ECONOMIC IMPLICATIONS OF A DEREGULATED YELLOW MAIZE MARKETING SYSTEM ON THE LIVESTOCK INDUSTRY

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The purpose of this article is to illustrate the possible effect of a deregulated yellow maize marketing system on the livestock industry (via the stockfeed industry). The stockfeed industry, with its different market segments, and the most important raw materials are described.. A sectoral linear programming model was used to simulate the one channel maize policy in thirteen regions. The social cost of the single channel maize marketing system (which distorted market signals) was calculated. The livestock industry (via yellow maize in stockfeed) was the major looser under the single channel maize marketing system. Moving to a freer market situation for yellow maize should result in a more balanced agricultural sector and an increase in the total economic welfare of the country, and particularly that of the livestock industry.

EKONOMIESE IMPLIKASIES VAN 'N GEDEREGULEERDE GEELMIELIEBEMARKINGSTELSEL OP DIE VEEBEDRYWE

Die doel van die artikel is om die moontlike effek van 'n gedereguleerde geelmieliebemarkingstelsel op die veebedryf (via die veevoerbedryf) te illustreer. Die veevoermark met sy belangrikste segmente word aangetoon en ook die belangrikste grondstowwe. 'n Sektorale lineêre programmeringsmodel is gebruik om die eenkanaal mieliebemarkingsbeleid in dertien streke te simuleer. Die sosiale koste van die eenkanaalmieliebemarkingstelsel aangetoon (wat markseine versteur het) word aangetoon. Die lewendehawebedryf was die grooste verloorder van die eenkanaalbeleid (via geelmielies in veevoer). Die beweging na 'n vryer mieliebemarkingstelsel behoort 'n meer gebalanseerde landbousektor daar te stel, ekonomiese welvaart van die land en veral die van die veebedrywe te verhoog.

1. Introduction

The purpose of this article is to illustrate the possible effects of deregulation of yellow maize marketing on the livestock industry due to the effects thereof on the stockfeed industry.

The year 1990/91 was used, as this was a relatively "normal" rainfall year, with average yields and average availability of grazing. The research was done during 1993/94 and the article was originally submitted in January 1995 - well before details of a deregulated maize marketing system were known. Obviously the results in a drought year will be different. However, it was not the subject of the research.

The stockfeed market was analysed in its different segments, to illustrate the size of the market and the most important raw materials used. Since yellow maize is the most important raw material, a sectoral linear programming model was used to simulate the single channel yellow maize marketing policy. This was done in thirteen regions, to illustrate the regional effect. Deregulation of the single channel "fixed" priced system was simulated, to illustrate a freer marketing system, with different pricing between regions. The impact of deregulation of the maize marketing system in thirteen regions will be shown, as well as the high social costs of a maize marketing system that distorts price signals.

2. Stockfeed market

2.1 Volume stockfeed manufactured

Table 1 depicts the volume stockfeed manufactured (Department of Agriculture, 1992), the price index of all stockfeed and certain stockfeed rations. Total stockfeed manufactured amounted to approximately 3,140 million tons in 1991. Since 1980 this volume increased by 22,2% which more or less corresponds with the increased use of maize for animal consumption (an increase of 26,2% over the same period). There appears to be a slight movement away from the purchasing of manufactured stockfeed in favour of home-mixing. This trend is confirmed by the fact that the manufacture of pig, cattle and sheep stockfeed mixes had declined by respectively 25,6% and 41,1% over this period. The sharp growth in manufactured poultry feed mixes (approximately 60,2%) indicates growth in the industry as well as the sensitivity of poultry to a variation in feed mixes.

According to Griessel (1992) it is estimated that over the period 1987/88 to 2000, stockfeed requirements will increase from 5,553 million tons to approximately 8,76 million tons - an increase of 57,8%. In respect of broilers (which took up 24% of stockfeed in 1987/88) an increase in production of approximately 70,6% is expected, accompanied by an increase in feed requirements of approximately 58,6%. In the case of cattle and sheep, an increase in production of respectively 42,5% and 42,8% is expected, while stockfeed requirements are expected to increase by 77,4%.

