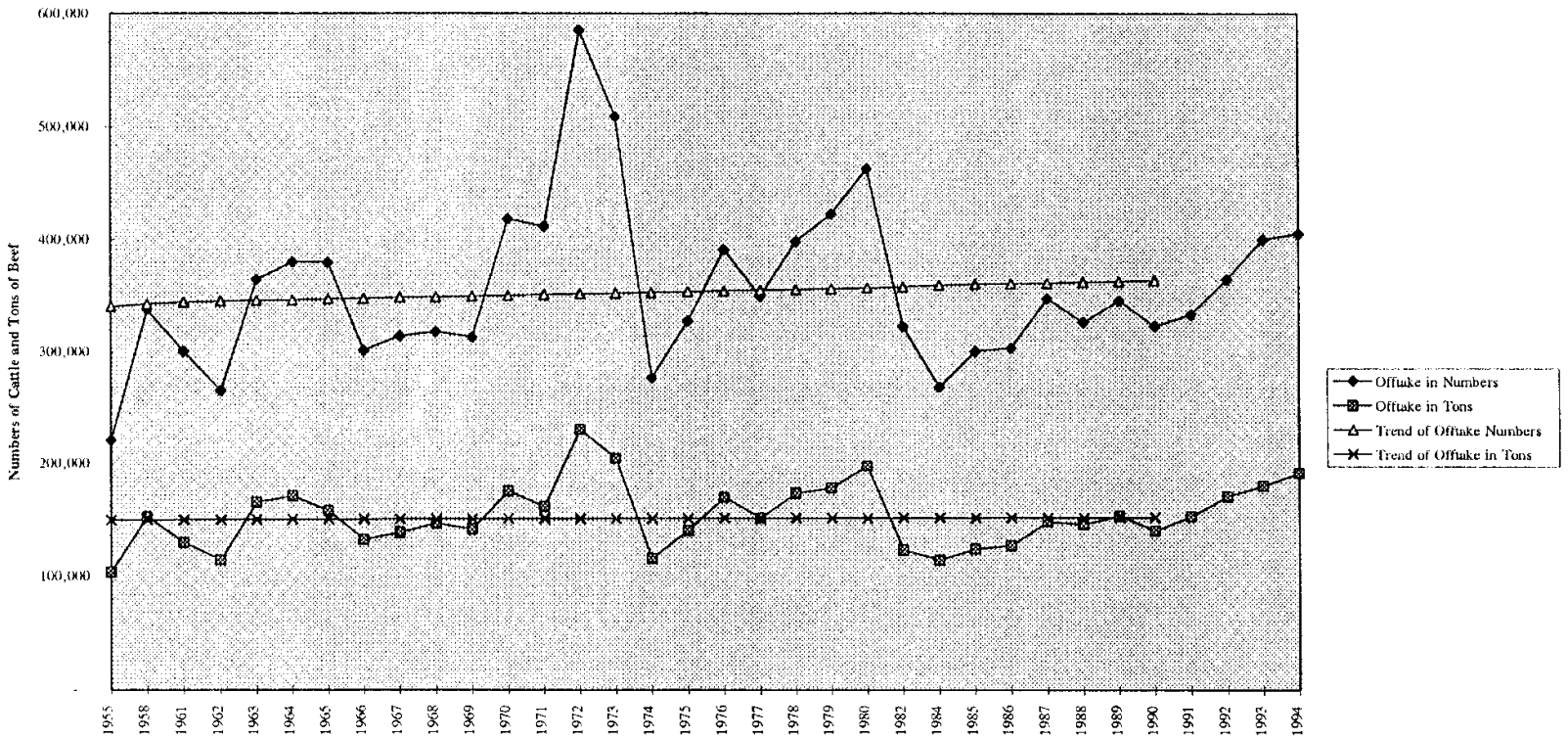
Figure 4 shows beef production measured both in numbers of cattle and in tons of beef from 1956 to 1994. Beef production measured in tons was calculated by multiplying the numbers of cattle marketed in a given year by the average live weight of an animal for that year, shown in Figure 3. Like herd size and average animal weight, beef production varies considerably over time, largely in response to rainfall. Trend lines calculated through 1990 (before the most recent drought) indicate that beef production has been relatively constant over the period: the number of cattle marketed has increased nearly 7% and the tonnage of beef marketed has increased about 2%, despite the declining numbers of cattle in herds. Both numbers of animals marketed and the tonnage of beef production increase sharply after 1990 as a destocking measure in response to severe drought. (They are not included in the trend line to avoid distortion.)

