Supply Response, Demand And Stocks For Southern African Beef

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SECTION 1

1. BACKGROUND

1.1 Introduction

Beef is an important agricultural product in Southern Africa in terms of resource utilisation. It is also an important export product for some of the countries. Namibia, Botswana, Zimbabwe and Swaziland have been allocated quotas for beef exports to the European Union (EU) under the Lomè Convention. With eminent trade liberalisation resulting in the lowering of import tariffs by many countries, new markets are opening up. If the Southern African countries can realise their full production potential, increased beef production and exports could stimulate economic growth, export earnings and development.

There are, however, several factors limiting their ability to realise this potential, such as the low technical efficiency achieved in cattle farming, low off-take rates and a land tenure system which is not conducive to stimulating farmers to conserve the grazing resource and to genetically improve their herds. In addition to this, the disease status of some countries, especially Zambia where foot-and-mouth disease is endemic, does not allow them to export to some of the most lucrative markets such as the EU and the Eastern countries.

Beef has always played an important role in food consumption patterns. However, the demand relationship has changed over time, i.e. the per capita consumption and real retail price fluctuate. In some countries, governmental price subsidies have stimulated the demand for beef and after omittance of subsidies, consumption dropped considerably. In many countries, beef is regarded as a luxury, while in the arid regions, poor rural communities depend on beef and milk as important elements in their diet.

Beef trade requirements have changed considerably over the past years. Countries dependent on beef exports have to adjust to maintain their trade or else will loose foreign markets. It is expected that from the year 2000 extremely

rigorous export standards will be imposed on third world countries, including South Africa, Botswana and Namibia.

1.2 Production

In most parts of Southern Africa cattle farming constitutes a significant proportion of agricultural activities and contributes largely to the sustenance of rural populations. In all these countries there are two systems of cattle farming, namely commercial farming and communal farming. In the former cattle are grazed on fenced grazing land. Range conservation and herd improvement measures are taken, and these herds achieve higher technical efficiency than those achieved by the communal farming systems. In the communal areas, cattle are grazed on unfenced grazing land. This system is characterised by over grazing, low off-take rates, low technical efficiency measures in terms of calving rates, mortality rates, etc. The proportion of communal versus commercial farming in Southern Africa is summarised in Table 1.1.

Table 1.1 Proportion of cattle owned by communal versus commercial farmers in Southern Africa

Country / region	Proportion of cattle kept under commercial system (%)	Proportion of cattle kept under communal system (%)
SA: Mpumalanga	88	12
SA: Northern Province	49	51
SA: North-West Province	69	31
Botswana	20	80
Lesotho	Na	na
Namibia	50	50
Swaziland	20	80
Zambia	20	80
Zimbabwe	25	75

Sources: Nepru, 1997: 29; National Department of Agriculture, 1996; Economist Intelligence Unit, 1996b:73-76.

Besides overgrazing and consequent nutritional stress of the animals, diseases are an important constraint to cattle production in Southern Africa. Foot-and-mouth disease occurs in all the countries. Pleuropneumonia and trypanosomiases also occur in Namibia and Botswana, and east coast fever in Swaziland. Due to diseases Zambia is not allowed to export beef to either South Africa or the EU, and Zimbabwe cannot export its beef to South Africa. In addition to these constraints, the Southern African region is also subject to periodic droughts and variable rainfall.

In many communal areas it was found that beef supply was only determined by cattle numbers (Van Renen, 1997). Cattle numbers were not adjusted according to environmental factors. However, according to the institutional set-up, some farmers did respond to economic variables such as prices, while others did not. Various studies proposed a negative response to prices. It is argued that communal farmers consider their cattle as a store of wealth, and they are only sold to meet immediate cash needs. Increased prices therefore allow the farmer to meet his cash needs by selling fewer cattle. Prompt payment was mentioned to be very important, and accounted for a high percentage of cattle being sold at auctions. Few communal herders in Botswana were, however, found to respond positively to prices. The limited access of the small herders to the high priced markets indicated that the problem with low off-take rates lies not with price responsiveness, but rather with the market. The herders' willingness to sell is affected more by the promptness with which they are paid than the price they receive, which is indicative of some deficiency in the marketing system. Based on the fact that small herders are price responsive, but that they have limited access to the best paying markets, it was concluded that, if they could be granted improved access, their off-take rates would increase.

It is known that cattle numbers in communal systems vary considerably from time

to time. Several paradigms have been put forward to explain these variations, including the “Tragedy of the Commons” paradigm which holds that cattle accumulation is encouraged by a divergence between private and social costs, the “Cattle Complex” argument which holds that cattle are kept primarily for their religious and social value, the “Store of Value” literature which argues that cattle are held as a store of value and are only sold to meet cash needs, the “Precautionary Motive” argument which dictates that herds must be large in order to overcome uncertainties and natural disasters, and the “Market Structure Conduct and Performance” literature which blames the high cattle numbers and low off-take rates on market imperfection and infrastructural constraints.

Cattle are accumulated beyond the carrying capacity of the land for several reasons. These factors include the possible negative price responsiveness of communal farmers and the fact that their cattle are considered as a store of wealth. In addition, herders try to build a herd large enough to have a breeding core that can be sustained during drought while still being able to meet household needs for herd products such as draught power and milk. The low elasticity of product substitution of land used for livestock combined with excessive government subsidisation eg of the Botswana livestock industry, inaccessibility of the best paying marketing opportunities, a complicated price system and lack of land rights are further contributing factors. Some researchers, however, argue that the current productivity of grazing land is not necessarily lower than that of similar quality land elsewhere. Communal grazing land is not characterised by open access, as a substantial proportion of rural households do not own cattle. Most cattle owners have small herds, and the herd sizes change little over time, which does not substantiate the argument that individuals have an incentive to increase their herds. The communal system proved to be sustainable, with the herd providing a stable flow of animals for home slaughter over a period of time.

In African pastoral economies, it was observed that the national herds vary in a saw-tooth fashion. There is a continuous herd increase beyond the carrying capacity of the land, and drought and disease are the only factors that can inhibit

this relentless herd increase. Once forage shortage sets in, animal mortalities increase, resulting in a decrease in the population. As herds decrease, the land recovers, thereby triggering another increase in the herd sizes.
In the commercial farming areas, in general, both rainfall and cattle numbers are major determinants of beef supply. Economic aspects are determining factors in beef production under a specific institutional set-up. However, cattle numbers were generally found to be mainly determined by weather conditions. Periods immediately following droughts were characterised by a sharp increase in cattle numbers and a decrease in off-take.

In general, off-take decisions are motivated by a diversity of factors. The availability of a marketable surplus and alternative sources of income were found to determine off-take rates, e.g. in Botswana. Small herders were shown to be price responsive, but access to markets was a constraint in some cases. In Bophutatswana it was also found that herd size affects off-take, as this determines the availability of a marketable surplus.

Two major aspects that define the difference between herders with regard to off-take rates are land rights and access to factor markets. The group with clearly defined land rights and who have access to factor markets are regarded as as profit maximisers whose cattle production activities are governed by weight gain and beef production. Access to factor markets enables this group to separate its consumption decisions from its beef production activities. On the contrary, the group that does not have exclusive land rights and has no access to factor markets are regarded as having no control over their herd weight gain and being unable to separate their production activities from their consumption decisions.

1.3 Consumption

The consumption of red meat varies considerably by species. In general, the per capita consumption of red meat and specifically of beef has decreased during the past decades, while the consumption of poultry and pork increased. The reason for red meat consumption trends lie in the income elasticities of the meats,

changes in tastes and preferences associated with socio-demographic trends of consumers, and the changing livestock production systems. These trends have had a major influence on prices of beef.

In South Africa, the market share of beef has declined to 25 per cent of total meat consumption. The retail prices of beef have declined in real terms and are to a certain extent determined by poultry retail prices. Since the poultry industry experiences survival problems due to competition of cheaper foreign products, the retail beef prices are affected, i.e. the real prices decrease. World market prices increasingly have a greater effect on the beef industry than during the existence of the regulatory boards. Aspects such as the economic climate, and global trends now affect Southern Africa to a greater extent.

1.4 Marketing and trade

International trade liberalisation and domestic food policy reform are likely to have a large impact on the beef industry in Southern Africa. Therefor, the impact of variables, such as tariffs, exchange rates, etc which could affect the industry should be assessed and quantified.

In South Africa, Zambia and Zimbabwe, meat marketing has been deregulated over the past few years. South Africa introduced a new Marketing of Agricultural Products Act, in terms of which the Meat Board will be closed and its functions privatised. In Zambia and Zimbabwe the Cold Storage Board of Zambia and the Cold Storage Commission, respectively, still play a role in beef marketing, but deregulation has stimulated private sector initiative in the meat marketing and processing sector. In Botswana the Botswana Meat Commission was established to purchase and slaughter livestock and process the meat in the best interests of the livestock industry of Botswana. In Namibia the Meat Board and Meatco perform similar functions. In Lesotho, marketing is controlled in various ways. This causes several distortions which inhibit private sector led trade, marketing and processing. In Swaziland, Swaziland Meat Industries handles commercial slaughterings.

The beef export quotas to the EU under the Lomè Convention stresses the importance that Botswana, Namibia, Swaziland and Zimbabwe have to adhere to strict measures to maintain animal health regulations. The preferential access will be lost if regulations are not complied. South Africa recently obtained partial foot-and-mouth disease free status. However, in terms of its qualified Lomè membership, it will not be granted a duty rebated export quota to the EU. Zambia does not have export status to either the EU or South Africa, due to its disease status and the poor standard of its abattoirs.

1.5 Outline of study

The purpose of this study is to determine the potential beef supply of the Southern African region, and to identify the factors that need to be addressed in order to realise this potential. In addition the study aims to determine the supply response of beef producers to both beef prices and climatological factors such as rainfall. This is necessary for policy formulation and marketing strategies if regional governments want to stimulate off-take rates. In order to determine the supply response to various factors, regression analysis is used as a tool to analyse time series data.

The demand side of the equations is addressed through demand analysis. Results of the demand side are necessary to determine consumer preferences and changes. Different methods are followed to determine some income and price elasticities of demand. The demand side is assessed in section three.

Beef trade is briefly assessed by making use of existing literature. This is of special relevance due to the liberalisation of agrarian policies. Results of previous sections will be used to predict future production and trade possibilities.

SECTION 2

2.1 BEEF PRODUCTION POTENTIAL IN SOUTHERN AFRICA

2.1.1 Introduction

Fourie (1972) reported a study on the meat production potential of Lesotho, Botswana and Angola. A similar study was done by Jamneck (1972) for Swaziland, Mozambique, Zimbabwe and Malawi. They determined the factors influencing meat production potential, and categorised them:

- Natural factors, which include topography, land area, climate, soil and vegetation, diseases and pests, type of cattle and their ability to adapt to prevailing conditions, and availability of water.
- Economic factors, including marketing organisation, transport facilities and distances to markets, slaughter- and export facilities, markets, and economically inviable herd sizes.
- Sociological factors, e.g. land rights and distribution of population, anthropological factors and extension.

Natural factors determining production potential are of a permanent nature and mainly influence the carrying capacity of the grazing land. In addition to climatic conditions, the ability of cattle to walk long distances and tolerate high temperatures is imperative for optimum production. The colour and texture of hair covering is also important, as this is an indication of their ability to reflect heat. Cattle that are not well adapted to the natural conditions will result in lower production and lower carcass weights. In cattle that are not well adapted, both appetite and fertility are also negatively influenced by high temperatures (Fourie, 1972: 30-31).

Cattle farming in Southern Africa mainly takes place on natural grazing. Southern Africa can be divided into farming regions based on certain natural features. Through significant regression analyses by Jamneck (1972: 75-86), it was determined that the carrying capacity of the natural grazing in Southern Africa is determined by rainfall, variation in rainfall, altitude, latitude and average

temperature. Elasticities were determined which illustrate that, if rainfall increases by 1 percent, the hectares per large stock unit (ha/LSU) required decreases by 0.5 to 0.8 percent. Should the variation of rainfall increase by 1 percent, the required ha/LSU will increase by 0.2 to 0.4 percent. A 1 percent increase in altitude will lead to a 0.3 to 0.9 percent increase in ha/LSU required. An increase of 1 percent in latitude is associated with a 0.7 to 1.2 percent decrease in ha/LSU required. With a 1 percent increase in average temperature, 1 to 1.7 percent more ha/LSU will be required. Based on this, the carrying capacity will be highest in areas with high rainfall, little variation in rainfall, at low altitude, as far east as possible and at low temperatures.

Natural conditions such as rainfall, temperature, soil type and stocking rates are determining factors of grazing quality and therefore of feeding conditions. Feeding conditions, in turn, determine herd performance to a large extent. Various production systems differ with regard to potential profit and adaptation to natural conditions (Louw, Groenewald and Grosskopf, 1977: 14). In Southern Africa several different production systems exist. In the communal areas cattle are grazed on unfenced natural pastures. In commercial extensive farming cattle systems are grazed on fenced land. Stocking rates are adapted to the carrying capacity of the land and steps are taken to preserve the carrying capacity of the grazing land. Selection is practised to improve the genetic potential of the herd. In areas where crops are grown, cattle are grazed on crop residues after harvesting. Traditional extensive systems play an important role in cattle production, but finishing cattle in feedlots for the market also play a major role. In South Africa up to 60 percent of stock are marketed through feedlots. In some systems weaner calves are sold to a feedlot, while in other systems stock are grazed on natural pastures up to either one or two years of age before being finished in a feedlot or marketed directly off the pastures. In the communal system cattle are often marketed at a much older age, as they also fulfil roles like the provision of draught power and milk.

Beef supply can be increased by addressing two factors, namely increasing the number of animals slaughtered and increasing the average carcass weight. The former can be reached by marketing animals at a younger age, increasing calving rates and decreasing mortality rates. Increased weight can be achieved by effective supplementation or feedlot-finishing.

Jamneck (1972: 103-113) showed that off-take rates can be increased considerably by marketing cattle at a younger age. Based on the livestock carrying capacity of each country, Fourie (1972: 101-117) calculated the potential number of livestock that could be kept. He then illustrated that by marketing cattle at 3 years of age instead of 7 years, it is possible to increase the off-take rate from 14.4 percent to 22.5 percent, while still keeping the same number of cattle. Improved grazing- and feeding practises may make it possible to have marketable cattle at a younger age.

In addition to low calving rates, high mortality rates, especially among calves younger than one year, are generally experienced in Southern Africa. Effective disease control programmes and programmes to combat the effect of droughts may contribute towards lowering mortality rates and increasing beef production (Jamneck, 1972: 110).

Economic factors such as the lack of roads and slaughtering infrastructure are often constraints to the cattle industries of developing countries (Sartorius von Bach, 1997). These factors have a direct influence on the efficiency and competitiveness of the sector, and must be created by man.

Factors such as off-take rates and carcass weight can be controlled by the farmer, but certain other factors need to be addressed by the responsible government ministries, e.g. the system of land rights, as well as economical factors. The system of communal land ownership limits agricultural development, and specifically causes total lack of control over grazing land which leads to overgrazing and destruction of the natural vegetation. It is, however, unlikely that

these systems can be changed dramatically without destroying the existing system of social control, and any change will therefore be neither acceptable nor successful. For this reason tribal authorities should accept responsibility for the land under their control. The extension services also have a responsibility in this regard, to advise the authorities on the technical aspects of grazing land management. With regard to infrastructure, the improvement of road- and rail facilities to the markets is a prerequisite for the stimulation of commercial and communal cattle farming. (Fourie, 1972: 118-123).

2.1.2 General potential

Southern Africa is an arid region, and is subject to devastating droughts and floods. Generally speaking, most of South Africa is hot, dry and arid. Grazing suitable for cattle is limited to some parts of the country and overgrazing is a vast problem. In Lesotho, vegetation mainly consists of grass, with few trees. Grazing lands have been damaged by overgrazing, and the grass species in certain areas are of inferior quality. Swaziland experiences high rainfall, but overgrazing and land mismanagement have contributed to land degradation. Only a part of the country offers reasonably good grazing for cattle. Botswana consists of a semi-arid plateau with mainly summer rains. A large part of the country is only suitable for extensive cattle farming. Vegetation includes shrub savannah, bush savannah and tree savannah. Overgrazing is common. The climate in Namibia is similar to that of Botswana, with droughts occurring frequently. Zambia has more favourable climatic conditions for cattle production. Vegetation consists of forest woodland and grasslands. Improved pastures are also utilised for cattle production. Climatic conditions in Zimbabwe are similar to those in Zambia. Many parts of the country are suitable for cattle production. The vegetation includes savannah bushveld and tree savannah.

Foot-and-mouth disease occurs in all of the countries under review, although very seldomly in Lesotho. South Africa and Namibia both have a classified zone free of foot-and-mouth disease. Trypanosomiasis occurs in Botswana and Namibia,

with parts of the Caprivi region consequently not suited for beef production at present. East coast fever occurs in Swaziland, and corridor disease is endemic to Zambia.

Based on the hypothesis and findings of Fourie (1972) and Jamneck (1972), the potential cattle numbers compared to the present cattle populations of the countries under review are shown in Table 2.1. Present cattle numbers were taken to be the average of the cattle numbers in the three years from 1994 to 1996. This was done to limit the effect of short term fluctuations. In the case of South Africa, Botswana, Lesotho, Zambia and Zimbabwe the relevant cattle numbers were obtained from the database of the Food and Agriculture Organisation of the United Nations (FAO, 1997b).

Based on FAO findings and the current beef industry Table 2.1 was compiled to present cattle numbers, their off-take rate and carcass weight leading to beef supply. An assessment by van Renen (1997) illustrates how the beef supply could increase under optimal circumstances[1].