The analyses show that a considerable increase in the demand for stockfeed can be expected up to the year 2000. This will again make an enormous demand on raw material supplies, both local and imported.

2.2 Stockfeed market segments

(1) Introduction

A distinction can be made between three important segments in the stockfeed market, viz. the stockfeed manufacturing industry (as represented by AFMA), the feedlot industry and the home-mixing industry.

Table 1: Stockfeed mixes manufactured and the price index

Years	Total manufactured (000 tons)	%	Price Index	%	Rations tons			
					Poultry	Dairy	Pork	Cattle & sheep
1980	2567,9	6,7	214,60	20,3	1095261	406463	193427	499622
1981	2950,3	14,9	244,90	14,1	1270802	411803	226732	586773
1982	3254,5	10,3	292,70	19,5	1435494	514394	266520	591686
1983	3422,9	5,2	364,20	24,4	1439350	511549	230591	743255
1984	3053,5	-10,8	395,30	8,5	1502414	437722	210477	434217
1985	2922,6	-4,3	429,80	8,7	1559726	362182	197409	353970
1986	2735,1	-6,4	475,60	10,6	1523991	365809	164510	302097
1987	2692,1	-1,6	522,90	9,9	1567952	396831	135393	297347
1988	3107,9	15,4	553,90	5,9	1782300	494266	201813	286520
1989	3429,6	10,4	638,40	15,2	1942005	513501	215685	281876
1990	3698,9	7,8	712,20	11,6	1838928	451490	169370	315821
1991	3140,0	-15,1	789,60	10,9	1754793	471259	141930	294433
% 91/80	22,2	-	267,9	-	60,2	15,9	-26,6	-41,1

Source: Abstract of Agricultural statistics (1992) (Unpublished data)

(2) Stockfeed manufacturing industry

The stockfeed manufacturing industry, as represented by AFMA, sold approximately 3,889 million tons of stockfeed and concentrates during 1990/91 (AFMA, 1992a).

Members of AFMA are estimated to have used approximately 82,9% of total oilcake (490 657 tons) during the year, as well as about 90,7% of total fish meal (approximately 230 650 tons). Virtually all manufacturers of stockfeed are members of AFMA (Bekker, 1992).

According to Potgieter (1991) the formal stockfeed industry (AFMA members) represents about 56% of the total stockfeed market. The percentage share of manufactured stockfeed in the total stockfeed market is shown in Table 2 according to each feed type.

Table 2 : Share of the formal stockfeed industry

Feedmix	% Share
Dairy	40
Poultry	97
Pigs	40
Cattle/Sheep	20
Horses	40
Dogs	100
Others	51
	56

Source: Potgieter (1991)

Stockfeed sales by the stockfeed manufacturing industry in regional context for the year 1990/91 show that the largest production capacity of stockfeed manufacturers is concentrated in three regions viz. the Western Cape (15%), Natal (18,5%) and Gauteng (24,3%). These are the three regions with the highest utilisation of production capacity during the year, and also the areas where most stockfeed was sold.

The capacity utilisation of the stockfeed manufacturers is a source of concern in own ranks. The fact that capacity utilisation amounted to only 65,05% for the entire country in 1990/91, holds implications. It is indicative of the financial pressure to which the industry is subjected, where fixed costs will inevitably form a major part of costs. The fact that there is approximately 35% unutilized capacity also confirms that no investment will be made in the industry in the next few years. The largest unutilized capacity is to be found in the grain producing areas; home-mixing had increased considerably in these areas. One reason given for this is the increased circumvention of the controlled marketing system. Users of stockfeed can save considerable sums in levies by producing and using their own raw materials in stead of using the commercial market.

As long as the "price gap" of grain and oilseed is regarded as too high by consumers (livestock farmers), this trend will continue. The further ripple effect of the grain and oilseeds price and marketing policy must not be under-estimated.