Of particular interest in Figure 4 is the offtake biomass which effectively shows the trend in beef production per unit of land since the amount of grazing land has remained constant. Beef production per hectare has remained constant over the 40 year period. The figures indicate that the decline in cattle numbers between the late 1950's and 1994 has been largely compensated for by an increase in herd productivity.

The constant level of beef production from a declining stock represents a large increase in herd productivity, measured as the turnover rate, the ratio of cattle offtake to numbers of livestock. Herd productivity was quite low in the 1960's, averaging around 15%, but rose steadily through the 1970's and 1980's to around 30% (Figure 5.A). Turnover rates of small stock exhibited a similar increase (Figure 5.B) suggesting a systematic change in farm management. The doubling of turnover almost precisely mirrors the halving of herd size.

Rates of offtake increased between 1960 and 1994 but fluctuated a great deal in response to changing weather conditions. The extremely high rates of offtake in the early 1970's, 1980's and 1990's represent de-stocking in response to droughts. De-stocking rates were considerably higher in the drought of the early 1970's than in the drought of the early 1980's even though the latter was termed the worst drought of the century. There are many factors which might explain the difference in de-stocking such as the difference in drought relief policies for the two periods. There is not enough information at this time to determine the reasons for variation in de-stocking rates.

Figure 4. Annual Beef Production in Numbers of Cattle and In Tons of Beef, 1955 to 1994



Source: Authors' calculations based on data obtained from the Meat Board of Namibia and assumptions regarding live exports discussed in the text.

Figure 5A. Numbers of Cattle and Herd Productivity in Commercial Areas, 1915 ro 1994

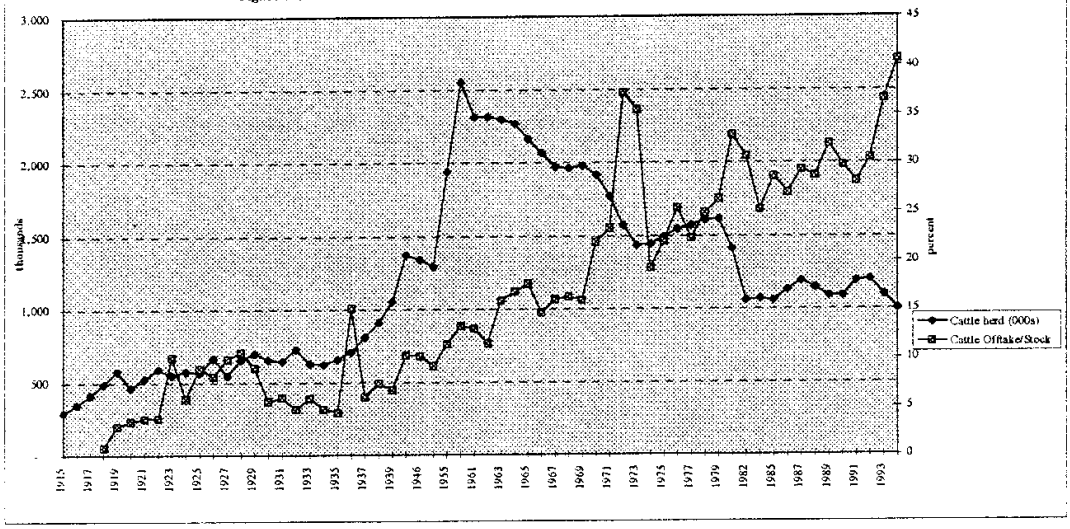
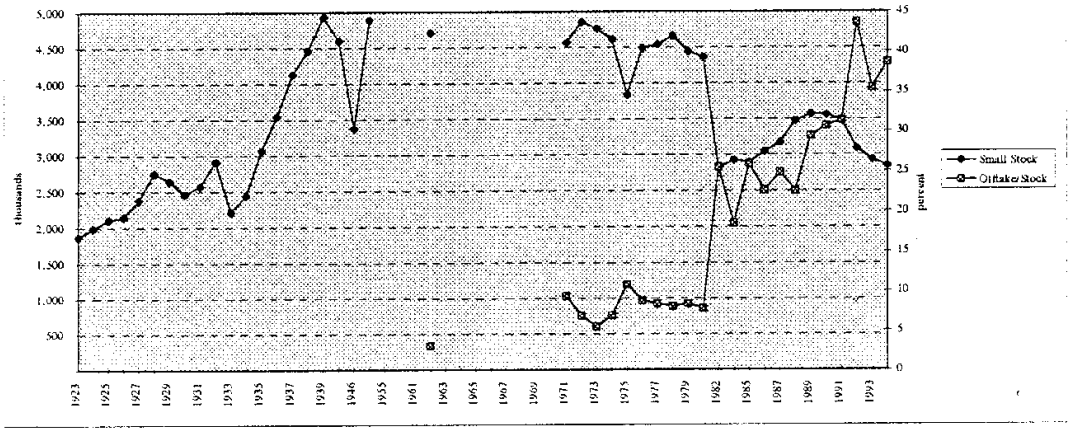