Table 2.1 Potential beef production in Southern Africa (1995 until 2015)

Country	Present population (3 year avg)	Off-take rates (%)	Carcass weight (kg)	Beef supply (tons)	Possible beef supply (tons)
South Africa	12 977 566	17	220	485 361	598 500
Botswana	2 522 667	13	175	57 391	144 000
Lesotho	590 077	10	150	8 851	9 000
Namibia	2 055 168	14	180	51 790	110 000
Swaziland	636 968	15	150	14 332	20 000
Zambia	2 633 333	5	175	23 042	260 000
Zimbabwe	4 745 405	8	200	75 926	209 250
TOTAL	26 161 184			716 693	1 350 750

Source: Adapted from Van Renen (1997) and FAO (1997)

From the above it is clear that the total production of the Southern African countries under review can be increased considerably. There is potential to

increase the present production of 716 693 tons by 88.5 percent to 1 350 750 tons. This potential increase can by attained by increasing cattle numbers in the case of Botswana, Namibia, Zambia and Zimbabwe, as well as a general increase in off-take rates and carcass weight. However, the above 2015 scenario will only realise if all measures required to improve off-take rates and carcass weight, are taken. The required measures include policy conducive to beef production, institutional arrangements conducive to proper grazing management, market access for all cattle farmers, transport infrastructure, agricultural extension services, veterinary services and disease control measures. Should these measures not be taken, the beef production potential in Table 2.1 has no chance to materialise.

In the communal farming environment, off-take rates are low because herds are small and there is little or no marketable surplus beyond household needs. Cattle have multiple uses, such as providing draught power and milk, and acting as a "bank" out of which cash is withdrawn when needed. Some sociologists are of the opinion that ownership of a large herd bestows power and prestige on the owner, while others differ on the importance of this factor. What becomes clear, however, is that the African communal farmer does not regard the value of cattle in the same light as the commercial farmer. Cattle farming is not seen as a commercial activity aimed at maximising income and profit, but rather as an activity aimed at meeting various household and other needs. In order to increase off-take rates in the communal areas, herd sizes will have to increase, the dependence of the rural household on goods and services provided by cattle will have to decrease, and the desire of the rural household for consumption goods (and thereby their need for cash) will have to increase. The above implies to a greater or lesser extent a cultural change, which is not envisaged to be attained in the short or even medium term.

Should Southern Africa attain its full beef production potential, some countries will

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[1] The potential carrying capacity determines the optimal cattle population. The improved off-take rate and higher carcass weight lead to possible beef supply for the selected countries.

be surplus producers and will therefore need to export their surpluses, either to the deficit producers within the region or to overseas countries. According to Skold, Williams and Hayenga (1987: 84-97), a long-term commitment and continual presence in the market is necessary to successfully export meat and meat products. Exporting cannot be viewed simply as a temporary sales alternative when domestic market sales are depressed. Importers seek dependable suppliers providing timely, quality and competitive products. Exporting can expand a firm's product line, market and profit potential. The steps in becoming a successful exporter are however neither quick nor costless. Entry into a foreign market requires a continual commitment. To remain successful, the meat exporter needs to be innovative and continually search for products and market niches. Awareness of the customer's requirements is the key for success.

2.1.3 Country-specific potential

Cattle fulfil multiple roles in the rural community and small herds rarely produce a surplus of animals above their owners' needs. These small herds will only be able to produce a surplus if technical efficiency can be increased. Even if changes in the marketing behaviour of communal farmers cannot be brought about in the short to medium term, increased carcass weight could already play a role in increasing beef supply, without increasing the number of cattle marketed.

South Africa has almost reached its full capacity with regard to cattle numbers, and very little expansion in this regard can be undertaken. Off-take rates in the commercial sector cannot be increased substantially. However, almost 40 percent of the total cattle population is in the hands of communal farmers, mostly in the former homelands. The off-take rates in this sub-sector are low, and can be increased substantially. At present, the market access of communal farmers is constrained by a lack of roads and communication infrastructure. Although a fairly well developed extension service is available to commercial farmers, this is also inadequate in the communal areas. If these factors can be addressed and communal farmers be granted improved market access, the profit incentive may

motivate them to operate their cattle farming activities on a commercial basis.

In Botswana, both increased cattle numbers and increased cattle production efficiency are still options for increasing beef production. The communal farmers, who own 82 percent of the national herd, achieve calving, mortality and off-take rates of respectively 50, 11 and 8 percent. This leaves much scope for improvement. An improved extension system, as well as improved nutrition in order to achieve increased carcass wheight, may play a significant role in increasing beef supply. The communal farmers have poor access to marketing infrastructure. This factor should be addressed in order to increase the off-take rate of the communal areas. The issue of communal grazing, which generally leads to overgrazing and destruction of ranch areas, needs to be resolved. Campaigns to increase public awareness of permanent irreversible damage to grazing areas have to be intensified.

Lesotho has reached saturation point with regard to cattle numbers. However, both the off-take rate and average carcass weight are low, and beef production can be increased by addressing these two factors. The livestock sector in Lesotho suffers from poor genetic quality and disease control. By rendering extension and veterinary services the technical efficiency can be improved and calving rates increased. The quality of the animals can be improved by crossbreeding and introducing high quality animals. However, care will have to be taken to ensure that animals introduced are adapted to the extremely harsh environmental conditions in Lesotho. Grazing land is being degraded by overstocking. This problem will have to be addressed in order to limit nutritional stress on the animals. The large number of young men employed in South Africa has led to farming being left in the hands of women and older people, which probably led to a decline in agricultural productivity. It is envisaged that with the Lesotho Highland water project, funds will become available for upgrading of rural infrastructure. This will increase rural farmers' access to markets as well as their exposure to a variety of consumption goods. The latter may increase their need for cash, and may lead to more cattle being marketed in order to obtain cash.

Namibia can still increase its cattle population somewhat, but the biggest potential for increased beef production lies in increasing off-take rates and carcass weights. In 1980 the national cattle herd equalled the potential cattle population. Sixty percent of the national cattle herd currently is in the hands of communal farmers. Technical efficiency in these areas is low. Overstocking caused range degradation and consequently animals are under constant nutritional stress and carcass weights are low. The problem of overgrazing needs to be addressed if the communal area is to realise its full beef production potential. Improved extension and veterinary services are required to achieve higher technical efficiency.

The veterinary cordon fence excludes beef produced in the northern communal areas from the more lucrative markets such as the EU. Should beef production in these areas be increased dramatically, the Namibian domestic market may not be able to absorb all the meat, and export markets can only be utilised if the veterinary restrictions could be lifted. Therefore it is imperative that disease control programmes aimed at the eventual lifting of the cordon fence, or at least moving it further north, be implemented. Infrastructure is poorly developed or lacking in the northern communal areas. Developing infrastructure will increase the market access of these farmers, which in turn could stimulate the commercialisation of their cattle farming activities.

Although Swaziland has scope to increase its cattle population, its greatest potential for increased beef production lies in increasing off-take rates and carcass weights. Although cattle are kept by 63 percent of households, cattle farming is not regarded as a commercial activity. Increased market access and resulting profits from cattle production may change this perception. An improved extension system may lead to increased technical efficiency, thereby yielding increased numbers of surplus animals that can be marketed. In order to improve animal quality and increase carcass weights, the land tenure problem needs to be addressed.

Zambia has vast potential to increase its beef production, both through expanding the cattle population and by increasing the off-take rate and carcass weight. The commercial sector owns about 15 percent of the national herd. High performance breeds are used and off-take rates of 16 percent are achieved. Cattle numbers can be increased and technical efficiency can also still be improved upon. The biggest potential for increased beef production is, however, in the communal sector. This sector owns 85 percent of the national herd. Much improvement in technical efficiency can still be attained. Raising cattle is more a way of life than a commercial venture. Off-take rates are low, and animal diseases, poor nutrition, the low production potential of the indigenous breeds and marketing problems also limit the productivity of this sector. The communal system militates against individual farmers attempting to improve their herds through selection and cross-breeding. It also leads to overgrazing, nutritional stress of the animals and consequently low weight gain. For these reasons the matter of land tenure needs to be addressed. An effective extension service is required to promote improved animal husbandry techniques and disease control measures.

In Zimbabwe, almost two thirds of the cattle population is in the hands of the communal farmers. In spite of this, the commercial farmers are responsible for 80 percent of all beef production. There is under-utilised land in the commercial sector, and further intensification in livestock production, both by increasing cattle numbers and by increasing technical efficiency, is still possible. With the communal farmers owning two thirds of the national herd, it must be recognised that the greatest potential for increasing beef production lies in this sector. At present these farmers keep indigenous breeds of cattle. Overgrazing and land degradation in these areas result in low calving rates of about 40 percent and high mortality rates. Cattle take 3 to 4 years to reach maturity and therefore off-take rates are low. Farmers need to increase their technical efficiency in order to increase off-take rates and carcass weights. Disease control measures should be strictly adhered to in order to open more markets for Zimbabwean beef. When addressing these problems, the necessity for an effective extension service

becomes apparent again. The problem of land tenure also needs to be addressed, in order to motivate farmers to conserve the grazing resource and to allow them to practise husbandry techniques aimed at improving the quality of their cattle.

2.2 SUPPLY ANALYSIS AND TREATMENT OF THE DATA

2.2.1 Approaches

There are several methods of analysing supply response, which can be classified into four categories. A broad distinction is drawn between programming and econometric models, with the latter subdivided into three, namely two-stage procedures, directly estimated systems and directly estimated single commodity models (Colman, 1983: 202).

Programming models, and specifically linear programming, involve the construction of a complete linear model to describe the production system of each of a number of typical farm types. By solving the problem repeatedly for different sets of prices, supply-price relationships can be established for each commodity. It is assumed that farmers operate to maximise their profit. If sufficient information is available about the number of farms in the population corresponding to each reference group, then it is possible to scale up and aggregate the supply-price functions for the individual farms in order to obtain market level supply response relationships (Colman, 1983: 202-203). This method has the capacity to handle the complex of inter-relationships arising from the multi-product nature of the farm, taking into account the effects upon supply of all product prices, all input prices, all relevant institutional, technological and physical restrictions and farmers' preferences. Solving for the optimum level of outputs and inputs takes full account of the competition between products for limited resources. One major problem, however, is to obtain a suitable classification of farms to permit the reference strata to be defined in such a way that they can be aggregated in order to obtain total supply (Buckwell and Hazell, 1972). Data requirements are extensive and consequently the collection of data at farm level is costly. The assumption that farmers maximise profits may lead to overestimation of supply

(Wipf and Bawden, 1969; Zepp and McAlexander, 1969). Also, it is reasonable to assume prices of inputs and outputs to be unaffected by the decisions of each individual, but at the market level increased supply will tend to decrease product prices and force up input prices (Colman, 1983: 215).

In two-stage procedures, output response relationships are not obtained by direct econometric estimation. They are derived, in a second stage, by algebraic manipulation, imposing profit maximising marginal conditions on results obtained by econometric estimation in the first stage. Because there is direct equivalence between 1. the production and cost functions, and between 2. production and profit functions, any one of these two functions could be econometrically estimated in the first stage and used to derive supply response parameters (Fuss and McFadden, 1978).

The directly estimated supply response systems approach uses the neo-classical theory of the firm to generate restricted systems of directly estimable supply functions (Colman, 1983: 208). The basis of the approach by Powell and Gruen (1968: 186) is the acceptance of an agricultural production possibility frontier which is determined by the assumed fixity of inputs within the annual time periods of the time-series analysis. A fixed bundle of inputs are allocated to the production of products in such a way as to maximise profits. The most important limitation of this approach is that it is assumes that the production possibility curve for the *N* products produced in a region displays a constant elasticity of transformation into products (Powell and Gruen, 1968: 319). It also assumes that all inputs are fixed and not product-specific, whereas in reality input and output levels are typically jointly determined and at least some factors are product-specific (Gardner, 1979).

The directly estimated partial supply models involve direct estimation of supply functions from time-series data. Most of these models are of a single commodity type. Since production in agriculture is not instantaneous, and is also dependent on past investment decisions, the production observed in any period tends to be

affected greatly by decisions taken in the past. These may be a function both of prevailing economic conditions at the time key decisions were taken and of expectations about future conditions (Colman, 1983: 210-211).

Nerlove (1958) has done extensive work on the formation of expectations. His theory of adaptive expectations is based on the elasticity of expectations. This theory assumes that the elasticity of a particular person's expectation of the price of a commodity is the ratio of the proportional increase of the expected future price. In an attempt to estimate the elasticity of supply of some agricultural commodities, Nerlove (1956:500) defines the coefficient of expectations (ß) as follows:

$$P_t^* - P_{t-1}^* = ß(P_{t-1} - P_{t-1}^*)$$

where: P^* = expected normal price

P = actual price

t = time

Each year, farmers revise the price they expect to prevail in the coming year in proportion to the error they have made in predicting the price for this period (Nerlove, 1956: 500). Hill (1971: 288) criticised Nerlove's models for not allowing for changes in the long-run supply curve, due to e.g. technological changes.

Historically, supply analysis has been based on single equation regression models using time series data. These analyses were useful for short term forecasting. Johnson (1955) showed that in some circumstances supply might be determined by external factors such as weather, rather than farmers' responses to price. Regression analysis is a quantitative method which formulates a model for fitting a curve on observed data. Simple regression assumes that there is only one independent variable, while multiple regression assumes the existence of more than one independent variable. Non-linear regression assumes that the dependent variable is a quadratic, logarithmic or exponential function or any other non-linear relationship, rather than a linear function. The purpose of regression

analysis is to estimate the value of the dependent variable in terms of the value of one or more other variables (Redelinghuis, Julyan, Steyn and Benade, 1978: 13).

Dynamic analysis of livestock product supply is complex. The reason for this is that a given animal at a given time may be viewed as any one of a finished good, a good in process, or a piece of fixed capital. These characteristics apply especially to female animals. Current prices will affect the number of animals supplied for slaughter, while, in a free market, prices themselves will be affected by current supplies. Hence there is interdependency between supplies and current prices (Hildreth and Jarrett, 1955:21). The effect of a given price change on livestock numbers may differ between one period and another. The underlying problem is to correctly identify the way in which producers form expectations about the relevant explanatory variables, such as price, and the way in which they respond to maximise their welfare over time. If farmers respond differently at different times to the same price change, it is because this change is not the sole influence on their expectations (Colman, 1983: 221). There are some theories on how supply response functions should allow for the role of investment. The partial adjustment mechanism devised by Nerlove (1958) dictates that the response to any change in economic stimuli is spread over a number of time periods in a geometrically declining way.

On the complexity of livestock supply response, Dillon and Anderson (1990: 102-103) identified a number of major complexities. There is a possibility of different grazing systems and combinations of various time sequences of input injections and output. Each system will have its own response function. The production process is divided into stages, namely pasture production and livestock grazing. These two stages are not independent. The two stages interact over time, with pasture output influencing livestock, and livestock influencing pasture output.

The multiple regression analysis method has some inherent limitations. The estimation procedure requires that the number of time-series observations exceeds the number of explanatory variables, and the larger the difference the

better. It can, however, not be assumed that behavioural parameters remain unchanged for long periods of time. This creates pressure to cut down on the length of the time-series, which in turn creates pressure to cut down on the number of explanatory variables. However, other analysis methods also have limitations, and regression analysis still remains the most preferred and used of the methods. Factors in its favour are that it operates directly upon the data and that it handles dynamic adjustments to supply in ways in which the other procedures cannot. It is also the simplest of the methods in terms of estimation methods and data requirements. It entails a small number of steps to generate supply response coefficients and it minimises the capacity for specification errors that could accumulate through successive stages. This technique has shown itself capable of generating acceptable and useful results (Colman, 1983: 223-224).

2.2.2 Data availability and sources

Time-series data for each of the countries included in the study was required in order to perform the regression analysis. South Africa is being represented by three provinces, namely Mpumalanga, Northern Province and North-West Province, as those are the most important beef producing areas. It was attempted to obtain data for the period 1970 to 1996, but this was not possible in all cases. Based on the factors determining beef production, as discussed in the previous chapters, the following independent variables were initially selected to be considered in the model: total annual rainfall, number of rainfall days per year, total cattle population, herd composition broken down into cows older than 2 years, heifers 1 to 2 years, oxen older than 2 years, between 1 and 2 years, calves under 1 year and bulls, and real producer prices of beef. The dependent variable was the number of cattle marketed per year. Sufficient data for Zambia and Zimbabwe could not be obtained, and they were therefore excluded for the purposes of the regression analysis. Table 2.2 gives an indication of the availability of data in the various countries and regions.

Table 2.2 Availability of data in the countries and regions included in this study

	Rainfall	Rain days	Cattle numbers	Herd composition	Producer prices	Cattle marketed
Mpumalanga	A	A	A	A*	A	A
Northern Province	A	A	A	A*	A	A
North-West Province	A	A	A	A*	A	A
Botswana	A	A	A	na	A	A
Lesotho	A	A	A	na	A**	A**
Namibia	A	A	A	na	A	A
Swaziland	A	A	A	A***	A	A
Zambia	A	A	na	na	na	na
Zimbabwe	A	A	na	na	na	na

A = Available

na = Not available

* Only available for the period 1986 to 1996

** Only available for the period 1987 to 1996

*** Only available for the period 1980 to 1996

Data with respect to rainfall and rainfall days was obtained from the various weather bureau's. Two or three points in each country or area were selected, and the average of rainfall data over that number of points was taken to represent an average for the country or province. With regard to Lesotho, however, some values were missing due to periodic closures of the meteorological stations.

Data on cattle numbers were obtained, in the case of South Africa, from the Directorate Agricultural Statistics and Management Information of the National Department of Agriculture. In the case of the other countries it was obtained from the various Ministries of Agriculture or Meat Boards and marketing authorities. Data on herd composition was only available for South Africa and Swaziland, and in both cases only for a limited period. Due to the lack of sufficient data in this regard, herd composition was not included in the eventual regression model.

South African beef producer prices and numbers of cattle slaughtered were obtained from the Meat Board. A weighted average price of all grades was used. For Botswana, producer prices and slaughterings were obtained from the Botswana Meat Commission and in the case of Namibia, from the Namibian Meat Board. The Swaziland and Lesotho data was obtained from the respective Ministries of Agriculture. Due to a fairly recent reorganisation of marketing in Lesotho, data was only available from 1987.

2.2.3 The model used in the analysis

The quantity of output is dependent on the quantity of one or more inputs. This relationship is represented by the following equation:

Y = f(X1, X2, X3, ..., Xm)

This represents some unspecified mathematical function of the quantities of the inputs (X1 to Xm) which determine the quantity of output (Y).