If stockfeed production is analysed in terms of the type of stockfeed manufactured and sold per region, it is clear that most stockfeed sales/species also occur in the three main areas, viz. the Western Cape, Natal and Gauteng.

The shares of the main feed types are as follows : poultry 57,72%, ruminants 26,77%, pigs 5,35%, horses 1,02%, dogs 3,02% with other feeds approximately 3,14% and concentrates 2,97%.

Sales of concentrates per region and the type of concentrates sold can be used to give an indication of the extent of home-mixing in areas as well as for what species of animals it is used. It appears that Natal has the greatest consumption in this regard.

The following deductions were made:

- Maize is the main raw material used (1,87 million tons) and comprises 50% of all raw materials. This confirms the importance of maize as a feed source and the ripple effect of the maize price and marketing policy.

- Maize by-products released from the white maize milling industry, amount to a further 175 430 tons (approximately 5,6%). It is a high value product which replaces whole maize in rations by considerably more than 1:1.

- Feed wheat and wheat bran jointly amounted to approximately 294 877 tons (approximately 9,4% of all raw materials).

- Oilcake amounted to a total of 431 166 tons which represents approximately 13,8% of all raw materials used.

- Fish meal amounted to 212 457 tons, while a further 67 094 tons other protein products were used. Other grains amounted to 63 591 tons.

(3) Feedlot industry

The feedlot industry depends heavily on stockfeed, which is mostly mixed and manufactured by the individual feedlots themselves. The financial results of a feedlot are very sensitive to changes in feed costs. This is one of the critical factors for survival (De Wet, 1992).

An analysis shows that approximately 610 000 tons feed had been used by feedlots in 1990/91 (SA Feedlot Association). All commercial feedlots are members of this Association (De Wet, 1992) and this can be used as a reasonably accurate indication of the extent of the market.

Certain deductions can be made :

- The main raw material for feed is maize waste (waste from the white maize milling industry) with 301 500 tons, i.e. approximately 49,4% of their raw materials.

- Yellow maize, mainly produced by feedlots, is the second largest raw material component with a share of approximately 16,5% (100 500 tons).

- Maize and maize products have a share of approximately 65,9% in the raw material composition of stockfeed at feedlots. This again shows the important influence which the maize price and marketing policy have on the market segment.

- Wheat bran, barley and feed wheat amounted to approximately 93 800 tons or 15,3% of raw materials.

- Traditional oilcake (sunflower, groundnuts and soya beans) amounted to 26 800 tons, while other non-traditional protein sources (such as cotton seed and waste products) amounted to a further 53 600 tons.

The feedlot industry does not use fish meal as it is too expensive (Schutte, 1992). Feedlots are increasingly trying to cut their feed costs by using non-traditional raw materials. They are even prepared to make use of unorthodox methods for the sake of financial survival (De Wet, 1992). It is also clear that feedlots adapt their formulation of feed rations according to the available raw materials, in order to mix the lowest cost ration.

(4) Home mixing-industry

It is extremely difficult to make an estimate of the so-called home-mixing industry's utilisation of raw materials. The segment usually consists of smaller stock units which have sufficient raw materials of their own or have access to raw materials in their immediate vicinity. It was found that the home-mixing industry is expanding especially where traditional raw materials (particularly controlled products such as maize and oilcake) are becoming relatively too expensive. These are also the stock production units that are integrating retroactively in an attempt to keep their feed costs as low as possible. The saving can be considerable. In the case of yellow maize which is the main raw material, the total "price gap" or Maize Board levy can be saved. During 1990/91 this amounted to approximately R95/ton, or, as a percentage of the listed price for yellow maize (Maize Board purchase price), a saving of approximately 26%. The increase in retention of yellow maize (i.e. utilised by the producer himself) clearly confirms this trend. In 1987/88 (marketing year) yellow maize retention amounted to approximately 289 kt and in 1991/92 to 553 kt (Maize Board, 1992).