Figure 5B Numbers of Small Stock and Herd Productivity in Commercial Areas, 1923 to 1994



Notes: Livestock numbers not available for all years in the 1940s and 1950s.
Herd productivity calculated as the ratio of annual offtake to numbers of cattle.

Source: Livestock numbers for 1915-1992 from (Rawlinson, 1994). Livrestock numbers for 1993 and 1994 from Directorate of Veterinary Services.
Offtake obtained from annual production reported by the Meat Board of Namibia.

The decline in the number of cattle over the past 35 years has been continuous but uneven, punctuated by droughts. The economic stress brought on by droughts did not result in a significant consolidation of farms; the number of farm businesses remained virtually the same in 1975, 1982 and 1991 (Harrison, 1983; Rawlinson, 1994), but the number of farmers who rely on off-farm employment for a significant share of their income increased, growing to 25% in 1982 according to (Harrison, 1983). Figures are not available for later years but, in 1990, 40% of commercial farms were found not to be economically viable based on size and carrying capacity of the farm (Rawlinson, 1994, p. 105). It is likely that many of these farmers supplemented farm income by other farm activities like tourism or off-farm activities. This evidence suggests that there may have been a tendency for the financial well-being of livestock producers to decline over the past thirty-five years.

No evidence can be found for the contention that changes in cattle numbers in the commercial areas are the result of changes in market prices for cattle and cattle products. A regression analysis of factors affecting the number of cattle marketed in the northern commercial areas (Sartorius von Bach and van Zyl, 1990; Sartorius von Bach et al, 1992) could find no significant relationship for producer price. Similarly, our own preliminary regression analysis of the factors affecting cattle numbers found no significant response to product prices.

Els (1996), of the Ministry of Agriculture's Rangeland Research Division, provided a fairly detailed explanation for the decline in cattle numbers and the increase in turnover rates between 1960 and 1995. During this period, the production system changed from one in which mostly oxen, six to eight years old, were sold, to one in which younger cattle, predominantly weaners for export, are sold. Further, data from the national performance testing scheme show that, over the period, there has been an increase from 50% to 65% in the calving rate of the national commercial cattle herd. Els attributes these changes in part to the national extension efforts aimed at persuading farmers to adhere to recommended stocking rates, to improve herd fertility, to improve animal growth rates, and to sell progeny at a younger age. Els also reported that rangeland degradation through bush encroachment had reduced cattle carrying capacities, though no quantitative measures were provided to substantiate this.

Els' explanation and the advice of the extension officers are consistent with the change in opportunities for farmers in Namibia over the past few decades. Up until 1960, livestock production was increased by opening up new land to grazing, either by acquiring title to land (in the early part of the century), or by establishing more water points which allowed more intensive use of existing grazing lands. That source of increased production was largely exhausted by 1960, so, after that time, farmers who wanted to improve profitability had to revise the livestock management system in order to make better economic use of grazing land (Benhke, 1997).