The following functional relationship was hypothesised and tested separately for each country or province included in the study, with the exception of Zambia and Zimbabwe, which were excluded from the analysis for reasons discussed earlier:

CM = f(RF, RF1, RF2, RF3, RF4, RD, RD1, RD2, RD3, RD4, CP, CP1, CP2, CP3, CP4, P, P1, P2, T)

where:

	CM	=	Cattle marketed
	RF	=	Rainfall
	RF1, 2, 3, 4	=	Rainfall lagged one, two, three or four years
	RD	=	Rain days
	RD1, 2, 3, 4	=	Rain days lagged one, two, three or four years
	CP	=	Cattle population
	CP1, 2, 3, 4	=	Cattle population lagged one, two, three or four years
	P	=	Beef producer prices
	P1, 2	=	Beef producer prices lagged one or two years
	T	=	Time

It is hypothesised that cattle marketed would be positively correlated with producer price and cattle numbers. It is also expected that cattle marketed will be positively influenced by rainfall and rain days. However, in times of drought, farmers are forced to market their cattle. After a drought, farmers may withhold cattle again to build their herds. In the short term negative correlation between rainfall and rain days on the one hand, and cattle marketed on the other, is therefor possible.

Natural logarithmic data was used in order to be able to acquire elasticities directly from the results. Several variables, of which it was suspected that the influence on cattle marketed would not be seen immediately, were lagged for periods from two to four years.

The objective of the regression analysis is to obtain the constants (i.e. intercept and slope) in a linear equation. The objective of correlation analysis is to obtain the coefficient of correlation between the independent (or explanatory) variable(s) and the dependent variable. Correlation measures the degree of the linear relationship between variables, and gives an indication of the accuracy of the fit of the regression line on the data (Redelinghuis *et al*, 1978: 20-23; Henkel, 1976: 69).

The coefficient of determination (R^2) is a measure of goodness-of-fit of the regression line on the data. In the case of simple linear regression, R^2 is the square of the coefficient of correlation. It represents the proportion of the total variation in the dependent variable (y) which is explained by fitting the regression, and can therefore also be calculated as the explained variation of y divided by the total variation of y. A R^2 value of 0.9876 therefore means that 98.76 percent of the change in the values of y can be predicted based on changes in the value of the explanatory variables, while other factors are responsible for the remaining 1.24 percent change in y (Redelinghuis *et al*, 1978: 20-23; Steyn, Smit and Du Toit, 1989: 128; Wonnacott and Wonnacott, 1972:341-342).

The t-value measures the significance of the explanatory variables and is calculated for each independent variable as the estimated coefficient divided by the standard error for that variable. The significance level is the probability that a larger absolute t-value would occur without a contribution of that variable. It is a common rule to retain variables with a t-value of two or larger, if *n* is large. A further test for model fitting is the F-ratio. F is a collective measure of significance

(Wonnacott and Wonnacott, 1972: 297-298; Wonnacott and Wonnacott, 1979: 185).

More often than not a part of the change in the dependent variable cannot be explained satisfactorily by only one independent variable. If this unexplained part could be reduced, more accurate conclusions can be drawn. This can be done through multiple regression (as opposed to simple regression), i.e. by including more than one independent variable. Multiple regression reduces the residual variance, which in turn reduces the standard error of the coefficients of correlation. From this it follows that statistical tests will be strengthened, e.g. by obtaining higher t-values.

Several influences are related to output and also interrelated among themselves. This could increase the problems of multicollinearity (Askari and Cummings, 1977: 261). When performing a multiple regression analysis, care needs to be taken to ensure that there is not a strong correlation among the chosen independent variables. The Durbin-Watson test is normally used to test for autocorrelation (Redelinghuis *et al*, 1978: 28-29; Wonnacott and Wonnacott, 1972:306). A statistical table, based on the significance level of the model, the number of observations and the number of explanatory variables, will give the upper and lower critical values for the Durbin-Watson statistic (d), namely d(l) and d(u). If $d < d(l)$, there is positive autocorrelation between the explanatory variables. If $d > d(u)$, there is no autocorrelation. If $d(l) < d > d(u)$, the test is inconclusive (Johnston, 1972: 252). Negative autocorrelation exists if $4 - d(l) < d < 4$ (Pindyck and Rubinfeld, 1991: 144).

2.2.4 Data problems

Time-series data was required in order to perform the regression analysis. South Africa is being represented by three provinces, namely Mpumalanga, Northern Province and North-West Province, as those are the most important beef producing areas. It was attempted to obtain data for the period 1970 to 1996, but

this was not possible in all cases. South African beef producer prices and numbers of cattle slaughtered were obtained from the Meat Board. For the period 1970 to 1985 only slaughterings in the controlled areas were available, while for the period after 1985 only aggregate data, i.e. total slaughterings in both the former controlled and uncontrolled areas, was available. This in effect divided the data into two data sub-sets. For further detail consult Van Renen (1997).

The Chow test is used to test for structural change. The F-statistic was calculated to test whether the coefficients in the two equations (based on the two separate data sets within the main set) are the same (Greene, 1993: 211-212). F-statistic values of, respectively, 118.1064, 15.452 and 58.43517 were calculated for Mpumalanga, Northern Province and North-West Province. The critical value in all three cases was 3.42. As the calculated F-statistic values are larger than the critical value, it confirms that there was indeed a structural change. A dummy variable was used to adjust the data set for the structural change. This yielded a data set that can be used meaningfully for regression analysis. This is an acceptable statistical practise as explained by Johnston (1972: 192-207). It is done with the purpose of correcting statistically for the effects of uncontrolled variables that could not be properly standardised between different classes of data.

According to Jones (1965: 500), two categories of approaches to measuring the supply elasticity of agricultural products exists, namely those that try to discover what ought to happen when prices change, and those that trace what does happen and assume cause and effect. In the present study, the data was converted to logarithms in order to be able to acquire elasticities directly from the results. Linear regression models were fitted on the logarithmic data. A polynomial distributed lag regression procedure was further performed using the lagged producer prices in order to determine the effect of prices, which are likely to only have an effect on the dependent variable after a period of time. Initially real prices were used in the analysis, but this was replaced by nominal prices in an attempt to obtain more meaningful results in the case of some countries or

regions. For some countries and regions this did indeed produce better models, as will be discussed in the following section.

2.3 RESULTS AND DISCUSSION

2.3.1 Results obtained

Two estimation procedures were performed for each country or region, namely a linear model on logarithmic data and a polynomial distributed lag regression model. Several models were estimated for each country or region individually, using both real and nominal prices. The best fitting models were selected and are discussed below. The other models obtained are presented in Van Renen (1997).

South Africa: Mpumalanga Province

Natural logarithmic data was used and linear coefficients of correlation (r) between cattle marketed and various independent variables were estimated. No significant r-values were obtained.

Four linear models and one polynomial distributed lag regression model using real prices were estimated. No models with significant F-values were obtained. In an attempt to obtain significant goodness-of-fit, four linear models and one polynomial distributed lag regression model were estimated using nominal producer prices instead of real producer prices. Nominal producer prices were used instead of deflated prices as it was suspected that producers respond to nominal prices. No significant coefficients of correlation between cattle marketed and nominal producer price were obtained. As was the case with real producer prices, the correlation between cattle marketed and nominal producer price lagged one or two years was even lower and also insignificant. No significant models were obtained.

Three additional linear models containing independent variables other than producer price were estimated. No significant models were obtained. None of the

variables included in the model explained the number of cattle marketed in Mpumalanga.

South Africa: Northern Province

Various variables yielded significant coefficients of linear correlation with cattle marketed in the correlation analysis of the Northern Province data. The coefficient values were, however, relatively low. The independent variables significantly correlated with cattle marketed are RF2 (0.42654), RF4 (0.52990), CP1 (0.54938), CP2 (0.73549), CP3 (0.80715) and CP4 (0.77788). The r-values are given in brackets.

Five linear models and one polynomial distributed lag regression model using real prices were estimated. No significant models were obtained. The polynomial distributed lag regression model did not yield significant results. In an attempt to obtain significant models with producer price as independent variable, five linear models and one polynomial distributed lag regression model were estimated using nominal producer prices instead of real producer prices. None of these models produced significant coefficients of correlation (r) between cattle marketed and producer price. The polynomial distributed lag regression model did not yield significant results either.

Twelve models containing independent variables other than producer price were estimated. Five significant models were obtained, of which the model below was selected as the best fitting model in terms of significance of the F-value as well as goodness-of-fit:

CM	=	2.206105*CP3		-	11.199603	
		6.583			-4.597	
		(0.0001)			(0.0002)	
		DF = 21	R^2 = 0.6580		Prob>F = 0.0001	DW = 0.951

CP3 represents cattle population lagged three years.

South Africa: North-West Province

Only one variable, namely CP3, was significantly correlated with cattle marketed. A coefficient of linear correlation (r) of 0.40716 was obtained.

Nine linear models and one polynomial distributed lag regression model using real prices were estimated. No models with significant F-values were obtained. In an attempt to obtain significant goodness-of-fit, five linear models and one polynomial distributed lag regression model were estimated using nominal producer prices instead of real producer prices. No significant correlation between cattle marketed and nominal producer prices were obtained. No significant models, using nominal prices, were obtained. A further six models using independent variables other than producer price were estimated. Two significant models were obtained, using, respectively, CP2 and CP3 as explanatory variables. However, in both cases the R^2-value indicated a poor level of goodness-of-fit. None of the variables in explained the number of cattle marketed in North-West Province.

Botswana

Similar procedures were performed on the Botswana data. The independent variables significantly correlated with cattle marketed in Botswana are RF4 (0.60750), CP1 (0.46768) and CP2 (0.53952). The r-values are given in brackets.

Six linear models and one polynomial distributed lag regression model using real prices were estimated. No significant models were obtained. The polynomial distributed lag regression model using real producer prices did not yield significant results either.

In an attempt to obtain significant models with producer price as independent variable, five linear models and one polynomial distributed lag regression model

were estimated using nominal producer prices instead of real producer prices. No significant r-values for correlation between producer price and cattle marketed could be obtained. Neither the linear models nor the polynomial distributed lag regression model yielded significant results.

A further eight models excluding producer price as independent variable were estimated. One model yielded a significant F-value and acceptable goodness-of-fit, using cattle population lagged for two years as explanatory variable:

CM	=	1.920615*CP2	-	9.949464		
		4.049		-2.669		
		(0.0014)		(0.0193)		
		DF = 13	R^2 = 0.5238	Prob>F = 0.0014		DW = 0.526

CP2 represents cattle population lagged two years.

Lesotho

Similar procedures were performed on the Lesotho data. Only one significant coefficient of linear correlation (r) with cattle marketed was obtained in the correlation analysis, namely CP3 with an r-value of -0.74766.

Nine linear models and one polynomial distributed lag regression model using real prices were estimated. One model yielded a significant F-value and acceptable goodness-of-fit, using cattle population lagged for three years and producer price as explanatory variables:

CM	=	3.520639*CP3	+	0.923489*P	+	54.351138		
		3.892		2.714		4.532		
		(0.0060)		(0.0300)		(0.0027)		
		DF = 6	R^2 = 0.7237	Prob>F = 0.0046				DW = 3.350

CP3 represents cattle population lagged three years, while P represents the real producer price of beef. The polynomial distributed lag regression model using real producer prices did not yield significant results.

In an attempt to obtain significant models with a higher degree of goodness-of-fit, five linear models and one polynomial distributed lag regression model were estimated using nominal producer prices instead of real producer prices. Neither the linear models nor the polynomial distributed lag regression model yielded models that were both significant and acceptable in terms of goodness-of-fit.

A further five models excluding producer price as independent variable were estimated. Two significant models were obtained, but they did not yield a level of goodness-of-fit as high as the model selected above. However, the model below was selected as the preferred model, as the Durbin-Watson measure in this case indicates that no serial correlation is present. In the case of the model above, negative serial correlation is present.

CM	=	3.828879*CP3	+	58.571259			
		3.184		3.676			
		(0.0129)		(0.0063)			
		DF = 8	R^2 = 0.5590		Prob>F = 0.0129		DW = 1.769

Namibia

Similar procedures were performed on the Namibian data. A number of significant coefficients of linear correlation (r) with cattle marketed were obtained in the correlation analysis. The r-values were, however, relatively low. The independent variables significantly correlated with cattle marketed in Namibia are CP (0.61838), CP1 (0.75555) and CP2 (0.50155). The r-values are given in brackets.

Nine linear models and one polynomial distributed lag regression model using real prices were estimated. One significant model, using cattle population and producer price as explanatory variables, was obtained. The polynomial

distributed lag regression model using real producer prices did not yield significant results.

In an attempt to obtain significant models with a higher degree of goodness-of-fit, five linear models and one polynomial distributed lag regression model were estimated using nominal producer prices instead of real producer prices. No significant r-values for correlation between producer price and cattle marketed could be obtained. One significant model with a slightly higher degree of goodness-of-fit than that obtained when using real prices, was obtained:

CM	=	0.051328*P	+	1.455105*CP	-	5.526507
		1.0777		3.880		-1.858
		(0.2973)		(0.0013)		(0.0816)

DF = 16 R^2 = 0.4872 Prob>F = 0.0048 DW = 1.345

P represents the nominal producer price of beef, while CP represents the total cattle population.

The polynomial distributed lag regression model did not yield a significant model.

A further eight models using independent variables other than producer price were estimated. Two significant models, with cattle population and cattle population lagged one year, respectively, were obtained. The level of goodness-of-fit was, however, not as good as that of the model selected above.

Swaziland

Similar procedures were performed on the Swaziland data. Only one significant coefficient of linear correlation (r) with cattle marketed was obtained in the correlation analysis, being CP4 with an r-value of -0.56591 and significance of 0.0060.

Nine linear models and one polynomial distributed lag regression model using real prices were estimated. No significant models were obtained. The polynomial distributed lag regression model using real producer prices did not yield significant results.

In an attempt to obtain significant models with producer price as independent variable, five linear models and one polynomial distributed lag regression model were estimated using nominal producer prices instead of real producer prices. No significant model with acceptable goodness-of-fit was obtained. The polynomial distributed lag regression model did not yield a significant model either.

A further five models excluding the variable producer price as independent variable were estimated. A significant model, using cattle population lagged for four years as explanatory variable, was obtained. However, the low R^2-value of this model yielded it unacceptable. None of the variables in explained the number of cattle marketed in Swaziland.

2.3.2 Discussion

Mpumalanga Province

Cattle marketed is not significantly correlated with either real producer prices or nominal producer prices. Cattle marketed was also not significantly correlated with any of the other variables. Different functional forms, i.e. linear models and the polynomial distributed lag regression procedure, did not yield significant models. It would therefore appear that, in the case of Mpumalanga, cattle slaughtering is determined by factors other than the variables selected for this study.

Northern Province

In the Northern Province, generally rainfall and cattle numbers were significantly correlated with cattle marketed. Neither real nor nominal producer prices were

significantly correlated with cattle marketed. A significant linear model with cattle population lagged three years was obtained. This model explains 65.8 percent of the variation in cattle marketed. An one percent increase in cattle numbers in the present year will lead to a 2.2 percent increase in cattle marketed three years later. Both the linear regressions and polynomial distributed lag regression procedures did not yield significant models containing either real or nominal producer price as explanatory variable.

North-West Province

Only cattle population lagged three years was significantly, although not strongly, correlated with cattle marketed. Different functional forms, i.e. linear models and the polynomial distributed lag regression procedure, using both real and nominal producer prices, were used. Linear models excluding producer price as explanatory variable were also estimated. No significant models with an acceptable level of explanatory power were obtained. It would therefore appear that, in the case of North-West Province, cattle slaughtering is largely determined by factors other than the variables selected for this study.

Botswana

In Botswana, only rainfall and cattle numbers were significantly correlated with cattle marketed. No significant correlation between producer price and cattle marketed was obtained, neither using real nor nominal producer prices in the data set. Both linear regression and polynomial distributed lag regression models were estimated, but no significant models with either real or nominal producer price as explanatory variable were obtained. A significant model with cattle population lagged two years was obtained. This model explains 52.4 percent of the variation in cattle marketed. An one percent increase in cattle numbers in the present year will lead to a 1.9 percent increase in cattle marketed two years later.

Fidzani (1993) in his study on the Botswana beef industry, used disaggregated data dividing the cattle sector into three sub-sectors based on herd size, namely

small herds (1 to 40 animals), medium herds (41 to 99 animals) and large herds (more than 100 animals). The most important reason for cattle sales cited by herders was to meet household needs. The large herders have access to the high priced markets and there is little price variability in this group. Small and medium herders, on the other hand, sometimes sell as an emergency option and in those cases are constrained in their ability to find the best paying markets. However, some herders in these two groups are well situated to benefit from the high priced markets. In these two groups there is therefore enough price variability that can be used to explain the off-take variations. Producer price was found to have a strong explanatory power with regard to off-take rate in the small and medium sized herds. Both groups responded positively to price changes. In small herds it was found that for an 1 percent increase in price, the off-take rate will increase by 0.768 percent. Medium herds will increase their off-take rate by 0.653 percent in response to an 1 percent increase in price. The average supply elasticity of all the groups was 0.653. These results were interpreted to lend support to the subsistence literature argument that the reticence of small herders to sell their animals is not due to a lack of price responsiveness, but rather to the absence of a marketable surplus (Fidzani, 1993: 215-223). Contrary to the findings of Fidzani (1993), this study did not obtain significant coefficients of correlation between cattle marketed and either real or nominal producer price.

Lesotho

Only cattle population lagged three years was significantly correlated with cattle marketed. Different functional forms, i.e. linear regression and polynomial distributed lag regression procedures, did not yield significant models with either real or nominal producer price as explanatory variable. A significant model containing cattle population lagged three years and real producer price was obtained. However, in this model the Durbin-Watson statistic indicated that negative serial correlation was present. Another model, containing only cattle population lagged three years, was therefore selected as the preferred model. This model explains 55.9 percent of the variation in cattle marketed. An one

percent increase in cattle numbers in the present year will lead to a 3.8 percent increase in cattle marketed three years later.