It is difficult to determine the size of this industry. Various methods can be used:

a) One possibility is the calculation which shows that AFMA supplies approximately 56% of the total stockfeed market (See Table 1). If the conversion is done on the AFMA figure for 1990/91, it means that the total stockfeed market was approximately 5,6 million tons in 1990/91. This calculation applied only to raw materials. From this must be deducted the supplies of the Feedlot Association (610 000 tons) and AFMA (3,12 million tons), which leaves about 1,87 million tons stockfeed for the home-mixing industry.

b) Another method would be simply to deduct the raw materials used by AFMA and the feedlot industry from the total available raw materials during the particular year. This will indicate the utilisation of raw materials by the home-mixing industry. Differences in stock levels will not be taken into account.

   This method was used in compiling Table 3 where the available raw materials are shown for stockfeed purposes as well as the utilisation thereof by AFMA and the feedlot industry. The rest is assumed as having been used by the home-mixing industry. A factor which makes the home-mixing industry appear to be considerably more extensive than Potgieter's calculation (1991) is the fact that yellow maize retained on farms (516 000 tons) was added in Table 3. According to this, the main raw materials used by the home-mixing industry were about 2,655 million tons, or approximately 41,4% of all raw materials. This is greater than the calculation of 1,87 million tons in the first method.

   This method should however give an accurate indication of the true size of the industry since it is based on the raw materials available and the utilisation thereof in the country.

Table 3: Estimation of available feed sources and usage in 1990/91 (tons per stockfeed market)

Feed sources	Available		Usage		
	Local	Imports	Afma	Feedlots	Home mixing
Yellow maize (commercial)	3 269 116	-	1 878 462	100 500	1 290 154
Maize residues[1)]	498 500	-	175 430	301 500	21 570
Feed wheat [2)]	44 964	-	11 464	33 500	-
Wheat bran	437 700	-	283 413	53 600	100 687
Barley	26 322	-	549	6 700	19 073
Oats	11 090	-	-	-	11 090
Grain sorghum	50 000	-	-	-	50 000
<u>Oilcake</u>:					
Sunflower	232 280		225 653	13 400	
Groundnuts	5 568	134 240	18 216	6 700	32 067
Soya	54 241		128 593	6 700	
Cottonseed/cake	88 301		63 704	-[6)]	-
Fish meal	105 083	135 567	212 457	-	28 193
Other protein	120 994	-	67 094	53 900	-
Other grain [3)]	606 391	-	63 591	26 800	516 000
Other [4)]	340 000	-	-	6 700	333 300
Concentrates [5)]	253 175	-	-	-	253 175
Total	6 143 725	269 807	3 128 626	610 000	2 655 309

Notes: [1)] Total 862 500 tons available, of which 364 000 tons were exported by the Maize Board
[2)] Larger than Wheat Board estimates
[3)] Yellow maize retained on farms 516 000 tons
[4)] Molasses of 340 000 tons (Potgieter, 1991)
[5)] Feed concentrates manufactured by AFMA for home mixing
[6)] Included with other proteins used by feedlots

c) A third method would be to work according to fish meal allocation. The home-mixing industry must apply annually for their share of the local fish meal allocation handled by the SAAU. Analysis of the applications can provide an indication of the size of the home-mixing industry per region and the feed used by each animal specie. By making use of standard lowest cost feed formulations, other feed sources can be determined. This method was discussed with the representatives of the RPO (Schutte, 1992) and AFMA (Bekker, 1992) who considered it an acceptable alternative

The total fish meal requirements applied for by the home-mixing industry are according to this method, approximately 28810,97 tons. It can be assumed that this is not the total industry, but experts believe it to be relatively accurate (Bekker, 1992; Schutte, 1992 and De Wet 1992). The tonnage fish meal differs approximately 2,2% from the tonnage fish meal estimated in Table 3 as being purchased by the home-mixing industry during the year. The fact that the applications were for slightly more that was purchased, is possibly indicative of the fact that certain applicants had used other protein sources. Further monitoring shows that the applications reflect how much oilcake had been used by home-mixers. If the quantities are added together (fishmeal needed to formulate the different rations of the applications), the amount was approximately 31 712,9 tons for 1990/91, which once again corresponds largely with the figure calculated in Table 3, viz. 32 067 tons - a deviation of slightly more than 1%.