In an attempt to test the validity of the explanation given by Els we developed a simple spreadsheet model of the national commercial cattle herd for the period between 1964 and 1994. The parameters of the model represented Els' assumptions about changing calving rates for heifers and cows (increased from 50% to 65%) and the average age of progeny sold (decreased from six years to one year). The model also assumed that the culling rate for breeding cows increased from 12% to 18%, that the calf mortality rate decreased from 11% to 8%, and that the bulling rate improved from 9% to 5% over the 30 year period. The model provides results remarkably consistent with those in figure 5A, in that stock numbers declined from 2,350,000 to

40% of this (1,075,000), and the turnover rate (by number) increased from 14% to 30% over 30 years. Though significant improvements in management have increased herd productivity, under good conditions of herd management and nutrition, calving rates of 75% or 80% should be possible[3] (Rawlinson, 1994, p. 94). Higher calving rates would provide higher levels of beef production than are currently achieved. In the next section, we consider the possible role of worsening environmental conditions in preventing higher calving rates.

5. Changing Rainfall and Land Degradation

Although cattle productivity has increased along with the decline in numbers, it has not increased to ideal levels (calving rates of 75-80%). This suggests the possible influence of deteriorating environmental factors including declining rainfall, and or, range degradation. Bush encroachment is widely recognized as a growing problem in commercial areas that reduces cattle carrying capacity. It may well be the case that, given the improvements and investment in agriculture over the past three decades, the land should have been able to support higher levels of production rather than simply being able to maintain constant levels of production. The evidence for two forms of worsening environmental conditions are considered here: a decline in rainfall and land degradation.

Decline in Rainfall

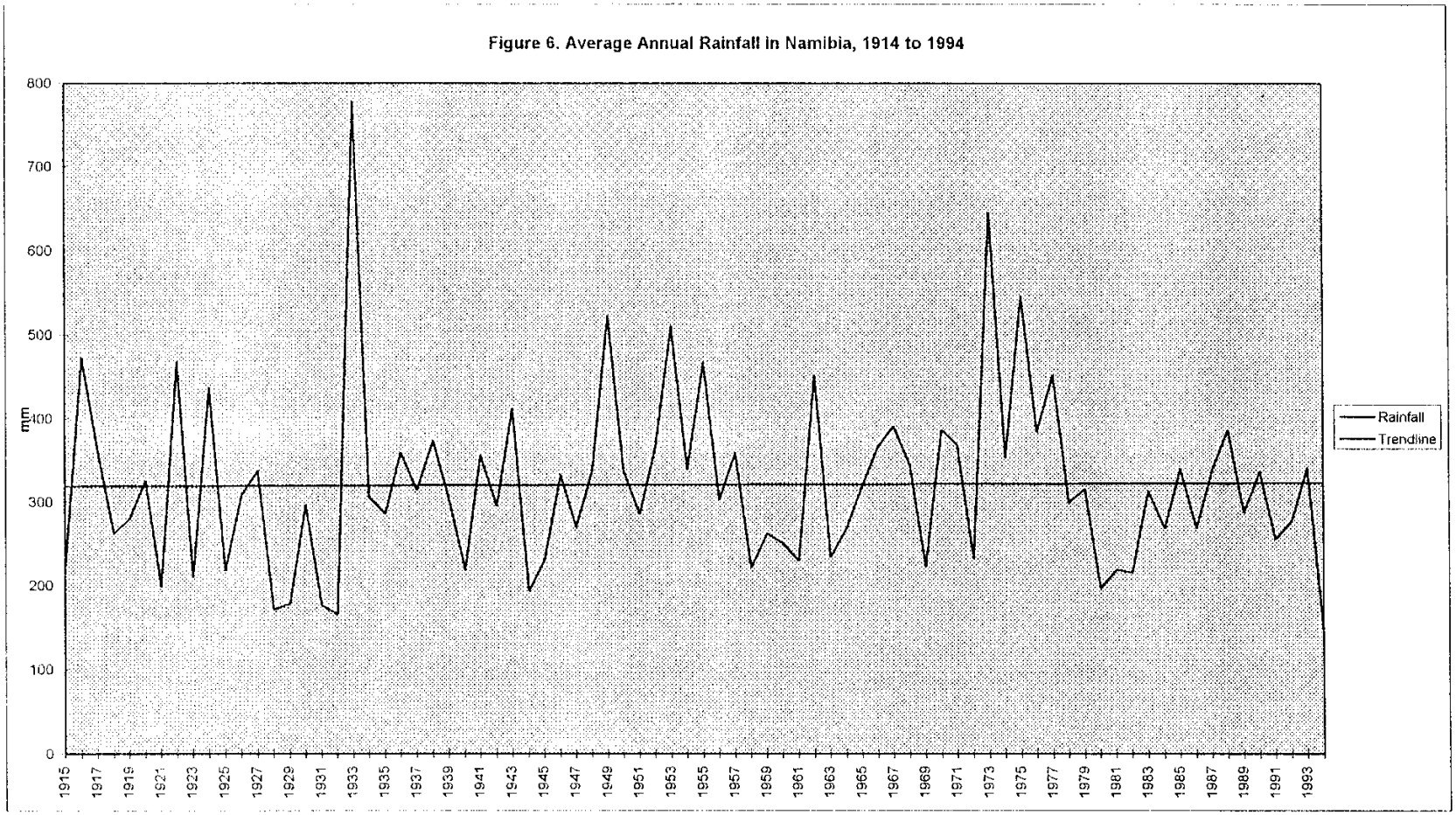
The possibility of a long-term decline in average rainfall in Namibia and the resulting decline in rangeland carrying capacity is a serious concern. Speculation about the possible worsening of Namibia's climate is not new. Writing in 1949, the Long-Term Agricultural Policy Commission (1949, p. 13) asserted that there was no doubt that the land had become more arid since European settlement in terms of reduced flow from springs, increasingly intermittent flow of streams and rivers, and falling water tables in boreholes. However, it is not easy to assess whether Namibia's rainfall patterns are changing for the worse because normal rainfall patterns are so erratic that the rainfall record may not yet be long enough to determine what the true patterns really are, e.g., the cycles of rainfall and drought, long-term average and median rainfall, seasonal and geographic distribution, recharge of groundwater, etc. Furthermore, the response of plant species used by livestock to the rainfall patterns is also not well understood.

