

THE DEMAND FOR LIVESTOCK PRODUCTS IN SOUTH AFRICA FOR 2000, 2010 AND 2020 : PART I

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The demand for livestock products is projected for the next 25 years. Data on expectations regarding the following factors were included (a) population growth, (b) urbanisation, (c) income per capita growth and (d) income elasticities. Data for each population group were included. The model shows significant increases in demand for livestock products especially under assumed high growth scenarios.

SAMEVATTING : DIE VRAAG NA LEWENDEHAWEPRODUKTE IN SUID-AFRIKA VIR 2000, 2010 EN 2020

Die vraag na lewendehawe produkte word geprojekteer vir die volgende 25 jaar. Verwagte inligting met betrekking tot die volgende faktore is inaggeneem (a) bevolkingsgroei, (b) verstedeliking, (c) per kapita inkomstegroei en (d) inkomste-elasticiteite. Data vir elke bevolkingsgroep is ingesluit. Die model toon betekenisvolle groei in die vraag na lewendehawe produkte veral onder die aanname van vinnige ekonomiese groei.

1. INTRODUCTION

In order for the agricultural industry to expeditiously adapt to future changes, it is important to study possible structural adjustments in the demand for food in South Africa. In this study, a model is developed to project the demand for livestock products for South Africa for the years 2000, 2010 and 2020. Projections of final product demand are made for beef, mutton, pork, poultry meat, eggs, fresh milk, milk powder and cheese. Structural adjustments in the demand for food may arise due to various reasons such as differences in population growth rates of different population groups, income-elasticities, urbanisation etc. A mathematical projection model is developed to consider some of the major demand components that may experience structural changes in South Africa during the next decades. In this article, the projected production and consumption for these livestock products will be estimated. From the latter estimates the derived demand for protein feed will be estimated in a follow-up article (see this issue of *Agrekon* p. 146).

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2. DEMAND FACTORS

The following factors are included in the livestock product demand projection model; (a) expected population growth, (b) expected urbanisation, (c) expected income per capita growth and (d) estimated income elasticities. Estimates for different individual commodities will be reported. Since demand forces mentioned above differ significantly amongst population groups, estimates for these groups are aggregated in the final model. Differences in consumption between population groups may be attributed to differences in living standards and taste preferences. It is expected that groups in future will merge and that group consumption differences may decline. The projected demand increase for individual population groups is further weighted by the per capita consumption of each population group for a given product to consider the contribution to demand by individual population groups. Cross-price elasticities were not included but the principle was considered by providing estimates for groups of commodities.

In the following sections the demand components will be estimated.

3. ESTIMATION OF INCOME ELASTICITIES

Income elasticities presented in Table 1, are obtained from Loubser (1990). Population groups, including urban and rural areas for Blacks show income elasticities. The Loubser (1990) study reported elasticities for small categories (for example beef mince, bulk purchase of beef and veal) and these elasticities were aggregated (weighted) using expenditure data to obtain elasticities for categories shown in Table 1. Information obtained from a study by Nieuwoudt (1990) was also considered when elasticities for components of the same item varied significantly in Loubser's (1990) study.

Elasticities shown in Table 1 are in accordance with economic expectations. Elasticities for rural Blacks were the highest and for Whites the lowest for most items. Elasticities for meat (except pork), and cheese, were high for all groups except Whites.

4. POPULATION GROWTH

Population growth projections are shown in Table 2 on a mid-year basis for the years 2000, 2010 and 2020. The population projections were obtained from Sadie (1993) for the years 1991 to 2011. Population growth rate between 2011 and 2020 was assumed as the same as the growth rate between 2002 and 2011. The split between urban and rural Black population was conducted as follows:

Table 1: Income elasticities of selected foods, South Africa, 1990.*

Product	Metropolitan				Rural Blacks
	Asians	Blacks	Coloureds	Whites	
All meat	0.89	0.95	0.90	0.32	1.34
Beef	0.65	1.04	0.70	0.34	1.33
Poultry	1.09	0.66	0.65	0.32	1.33
Pork	0.40	0.00	0.60	0.32	0.25
Mutton & goat's meat	1.65	1.30	0.65	0.23	1.52
Eggs	0.53	0.74	0.53	0.15	1.42
Fresh milk	0.74	0.50	1.07	0.21	0.60
Milk powder	0.00	0.88	0.57	-0.23	0.40
Cheese	0.65	2.03	1.38	0.46	0.65

Source: Loubser (1990); Nieuwoudt (1990).