It can therefore be deduced that the size of the home-mixing industry, as calculated and shown in Table 3 in relation to total raw materials of 2,655 million tons (41,4% of total), is reasonably accurate.

This is an important segment therefore and more attention should be given to gathering information concerning the home-mixing industry.

(5) Summary: Substitution characteristics of stockfeed and the implications

The aforementioned supply and demand trends in the stockfeed market are greatly influenced by the availability of raw materials and their relative prices. Within the prescribed ration specifications a great deal of substitution is possible. The substitution possibilities are determined on the one hand by the available raw materials and on the other hand by the relative price, within the allowable inclusion levels of each animal ration (Potgieter, 1991).

As the relative prices and availability of raw materials vary from year to year, changes are effected by the stockfeed industry since they are always striving for the lowest cost ration composition.

Analyses by Potgieter (1991) for a particular year showed for example that ration compositions could change considerably if the main raw material viz. maize, becomes too expensive, relative to other available raw materials. Different feed rations offer different substitution possibilities. The substitution possibilities naturally also differ from region to region and are determined by the availability of raw materials per region as well as the relative price (landed costs).

From the preceding research it was clear that the availability and prices of stockfeed (landed costs) can differ considerably from one region to the next. It follows therefore that the regional composition of animal production will also vary, with varying ration specifications.

From this it can be concluded that regional prices of raw materials are important, as are the available quantities and other production possibilities per region. The policy for long followed by the Grain Boards and the Oilseeds Board not to allow for regional prices, caused serious distortions of market factors. The policies also aimed to restrict imports and to recover unrealistic import levies. This was a further limiting factor in the development of livestock industries in terms of supply and demand factors.

In a Canadian study the fixed prices of feed wheat (as applied locally by the Canadian Wheat Board) were found to have an adverse effect on the livestock industries and stockfeed industry (Alston, et al, 1991). In certain areas feed grain prices were "too low" and in other areas "too high", which led to considerable distortions in the allocation of production factors. It also resulted in a transfer of wealth in certain regions from stock industries to grain industries and vice versa in other regions.

3. Deregulation of the yellow maize marketing system

3.1 Introduction

It is evident from detail analyses done (Willemse, 1994), that single channel maize marketing had serious shortcomings and that it had a major influence on the livestock industry (and the formulation and manufacturing of animal feed). One of the most serious distortions is that regional prices did not reflect regional supply and demand, resulting in a misallocation of resources. The livestock industry has been identified as a major growth industry in the future (Committee for the Development of a Food and Nutritional Strategy for Southern Africa, 1990) and the fact that it is the single largest user of maize and maize products, has serious policy implications. Furthermore, since the maize industry is the largest field crop and since the maize marketing system has acted as an umbrella for wheat and oilseeds, this has further serious policy implications. It can therefore be concluded that a change in the maize marketing system is a major prerequisite for future growth in the livestock industry and for a more market related production and marketing system in other field crops.

Restructuring of the agricultural marketing system is also inevitable under a democratic government in South Africa. Various studies showed that the current agricultural marketing system has major short comings (LAPC, 1993; World Bank, 1993 and Willemse, 1994).

Deregulating the single channel maize marketing system into a surplus removal system, will result (amongst others) regional demand and supply factors to will be reflected in regional prices. A deregulated maize marketing system should result in a more competitive livestock industry, a more balanced production pattern for other field crops and ultimately a more balanced regional agricultural sector (Willemse, 1994).

3.2 Model description and validation

(1) Description

A sectoral linear programming model was assembled, based on 13 grain producing regions in South Africa and the consumption of raw materials in this regions for the stockfeed industry. Three import harbours were also taken into account as potential supply points.