Analysis of annual rainfall records for more than 200 meteorological stations from 1914 to 1994 (Figure 6) reveals no long-term decrease in rainfall; the trend line has been flat. The trend line calculated for the period of declining cattle numbers, 1960 to 1995, shows a decline in average rainfall of some 15%, but is not statistically significant. Els (1996) suggested that the peak numbers of cattle observed in the late 1950's reflected stocking rates appropriate to carrying

[3] While (Rawlinson, 1994, p. 94) reported an 80% calving rate as the potential standard for Namibia, it is not clear whether this level of technical efficiency is also the most economically profitable calving rate, given the product prices and input costs Namibian farmers face (Benhke, 1997).

capacity during that relatively wet decade and farmers' optimistic expectations that this represented "normal" rain patterns. He considered that the subsequently drier weather including several severe droughts have gradually convinced farmers to stock cattle at the lower rates

Figure 6. Average Annual Rainfall in Namibia, 1914 to 1994



Note: Rainfall records were supplied by less than 100 stations before 1929, about 150 stations from 1929-1950, and over 200 stations since then.

Source: unpublished data from the Weather Bureau of Namibia.

appropriate to carrying capacity during dry years. Results of our own preliminary regression analysis of factors affecting changes in the number of cattle indicate a significant response to rainfall, particularly with a two year lag. This is confirmed by the results of a study of factors affecting the supply of cattle and beef in the northern commercial areas (Sartorius von Bach and van Zyl, 1990; Sartorius von Bach et al, 1992). Thus, there seems to be a short term effect of rainfall on stock numbers, but the more than 50% drop in number over the period can only in small part be due to the effect of rainfall.

The extent to which rainfall has played a part in the large decline in stock numbers over the last 30 years cannot be determined. Further analysis of rainfall patterns for factors related to carrying capacity that are not revealed by trend line analysis is needed. These factors include spatial variability of rainfall, and the frequency, severity, and duration of droughts. In addition, study is needed of the critical factors that transform rainfall into carrying capacity, e.g., groundwater recharge and productivity of specific plant species. Olszewski (1996) provides an example of such research currently in progress.