* Elasticities in Loubser (1990) study were weighted by expenditure data in order to derive elasticities presented in this table. Elasticities from the Nieuwoudt (1990) study were derived from an earlier (1988) study of the BMR.

Table 2: Population (in thousands) projections. RSA, 1993, 1995, 2000, 2010 and 2020 (Mid year projection)

Population group	1993	1995	2000	2010	2020*
Asians	1018.3	1045.2	1104.5	1208.1	1305.3
Blacks (Total)	30055.6	31481.3	35198.0	42538.3	50857.3
Blacks Urban ^{xx}	12716.0	14141.7	17858.4	25198.7	33517.7
Blacks Rural ^{xx}	17339.6	17339.6	17339.6	17339.6	17339.6
Coloureds	3401.8	3495.6	3724.8	4091.4	4461.6
Whites	5149.9	5218.5	5363.2	5522.1	5658.2
Total	39625.6	41240.6	45390.5	53359.9	62282.4

Source: Sadie (1993)

* Growth rate between 2011 and 2020 was assumed as the same as the growth rate between 2002 and 2011.

^{xx} Rural population is assumed constant, following suggestion by P.H. Spies (1996), former Head, Bureau of Future Research, University of Stellenbosch.

According to a research report by Martins (1994) undertaken for the Bureau of Market Research (BMR), 57.69 % of the Black population in 1993 resided in rural areas. Martin's percentage rural (urban) population figure was used in this study as per capita food consumption in urban and rural areas was also obtained from

his study (Martins, 1994). As the total population figure of Sadie (1993) was used, the urban and rural population for 1993 were estimated as follows; rural population is 57.69173 % of 30.0556 million equals 17.3396 million. The reason for this procedure is that the Black population figure for 1993 reported by Sadie (1993) of 30.556 million and used in this study differs slightly from that reported by Martins (1994) of 29.775 million.

According to Spies (1996) a realistic way of projecting urban and rural population is to assume that rural population remains constant. That is the total growth in Black population occurs in urban areas. This procedure was adopted in this study. Black urban and rural areas merge into one another, which complicates distinction between urban and rural. The Central Statistical Services report a different split between urban and rural as that used in this study due to differences in definitions. As food consumption data were not available for urban and rural consumers for the Central Statistical Services urban/rural population split, the latter split was not used.

5. INCOME GROWTH AND DISTRIBUTION

Real per capita income growth is shown in Table 3 for the different population groups under different scenarios of growth in total income (Van der Berg, 1996). For instance under a scenario of total income growth of 3%, the per capita incomes of the various population groups are expected to increase as follows; Asians (2.0 %); Blacks (3.7 %); Coloureds (2.7 %) and Whites (0.1 %) (Van der Berg, 1996). This projection implies a significant narrowing in the income gap between per capita income of the different groups. Van der Berg (1996), assumes a 0.8 percentage point decline in the wage gap and an employment elasticity of 0.5 %.

Table 3: Real per capita growth under different scenarios, South Africa, 1995- 2020

	McGrath		Spies		Van der Berg		
	A	B	Current	High	5 %	3 %	1 %
Asians	4.4	2.5	1.0	2.75	3.3	2.0	1.0
Blacks	4.4	2.5	0.0	2.75	6.1	3.7	-1.5
Coloureds	4.4	2.5	0.0	2.75	4.1	2.7	1.5
Whites	-.25	2.6	0.0	1.50	1.4	0.1	-.3

Source: Van der Berg (1989, 1996)

It further assumes that Blacks experience negative effects of low employment growth and benefit the most if employment growth is higher. Van der Berg (1996) agreed with the writer that rural Black income could be expected to increase at a lower rate than urban Black income. In his model growth rates in rural areas were assumed to be 2 percentage points below urban rates (Van der Berg, 1996).

According to McGrath (1996), South Africa achieved a growth of 3 % in the upswing of the business cycle and he thus views a growth of 5 % as too high. He calculated per capita growth rates assuming a 3.5 % growth in GNP for two scenarios;

Scenario A (wealth redistribution): Whites (- 0.25 %)
Non Whites (+ 4.4 %)

Scenario B (no wealth redistribution): Whites (+ 2.6 %)
Non Whites (+2.5 %)

McGrath (1996) Scenario A for a 3.5 % GNP growth appears in line with Van der Berg (1996) 3 % growth rate in GNP. According to Spies (1996), per capita disposable income of Blacks and Whites is declining somewhat, while that of Coloureds is increasing somewhat. The reason for the low per capita disposable income growth is that under weak economic conditions, disposable income growth is lower than GNP growth. He considers a 2.5 % to 3 % increase in per capita disposable income for Blacks, Asians and Coloureds as a high growth scenario.