Namibia

Cattle marketed in Namibia was significantly correlated with cattle numbers. Several linear as well as polynomial distributed lag regression models were estimated. A significant linear model with acceptable goodness-of-fit was obtained, containing cattle population and nominal producer price as explanatory variables. This model explains 48.7 percent of the variation in cattle marketed. An one percent increase in cattle numbers will lead to a 0.05 percent increase in cattle marketed, while a one percent increase in the nominal producer price of beef will lead to a 1.5 percent increase in cattle marketed.

Sartorius von Bach (1990) in his study on supply response in the Namibian beef industry found that producer prices were only selected as an explanatory variable in models for areas close to abattoirs. In other areas they were not selected as a significant variable. In commercial farming areas, farmers did respond to rainfall, though. In communal areas, farmers did not respond to rainfall, and cattle numbers were the sole determinant of cattle marketed. The present study, however, used aggregate data for the whole of Namibia, whereas Sartorius von Bach (1990) used disaggregated data for individual regions. Using aggregate data could hide these differences between the various regions. When considering the coefficients of linear correlation (r) obtained in this study, a significant coefficient of correlation of 0.61838 between cattle numbers and cattle marketed is obvious. A higher coefficient of correlation of 0.75555 between cattle marketed and cattle numbers in year T1 was obtained, and another significant r-value of 0.50155 in year T2.

Swaziland

Cattle numbers lagged four years were significantly correlated with cattle marketed. No significant models were obtained using either real or nominal producer prices in both the linear regression and polynomial distributed lag regression procedures. A significant model containing cattle population lagged four years was obtained, but this model was not deemed acceptable as it only explains 32 percent of the variation in cattle marketed. This indicates that although cattle population lagged four years does play a role in determining off-take in Swaziland, there are other factors, not included with the variables selected for this study, that also play a role.

Doran *et al* (1979) did a regression analysis on Swaziland cattle slaughter against price and rainfall. They found that price and rainfall together accounted for 65 percent of the variation in annual cattle off-take, with 40 percent due to price and 25 percent due to rainfall. Both variables were highly significant, and both variables had a negative sign attached to the coefficient, which supported their expectation that off-take from the Swazi Nation herd is inversely related to both price and rainfall. This they regarded to support the theory that cattle are considered as store of wealth. In the present study, very low coefficients of correlation (r) between cattle slaughtered and rainfall were obtained. No significant correlation between cattle slaughtered and prices were obtained.

2.3.3 Major findings

Meat marketing has been deregulated considerably over the past decade in South Africa, Zambia and Zimbabwe. This has introduced producer prices based on supply and demand, as well as private sector initiative in meat marketing and processing. Before deregulation, producer prices and to some extent producer behaviour with regard to e.g. stocking rates were distorted by policy measures. In South Africa, the surplus removal scheme aided by the supply control measures applied by the Meat Board benefitted large suppliers at the expense of small suppliers.

In Namibia the Meat Board and Meatco are still responsible for meat marketing, and in Botswana the Botswana Meat Commission plays this role. Examples of distortions caused by the complicated pricing system and activities of the BMC are the inefficient use of forage because cattle are held beyond their peak weight, and the inaccessibility of higher paying markets for western and northern communal herders due to the centralisation of abattoirs. Meat marketing in Swaziland and Lesotho is regulated by various government departments and institutions.

The response of producers to economic factors, represented by producer price, was tested by regression analysis. Only in the case of Namibia was nominal producer price included in the model selected. Even in this model, producer price contributes only slightly to the explanatory power of the model. A model with only cattle population explains 45 percent of the change in cattle marketed, while adding producer price as an explanatory variable increases the explanatory power to 49 percent. No other significant models with sufficient explanatory power, containing producer price as an explanatory variable, were obtained. This indicates that, with the exception of the Namibian producers, cattle producers in general in Southern Africa do not respond to economic factors.

Natural and climatological factors were represented in the regression analysis by rainfall and rain days. These variables were not included in any of the models selected. Only in the case of the Northern Province two significant models containing lagged rainfall were obtained, but in both cases the explanatory power of the models was very low. These results indicate that producers do not respond significantly to climatic factors.

Only the cattle population variable and its lagged values yielded significant models with acceptable explanatory power. This confirms that cattle producers do not respond to economic or climatic factors. This could be due to policy distortions which occurred throughout most of the period for which data was

collected, in the case of South Africa, Zambia and Zimbabwe. In Botswana, Namibia, Lesotho and Swaziland, regulated meat marketing with associated policy distortions is still continuing. In addition, in most of the countries under review, the communal farmers are to some extent excluded from marketing opportunities, e.g. the veterinary cordon fence in Namibia which excludes farmers in the northern communal areas from the abattoirs that are allowed to export beef to the EU, and centralised abattoirs in Botswana that are situated far from the communal areas and deny communal farmers access to the higher priced markets. These institutional arrangements distort the normal response of rational producers to economic factors. Another possible explanation for the lack of response to economic and climatic factors may be the use of aggregated data in this study. Previous research used disaggregated data and found in Botswana that the price responsiveness of small, medium and large herders differed. Similarly, it was found in Namibia that economic and climatic factors were selected in some areas, while only cattle population was selected in other areas. Using aggregate data as was done in this study may hide these differences on disaggregated level.

SECTION 3

THE DEMAND FOR BEEF

3.1 Introduction

In most Southern African countries, the total per capita consumption of meat products has remained relatively static. A tendency to decrease nevertheless exists. Three factors are of importance for meat consumers - a variety in the choice of meat, relative prices and convenience in terms of readiness to eat. Meat is purchased according to relative prices to keep the consumption expenditure low and to obtain sufficient protein. This causes particular levels of demand for specific commodities to change with time.

Demands for meat products are, in reality, directly and indirectly linked to each other. Their related prices are mutually dependent, which, to a certain extent, is indicated by shifts in consumption caused by policy adjustments for one commodity. Some South African researchers determined substitutional and complementary effects between the different types of meat. The extent to which some prices affect one another, was identified and used in by Van Heerden, Van Zyl & Vivier (1989). They showed that price leadership results are useful for purposes of reviewing some aspects of market control in the South African meat market. Van Heerden *et al*. (1989) found that the meat market as a whole showed a strong measure of mutual dependence. All meat prices (excluding beef prices) took more than a month to adjust to changes in market conditions, which indicates the weak effectiveness of the meat market. They found, also, that beef prices lead chicken prices, although chicken prices were closely related to the market leader (prime beef).

3.2 Analysis

3.2.1 Introduction

The theory of consumer demand is rooted in the physiological and psychological needs of individuals. Demand is a behavioral relationship that describes how much of a product will be purchased at different prices under a carefully defined set of

conditions. In the regard, Schönefeldt (1998) surveyed factors among South Africans that they consider the most important when purchasing meat. The following factors in diminishing order were found:

- taste (75%);
- colour of meat (48%);
- quantity of fat (45%);
- price (36%);
- tenderness (30%);
- nutritional value (21%);
- not frozen (20%);
- packaging (17%);
- classification (15%); and
- preparation time (14%).

Most of the above preferences are difficult to quantify in a quantitative statistical approach. Furthermore, different approaches can be used. Literature show that the single random coefficient model (Hildreth & Houch, 1968, Swamy & Mehta, 1975, Cooley & Prescott, 1974) has extended to multi-regression models using seeminly unrelated regression approaches (Singh & Ullah, 1974). Garbade (1977) and Chavas (1983) have discussed in details the estimation of variable parameter regression. Switching regressions and random coefficients were introduced by Quandt (1972) and Swamy and Mehta (1975). The next step was to introduce the Kalman filter (see Abraham & Ledolter, 1983). Generalised least-squares (Sant, 1977) and the Bayesian estimation (Sarris, 1973) are different approaches to estimate random coefficient regression models, as they are equivalent to the Kalman filtering techniques (Chavas, 1983).

The economic variables that should be included for building an econometrical model should include the per capita consumption for different meat commodities, real retail prices, a time trend and if possible some of the Schönfeldt mentioned consumption preferences. However, difficulties in obtaining data caused that the demand for beef,

mutton and pork in South Africa was analysed with monthly data (January 1980 to March 1997). In the Botswana case analyses were made for three different localities, Maun, Gabarone and Lobatse with monthly data (January 1986 to May 1997). The aim of determining demand curves is to obtain price and income elasticities for various meat. These curves are based on numerous limiting assumptions and historical data. The data consist of various meat prices. These sets of data are regarded by the Central Statistical Services (1997) as representive. Retail prices were deflated by the food price index. Other data were supplied by the Meat Board (1997). Per capita figures were determined by using population estimates obtained from the Central Statistical Services (1997), who provided income estimates too, which led to the determined real income per capita index.

Besides the analyses for South Africa and Botswana, the Namibian case was analysed by modelling the effects of household characteristics on demand with cross-sectional survey data. This information is primarily used for preparing demand projections. As in many other studies based on survey data, the assumption was applied that households expenditure is equal to disposable income. This makes the choice of analytical approach greater, but analyses do not necessarily loose significance (Houthakker, 1957). For the purpose of this study, data of the household income and expenditure survey of the Central Statistical Office (1995) were used and inflated to the current situation. For the Namibian case, household characteristics were modelled for all regions.

3.2.2 The model used in the demand analysis

The quantity of output is dependent on the quantity of one or more inputs. This relationship is represented by the following equation:

Y = f(X1, X2, X3, ..., Xm)

This represents some unspecified mathematical function of the quantities of the inputs (X1 to Xm) which determine the quantity of output (Y).

The following functional relationship was hypothesised and tested separately for 1. beef: South Africa and Botswana's three locations and 2. mutton and pork only for South Africa:

BC = f(BP, BP1, BP2, BP3, BP4, BP5, BP6, MP, MP1, MP2, MP3, MP4, MP5, MP6, PP, PP1, PP2, PP3, PP4, PP5, PP6, RI, T, DB, DM, DP)

MC = f(BP, BP1, BP2, BP3, BP4, BP5, BP6, MP, MP1, MP2, MP3, MP4, MP5, MP6, PP, PP1, PP2, PP3, PP4, PP5, PP6, RI, T, DB, DM, DP)

PC = f(BP, BP1, BP2, BP3, BP4, BP5, BP6, MP, MP1, MP2, MP3, MP4, MP5, MP6, PP, PP1, PP2, PP3, PP4, PP5, PP6, RI, T, DB, DM, DP)

where:

BC	=	Beef consumption per capita
MC	=	Mutton consumption per capita
PC	=	Pork consumption per capita
BP	=	Retail real beef price
BP1,2,3,4,5,6	=	Retail real beef price lagged 1,2,3,4,5,6 months
MP	=	Retail real mutton price
MP1,2,3,4,5,6	=	Retail real mutton price lagged 1,2,3,4,5,6 months
PP	=	Retail real pork price
PP1,2,3,4,5,6	=	Retail real pork price lagged 1,2,3,4,5,6 months
RI	=	Real income per capita
T	=	Time in months
DB	=	Dummy beef (preference change)
DM	=	Dummy mutton (preference change)
DP	=	Dummy pork (preference change)

It is hypothesised that meat consumption would be negatively correlated with its own retail price and positively correlated with other meat products. It is also expected that the liberalisation changes in the South African economy have caused a change in behavioral consumption among the South African consumers. Factors, such as urbanisation, education and technology, along with the changing average real income affects the standard of living and consumption patterns.

Natural logarithmic data was used in order to acquire elasticities directly from the results. Several variables, of which it was suspected that the influence on meat consumption would not be evident immediately, were lagged for periods from one to six months.

Regarding the household consumption models for Namibia, an approach beginning with Engel's (1895) study was used. Several scholars have tried to explain the relationship between income and household expenditures on food (Allen & Bowley, 1935; Stone, 1954; Prais & Houthakker, 1955; Houthakker, 1957; Cramer, 1971; and Goreaux, 1978, Hazell & Röell, 1983). This study draws on the methodologies suggested in existing literature and attempts to verify some of the elasticities obtained by authors in previous studies.

The basic proposition by Engel was that, "the proportion of income spent on food declines as income rises". This has been the fundamental premise for almost all studies on household expenditure. The differences in the various studies lie in either the data used to verify the proposition (time series versus cross-section), or the types of variables used in conjunction with income, or the type of functional form employed, to estimate the relationship between variables. The latter two issues, the variables used, and the functional form need further comment.

Engel's Law refers to the relationship between income and food consumption, thus the appropriate dependent variable should be the proportion of income spent on food. For various reasons, it is common to find the proportion of total household expenses on a particular item used as the dependent variable instead of the proportion of

income. Houthakker (1957) argues that there are both theoretical and practical reasons for preferring expenditures to income as a dependent variable. For example, the elasticities calculated, based on the expenditure measure reflect both the increase in physical quantities and the increase in "quality". Furthermore, researchers have found the measurement of income less accurate than that of expenditures. Thus, the decision to use the proportion of household expenditures as the dependent variable in this study was dictated primarily by this reasoning.

The problem of functional form is less clear. The major candidate functions are the linear, double-log, semi-log, log-inverse, hyperbolic, inverse, and log-normal (Goreaux, 1978). There have been some attempts to employ flexible functional forms such as Box-Cox (Haque, 1988). The theoretical and practical considerations for choosing a functional form are well summarised by Goreaux (1978) and need no repetition. The choice of functional form is an empirical question, even though theoretical considerations play a role where the empirical evidence is less conclusive.

Houthakker (1957) used the double-logarithmic function, because it allows more freedom in dealing with multiple currencies, and it permits an easier introduction of the effects of family size. Sinha (1966) used a log-log inverse function with data from India based on "goodness-of-fit, absence of autocorrelation, and economic interpretation of the function." As surgested by Massell (1969), two-stage least squares should be used to correct the problem of correlation between independent variables and the distrubance term when total consumption is used as independent variable. However, results proved to be inconclusive.

Thus, the ordinary least squares regression with log-linear functional form was chosen in this study for its simplicity even though there are several cautions in the literature regarding its suitability for demand studies (Goreaux, 1978; and Houthakker, 1957). Food consumption is expressed in terms of expenditures rather than quantities (Houthakker, 1957). Finally, family size was introduced as an additional explanatory variable to take account of differences in households. By measuring variables on a per capita basis and introducing family size as an additional variable, it

is possible to account for economies of scale in consumption for larger families (Haque, 1988).

The general form of the functional model fitted in this study is as follows:

$$Yi = a + b*exp + c*size + e_i$$

where Yi = household expenditure on the i^{th} protein item

i^{th} item= beef (B)
chicken (C)
venison (V)
goat meat (G)
mutton (M)
pork (P)

exp = household total expenditure

size = family size

e_i = random error term assumed

a, b, c are parameters to be estimated

Expenditure measures are on a per capita basis. The natural logarithms of values of variables are used in the log-linear estimation.

Two different coefficients are determined, the expenditure coefficient and the household size coefficient. The selection of the functional form has the advantage that the coefficients can also be interpreted as the elasticities. The coefficient of household expenditure is called income elasticity, while the household size coefficient is called the family size elasticity. These elasticities are interpreted as follows: as the per capita basis household expenditure increases, the individuals tend to spend less (negative sign) or more (positive sign); i.e. an income elasticity of 0.234 means that with a 1% increase in household income, the demand for that specific good will increase by 0.234%.

The procedure to analyse the family size effect on expenditures, suggested by Houthakker (1957) is a combination of two effects: “a specific effect” and an “income effect”. The specific effect results from the increase in the need for various commodities when family size increases. The increase in need is usually less than proportional to the increase in size because of economics of scale in large households. On the other hand, the increase in family size does not increase the need for every commodity in the same proportion and may indeed reduce the need for some. Thus, an increase in the family size makes people relatively poorer. This is known as an income effect. Depending on the relative sizes of the positive specific effect and the negative income effect, the aggregated household size effect will be positive or negative. Generally, no consistency of the pattern of the family size on the expenditure categories will be seen, i.e. in some cases, the specific effect will dominate and in other cases the income effect will dominate.

3.3 Results

3.3.1 South Africa

Different models were run to select the best fit. In the case of beef, the retail real pork price, the beef price and the dummy for beef were the only variables explaining national beef consumption, i.e. the income per capita and trend variable were not selected. In assessing the dummy variable by means of graphical plots, the consumption pattern could be divided into two groups, namely group one: 1980 to 1985 and 1988 to 1990 and group two 1986 to 1987 and 1991 to 1997. Both the selection of the dummy variable in the model and the two groupings of consumption data clearly illustrate that preferential changes affect beef consumption.

BC	=	0.788*PP	-	0.128*BP	+	0.230*DB	+	5.474
		6.309		-1.597		5.129		18.886
		(0.0001)		(0.1022)		(0.0001)		(0.0001)
		DF = 167	R^2 = 0.7860		Prob>F = 0.0001		DW = 1.669	

Regarding the national South African mutton consumption, the beef price, mutton price and the dummy for mutton explained the consumption pattern. The dummy

variable was grouped in two, namely 1980 to 1990 and thereafter (1991 to 1997). This grouping is clearly different than in the case of beef.

MC	=	0.381*BP	-	0.889*MP	+	0.516*DM	+	7.364
		4.265		-5.607		14.291		14.678
		(0.0001)		(0.0001)		(0.0001)		(0.0001)
		DF = 167	R^2 = 0.6988		Prob>F = 0.0001		DW = 2.216	

Another model shows that the retail price of pork affects the mutton consumption too.

MC	=	0.949*PP	-	1.231*MP	+	0.296*DM	+	7.020
		6.742		-7.658		5.668		15.001
		(0.0001)		(0.0001)		(0.0001)		(0.0001)
		DF = 167	R^2 = 0.7380		Prob>F = 0.0001		DW = 2.469	

South African pork consumption is determined by the retail price of beef, pork and a dummy variable. The dummy variable was grouped in the same manner as the case of mutton, i.e. pork and mutton consumers react similar to preferential changes.

PC	=	0.269*BP	-	0.212*PP	+	0.245*DP	+	5.368
		5.579		-2.822		9.083		30.737
		(0.0001)		(0.0054)		(0.0001)		(0.0001)
		DF = 167	R^2 = 0.6835		Prob>F = 0.0001		DW = 1.598	

3.3.2 Botswana

The data availability for Botswana caused some modelling problems. However, significant models were found to determine consumption patterns of beef for the Gabarone, Lobatse and Maun communities, but the R^2 were relatively low. No significant effect of preferential change was observed from the three communities. However, the graphical plots showed that consumption in Gabarone can be split into before and after January 1996, in Maun three patterns were observed, namely the year 1995, the year 1990 and the remaining years, while in Lobatse two groupings of before 1993 and thereafter, are observed.