Nine main crops compete for cropping land: maize, wheat, sorghum, sunflower, groundnuts, soya beans, cotton, barley and oats, all of which produce raw materials for animal feed. Fish meal was also taken into account as a raw material. These crops account for more than 85 percent of the total raw materials used in the animal feed industry (Table 3). The aggregate supply of each product is upward-sloping because costs differ between regions and because of competition for land within regions.

Detailed yield, cost and gross margin data were obtained from enterprise budgets (Combud) which were compiled on a regional basis by the Department of Agriculture. The data refer to the 1990/91 year - which was a relatively normal production year.

The construction of the model was done in three distinct phases: First the basic model with costs and fixed prices only was assembled. Next, risk was included by using the mean absolute deviation method (MOTAD). Finally, variable product and input prices were respectively modelled by using stepped demand functions. A detailed description of the structure of the model and theory can be find in Willemse (1994) and will not be described here.

The model consists of three distinct sections, namely the supply side depicting farm production and raw material imports, which is characterised by the **supply equations** and the **risk section**, and the demand for the raw products, depicted by the set of **demand equations**. The latter was done in two stages: first, substitution in the feed market was modelled separately to determine the price elasticity of the relevant products (in this particular case, yellow maize). The second stage used this information to generate the relevant demand functions for the various commodities included in the model.

Demand is thus modelled in two separate procedures. Substitution effects between the large number of possible ingredients of a given animal feed, is captured by using the procedure described by Potgieter (1991) and Potgieter and Van Zyl (1992). Because the procedure employed here follows the methodology developed there closely, it is not repeated here. Basically, a minimum cost formulation of the formal animal feed sector in South Africa (individually and in total) is done. This is then used to determine the effect of price changes of a specific commodity on the quantity of that product demanded. The price elasticity of demand derived in this step-wise fashion is then used as an input in the model described above. The price elasticity of supply for yellow maize (-1.404) derived exogenously in this manner, is subsequently used to endogenously determine step-wise supply functions for yellow maize in each of the resource/consumption regions.

Transport opportunities/activities link the supply and demand sections of the model together: each of the thirteen resource regions or three import harbours can supply any of the sixteen consumption points (13 regions and three export harbours). Supply and demand for each region are treated as if it is coming from one specific locality, rather than from all over the region. This is done to simplify the use of transport costs between and within resource regions. Consumption and production points were subsequently developed to facilitate this. These production and consumption points differ for every region, so that interregional transport costs apply. The assumption is that transport costs from any point in a region to any point in another region is the same. This is in line with the assumption that production practices, yields, risk and prices are the same within regions.

The model thus has the following sections:

Supply
- production of white and yellow maize in each of the 13 resource regions;
  import of yellow maize at the three harbours;

Linking activities
- transport of yellow maize from any of the 16 supply points to the 16 demand areas, i.e. 13 regions and three export harbours;

Demand
- yellow maize demand schedules for each of the 16 demand points;
- demand schedule for white maize; and

Risk
- incorporation of production risk.

For this specific application described here, the final model has 26 production activities, 3 import activities, 256 transport activities, 17 demand schedules of which 14 consist of 10 steps each, and 10 years of risk data for each crop in each region. In addition, the model was structured in such a way as to allow for the easy measurement of producer, consumer and total welfare, which form part of the different objective functions, depending on the scenario followed.

(2) Data requirements and inputs

The data requirements were quite formidable as the data is not necessarily collected or published in the required format, and several sources were used for the collection (Willemse, 1994).

The first stage of the estimation procedure required the exogenous estimation of the relevant demand elasticities. This required detailed information on (Potgieter, 1991 and Van Zyl, 1992):

- prices of all potential ingredients of balanced animal feed rations for every source (domestic or imported);
- quantities and availability of all the above ingredients or commodities per source;
- specific balancing and nutritional requirements of each type of balanced animal feed;
- quantities of each type of balanced animal feed required; and
- composition and nutritional value of each commodity with respect to the key factors.