Land Degradation

There is considerable disagreement about the nature and extent of rangeland degradation in Namibia. Anecdotal evidence for land degradation exists and Namibia has an active program to combat desertification (NAPCOD), but little systematic information has been collected and there are no reliable time series which could be used to assess the extent and the rate at which land degradation may be occurring, or to determine whether apparent changes in the land are part of a natural cycle or the result of poor management practices. Results from research on changes in rangeland condition under recommended stocking rates in the Kalahari duneveld habitat (a savanna habitat found in the south east of the commercial areas) suggest that the herbaceous component of the vegetation is resilient (Fourie et al, 1987). It appears that deterioration in the herbaceous species composition occurs during dry cycles, but that this tends to be reversed during wet cycles. The one phenomenon for which there is widespread agreement is bush encroachment, the replacement of plants suitable for grazing by types of bush (mostly *Acacia mellifera* and *Dichrostachys cinerea*) which are inedible to cattle or sheep (Adams and Werner, 1990). Bush encroachment is largely confined to commercial farming areas and is attributed to factors such as the suppression of veld fires, the absence of browsers, overgrazing and poor management of livestock.

Despite a great deal of discussion and anecdotal evidence about bush encroachment and speculation about its impact on carrying capacity, there has been little systematic effort to measure the phenomenon. There has been only one attempt, in 1986, to quantify bush encroachment (Table 2). It seems likely that land degradation in the form of bush encroachment has at least to a small extent been an influence in the reduction of cattle numbers. However, until estimates of bush encroachment are available for at least several points in time so that comparisons can be made, the role of bush encroachment in causing the decline in numbers of cattle cannot be determined.

Table 2. Bush Encroachment in Commercial Farming Areas (thousands of hectares)

District	Land Area	Percent Infested by Bush
Grootfontein	2,565	80%
Tsumeb	894	90
Otjiwarongo	1,955	75
Outjo	2,628	50
Okahandja	1,432	50
Gobabis	4,039	50
Omaruru	850	50
Total	**14,363**	**8,628**

Source: Die Rooivleisproduksiebevorderingskomitee, 1986.

6. Conclusions

Livestock numbers in the commercial areas of Namibia increased during the first half of the century (1915 to 1960) as new farming land was settled and developed. Thereafter, stock numbers on this land have steadily declined, despite continued intensification of water provision. In the case of cattle, numbers have declined to some 40% of those present in 1960. Dean and Macdonald (1994) found a similar pattern for the savanna areas they studied in the North West and Northern Cape provinces in South Africa. They attributed the stocking rate declines to rangeland degradation. They deduced that farmers tend to stock at the maximum rate possible and that stock densities have been driven down by reductions in range productivity. Among the factors considered in their study, they examined the possibility that stocking densities may have been lowered to reduce losses during frequently occurring droughts and to improve the quality of the rangeland, which, in turn, improves the ability of herds to withstand drought. This hypothesis was rejected because Dean and Macdonald found that state aid and insurance schemes actually provided incentives for overstocking. However, they did not explicitly examine turnover rates and the possibility that stocking densities may have been reduced to increase herd productivity.

Quan et al. (1994), based on interviews with a small number of commercial farmers and agricultural extension officers in the northern Namibia and a review of the literature, found that stocking densities were much lower than they had been 20 years ago. Quan et al. interpreted the decline in stocking density as a loss of productivity mainly attributable to bush encroachment; they did not determine whether turnover had also declined over this period. However, as Benhke and Abel (1996, p.18) point out, land degradation and loss of productivity are better measured in terms of changes in **output** per hectare, rather than changes in **stocking densities**. Stocking density is a poor indicator of productivity because of the relationship between livestock population size and population growth rate: as the stocking rate rises, competition for fodder increases and, as a consequence, the reproductive rate declines and mortality increases. For

farmers whose objective is beef production, lowering the stocking density can be a way to increase turnover and profitability by raising reproductive rates and lowering mortality.