In the case of Gabarone, the retail price of beef determines consumption. None of the other available variables yielded significant results.

BC	=	3.172	-	0.456*BP			
		7.226		-1.757			
		(0.0001)		(0.0928)			
		DF = 23	R^2 = 0.0832		Prob>F = 0.0928	DW = 1.769	

In assessing how the nearby Lobatse market could affect consumption of beef in Gabarone, a significant model was obtained. In this regard, it should be noted that most of Botswanas beef slaughtered for the Botswana population stems from Lobatse, while Gabarone only has a medium scale municipal abbatoir.

BC	=	3.638	-	0.992*BP			
		6.553		-2.221			
		(0.0001)		(0.0370)			
		DF = 23	R^2 = 0.1460		Prob>F = 0.0370	DW = 1.613	

The opposite was found to hold for Lobatse, i.e. the Gabarone retail price affected the Lobatse beef consumption, while the own Lobatse retail price for beef did not significantly influence beef consumption.

BC	=	4.029	-	2.051*BP			
		3.881		-3.193			
		(0.0008)		(0.0042)			
		DF = 23	R^2 = 0.2856		Prob>F = 0.0042	DW = 1.871	

The Maun population is more rural than in the Gabarone and Lobatse regions. Most of the cattle slaughtered here are destined for Gauteng province. The latter determines the prices too, as shown in the model below. However, it takes three months for this price effect to filter through. Maun's own retail price did not significantly explain local consumption. A polinomial fit was tested, but did not yield better results.

BC	=	-	1.195	-	0.538*BP3		
			-6.867		-7.509		
			(0.0001)		(0.0001)		
		DF = 117	R^2 = 0.3213		Prob>F = 0.0001	DW = 1.553	

3.3.3 Namibia

The following equations present the income and household size variables. Since the data was transformed into the logarithm functional form, the elasticities of the variables are the same as the coefficients of the equations.

Khomas region

YB	=	0.243*exp	-	0.267*size	+	3.037		
		31.829		-35.061		35.731		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 19400	R^2 = 0.200		Prob>F = 0.0001		DW =	1.373
YC	=	0.405*exp	-	0.215*size	+	1.812		
		56.772		-30.204		29.414		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 19468	R^2 = 0.306		Prob>F = 0.0001		DW =	1.757
YV	=	0.034*exp	-	0.837*size	+	6.047		
		1.949		-48.266		37.902		
		(0.052)		(0.0001)		(0.0001)		
		DF = 985	R^2 = 0.705		Prob>F = 0.0001		DW =	1.878
YG	=	0.502*exp	+	0.027*size	+	0.002		
		42.114		2.225		0.223		
		(0.0001)		(0.026)		(0.823)		
		DF = 6266	R^2 = 0.242		Prob>F = 0.0001		DW =	1.175
YM	=	0.380*exp	-	0.132*size	+	1.211		
		31.123		-10.792		7.733		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 8699	R^2 = 0.225		Prob>F = 0.0001		DW =	1.275
YP	=	0.571*exp	-	0.181*size	-	1.758		
		42.106		-13.337		-10.477		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 4075	R^2 = 0.470		Prob>F = 0.0001		DW =	1.792

Otjozondjupa region

YB	=	0.353*exp	-	0.361*size	+	1.893		
		39.791		-40.728		20.287		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 12217	R^2 = 0.413		Prob>F = 0.0001		DW =	1.671

YC	=	0.334*exp	-	0.527*size	+	1.467				
		33.076		-52.140		11.988				
		(0.0001)		(0.0001)		(0.0001)				
		DF = 5660	R^2 = 0.562		Prob>F = 0.0001		DW	=	1.372	
YV	=	0.227*exp	-	0.386*size	+	2.978				
		11.538		-19.602		13.121				
		(0.0001)		(0.0001)		(0.0001)				
		DF = 3393	R^2 = 0.322		Prob>F = 0.0001		DW	=	1.421	
YG	=	0.755*exp	+	0.108*size	-	4.003				
		55.043		7.871		-23.138				
		(0.0001)		(0.0001)		(0.0001)				
		DF = 4453	R^2 = 0.480		Prob>F = 0.0001		DW	=	1.478	
YM	=	0.661*exp	-	0.083*size	-	1.630				
		29.602		-3.706		-6.437				
		(0.0001)		(0.0001)		(0.0001)				
		DF = 1496	R^2 = 0.506		Prob>F = 0.0001		DW	=	1.534	

Oshana region

YB	=	0.594*exp	-	0.125*size	-	0.863		
		101.323		-211376		-13.372		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 20824	R^2 = 0.438		Prob>F = 0.0001		DW = 1.756	
YC	=	0.319*exp	-	0.293*size	+	1.339		
		29.886		-27.469		12.052		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 7864	R^2 = 0.266		Prob>F = 0.0001		DW = 1.224	
YG	=	0.718*exp	+	0.159*size	-	3.477		
		40.735		8.997		-16.604		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 3184	R^2 = 0.398		Prob>F = 0.0001		DW = 1.477	
YM	=	0.778*exp	-	0.132*size	-	2.596		
		17.938		-3.031		-5.703		
		(0.0001)		(0.003)		(0.0001)		
		DF = 186	R^2 = 0.684		Prob>F = 0.0001		DW = 0.975	
YP	=	0.587*exp	-	0.100*size	-	1.954		
		29.978		-5.110		-9.028		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 2009	R^2 = 0.411		Prob>F = 0.0001		DW = 1.576	

Hardap region

YB	=	0.558*exp	+	0.216*size	-	2.406		
		18.581		7.181		-7.070		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 1176	R^2 = 0.231		Prob>F = 0.0001		DW = 1.221	
YC	=	0.424*exp	-	0.368*size	+	1.275		
		36.070		-31.240		10.984		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 5103	R^2 = 0.471		Prob>F = 0.0001		DW = 1.287	
YV	=	0.407*exp	-	0.420*size	+	1.732		
		12.325		-12.706		4.085		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 566	R^2 = 0.471		Prob>F = 0.0001		DW = 1.085	
YG	=	0.467*exp	-	0.278*size	+	0.721		
		33.193		-19.765		4.657		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 3531	R^2 = 0.386		Prob>F = 0.0001		DW = 1.553	
YM	=	0.449*exp	-	0.315*size	+	1.382		
		35.134		-24.661		9.722		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 4350	R^2 = 0.421		Prob>F = 0.0001		DW = 1.872	

Erongo region

YB	=	0.439*exp	-	0.269*size	+	0.700		
		34.016		-20.837		4.814		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 5398	R^2 = 0.402		Prob>F = 0.0001		DW	= 1.675
YC	=	0.504*exp	-	0.248*size	+	0.840		
		47.079		-23.172		9.042		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 6389	R^2 = 0.433		Prob>F = 0.0001		DW	= 1.754
YV	=	-0.558*exp	-	0.779*size	+	15.495		
		-24.456		-34.126		41.733		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 601	R^2 = 0.706		Prob>F = 0.0001		DW	= 1.532
YG	=	0.408*exp	+	0.071*size	-	0.682		
		22.075		3.854		-2.670		
		(0.0001)		(0.0001)		(0.008)		
		DF = 3617	R^2 = 0.139		Prob>F = 0.0001		DW	= 1.075
YM	=	0.335*exp	-	0.038*size	+	1.592		
		11.638		-1.309		5.013		
		(0.0001)		(0.191)		(0.0001)		
		DF = 1291	R^2 = 0.123		Prob>F = 0.0001		DW	= 1.182
YP	=	0.724*exp	+	0.059*size	-	3.107		
		26.533		2.159		-10.361		
		(0.0001)		(0.031)		(0.0001)		
		DF = 1020	R^2 = 0.479		Prob>F = 0.0001		DW	= 1.511

Karas region

YB	=	0.236*exp	-	0.304*size	+	2.356		
		12.411		-15.933		11.532		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 2530	R^2 = 0.199		Prob>F = 0.0001		DW	= 1.171

YC	=	0.317*exp	-	0.287*size	+	2.534				
		22.899		-20.789		21.073				
		(0.0001)		(0.0001)		(0.0001)				
		DF = 5121	R^2 = 0.275		Prob>F = 0.0001		DW	=	1.378	
YV	=	0.433*exp	-	0.184*size	-	1.895				
		8.025		-3.419		-1.766				
		(0.0001)		(0.001)		(0.079)				
		DF = 268	R^2 = 0.227		Prob>F = 0.0001		DW	=	1.041	
YG	=	0.523*exp	-	0.172*size	+	0.195				
		28.117		-9.253		1.040				
		(0.0001)		(0.0001)		(0.298)				
		DF = 2310	R^2 = 0.389		Prob>F = 0.0001		DW	=	1.577	
YM	=	0.321*exp	-	0.380*size	+	2.871				
		28.439		-33.693		21.731				
		(0.0001)		(0.0001)		(0.0001)				
		DF = 6640	R^2 = 0.371		Prob>F = 0.0001		DW	=	1.772	
YP	=	0.541*exp	-	0.053*size	-	1.341				
		11.705		-1.138		-2.174				
		(0.0001)		(0.255)		(0.030)				
		DF = 711	R^2 = 0.337		Prob>F = 0.0001		DW	=	1.278	

Okavango region

YB	=	0.684*exp	+	0.065*size	-	4.277		
		107.533		10.215		-49.704		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 17757	R^2 = 0.432		Prob>F = 0.0001		DW	= 1.874
YC	=	0.433*exp	-	0.300*size	+	0.760		
		38.555		-26.726		6.898		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 6541	R^2 = 0.419		Prob>F = 0.0001		DW	= 1.910
YV	=	0.482*exp	-	0.122*size	-	4.341		
		18.939		-4.782		-8.870		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 1479	R^2 = 0.308		Prob>F = 0.0001		DW	= 1.263
YG	=	0.512*exp	-	0.017*size	-	2.265		
		36.593		-1.209		-14.074		
		(0.0001)		(0.227)		(0.0001)		
		DF = 4905	R^2 = 0.270		Prob>F = 0.0001		DW	= 1.097
YP	=	0.597*exp	-	0.020*size	-	2.150		
		42.629		-15.591		-14.647		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 2956	R^2 = 0.503		Prob>F = 0.0001		DW	= 1.852

Oshikoto region

YB	=	0.534*exp	-	0.124*size	-	0.455		
		64.817		-15.070		-5.190		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 13355	R^2 = 0.375		Prob>F = 0.0001		DW	= 1.775
YC	=	0.385*exp	-	0.381*size	+	1.622		
		28.578		-28.300		12.954		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 4605	R^2 = 0.472		Prob>F = 0.0001		DW	= 1.884
YG	=	0.226*exp	-	0.216*size	+	2.172		
		12.598		-12.014		9.097		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 3467	R^2 = 0.145		Prob>F = 0.0001		DW	= 1.026
YM	=	0.122*exp	-	0.357*size	+	5.048		
		3.423		-10.066		14.387		
		(0.001)		(0.0001)		(0.0001)		
		DF = 794	R^2 = 0.177		Prob>F = 0.0001		DW	= 1.102
YP	=	0.288*exp	-	0.490*size	+	2.679		
		13.920		-23.722		12.550		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 1625	R^2 = 0.450		Prob>F = 0.0001		DW	= 1.973

Ohangwena region

YB	=	0.557*exp	-	0.029*size	-	2.157		
		87.225		-4.519		-28.514		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 18773	R^2 = 0.322		Prob>F = 0.0001		DW	= 1.469
YC	=	0.217*exp	-	0.383*size	+	2.472		
		17.794		-31.365		17.794		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 5622	R^2 = 0.247		Prob>F = 0.0001		DW	= 1.431
YG	=	0.342*exp	-	0.121*size	-	0.973		
		28.920		-10.225		-5.223		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 6695	R^2 = 0.158		Prob>F = 0.0001		DW	= 1.075

Kunene region

YB	=	0.477*exp	-	0.204*size	+	0.340		
		34.605		-14.804		2.240		
		(0.0001)		(0.0001)		(0.025)		
		DF = 4765	R^2 = 0.379		Prob>F = 0.0001		DW	= 1.435

YC	=	0.514*exp	-	0.252*size	+	0.602		
		24.537		-12.043		3.465		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 2015	R^2 = 0.497		Prob>F = 0.0001		DW =	1.682
YV	=	0.458*exp	-	0.187*size	+	1.820		
		7.790		-3.171		7.741		
		(0.0001)		(0.002)		(0.0001)		
		DF = 300	R^2 = 0.344		Prob>F = 0.0001		DW =	1.325
YG	=	0.254*exp	-	0.290*size	+	2.581		
		15.632		-17.818		13.816		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 4210	R^2 = 0.231		Prob>F = 0.0001		DW =	1.157
YM	=	0.662*exp	+	0.122*size	-	3.086		
		20.958		3.545		-8.207		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 690	R^2 = 0.397		Prob>F = 0.0001		DW =	1.235

Omaheke region

YB	=	0.374*exp	-	0.271*size	+	1.325		
		20.632		-14.984		7.119		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 3261	R^2 = 0.338		Prob>F = 0.0001		DW =	1.875
YC	=	0.199*exp	-	0.625*size	+	3.546		
		9.162		-28.717		15.982		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 1513	R^2 = 0.594		Prob>F = 0.0001		DW =	1.347
YV	=	0.297*exp	-	0.340*size	+	2.758		
		10.226		-11.718		9.198		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 976	R^2 = 0.273		Prob>F = 0.0001		DW =	1.254
YG	=	0.330*exp	-	0.306*size	+	1.044		
		20.632		-14.984		3.418		
		(0.0001)		(0.0001)		(0.001)		
		DF = 2108	R^2 = 0.329		Prob>F = 0.0001		DW =	1.575
YM	=	0.314*exp	-	0.287*size	+	2.139		
		9.009		-8.230		5.281		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 967	R^2 = 0.293		Prob>F = 0.0001		DW =	1.234
YP	=	0.169*exp	-	0.770*size	+	3.569		
		4.532		-20.683		23.605		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 238	R^2 = 0.713		Prob>F = 0.0001		DW =	2.171

Caprivi region

YB	=	0.682*exp	-	0.021*size	-	1.600		
		89.317		-2.707		-22.161		
		(0.0001)		(0.007)		(0.0001)		
		DF = 11773	R^2 = 0.479		Prob>F = 0.0001		DW	= 1.874

YC	=	0.621*exp	-	0.138*size	-	0.354		
		51.097		-11.367		-3.635		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 4912	R^2 = 0.500		Prob>F = 0.0001		DW =	1.770
YV	=	0.620*exp	+	0.042*size	-	2.752		
		25.168		1.688		-13.230		
		(0.0001)		(0.092)		(0.0001)		
		DF = 1025	R^2 = 0.394		Prob>F = 0.0001		DW =	1.278
YG	=	0.598*exp	+	0.088*size	-	1.866		
		19.335		14.984		-5.942		
		(0.0001)		(0.005)		(0.0001)		
		DF = 960	R^2 = 0.311		Prob>F = 0.0001		DW =	1.373
YP	=	0.443*exp	+	0.547*size	-	0.808		
		12.259		15.142		-3.936		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 408	R^2 = 0.468		Prob>F = 0.0001		DW =	1.539

Omusati region

YB	=	0.529*exp	-	0.110*size	-	1.063		
		82.266		-17.092		-14.688		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 17942	R^2 = 0.327		Prob>F = 0.0001		DW =	1.773
YC	=	0.289*exp	-	0.449*size	+	1.862		
		24.265		-37.642		15.556		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 4982	R^2 = 0.372		Prob>F = 0.0001		DW =	1.579
YV	=	0.789*exp	-	0.602*size	-	9.627		
		17.091		-13.045		-10.978		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 165	R^2 = 0.682		Prob>F = 0.0001		DW =	1.272
YG	=	0.285*exp	-	0.156*size	+	0.374		
		18.226		-9.967		1.772		
		(0.0001)		(0.0001)		(0.076)		
		DF = 3935	R^2 = 0.133		Prob>F = 0.0001		DW =	1.047
YM	=	0.326*exp	-	0.181*size	+	1.241		
		5.793		-3.206		2.617		
		(0.0001)		(0.002)		(0.009)		
		DF = 279	R^2 = 0.122		Prob>F = 0.0001		DW =	0.877
YP	=	0.472*exp	-	0.421*size	-	1.333		
		32.816		-29.240		-7.637		
		(0.0001)		(0.0001)		(0.0001)		
		DF = 2655	R^2 = 0.466		Prob>F = 0.0001		DW =	1.839

3.4 Discussion

3.4.1 South Africa

Own and cross-price elasticities of demand are present in all demand equations. The own beef price elasticity of -0.128 shows that if the price of beef increases with 1 per cent, the beef consumption per capita will only react slightly (0.128%). The beef consumption is more responsive to the pork retail price, i.e. if the pork price increases by 1 per cent, the consumers will purchase beef (increase of 0.788%).

Regarding mutton, the consumers are very price responsive. The own price elasticity of demand ranged between -0.889 and -1.231. Mutton consumers further react to pork retail price changes, but to a lesser extent to beef prices.

The consumers of pork are relatively unresponsive to both the retail pork and beef prices, i.e. if the price of beef increases by 1 per cent, the consumption of pork will increase by 0.269 per cent, and if the pork price increases by 1 per cent, the consumption of pork will decrease by only 0.212 per cent.

Income elasticities were not found to be a significant explanatory variable, using national aggregated data. It was found that the dummy variables were in all cases significant explanatory variables, which indicates that preferential changes of meat consumers in South Africa took place in recent years. The beef and pork consumers react relatively little to own price changes, while mutton consumption fluctuates more with own price changes.