6. PER CAPITA CONSUMPTION OF SELECTED FOOD ITEMS

Table 4 shows per capita consumption for selected food items for all groups in metropolitan areas and in rural areas for Blacks. Per capita expenditure data were derived from total expenditure data and population numbers obtained from BMR data (Martins, 1994). Race group for metropolitan areas gives household expenditure but not for rural areas. Sufficient data were, however, provided in this publication to estimate rural and urban consumption per capita separately using a system of two equations and two unknowns. In the following equations urban and rural per capita consumption is weighted by the proportion of urban and rural population which is equal to per capita consumption for the total population.

$$a_1 U + a_2 RU = b_1 \quad (\text{Total Black population})$$

$$a_3 U + a_4 RU = b_2 \quad (\text{National \& Former TBV Countries})$$

where U = per capita urban consumption (Rands)

where

RU = per capita rural consumption (Rands)

a₁ = proportion urban population, a₂ = proportion rural population and

b₁ = consumption per capita for food item for the total Black population.

a₃ = proportion urban population, a₄ = proportion rural population and

b₂ = consumption per capita for same food item in the national and former TBV countries.

The urban and rural consumption figures for beef will be derived as an example.

$$0.4231 U + 0.5769 RU = 126.49$$

$$0.1438 U + 0.8562 RU = 77.80$$

where

$$a_1 = 0.4231, a_2 = 0.5769 \text{ and } b_1 = R126.49$$

$$a_3 = 0.1438, a_4 = 0.8562 \text{ and } b_2 = R77.80$$

$$U = R227.0 \text{ per capita}$$

$$RU = R52.7 \text{ per capita}$$

Table 4: Expenditure in R per capita for selected foods, South Africa, 1993

Product	Metropolitan				Rural Blacks
	Asians	Blacks	Coloureds	Whites	
Beef	194	227	202	517	53
Poultry	168	83	98	155	47
Pork	17	20	28	115	3
Mutton & goat's meat	396	67	158	304	14
Eggs	44	34	45	58	3
Fresh milk	308	91	154	345	13
Milk powder	5	14	5	27	6
Cheese	50	5	36	97	4

Source: Martins (1994)

Consumption (per capita) for the other products was derived similarly. The urban consumption figures derived in this way represent urban consumption in

the former RSA as well as urban consumption in the former national and TBV countries. The derived figures differ somewhat from the consumption in metropolitan areas as presented by Martin (1994) as metropolitan consumption in his report only refers to the former RSA and excludes TBV countries and national states.

It is clear from Table 4, that per capita consumption for livestock products for Blacks is significantly lower in rural areas than urban areas. Rural per capita consumption may understate actual consumption for most of these products due to the difficulty of including food produced and consumed in rural areas. In the model, the Black population in the rural areas is assumed not to change following suggestion by Spies (1996) and the effect of an understatement in consumption on model projections will be small. Rural population growth rates are, however, high and people will migrate to urban centres leading to significant increases in the demand for livestock products.

According to Table 4, per capita consumption differs significantly between different population groups. Regarding meat, urban Blacks are high consumers of beef but relatively lower consumers of poultry and mutton/goat's meat. Consumption of pork meat is low by all groups except for Whites. Poultry meat consumption is relatively high for Asians compared to Blacks and Coloureds. Mutton and goat's meat consumption is high for Asians. Whites are the highest consumers of beef and pork meat.

Fresh milk consumption is significantly higher for Whites and Asians than for urban Blacks. Lactose intolerance, more prevalent amongst Blacks (Steward, 1996), impacts negatively on the consumption of fresh milk by Blacks.

The relatively higher population growth rate for Blacks compared to Whites will significantly increase the demand for products where Black consumption is relatively important, for instance, beef. On the other hand per capita consumption of pork meat, cheese and fresh milk may increase relatively less as Whites consume these products more with a low population and low projected income growth.

7. PROJECTIONS OF FINAL DEMAND OF ANIMAL PRODUCTS

Projections of final demand in 2000, 2010 and 2020 as a percentage of 1995 consumption are shown in Tables 5 and 6.

In Table 5, Van der Berg's growth scenarios for 3 % and 5 % are simulated and in Table 6, Spies's low income and high-income scenario's are simulated. According

to Tables 5 and 6, food demand is highly sensitive to assumptions regarding income growth due to high-income elasticities of demand of the Black population.