In the case of Namibia's commercial cattle farms, output, measured by annual offtake per hectare, has not declined over this period, so there is no strong evidence for loss of productivity in the cattle-producing areas. While it is impossible to determine the primary factor involved, it would seem that there has been a deliberate de-stocking on the part of farmers in a process whereby herd productivity has increased. Despite this, beef production per unit of land has remained static and has not reached the potential standard for the beef industry (in terms of calving rates). Range degradation (bush encroachment) and, possibly, changes in rainfall may be contributing factors to this situation. Without range degradation and a decline in effective rainfall over the period, it can be hypothesised that herd productivity might have increased to higher levels, and beef production from the land could have improved.

The decline in cattle numbers appears to have levelled off in recent years and may represent an adjustment to stocking rates that are economically and ecologically appropriate in the longer-term for Namibia's climate. Of course, if land degradation worsens, the current stocking rates will not be appropriate in the future. Also, as the economic conditions mentioned at the beginning of this paper change, the economically appropriate stocking rate may change as well.

Measurements of land degradation and the extent to which it has increased over the last 30 to 40 years could be used to estimate the loss of carrying capacity and of livestock production nationwide. The cost of land degradation in terms of lower annual production can then be calculated. This information is indispensable to assess rangeland management strategies that are likely to be ecologically and economically viable for farmers in the future, including not only options for livestock production, but alternatives such as mixed livestock/wildlife ranching, or other tourism-related activities. These results will also have important implications for broader policy as well, such as land reform, drought policy, and agricultural trade policies. The Namibian Programme to Combat Desertification has agreed in principle to attempt to estimate this based on analysis several sources of data including aerial surveys at decade intervals and an analysis of representative farms. When this information becomes available, the long-term policy issues can be addressed.

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Appendix A. Correspondence Between Age Groups of Cattle and the Cattle Carcass Grading Systems Used in Namibia, 1956 to 1994

Four grading systems were in use over the period 1956 to 1994. The current grading system establishes grades for each age group and within each age group for different carcass conditions; each carcass can be associated with an age group. In earlier years, grading was based mainly on the condition of the carcass so that, for example, carcasses with similar fat content might receive the same grade even though one might be a weaner and the other a five year old cow. Consequently, a large number of slaughtered cattle in the period 1956 to 1981 had to be assigned to a "mixed age" group (see Table B). Age group is defined in terms of number of permanent teeth:

A group has no permanent teeth
B group has 1-6 permanent teeth
C group has 7 or more permanent teeth

Table A: Correspondence between age groups and cattle carcass grading systems, 1956 to 1994

Grading System	Group A	Group B	Group C	Mixed Ages
1992 to present	A0 A1 A2 A3 A4 A5 A6	B0 B1 B2 B3 B4 B5 B6	C0 C1 C2 C3 C4 C5 C6	
1982-1991	Super A A1 A2 A3	Prime B B1 B2 B3	Top C C1 C2 C3	Grade 4
1970 to 1981	Super Prime A Grade 1-A	Prime B Grade 1-B		Grade 1-C Grade 2 Grade 3 Grade 4
1956 to 1969	Super Prime A	Prime B		Prime C Grade 1 Grade 2 Grade 3 Grade 4 Grade 5

Source: Annual Reports of the Meat Board, Government Gazette (25 June, 1996; 8 May, 1981; 1 August, 1980; 22 December, 1972; 15 March and 24 May, 1968; 17 August, 1962) and personal communication with staff of the Meat Board.

Appendix B. Distribution of Cattle Slaughtered in Namibia by Age Group, 1956 to 1994

The shares of total slaughter by age group are calculated from data obtained from the Annual Report of the Meat Board based on the correspondence between age group and carcass grading systems given in Appendix A. Annual Reports are could not be obtained for all years. The final column in Table B indicates the share of total production for which grading was reported in the Meat Board's Annual Report. In the 1950's and 1960's since much of the cattle was slaughtered in South Africa, the grading report included cattle exported live and slaughtered in South Africa in addition to cattle slaughtered in Namibia. Cattle exported live for finishing were not included. In later years, only cattle slaughtered in Namibia at MEATCO (or its equivalent) are included.