3.4.2 Botswana

Since no price data for other types of meat than beef was available for Botswana, no cross-price effects could be analysed. It was found that income and preferential changes did not significantly explain consumption of beef. The only explanatory variable for Botswana was the retail beef price at different localities. Consumers of beef in Gabarone reacted to beef price changes, i.e. a 1 per cent

increase in price resulted in a 0.456 per cent decrease in consumption. The nearby Lobatse retail beef prices had a significant effect on beef consumption in Gabarone, for each percentage increase in Lobatses price, the consumption of beef in Gabarone decreased with 0.992 per cent. This shows that price determination in one town affects the consumption in another town.

The same was found for Lobatse, where the Gabarone beef price determined consumption. Here the effect was great, a 2.051 percent change in consumption caused by an 1 per cent change in Gabarones price. The Lobatse retail price had no significant effect on consumption. The same was found for Maun. This is an indication that price determination is affected by regulatory measures, meaning that free market forces can not take place. The Maun consumption was determined by the three months lagged Gauteng retail beef price.

3.4.3 Namibia

The following table summarises the income elasticities of demand for different areas of Namibia. Most of the elasticities fall in the range 0.1 to 0.8 which indicates that an increase of 1 per cent in household income result in an increase in demand for meats of between 0.1 to 0.8 percent. Only in the case of venison in one specific central area (Erongo) the demand will decrease. This is a region, where the game population is high, compared to other regions. In many of the central Northern Communal Areas, no venison is available. A similar situation exists for mutton in these regions.

Table 3.1 Income elasticities of demand of various meats in Namibia

Item	Northern Communal Areas (a)	Central Commercial Areas (b)	Southern Commercial Areas (c)
Beef	0.477 - 0.684	0.243 - 0.439	0.236 - 0.558
Chicken	0.217 - 0.621	0.199 - 0.504	0.317 - 0.424
Venison	0.458 - 0.789	-0.558 - 0.227	0.407 - 0.433
Goat meat	0.226 - 0.718	0.330 - 0.755	0.467 - 0.523
Mutton	0.122 - 0.778	0.314 - 0.661	0.321 - 0.449
Pork	0.443 - 0.597	0.169 - 0.724	0.541

Note: a = Kunene, Omusati, Ohangwena, Oshana, Oshikoto, Okavango, Caprivi
b = Otjozondjupa, Erongo, Omaheke, Khomas
c = Hardap, Karas

To determine preference ratings of meat, the family size elasticity was used as proxy, i.e. the lower the negative sign of the elasticity, the higher is the demand for the specific meat type. This compares well with the high income elasticities. It was found that in the Northern Communal Areas meats (pork, mutton, goat meat and beef) were preferred which were not freely available, such as chickens. In regions, such as the Kunene region, where goats and sheep are well adapted to nature, the population prefer venison and beef. However, differences occur, eg. in Caprivi beef and chicken are the most preferred meats.

In the Central Commercial Areas, chicken, mutton and pork are preferred most. These areas are known for beef ranching and game farms. The Southern areas are more arid and well suited for small-stock. Here, beef and pork are in high demand. It appears thus that the scarcity of specific meats dictates the demand.

SECTION 4

PROSPECTS FOR TRADE

4.1 Introduction

International trade liberalisation and food policy reform are likely to have a large impact on the beef sub-sectors of countries in Southern Africa. A few Southern African countries are exporters of beef. Beef trade between them and the rest of the world is dominated by the EU, mainly due to the preferential access of Botswana, Namibia and Zimbabwe on the artificially lucrative EU market under the Lome' Convention. The assurance of a beef market is, however, not acompanied by price guarantees. Therefore, changes in EU's Common Agricultural Policy (CAP), particular in the light of world trade liberalisation makes beef trade of the exporting countries vulnerable.

4.2 Livestock pricing policies in Southern Africa

Governments in many countries in Southern Africa manipulate agricultural and food prices to achieve a variety of economic, social and political objectives. Many price policy objectives and instruments employed to influence prices, however, often created negative incentives for agricultural producers (*cf* Cleaver (1985), Oyejide (1986), Tshibaka (1986) and Ghai & Smith (1987)). Besides the above studies on cash crops and staple foods, intervention by governments in the pricing and distribution of these crops also extends to the livestock sub-sector.

Although there are several objectives of livestock pricing policies, the array of different objectives pursued can be summarised under (Williams, 1993):

- stabilization and inflation control,
- government revenue generation,
- self-sufficiency, and
- export promotion.

Of these four objectives, the first three are ubiquitous. The export promotion objective is common to Botswana, Namibia and Zimbabwe.

The stabilization objective takes on two forms: price and income stabilization. The aim of price stability is to minimize erratic price fluctuations with a view to achieving both consumer and producer price stability. The income stability is basically producer oriented. The main instrument used to achieve price stability on the consumer side is consumer price control and on the producer side marketing boards usually control or administer prices.

Another objective is to raise revenue for government development tasks. This is done in most developing countries without adequate administrative apparatus to impose direct taxes. Thus, indirect taxes, e.g. import and export tariffs are commonly used in these countries. Regarding the nominal protection coefficients (NPC), used as measure of distortion of production incentives, most cases presented a fall in the NPC for beef, which in the case of Zimbabwe was caused by a rise in the real border equivalent price coupled with a moderate fall in real domestic prices (Williams, 1993). The NPC in South Africa also decreased over time (Helm & van Zyl, 1995).

The self-sufficiency objective in the livestock sub-sector is often seen as a rationale to improve the nutritional status of milk and beef. Equally important is the desire to reduce the dependency on imports in the face of foreign exchange shortages and unpredictable world prices of beef. Instruments used to address the latter were remunerative producer prices, trade quotas, and outright bans on imports and exports.

The last objective is associated with the desire to improve the contribution of the livestock sub-sector to net foreign exchange earnings. The major contributing factor in earning real foreign income is the Lome convention.

4.3 Beef exporting requirements in the next century[2]

The outbreak of the Mad Cow Disease during 1996 had a significant effect on the red meat markets. Consumers are increasingly concerned about the wholesomeness of the meat they purchase, due to negative publicity. Consumers want to be assured of the quality and safety of the food they eat. Retailers are demanding higher standards, not only of the meat they buy, but also of the farming environment in which the animals are raised.

The way in which beef is marketed to Europe is changing. The focus is increasingly directed to consumer health and safety. Current systems are devised to control all steps used in the production of meat for human consumption, giving the highest level of consumer health safeguards. In addition to harmful residues, special attention is now paid to diseases like Salmonellosis, Listeriosis, Campylobacteriosis and E. coli 0157 infections which are invisible during normal post mortem meat inspection procedures but are serious human health hazards. The spotlight is also naturally falling on the potential transmission of specific pathogens by the use of animal feeds, eg BSE (also known as Mad Cow Disease).

A new concept, called the "stable to table concept" is presently under investigation by the European Commission and implementation can soon be expected. This is a holistic concept, aimed at the control and supervision of all production activities, by a competent authority. This authority has to intensively monitor the cattle on the farm site, where they are raised and kept , to the transportation, slaughtering, processing, packaging and sale to the final consumer. Namibia at present takes the lead in implementing this concept, ensuring their continued export of meat and meat products to the EU. The following measures have to be implemented:

- inspection on farm level, including conditions of raising of animals, use of pesticides and veterinary medicines, disease occurence, etc.,

[2] This section is based on findings of Schneider & Paskin (1998)

- on-farm microbiological examinations of eg the faeces and soil to trace specific pathogens hazardous to humans,
- establishement of proper information systems between bodies taking part in meat inspection as a whole,
- application of the self-controlling Harzard Analysis at Critical Control Point System (HACCP) in abattoirs and meat processing establishments, and
- attention to the wholesomeness of fresh meat and meat products in its broadest sense, including guaranteed tenderness, freedom of residues of any kind and to feedstuffs used without protein derived from any animal source or additives of antibiotic growth promotors.

Environmental and animal welfare aspects have to be specifically addressed in view of the European consumers' concerns for slaughter animals' well-being and proper natural or environmentally friendly keeping and raising of domestic animals. It is expected that from the year 2000, extremely rigorous export standards will be imposed on all third world countries, including Southern Africa. In this regard Namibia for instance is busy developing a special quality assurance scheme for Namibian meat, to be known as the Farm Assured Namibian Meat (FAN) Meat. Other meat exporting countries in Southern Africa will certainly follow in a similar way to maintain trade benefits.

4.4 Trade flow of beef in the Southern Africa [3]

Beef is traded not only within the SADC region, but extraregional trade also takes place. Both, intraregional and extraregional trade should complement each other. However, the trade provisions of the Lome' Convention profoundly affect the extraregional trade patterns of the SADC member countries. In particular, Botswana, Namibia and Zimbabwe are beneficiaries of the Beef Protocol. These countries are all dependent on the export earnings generated by these Protocol. Apart from the export revenue, the trade preferences appear to have made little impact on the expansion of exports, investments and economic diversification.

[3] This section is partly based on the findings of Jooste (1996)

The Lome Convention expires in 2000 and negotiations to conclude a successor agreement will commence in November 1998. This will influence the SADC's trade integration agenda. The green paper by the EU in November 1996 outlines possible options for a successor agreement and reveals that the EU does not favour a continuation of the current system of non-reciprocal trade preferences, which in turn do not comply with the WTO rules.

A study by Jooste (1996) investigated the regional trade of beef in Southern Africa. He found that the internal markets for beef are very important to own producers. It was also shown that trade relations between South Africa and Namibia are intense, but negligible between Botswana and South Africa. Botswana prefers to trade with countries in the EU and intense trade relations have developed over time. Namibia's trade relations with the EU is also intensive, but she still perceives South Africa as her most important market. The analyses furthermore showed that the EU countries are becoming a more important source of beef to South Africa. With the expire of Lome, the Namibian and Botswana beef industries thus have to explore new markets.

Jooste (1996) developed a transport model to determine the optimal beef trade. This model analyses the distribution and intraregional movement of beef and regards this as a function of availability, prices, transport costs and policies. Different scenarios were adressed, such as the case of drought, no tariffs levied, the international price equal to domestic prices, depreciation of the SA Rand, etc. The study shows limitations in terms of generalising the real world into easy cases, but still presents the following valuable findings:

- An *ad valorem* tariff of 40% on the imports of beef from non-SACU countries enables South Africa, Namibia and Botswana to offset imports by local beef supplies, in normal and drought years. In good rainfall years, only Namibia and Botswana can compete with overseas suppliers of beef. Domestic

surplusses will be disposed of if the domestic price of beef decreases by approximately 14%.

- In the absence of tariffs on imports of beef, no country in SACU will be able to compete with overseas suppliers of beef. This conclusion stems from an unfair policy of foreign countries stimulating own production and exports through price incentives, subsidies and other policy measures. Although this practice is set to change, vagencies of policies will still influence trade patterns for some time.
- Transport costs and a modest depreciation in the exchange rate of the SA Rand alone cannot by themselves offset imports from overseas. Even if the cost to transport beef between regions is lowered by 20%, imports will still take place in the absence of tariffs. A combination of lower transport costs and a depreciation of the exchange rate to R4.35 per US$ will increase the competitiveness of producers in the sense that the tariff needed to put the international price and domestic price of beef on par would be approximately 2% in the long run.
- Policy regarding tariffs on other products is also important for the beef subsector. High import tariffs on inputs used in feedlots can render it impossible for these producers to maintain profitability. Low tariffs on substitutes, for example poultry, may shift the demand away from beef towards these substitutes.

The SADC free trade area could present a problem for Namibian beef exporters if the SACU preferential access is liberised and free SADC trade confer. Zimbabwe will compete in the sphere of beef cuts rather than live animals. At present South Africa imports about 58% of Namibian exports of beef cuts. However, this threat only holds if the quality of beef of the two countries proves to be the same. For Zimbabwean producers the SADC free trade area poses a threat too. At present, EU originated beef may not reach the Zimbabwe local market. South Africa imports EU beef and this beef could filter through to Zimbabwe, once the SADC free trade protocol is signed.

4.5 JFK, hier kom die gedeelte in van inset-uitset matriks resultate van die livestock industry van SA, jy weet wat Scott McDonald hulle doen (slegs die gedeelte) Hierdie resultate is belangrik om die vermenigvuldiger effekte en die belangrikheid van die bedryf te beklemtoon - wat dus ook handel bevorder. Wat spesefiek getoon moet word is hoe SA in die prentjie inpas.

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APPENDIX A

EXISTING CATTLE PRODUCTION ENVIRONMENT IN SOUTHERN AFRICA

Appendix A gives an overview of the present situation with regard to the agricultural sectors of South Africa, Botswana, Lesotho, Namibia, Swaziland, Zambia and Zimbabwe, with specific reference to their beef production sectors. It will address aspects such as production systems, marketing and institutional arrangements and trade in beef.

SOUTH AFRICA

The beef industry

In most parts of South Africa beef production forms an integral part of a mixed farming system. Income derived from this branch of farming contributes largely to the economic viability of farming enterprises and the sustenance of the rural population. In 1996 beef represented approximately 68 percent of all red meat produced in the country and beef production contributed approximately 11.4 percent to the gross value of all agricultural production and approximately 68.6 percent to the gross value of red meat production (National Department of Agriculture, 1997).

Beef production is largely dependent on natural and cultivated pastures, although at present 60 percent of all slaughtered stock is still marketed through feed-lot operations. Due to the mixed nature of farming a reasonable estimate of the number of cattle farms is difficult to establish. However, a typical beef farm is 3800 hectares in extent with a beef herd of approximately 380 animals. The total cattle population in the commercial sector is about 8.4 million heads. South Africa is generally a deficit beef producer and beef production is primarily domestically orientated (National Department of Agriculture, 1997).

The evolution of the beef industry is influenced by several factors, including the following:

- The economic implications of changing weather conditions
- Production costs
- Improved technology and managerial skills
- Competition from alternative farming enterprises
- Population growth (currently 2.15 percent per annum) which affects demand
- Availability of other meats - poultry meat is substituted for red meat by consumers
- Steadily rising income levels during the past decade coupled with an income elasticity of demand substantially greater than one among the lower income groups (National Department of Agriculture, 1997).

Certain policies and measures have been implemented by the Government to regulate the meat industry. These are:

- Research by Government institutions and universities, and guidance to producers in respect of breeding and pasture management and general management practices
- Drought and flood schemes operated by Government
- The slaughtering of cattle and marketing of beef are subject to health and sanitary standards imposed by the Government.
- The Government is also involved in schemes for the prevention and/or eradication of animal diseases, e.g. a mandatory dipping scheme and measures to prevent the spread of foot-and-mouth disease from adjoining territories (National Department of Agriculture, 1997).

There are various aspects of the economic impact of declining beef prices arising from importing subsidised beef. Consumers are the main short run beneficiaries from lower beef prices, but in the long run they will be worse off if lower beef prices lead to decreased investment in the domestic livestock industry. Two of the most important agricultural sectors in South Africa are beef and maize. In

1994/95 they contributed respectively R3 336 million (11 percent) and R4 000 million (12 percent) to the South African agriculture. Fifty percent of the maize crop is used for feeding which includes beef. The Maize Board was abolished on 30 April 1997 and it is envisaged that maize formerly exported under the one channel marketing scheme will increasingly be used for domestic animal feed. Approximately six tons of feed, depending on a number of factors, produces one ton of beef. Maize exports are not expected to be economically viable under normal conditions. Agricultural sectors are inter-linked and the displacement of local beef production by subsidised meat imports will lead to a concomitant displacement in feed and also maize production (Nieuwoudt, 1997).

Backward and forward linkages of agriculture and other sectors imply that input supply and sectors on product marketing are adversely affected. Agriculture has a multiplier of 1.6 which means that a drop of R1 million in agricultural production could lead to a R1.6 million decline in GDP. In addition, South African agriculture is labour intensive and the contraction of beef and maize production will destroy jobs in a sector characterised already by high unemployment. On-farm employment in South Africa is responsible for 13 percent of formal employment. Because of the linkage effect a further 402 000 people are employed in the agricultural manufacturing sector, resulting in 28 percent of formal jobs. South Africa produces surpluses of high quality beef and has a shortage of lower quality manufacturing beef. On the balance the country is a net importer of beef and provides a market for the most important agricultural export product of the depressed economies of Southern Africa (Nieuwoudt, 1997).

Institutional set-up and domestic beef marketing

The Meat Board was established in terms of the Marketing Act of 1968, and performs several functions, including collecting, processing, evaluating and distributing information, product promotion, market development, facilitating liaison between all role-players in the industry and promoting production. In the past the Meat Board has been involved in various deregulation exercises, e.g. it

used to operate a surplus removal scheme, whereby, during periods of oversupply, it bought all carcasses that could not be sold at a guaranteed minimum price. This function was terminated in 1993. The aim of this scheme was to remove surpluses from the market by exports. Due to sanctions, strict sanitary measures and international subsidisation of meat prices exports could, however, not take place. Surpluses were therefore sold into the domestic market. Although the buying actions of the Meat Board did increase producer prices, the selling actions had a larger depressing effect on prices (Venter and Van Zyl, 1996: 144-147). In order to aid the surplus removal scheme in increasing producer prices, supply control measures in the form of quotas and permits were instituted. Elliot, Nieuwoudt and Darroch (1987: 69) found that in the allocation of these permits and quotas, regular suppliers, such as feedlots, were favoured, while unsuccessful applications were associated with smaller, irregular suppliers. As permits and quotas have value, the existence of the scheme benefits large suppliers at the expense of small suppliers. Nieuwoudt (1987: 284) states that these feedlot operators received substantial windfalls by being allocated permits, as permits have value. Permits derive their value from the fact that the scheme increases the prices on the city abattoirs while depressing the prices on country auctions. Pressure to sell cattle is higher during droughts, which will increase the value of permits. The economic implication is that during a drought permits would depress country auction prices to a greater extent, thereby aggravating the position of farmers during adverse times. Meyer (1988: 7) found that the actions of the Meat Board to keep prices high during times of drought has resulted in the over-utilisation of grazing during droughts, which rendered the land less productive afterwards.

Since the Report in 1992 of the Kassier Committee of Inquiry into the Marketing Act, deregulation took place rapidly and is still continuing in accordance with the declared national policy of deregulation. A new Marketing of Agricultural Products Act was drawn up in 1996 and came into effect on 1 January 1997. This Act supports a more liberalised agricultural marketing dispensation. While there is movement towards a freer market, the necessity for limited market intervention

remains. The new act makes provision for such intervention if there is sufficient support and if it can be motivated. In terms of the new Marketing of Agricultural Products Act of 1996 the Meat Board will be phased out by 31 December 1997 (National Department of Agriculture, 1997).