Table 5: Projections of demand for 2000, 2010 and 2020 using van der Berg's growth assumptions (1995/96 = 100)*

	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX
	A	B	C	D	E	F
	2000/2001		2010/2011		2020/2021	
	3%	5%	3%	5%	3%	5%
Beef	125.32	137.19	197.91	266.68	323.44	547.44
Poultry	121.16	131.59	176.55	230.35	264.30	424.18
Pork	110.10	112.12	129.26	136.83	151.25	167.29
Mutton/Goat's meat	121.77	132.38	183.32	242.82	288.13	476.78
Eggs	124.00	133.23	189.03	242.78	296.54	471.85
Fresh Milk	116.98	122.60	159.31	189.90	224.41	319.25
Milk Powder	118.20	123.03	164.97	195.45	239.37	343.72
Cheese	114.53	122.47	154.39	195.74	221.72	346.42

* Calculations are shown in Appendix A

Table 6: Projections of demand for 2000, 2010 and 2020 using low and high income growth projections of Spies (1996) (1995/96 = 100)*

	INDEX	INDEX	INDEX	INDEX	INDEX	INDEX
	A	B	C	D	E	F
	2000/2001		2010/2011		2020/2021	
	Low	High	Low	High	Low	High
Beef	112.04	124.72	134.80	189.60	160.20	289.92
Poultry	110.98	122.46	131.92	178.08	155.32	258.55
Pork	108.96	111.57	125.11	134.29	142.81	160.77
Mutton/Goat's meat	110.03	121.96	128.82	179.59	149.68	268.33
Eggs	113.24	123.27	138.39	181.74	166.44	269.14
Fresh Milk	110.42	117.23	129.73	158.00	151.05	215.80
Milk Powder	111.88	116.89	134.53	157.36	159.89	216.07
Cheese	105.91	115.85	115.62	155.92	125.80	216.33

* Calculations will be provided on request from the author. Calculations are derived in a similar fashion as outlined in Appendix A.

The attainability of a very high per capita income growth scenario was thus questioned.

Van der Berg's high growth scenario, which assumes that Black urban per capita income grows at 6.1 %, was seen as less likely than Spies's scenario's. Spies's low-income scenario assumes the continuation of present growth while his high-income scenario assumes a growth of 2.75 % per capita for the Black population. Van der Berg scenario is, however, important as it shows if his high growth rate scenario is achieved that food demand will increase significantly due to high-income elasticities for Blacks. The high-income growth scenarios are expected to overestimate demand, as income-elasticities will generally decline with high per capita income growth. Income elasticity of demand changes as income and thus lifestyle, tastes, preferences, perceptions of quality, etc. change over time. Working with fixed income elasticities under a high growth scenario over such a long forecasting period leads to overestimation. This is especially a problem in Van der Berg's high-income growth scenario.

According to Table 6 beef has the highest projected demand increase of all products. The high projected demand increase for beef is due to (a) high per capita consumption for beef amongst blacks who also have a high population growth, (b) a high income elasticity of demand for beef, and (c) urban purchases that are significantly higher than rural purchases. The projected demand increase for pork meat on the other hand is low as Whites who have a low population and projected income growth largely consume it.

The projected demand for poultry and mutton, albeit less than for beef is strong for both high and low-income scenarios. The demand increase for eggs is the second highest and that for pork meat the lowest.

If future demand is not being met by significant imports then results presented in Tables 5 and 6 show that major future investments are required in the RSA agricultural industry.

8. CONCLUDING COMMENTS

A demand projection model was developed for individual food items in South Africa for 2000, 2010 and 2020. This model considered the following factors that impact on structural adjustment in the demand for food (a) population growth rate (b) income elasticity (c) economic growth rate and (d) urbanisation. Growth in demand for each population group was considered separately as the above structural parameters differ between groups. In the aggregated projection model these demand components were weighted by also using per capita consumption data of different food items.

With income growth matched by population growth in South Africa (1990's), the most important determinant in the food demand equation is population growth. Under such a situation income elasticities are relatively unimportant in explaining growth in demand. With high-income growth scenarios, food demand is highly sensitive to income growth and income elasticities.

The expected change in the racial mix of the South African population has important impacts on food demand. For instance with the Black population growth rate being higher than those of the other groups, the per capita food consumption of all groups taken together may decline over time even although per capita growth rate of each group may be increasing. The reason being that the group with the highest population growth often has the lowest per capita consumption of livestock products. This phenomenon partially explains the low growth in total demand for pork meat.

The model predicts a strong increase in the demand for beef, which is expected to lead to further relative price increases of beef relative to poultry.

The model shows significant increases in the demand for livestock products especially under high-income growth scenarios. Real prices of these food items will increase accordingly in the absence of imports while relative prices will change.