Table B: Distribution of cattle slaughtered in Namibia by age group, 1956 to 1994 (in percentages)

	A	B	C	Mixed ages	Total	Other	Graded Carcasses as a Percent of All Marketed Cattle
1956	1	2		94	98	2	66
1957	1	1		97	99	1	76
1958	-	-	-	-	-	-	
1959	-	-	-	-	-	-	
1960	-	-	-	-	-	-	
1961	1	1	na	95	97	3	64
1962	1	1	na	96	98	2	63
1963	1	1	na	96	98	2	71
1964	2	2	na	95	98	2	62
1965	1	1	na	95	98	2	59
1966	4	3	na	91	98	2	54
1967	6	5	na	85	97	3	66
1968	12	20	na	68	99	1	66
1969	17	18	na	62	97	3	63
1970	11	12	na	72	95	5	25
1971	5	15	na	77	98	2	10
1972	6	17	na	73	97	3	27
1973	7	16	na	74	97	3	36
1974	7	24	na	66	97	3	23
1975	9	28	na	61	98	2	24
1976	9	25	na	63	98	2	33
1977	10	27	na	61	98	2	43
1978	8	24	na	66	98	2	40
1979	7	18	na	73	98	2	46
1980	8	24	na	67	99	1	49
1981	-	-	-	-	-	-	-
1982	7	26	57	8	97	3	43
1983	-	-	-	-	-	-	-

1984	15	37	44	2	97	3	58
1985	18	40	38	2	98	3	54
1986	18	48	30	3	99	1	53
1987	14	55	27	2	97	3	47
1988	14	54	29	1	98	2	51
1989	16	53	28	2	99	1	53
1990	15	51	31	1	98	2	55
1991	11	57	30	1	98	2	59
1992	10	64	24	0	98	2	57
1993	9	59	30	0	98	2	55
1994	10	58	29	0	98	2	53
1995	12	60	26	0	98	2	na

na: not available

-: data for these years not available.

Note: Other cattle includes condemned carcasses.

Source: Annual Reports of the Meat Board.

Appendix C. Estimated Distribution of All Marketed Cattle by Age Group, 1956 to 1994

The age distribution of all marketed cattle was calculated as the weighted sum of the age distribution of slaughtered cattle and the age distribution of live exports, the weights equal to the respective shares in total annual production of slaughter and live exports. The shares of domestic slaughter and of live export in total annual production are available from the Meat Board's Annual Report. As discussed in the text, the age distribution of domestically slaughtered cattle is also provided by the Meat Board. Information about the age distribution of live exports is available for recent years only. Weaners account for two-thirds of all live exports and it is considered that this share has been fairly constant over time (personal communication with Mr. J. van der Merwe, Meat Board).

Table C: Estimated distribution of all marketed cattle by age group, 1956 to 1994 (in percentages)

	A	B	C	Mixed ages	Total
1956	24	2	na	74	100
1957	17	1	na	82	100
1958	-	-	-	-	-
1959	-	-	-	-	-
1960	-	-	-	-	-
1961	25	1	na	75	100
1962	25	1	na	74	100
1963	20	1	na	79	100
1964	26	1	na	72	100
1965	28	1	na	71	100
1966	33	2	na	65	100
1967	27	4	na	68	100
1968	31	16	na	54	100
1969	36	15	na	50	100
1970	53	7	na	40	100
1971	62	6	na	32	100
1972	52	9	na	39	100
1973	47	9	na	44	100
1974	56	12	na	32	100
1975	57	13	na	30	100
1976	52	14	na	34	100
1977	46	16	na	37	100
1978	48	14	na	38	-
1979	44	11	na	45	100
1980	43	15	na	42	100
1981	-	-	-	-	-
1982	48	15	33	4	100
1983	-	-	-	-	-
1984	43	26	30	1	100

1985	47	26	25	1	100
1986	49	31	19	2	100
1987	51	32	16	1	100
1988	49	33	18	0	100
1989	49	33	17	1	100
1990	47	32	20	1	100
1991	42	37	20	0	100
1992	44	41	15	0	100
1993	45	36	18	0	100
1994	48	35	17	0	100
Average, 1970-1994	**49**	**22**	**21***		

*average for 1982 to 1994 only.
na: not available

-: data for these years not available.

Notes: The figures are weighted for both Namibian slaughter and live export.
Though information about slaughter weight was available for 1995, calculations could only be made through 1994 because complete information about production was not available.

Source: Figures are calculated using methods described in the text, based on data obtained from the Meat Board's Annual Reports and unpublished information.