Table 1 shows the availability of beef in South Africa. The availability of beef is determined by local production plus imports minus exports, as well as transactions by the Meat Board. The latter is the result of the floor price system in terms of which the Meat Board removed surpluses from the market and sold it again in times of shortages. Beef imports increased substantially since 1994. South African exports are very small, though, and this situation is not expected to change (Jooste, Van Schalkwyk, Bekker and Louwrens, 1997: 85).

Table 1 The availability of beef (tons) on the South African market:1990 to 1995

Year	Slaughtering	Imports		Exports	Meat Board Transactions		Total Availability
		Neighbouring Countries	Over-Seas		Purchases	Sales	
1990	433208	55346	2808	863	597	681	490583
1991	461866	50477	3133	920	578	1400	515380
1992	489247	52679	3900	1533	14467	3038	532845
1993	446663	52297	7603	2973	11552	9966	502004
1994	369226	57848	41775	2173	5	6214	472885
1995	340270	56781	51883	2081	0	110	446962
1996	309723	71374	47135	2177	0	0	426056

Source: Jooste *et al* (1997: 85)

Meat consumption is stimulated by the promotional activities of the Meat Board. Expenditure in this regard amounted to R11.9 million during 1996. Factors influencing local beef consumption include the following:

- Actual beef prices and their relationship to price levels of competing meats and other protein foods
- General availability of beef and other meats - broiler production and imports thereof play an important role
- Changing levels of personal disposable income, especially those of the lower income groups
- Income elasticity of demand of the lower income groups, which at present is substantially greater than one
- Population growth
- Advertising of meat
- Consumers' perceptions of the health considerations with respect to red meat (National Department of Agriculture, 1997).

Trade arrangements for beef

Stimulated by the lifting of anti-apartheid sanctions, South African agricultural marketing is increasingly characterised by internationalisation. The weakening of the South African Rand will give further momentum to this process (Rwelamira and Kleynhans, 1996: 8.21).

Following the implementation of South Africa's commitments in terms of her membership of the World Trade Organisation, the policy with regard to meat has also undergone changes. During October and November 1990 quantitative restrictions on meat imports were replaced by tariffs. The Meat Board is no longer an importer of meat and any person can import meat, provided that the applicable import duties are paid. In addition, several sanitary measures also apply, including the following:

- In terms of the Animal Diseases Act (Act 35 of 1984) all imports of animals and animal products into South Africa are subject to a veterinary import permit issued by the Director of Animal Health of the National Department of Agriculture.
- In terms of the Abattoir Act (Act 121 of 1992) any meat plant in a country

wishing to export meat to South Africa must be approved by the Director of Veterinary Public Health of South Africa.

- On arrival in South Africa, the physical condition, temperature and bacterial count of fresh meat are monitored. Consignments not complying with South African standards are condemned and must be returned to the country of origin or used for the manufacturing of pet food under Departmental supervision.
- The Perishable Products Export Control Board, in terms of the Agricultural Products Standards Act (Act 1219 of 1990), inspects products due for exportation (National Department of Agriculture, 1997).

The neighbouring states traditionally supply a large share of South Africa's imports of beef in the form of frozen and chilled quarters and live cattle. These imports are sold in South Africa on the same basis as domestically produced beef (National Department of Agriculture, 1997).

Import duties on bovine meat (fresh, chilled or frozen, carcasses, bone-in or boneless) amount to 40 percent. This is already well within South Africa's WTO commitments, which have been set at 69 percent in the year 2000. In addition, South Africa is also a member of several bilateral- and multilateral trade agreements.

The trade agreement between South Africa and Malawi makes provision for all goods grown, produced or manufactured in Malawi, including meat and meat products, to be exported to South Africa free of customs duty. South Africa can export to Malawi all products grown, produced or manufactured in South Africa at a rate of duty provided for in Malawi's Custom's Tariffs (National Department of Agriculture, 1997).

The Trade Agreement with Zimbabwe provides for beef imports free of customs duty or at a rebate of duty. This agreement is currently being re-negotiated.

The first Southern African Customs Union Agreement was signed in 1910. At present the SACU comprises South Africa, Botswana, Lesotho, Namibia and Swaziland. All agricultural products grown, produced or manufactured in the common customs area are subject to the conditions set out in the SACU Agreement. This agreement is currently being re-negotiated. The possibility of SACU entering into a bilateral agreement with Zambia is also being explored at present.

South Africa is a member of the Southern African Development Community (SADC), which aims to establish a free trade area amongst the eleven members (i.e. South Africa, Botswana, Lesotho, Namibia, Swaziland, Zimbabwe, Zambia, Mozambique, Malawi, Tanzania and Mauritius). Import tariffs on all products will have to be phased down over a set period of time, except in the case of sensitive products, which will be handled under separate protocols. In the case of South Africa, red meat may be identified as a sensitive product.

South Africa is at present also engaged in negotiations towards a possible Free Trade Agreement with the EU. The EU has classified South Africa as a country with no beef industry, and consequently pays export subsidies to its exporters of beef to South Africa. South Africa has filed a complaint about this with the EU, as it is felt that these subsidised exports are harming both the South African beef industry and those of its neighbours, especially Namibia.

According to Nieuwoudt (1997) the import cleared price of subsidised EU beef exports to South Africa is 51 percent below domestic South African wholesale prices. Based on the elasticity of demand and supply, it is estimated that EU beef exports to South Africa during 1995 depressed local South African beef prices by approximately 9.7 percent. Based on the elasticity of supply, it is also estimated that beef imports from the EU have displaced South African production and SACU imports by 23 159 tons during 1995. In 1996 all SACU countries exported a total of 70 000 tons of beef to South Africa at a value of R551 million. The loss in revenue for SACU countries due to lower prices and trade displacement is

estimated by Nieuwoudt (1997) to amount to R117 million per year at 1996 prices.

BOTSWANA

The beef industry

Livestock production in Botswana is dominated by cattle and small stock. Pig production is very limited (Botswana Meat Commission, 1997). The Botswana cattle herd has increased by almost 50 percent (from 2 million to almost 3 million) from 1970 to 1982. This long term growth is attributable to investments in water resources, especially the development of boreholes in areas which were previously uninhabitable due to a lack of water sources (Rwelamira an Kleynhans, 1996: 3.10 - 3.11). The drought has, however, had a negative effect on cattle numbers, resulting in a constant decline since 1991 (Botswana Meat Commission, 1997). Cattle production takes place on 77 percent of all national land (Fidzani, Makepe and Tlhalefang, 1997: 8).

The cattle sector in Botswana consists of two main sub-sectors, namely the communal sector, which holds 80 percent of the national herd, and the commercial sector, holding the remaining 20 percent. In the former, cattle are kept and grazed on unfenced open rangelands, while in the latter they are on enclosed freehold land. The management practises in these two sectors differ considerably, causing technical efficiencies to vary significantly between the two sectors (Fidzani *et al*, 1997: 5). Commercial farmers achieve calving rates, off-take rates and mortality rates of respectively, 70 percent, 17 percent and 5 percent. The corresponding figures in the case of communal farmers are 50 percent, 8 percent and 11 percent (Republic of Botswana, 1991).

In Botswana, cattle are distributed in the eastern hardveld areas and the sandy central Northwest, South and western parts of the country. The semi-arid climatic zone is suitable for extensive beef production. The country is a net importer of grain to feed people, and cattle are produced on natural grass with mineral supplementation. Cattle normally mature at around 24 to 30 months of age. The

northern part of the country is reserved for wildlife. There is a very comprehensive network of cordon fences which ensure that cattle do not mix with wildlife whilst at the same time giving ample access to water and grazing for both (Botswana Meat Commission, 1997).

Land tenure, institutional arrangements and marketing

According to the 1991-97 National Development Plan there are three main categories of land in Botswana, being:

- Freehold land, which involves exclusive ownership and comprises about 5 percent of the total land, mostly along the eastern and southern boundaries of the country
- State land, which comprises about 25 percent of the country, and includes national parks, game reserves, etc.
- Communal land, which is allocated by Land Boards. Under customary law all tribesmen and women are entitled to land for their own use, but do not acquire exclusive rights to it. Grazing rights on traditional cattle posts are not exclusive, but ownership of a borehole provides *de facto* rights to water and therefore to the surrounding grazing resources. As part of the Tribal Grazing Land Policy introduced in 1975, 50-year leases have been introduced on some tribal land earmarked for commercial use (Republic of Botswana, 1991).

The Botswana Meat Commission (BMC) has a statutory monopoly over exports of meat, by-products, processed meat, canned meat and live cattle, and is the main outlet for most beef producers in Botswana. The BMC owns a meat marketing organisation in Europe with headquarters in London. This organisation mainly sells to the UK, Germany, Reunion, and Holland. It also has contracts to market Zimbabwean and Namibian meat to Europe. Botswana has an EU levy abated quota under the Lomè Convention. Beyond this, beef is sold at lower prices to the EU market or to other countries, including South Africa (Rwelamira and Kleynhans, 1996: 3.11). According to the BMC (1994), Botswana exported 65 percent of its beef to the EU during 1994. During 1991/92 only 5.1 percent of the

BMC's output was marketed within Botswana. Not all Botswana citizens have access to beef because of a lack of income (Rwelamira and Kleynhans, 1996: 3.11).

As a statutory corporation the BMC is not supposed to make profit. After covering its operation and capital costs, all proceeds are paid as bonuses to producers who have sold animals to the corporation during that financial year. Due to limited slaughter capacity in the past, it used a seasonal pricing system to encourage farmers to sell outside the peak period. Although slaughter capacity has been increased since, the system is still being used to induce farmers to sell during the dry period. A grading system which is biased towards young animals was introduced to encourage farmers to sell young animals. In order to promote improved breeds, conformity with regard to body structure was also included in the grading system. On social justice and equity considerations it was also decided that there shall be cross-subsidisation between regions that may sell to the EU and regions that may not (Fidzani *et al*, 1997: 15-16).

Besides the BMC, there are also several other public and private institutions that are associated with the beef sector:

- The Botswana Livestock Development Corporation acts as a public sector buyer of cattle in the remote areas of Botswana where buying competition is weakest. It also supplies quality breeding animals.
- The Botswana Vaccine Institute does vaccine research and produces and supplies vaccines against foot-and-mouth disease and rinderpest.
- The Botswana Agricultural Marketing Board buys products from and sells inputs to farmers on a competitive basis.
- Other institutions involved include the National Development Bank, the Botswana Development Corporation, the Botswana College of Agriculture, co-operative societies, agricultural management associations, commercial banks, cattle traders and a range of NGO's (Rwelamira and Kleynhans, 1996: 3.11).

Botswana had a policy of food self-sufficiency until 1991, at which time a policy of

food security was adopted. This new policy emphasises the principle of comparative advantage and trade. Rational decisions that promote the long-term interests of the country will guide the allocation and utilisation of natural resources to produce what they are best suited for (Rwelamira and Kleynhans, 1996: 3.12).

Trade arrangements of beef

The economy of Botswana was formerly dominated by the livestock industry, until minerals and diamonds were discovered in the 1970's. At present, with the exception of livestock farming, other farming activities mainly take place on subsistence level. Livestock utilise about 35 percent of the country. Cattle numbers are largely influenced by rainfall. The Botswana Meat Commission (BMC) was established to purchase and slaughter livestock and process meat and meat products in the best interests of the livestock industry of Botswana. It owns the only export abattoirs. Botswana enjoys preferential access to the EU market under the provisions of the Lomè Convention, with an annual export quota of 19 000 tons. Slaughter animals are transported to the abattoirs on hoof, by lorry or by train. Slaughter age is normally between 18 and 36 months. Botswana- and EU legislation, e.g. inspection by veterinary authorities at the place of origin, *ante mortem* inspection, etc. are adhered to at all times. The only notable intra-regional exports are to South Africa (Botswana Meat Commission, 1997). Beef was, in value terms, in 1994 the third most important export product after diamonds and minerals. The UK is the largest export market for beef. The Government has aimed to maintain a high but sustainable level of cattle production through improved livestock management and husbandry techniques, land conservation and a more efficient land-tenure system. Beef processing accounts for approximately 80 percent of agricultural output and over 95 percent of production is exported. The Botswana Meat Commission has three abattoirs, one each in Lobatse, Maun and Francistown, with a total annual slaughtering capacity of 300 000 cattle and 130 000 small stock. The decentralisation is designed to make it easier for all producers to market their cattle. There has been a ban on exports from the north-west of Botswana to the EU, due to the danger of

spreading foot-and-mouth disease. Botswana has rarely filled its export quota of 19 000 tons to the EU. These exports are subject to an import levy in the EU, of which 90 percent is rebated at present (Economist Intelligence Unit, 1996a).

The EU market is very important to the Botswana beef industry, as 65 percent of total beef exports are directed to the EU market. Jooste and Van Schalkwyk (1996: 125-128) mention that even though Botswana may export beef to the EU under the provisions of the Lomè convention, all exports will be prohibited should an outbreak of foot-and-mouth disease occur. In addition, should Botswana not succeed to renew its export quota when the present Lomè agreement expires in the year 2000, they may face serious problems. A less accessible EU market will have a negative impact on the economy as they will not find it any easier to find markets in other countries or economic groupings. The Botswana industry has also become less important to South Africa, because South Africa has started to find it cheaper to import from elsewhere. This a is clear picture of how trade policies influenced trade flows and directions. Table 2 shows the recent decline in South African imports of beef from Botswana.

Table 2 Proportion of South African beef imports originating from Botswana, 1992 to 1994

Year	Total South African beef imports (tons)	South African imports from Botswana (tons)	Proportion of beef imports from Botswana (%)
1994	99 700	1 800	1.8
1995	108 600	4 100	3.8
1996	118 900	3 800	3.2

Source: National Department of Agriculture, 1997

LESOTHO

Production and land tenure systems

Livestock provides a significant proportion of rural income. Much of Lesotho's

terrain is well suited to animal husbandry, although the sector suffers from poor and declining animal quality and disease control. The 1992 drought reduced animal numbers by up to 30 percent in some districts. A number of projects are underway to improve the cattle herd for stock rearing. An abattoir opened in 1986 creating the capacity for meat exports to the regional market (Economist Intelligence Unit, 1996a).

Agriculture provides employment for about 50 percent of the domestic labour force. The contribution of agriculture to GDP declined from 50 percent in 1973 to 13 percent in 1993 (Economist Intelligence Unit, 1996a). One of the constraints to agriculture in Lesotho is the serious overstocking. Although cattle numbers increased substantially (by 22 percent) from 1986 to 1990, the contribution of this sector to GDP declined from 8 percent to 6.5 percent during the same period (Rwelamira and Kleynhans, 1996: 4.5). Only 13 percent of the land is suitable for arable production. The Government has adopted a series of measures to improve agriculture, so far without much success. The emphasis has shifted in recent years from direct public-sector investments towards creating better incentives for the private sector. A new market-orientated policy was announced in 1987. Subsidies are being phased out and higher producer prices are being introduced to encourage output (Economist Intelligence Unit, 1996a).

Lesotho's land tenure system is predominantly based on the customary Laws of Lerotholi. In terms of these laws, land belongs to the Basotho nation and is held in trust by the king as head of the state. This means that land is communally owned. Landlessness is becoming an increasingly more important problem. In 1993, 70593 rural households did not have access to land, and this figure is expected to rise to 50 percent of rural households by the year 2000 (Matlosa, 1987).

Customary landholding encourages scattered and unplanned villages, poor land utilisation and range management, besides all the other weaknesses of the system such as lack of incentive for farmers to invest in the land. The system also

discourages land consolidation in order to establish economically viable farm units (Rwelamira and Kleynhans, 1996: 4.8). Since 1967 the Lesotho government has acted to address these shortcomings through five different acts geared towards land reform. These include a provision that a land allocation may be inherited by a single heir (the eldest son in the family) (Setai, 1984: 13). In addition, a small garden around a family's house is not regarded as communal property, and may therefore be fenced off and is inheritable. There is evidence that farming practises in the private gardens are better and that soil fertility measures are taken more seriously (ILO, 1979).

Institutional set-up and domestic marketing

Substantial distortions exist in agricultural marketing and processing. These distortions inhibit the development of private sector led trade, marketing and processing, keep producer prices down, skew relative prices towards the production of traditional food crops for which Lesotho has little comparative advantage, and increase consumer prices of staples above their import parity price (World Bank, 1995). Until recently Co-op Lesotho had a monopoly on buying agricultural produce from growers and supplying them with inputs. As a result of the inefficient operations of this co-operative, producers' yields have suffered and produce could not always be marketed when it was harvested, which depressed producer prices. A more liberal marketing environment would attract private traders, raise producer prices and increase yields. Co-op Lesotho suspended operations in 1993 due to serious financial difficulties (Rwelamira and Kleynhans, 1996: 4.12).

Some policies hurt livestock producers by restricting channels for marketing products and for purchasing inputs. This tends to depress the profitability of livestock production. In Maseru the National Abattoir, which is owned and operated by the Ministry of Agriculture, holds a monopoly on the slaughter of animals. This prevents the emergence of small scale abattoirs which could create new entrepreneurs, employment and a lower meat price for consumers. The

abattoir also operates a feedlot (Rwelamira and Kleynhans, 1996: 4.13 - 4.14).

NAMIBIA

The beef industry

Agriculture contributes about 11 percent of the Namibian GDP and 70 percent of the population is directly or indirectly dependent on farming for their livelihood. Livestock farming normally contributes 80 to 90 percent of the value of commercial agricultural production. Commercially marketed cattle are exported live to South Africa or slaughtered locally by the Meat Corporation of Namibia (Meatco). In 1996, 44 percent of the cattle marketed were slaughtered locally. Abattoir capacity has been increased to take advantage of the country's beef export quota to the EU market under the Lomè Convention - currently 13 000 tons annually. A veterinary cordon fence runs across the country south of the Etosha Pan (Economist Intelligence Unit, 1996b).