9. REFERENCES

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Appendix A

$$\text{INDEXA} = 100 * \text{CONA} / \text{CON.}$$

$$\text{INDEXB} = 100 * \text{CONB} / \text{CON.}$$

$$\text{INDEXC} = 100 * \text{CONC} / \text{CON.}$$

$$\text{INDEXD} = 100 * \text{COND} / \text{CON.}$$

$$\text{INDEXE} = 100 * \text{CONE} / \text{CON.}$$

$$\text{INDEXF} = 100 * \text{CONF} / \text{CON.}$$

$$\text{CON} = 5218.5 * \text{WC} + 3495.6 * \text{CC} + 14141.7 * \text{BUC} + 17339.6 * \text{BRC} + 1045.2 * \text{AC.}$$

$$\begin{aligned} \text{CONA} = & 1104.5 * \text{AC} * (1 + 0.1041 * \text{IA}) + 17858.4 * \text{BUC} * (1 + 0.1992 * \text{ibu}) + 17339.6 \\ & * \text{BRC} * (1 + 0.0879 * \text{ibr}) + 3724.8 * \text{CC} * (1 + 0.1425 * \text{ic}) + 5363.2 * \text{WC} * \\ & (1 + 0.0050 * \text{iw}). \end{aligned}$$

$$\begin{aligned} \text{CONB} = & 1104.5 * \text{AC} * (1 + 0.1763 * \text{IA}) + 17858.4 * \text{BUC} * (1 + 0.3445 * \text{ibu}) + 17339.6 \\ & * \text{BRC} * (1 + 0.2225 * \text{ibr}) + 3724.8 * \text{CC} * (1 + 0.2225 * \text{ic}) + 5363.2 * \text{WC} * \\ & (1 + 0.0720 * \text{iw}) \end{aligned}$$

$$\begin{aligned} \text{CONC} = & 1208.1 * \text{AC} * (1 + 0.3459 * \text{IA}) + 25198.7 * \text{BUC} * (1 + 0.7246 * \text{ibu}) + 17339.6 \\ & * \text{BRC} * (1 + 0.2877 * \text{ibr}) + 4091.4 * \text{CC} * (1 + 0.4913 * \text{ic}) + 5522.1 * \text{WC} * \\ & (1 + 0.0151 * \text{iw}). \end{aligned}$$

$$\begin{aligned} \text{COND} = & 1208.1 * \text{AC} * (1 + 0.6274 * \text{IA}) + 25198.7 * \text{BUC} * (1 + 1.4307 * \text{ibu}) + 17339.6 \\ & * \text{BRC} * (1 + 0.8271 * \text{ibr}) + 4091.4 * \text{CC} * (1 + 0.8271 * \text{ic}) + 5522.1 * \text{WC} * \\ & (1 + 0.2319 * \text{iw}). \end{aligned}$$

$$\begin{aligned} \text{CONE} = & 1305.3 * \text{AC} * (1 + 0.6406 * \text{IA}) + 33517.7 * \text{BUC} * (1 + 1.4801 * \text{ibu}) + 17339.6 \\ & * \text{BRC} * (1 + 0.5241 * \text{ibr}) + 4461.6 * \text{CC} * (1 + 0.9465 * \text{ic}) + 5658.2 * \text{WC} * \\ & (1 + 0.0253 * \text{iw}). \end{aligned}$$

$$\begin{aligned} \text{CONF} = & 1305.3 * \text{AC} * (1 + 1.2517 * \text{IA}) + 33517.7 * \text{BUC} * (1 + 3.3942 * \text{ibu}) + 17339.6 \\ & * \text{BRC} * (1 + 1.7307 * \text{ibr}) + 4461.6 * \text{CC} * (1 + 1.7307 * \text{ic}) + 5658.2 * \text{WC} * \\ & (1 + 0.4156 * \text{iw}) \end{aligned}$$

Income elasticities are; ia=Asian, ibu=urban Black, ibr=rural Black, ic=Coloured and iw=White. Per capita consumption is; AC=Asians, BUC=urban Black, BRC=rural Black, CC=Coloured and WC=White.

Appendix B

ASSUMPTIONS

The following assumptions were made in projection models

1. Income elasticities remain the same during 1995 to 2020.
2. Black rural population remains unchanged during 1995 to 2020.
3. Population growth rate between 2011 and 2020 was assumed the same as that between 2002 and 2011.
4. Cross elasticities considered only in an indirect way through relative changes in prices and using the concept of total rather than partial price-elasticities.