Beef in Namibia is produced under two different production systems, namely the communal and commercial system. The communal farming areas comprise 41 percent of all the land. In 1991, 67.5 percent of the country's population was accommodated in these areas of which 90 percent are directly dependent on primary agricultural production. Land tenure is communal, and cattle are grazed on communal pastures. Poor land use is a common feature of communal animal husbandry. The farmers have a long tradition as herdsmen, with cattle being the mainstay of their livelihood. The more traditional the lifestyle the more conservative the marketing regime. In general the herd functions as a store of wealth and remains untouched. Relatively more cattle are kept for status than for utilisation or to improve standards of living. A man is not considered of any importance if he does not own a large herd of cattle. It is reasoned that the more cattle you possess the better are your chances of surviving a drought. In addition to being a major store of capital, livestock also play other roles in the communal society, including generating cash when required, providing food e.g. milk, providing draught power, being slaughtered for traditional occasions and being

used as payment for lobola and fines (Rawlinson, 1994: 111-114).

Average herd sizes differ. In Kaokoland it is estimated to be between 30 and 50 head, while in the Caprivi it was found to be 63. In the Kavango, data shows that 83 percent of owners hold herds of less than 40 heads. The herd composition in the northern communal areas compares well to that of the national Namibian herd, which comprises 37 percent cows, 21 percent calves and 40 percent young growing stock (Rawlinson, 1994: 114-116).

The most important factors hampering production in the communal areas are animal diseases and overgrazing. The two most important diseases are foot-and-mouth disease and contagious pleuropneumonia or bovine lung sickness. As a result of the occurrence of these endemic diseases the export of livestock on the hoof is not allowed to areas south of the veterinary cordon fence. Overgrazing has lead to reduced carrying capacity of the grazing areas. Calving percentage estimates range from 30 to 50 percent, and off-take rates are low. The cattle produce a relatively low carcass weight, and grade poorly because only mature, old or lean animals are sold. The reason for this low productive efficiency is that animals are under constant stress from birth to slaughter. Overstocking causes quantitative as well as qualitative nutritional deficiency (Rawlinson, 1994: 116).

Domestic marketing and trade

The marketing of meat is done by the Meat Board of Namibia. Meat prices are determined by the market (Rwelamira and Kleynhans, 1996: 7.14 - 7.15). Meatco was formed in 1985 with the aim of obtaining and operating abattoirs within Namibia and marketing the products in Namibia and foreign countries to the best advantage of Namibian producers (Rawlinson, 1994: 195).

Namibia's main export market for cattle and beef is South Africa. In terms of carcass units, 65 percent is exported as live animals and 35 percent in the form of beef. Namibian exports to South Africa is substantially more than the total of

exports to other destinations. As far as South Africa is concerned, this was also more than South Africa's total imports originating from all other countries (FAO, 1996). Table 3 summarises Namibian exports of cattle and beef to South Africa and the EU.

Table 3 Namibian exports of cattle and beef to South Africa and the EU, 1992 to 1996

	Exports to South Africa		Exports to the EU
Year	Live cattle (head)	Beef (tons)	Beef (tons)
1992	157 000	na	na
1993	180 000	na	na
1994	192 000	15 400	10 996
1995	199 000	9 600	11 957
1996	277 000	9 400	12 235

Source: National Department of Agriculture, 1997; Meat Board of Namibia, 1997

Namibian cattle represent 10 percent of cattle slaughtered in South Africa. EU exports of subsidised beef to South Africa affected price levels in Namibia negatively. A price drop of 10 percent is estimated to occur due to the subsidised EU exports to South Africa. This translates to a similar drop in prices in the SACU countries, including Namibia. Based on beef supply elasticities, it further translates to a 5.4 percent decrease in production. In 1996, 60 percent of cattle in Namibia were in the hands of small scale communal farmers. For these farmers, cattle are in most cases the only product they sell. Sixty percent of the Namibian population live in the areas which are dependent on cattle. Low prices in the South African market has already brought two beef manufacturing plants in the northern communal areas of Namibia to a standstill. This counteracts efforts by the EU, Namibian Government and Namibian Meat Board to upgrade livestock facilities in these areas (Nieuwoudt, 1997).

Namibia has a 13 000 ton quota for exports to the EU under the Lomè Convention. In 1995 it almost filled this quota by exporting 12 369 tons of beef to the EU (FAO, 1996). Table 3.3 summarises the Namibian beef exports to the EU over the period 1994 to 1996. In order to maintain the access to the EU market, veterinary services and the control of livestock diseases are always extremely important in an animal production environment.

Namibia depends on exporting more than 80 percent of its meat production. Control over chemical residues in meat destined for some countries has also become an important issue. The relevant functions are performed by the Directorate of Veterinary Services of the Department of Agriculture, Water and Rural Development. At all abattoirs hygienic slaughtering is carefully controlled by meat hygiene veterinarians, meat inspectors and meat examiners (Rawlinson, 1994: 36-44).

SWAZILAND

Production

Under the prevailing system of land distribution, about 44 percent of land is held on a free-hold basis, mainly by non-Swazi and European settler farmers. The remainder is held in trust as Swazi Nation Land (SNL) by the monarchy, and is controlled and allocated by chiefs according to traditional arrangements. About 65 percent of farmers on this land own cattle. Swazi smallholders own more than 80 percent of the national cattle herd, whose numbers are highly vulnerable to drought (Economist Intelligence Unit, 1996b: 73-76). The SNL tenure system is characterised by small fragmented farm holdings, which causes soil erosion and low productivity. There is severe gully erosion and a general deterioration of rangelands. This is mainly due to overgrazing and poor livestock management practises on Swazi National Land. The communal tenure system allows free grazing and accumulation of livestock, thereby undermining the concept of land carrying capacity and promoting environmental degradation (Mushala, 1992). Overall, the livestock population in Swaziland is unacceptably high. This situation is exacerbated by the rapid human population growth, which increased to 3.2 percent for the period 1976-86 (Rwelamira and Kleynhans, 1996: 9.8).

In 1993, agriculture (including forestry) contributed 21 percent to GDP. About 65 percent of the labour force were employed in the agricultural sector and related agro-industries (Rwelamira and Kleynhans, 1996: 9.4). It must however be

mentioned that, although livestock rearing is important in the communal farming society, it is not an important commercial activity and does not constitute a substantial proportion of agricultural output. The most important industries within the agricultural sector are sugar and forestry. Low (1982: 136-137) mentions that subsistence farm-households do participate in the modern market sector. However, this participation takes the form of purchase of market goods and engagement in employment rather than the sale of farm produce. He suggests that the question of comparative advantage in on-farm and off-farm production is particularly relevant to traditional farming in Southern Africa.

Institutional set-up and marketing

All the major crops and livestock products are sold through either parastatal organisations or associations in which the government has shares (Rwelamira and Kleynhans, 1996: 9.16). Swaziland Meat Industries, which was taken over by the Royal Swazi Sugar Corporation in 1993, handles commercial slaughterings. After 1993 the number of animals slaughtered as well as export receipts increased substantially. Frozen and canned meat is exported to the EU under a Lomè Convention quota of 3 300 tons. Production in 1994 was 3 700 tons (Economist Intelligence Unit, 1996b: 76).

ZAMBIA

The beef industry

Agriculture contributed 32 percent of the GDP in 1994 (Economist Intelligence Unit, 1996c: 3). During the period 1980 to 1990, the livestock industry contributed on average 26 percent to the agricultural GDP (Rwelamira and Kleynhans, 1996: 11.11). About 85 percent of the national cattle herd is held by traditional farmers (Economist Intelligence Unit, 1995: 19). Forty percent of the land area, i.e. 300 300 km², consists of permanent grassland (FAO, 1991). The cattle population has declined from 2.7 million in 1990 to 2.5 million in 1995, mainly due to droughts (Kafuli and Mawele, 1997: 113).

Land in Zambia is divided into three categories namely state-, reserve- and trust land. Reserve and trust land constitute 93 percent of the total land, and fall under customary law. Reserve land is allocated for the sole use of the indigenous population, and trust land is reserved for the common benefit of the population. State land is used for commercial farming and for townships, transport and communication infrastructure. It constitutes 7 percent of all land and is administered under the statutory leasehold system. This system allows for private ownership, and it is under this system that a high degree of commercialisation is attained (Rwelamira and Kleynhans, 1996: 11.15).

Beef in Zambia is produced under two different production systems, namely the traditional and commercial systems. The predominant one is the traditional farming system which is characterised by low levels of productivity. This system includes about 76 percent of the farming households. They produce primarily for subsistence with occasional marketable surpluses. About 4 percent of farming households are small commercial farmers who employ a range of productive inputs and obtain high yields. The small-holder farmers are the third category of farmers. They emerged in the mid-1980's and constitute about 20 percent of farmers. Their yields are much higher than those of the traditional farmers, but they cultivate smaller lands than those of the commercial farmers (GRZ, 1984). The commercial system involves both intensive and extensive systems. The extensive system mainly utilises pastures. Under the intensive system steers are fattened in feedlots (Kafuli and Mawele, 1997: 113).

Some environmental issues occur and could affect agriculture in future. There is conflict with regard to the use of the land. This is associated with the allocation of land between crop production and livestock rearing. Smallholders do not have title to the land and animals are grazed in the same area where crops grow, and sometimes destroy these. The grazing land is also overstocked and consequently overgrazed. Metropolitan areas expand and take up space which was previously intended for agricultural use (Rwelamira and Kleynhans, 1996: 11.14).

Institutional set-up

During the colonial period agricultural policies were formulated around the mining industry in order to supply cheap food to mine workers. African agriculture was discouraged in order to secure sufficient labour for the mining industry. These policies kept the productivity of African small farms low. Post-colonial polices were also characterised by the bias towards urban- and mining areas for a long time. This has resulted in a disproportionate share of economic and social infrastructure being developed in urban areas at the expense of the rural population. This in turn has pushed peasants, especially the youth, out of the rural areas into the urban areas in search of jobs (Mkandawire and Matlosa, 1993).

The post-colonial government did, however, do a number of things to encourage agricultural development. Most of the projects involved only small sections of the agricultural population, though. These projects were also highly capitalised with sophisticated machinery and inputs, while the farmers involved in them had little knowledge on maintaining the machinery, applying chemicals and managing the improved seed varieties. It is argued that the commercial sector for agriculture gained most from the post-colonial government policies. The concentration of agricultural resources on a small number of farmers failed to widen the base of food production since the majority of farmers were left out (Mkandawire and Matlosa, 1993).

The agricultural production potential of Zambia varies according to the agro-ecological zones. The low rainfall area comprises 308 000 km² (FAO, 1991). Rainfall in these areas is highly variable and often inadequate to sustain traditional crops in drought years. More than 25 percent of Zambia's cattle population is found on smallholder farms in these areas. The potential for increasing production is limited by diseases, poor feeding, marketing problems and the low production potential of traditional breeds (Rwelamira and Kleynhans, 1996: 11.21).

The medium rainfall area comprises 66 000 km²(FAO, 1991). Soils are qualitatively better and rainfall is adequate and usually reliable. Seventy two percent of Zambia's cattle population is found in these areas. Increase of livestock productivity has been limited by endemic diseases and poor feeding practises. There is a serious problem of overgrazing, which is aggravated by a high rate of deforestation resulting in serious soil erosion and land degradation. Reversal of this trend is essential to ensure sustainability of production potential and the environment. A substantial increase in non-tsetse fly areas is, however, possible if endemic diseases such as anthrax are brought under control. This requires a sustainable program of vaccination and an accompanying extension package for farmers (Rwelamira and Kleynhans, 1996: 11.21 - 11.22).

In the high rainfall areas moisture is abundant, but soils are less fertile. Cattle are normally not raised in these areas (Rwelamira and Kleynhans, 1996: 11.21 - 11.24).

Marketing

Prior to 1989 the National Agricultural Marketing Board (NAMBoard) was responsible for the marketing of most commodities. Specialised parastatals were also involved in the handling of beef and some other products. The Cold Storage Board of Zambia (CSBZ) was responsible for the marketing of beef, and bought cattle from farmers in both the traditional and commercial sector. For controlled commodities, both procurement and sales prices were regulated and losses incurred by the parastatals were covered by government subsidies. Transport rates were also regulated and subsidised. As a result of the Structural Adjustment Programmes, the NAMBoard was dissolved and the co-operative system was given the exclusive right of procuring and selling maize. For other products, marketing has been liberalised, but the co-operative system also acts as a buyer of last resort for these products. The co-operative system acts as a parastatal organisation, and its financing and most of its resources are directly controlled by

the government (Kafuli and Mawele, 1997: 117; Rwelamira and Kleynhans, 1996: 11.19 - 11.20).

Liberalisation of beef marketing in Zambia has been a gradual process which started in the early 1980's and ended in 1986 when the CSBZ was privatised. This stimulated private sector initiative in beef marketing and processing. Beef marketing and processing, however, is currently dominated by a few large companies who have close links with the commercial sector. In order to cut down on transportation costs, private traders and butchers prefer to buy from farmers located closer to Lusaka, which means that farmers in remote areas obtain lower prices for their cattle, or have to drive them over long distances to towns in order to fetch higher prices (Kafuli and Mawele, 1997: 118-119). Table 4 summarises the Zambian slaughterings, exports and imports for the period 1991 to 1994.

Table 4 Zambian cattle slaughterings, meat and live cattle exports and imports (carcass units)

Year	Slaughtering	Exports	Imports
1991	198 562	5778	1166
1992	225 698	5722	0
1993	175 365	817	0
1994	197 562	0	156

Source: FAO (1996)

According to Rwelamira and Kleynhans (1996: 11.19 - 11.20), a study by the Preferential Trade Area (PTA) of Eastern and Southern Africa identified export expansion potential for Zambia for, amongst others, beef. Payne (1997) also lists beef amongst Zambian agricultural products that have potential for production and processing. If trade co-operation among members of PTA and SADC is developed in future, Zambia could increase exports to the PTA/SADC sub-region. Zambia's official trade with SADC members was only 8 percent of total trade in 1994, while that with PTA was 11 percent (FAO, 1991).

ZIMBABWE

The beef industry

The Zimbabwean agricultural sector is dualistic in nature, comprising the large-scale sector which is highly capital-intensive on the one hand, and the less productive small scale sector on the other (Takavarasha, Mafurirano, Zitsanza and Mfote, 1997: 140). In 1994, the agricultural sector contributed 13.6 percent to the Zimbabwean GDP (Economic Intelligence Unit, 1996e: 3). In 1992 the agricultural sector employed 67 percent of the labour force (Rwelamira and Kleynhans, 1996: 12.5). The most important products are maize, tobacco and cotton (Economic Intelligence Unit, 1996e: 3). Agricultural land accounts for 85 percent of the total land area, with the remainder under national parks, state forest and urban and state land (Takavarasha *et al*, 1997: 143). Zimbabwe is generally self-sufficient in food, and in average or better rainfall years it exports significant quantities of meat and maize, in addition to the usual exports of tobacco, cotton and sugar (Economic Intelligence Unit, 1996d: 26-27).

In 1990 the national cattle herd was estimated to be 6 million heads, of which about 4 million were kept in the communal areas (Economic Intelligence Unit, 1996d: 26-27). Beef production is mostly done by the commercial farmers, who contribute 80 percent. The commercial sector is characterised by much under- and unutilised land, and further intensification is still possible in the crop- and livestock sectors (Takavarasha *et al*, 1997: 151). In the communal areas, livestock is grazed on common land. Increased population and livestock pressure in these areas, coupled with the fact that most of the communal areas are situated in the semi-arid region, has resulted in rapid degradation of the land resource (Rwelamira and Kleynhans, 1996: 12.20). The smallholder sector is characterised by low off-take rates, mainly because cattle have multiple roles including draught power provision, store of wealth and milk production (Takavarasha *et al*, 1997: 151-152).

Marketing and trade

The Cold Storage Commission (CSC) is responsible for the marketing of beef. Under the Economic Structural Adjustment Programme (ESAP), marketing boards and commissions are being managed commercially, and some have been converted into government-owned companies which will be at least partly privatised. In July 1993 an agricultural marketing exchange, called the Zimbabwe Agricultural Commodity Exchange (ZIMACE), began operations (Economic Intelligence Unit, 1996d: 27).

Since the deregulation (1985-1990) of marketing and prices over 30 abattoirs have been established. Farmers can sell to any of the CSC, traders or private abattoirs. Although market liberalisation has to some extent increased competition it would appear that the decimation of the national herd by drought together with restocking problems experienced thereafter have suppressed competition. Although beef prices are now fully deregulated, the general observation is that the influence of the Cold Storage Company is still significant, since all the competitors appear to be followers when it comes to raising the price of beef. Thus consumers have not fully benefited from this increased competition (Takavarasha *et al*, 1997: 157-158). Beef sales to marketing authorities in Zimbabwe are summarised in Table 5 below.

Table 5 Cattle sales to marketing authorities

	1990	1991	1992	1993	1994
Number of cattle	408700	419200	522700	407800	345700
Value (Z$m)	273.6	363.8	448.0	704.9	847.7

Source: (Economic Intelligence Unit, 1996d: 53)

Zimbabwe is a net exporter of most agricultural products, including beef, in normal years. The agricultural sector accounts for over 40 percent of export earnings. Generally trade takes place both on the international and regional markets, but for beef the larger portion goes to the EU, with the United Kingdom and Germany

being the two most important destinations. These two countries combined took 90.1 percent of Zimbabwe's beef exports in 1995 (Takavarasha *et al*, 1997: 158-159). Zimbabwe has been a major beneficiary of the Lomè Convention. It initially received a 9100 ton quota for beef, but this was recently raised to 14600 tons (Economic Intelligence Unit, 1996d: 29-32).

Zimbabwe should benefit from the implementation of the Marrakech Agreement, as this should end the dumping of especially beef on the regional markets. This should enable Zimbabwe to regain lost markets in West Africa and South Africa (Economic Intelligence Unit, 1996d: 29-32). Both smallholder and commercial farmers in Zimbabwe are efficient producers of beef when they produce for the export market. Their efficiency has increased during the reform period. This indicated that, given a reduction in trade barriers, Zimbabwean beef producers can effectively compete on both regional and international markets (Takavarasha *et al*, 1997: 162).