This data were obtained from several sources, the most valuable contribution coming from AFMA. Using the data and the procedures described above, the elasticities derived for further use were as follows:

Yellow maize:	-1.404
White maize:	-0.301

For the construction of the model described, data requirements were as follows:

- production, area and yield data for both white and yellow maize for each of the 13 resource regions;
- production costs, as well as average handling and storage costs, for white and yellow maize in each of the 13 resource areas;
- c.i.f. prices and harbour handling costs for yellow maize imports;
- net export prices of white and yellow maize;
- base prices and quantities of yellow maize consumption in each of the 16 demand points in order to determine the step-wise demand schedules for each region;
- base price and quantity of national white maize consumption;
- transport costs from every supply point to every consumption (demand point); and
- risk data consisting of prices and yields of yellow and white maize for the 10 year period 1981-1990.

(3) Model validation

Validation of the model is a process that leads to: (1) a numerical report of the model's fidelity to the historical data set; (2) improvements of the model as a consequence of imperfect validation; (3) a qualitative judgement on how reliable the model is for its stated purposes; and (4) a conclusion (preferably explicit) for the kinds of uses that it should not be used for (Hazell and Norton, 1986). Validation begins with a series of comparisons of model results with the reported actual values of the variables. Although several validation tests are relevant, only the production and price tests were used here.

Production is the variable most commonly used in validation tests, and for a number of agricultural models there are reported validation results. Typically, there is considerable variation over products in the closeness of the fit to the historical data, and the model builder may be willing to accept greater deviations in minor products if the predictions are good for the major products. There is no consensus on the statistics to be used in evaluating the fit, but in most cases simple measures such as the mean absolute deviation (MAD) or the percentage absolute deviation (PAD) have been used. The price test is identical to the production test except that it is performed on product prices.

The testing of the model was done by imposing all of the policies which are currently (1991/92) in operation in order to see how well it simulated the current situation. The better the current situation is represented by the model, the more reliable the model.

The values generated by the model corresponded fairly well with the actual values. If a deviation of 15 percent is deemed acceptable for the model as a general rule of thumb (as suggested by Hazell and Norton, 1986), only white maize production in two relative small production regions had larger deviations of -34.8 and 16.9 per cent respectively. However, the absolute deviations are relatively small in both cases, so that the result is not crucial to the general good fits obtained with the model. A PAD of 8.73 percent across all production regions is obtained which is particularly good for this type of model.

The model was thus accepted as being relatively accurate and can be used for simulating the effects of policy changes with some confidence.

4. Results

4.1 Introduction

Three different types of policy scenarios were modelled to illustrate the effects of policy changes on production, price and consumption of maize, as well as the welfare effects of policy changes. The policy scenarios modelled were:

Scenario A: Changes in the objective function (current marketing system)

1) Maximise producer surplus
2) Maximise consumer surplus
3) Maximise total surplus

Scenario B: Changes in the marketing system (no imports)

1. Present marketing system for maize (base scenario)
2. Free market system with no statutory price fixing (with no imports)

Scenario C: Changes in the marketing system and imports

1. Quantitative import control for maize (base scenario)
2. Zero import tariff, allowing imports.

Scenario A refers to what is best for whom, namely what the policy should try to accomplish. Should the policy attempt to benefit producers, or rather consumers? This is particularly important in the production of a product like maize which is the major staple food to the majority of the poor in South Africa and is also the major animal feed crop. In this respect it is important to know what the economic opportunity costs are of favouring a particular group over another. The maximisation of the total surplus provides the optimal solution seen from the national viewpoint of the economy as a whole. However, there may be certain policy objectives that warrant the favouring of a particular group. In such cases the cost of such policies to the society as a whole is important.

Scenario B refers to a situation where the fixed price single channel marketing system for maize is abolished and market clearing prices are established through the interaction of supply and demand in a freer marketeconomy. This situation allows for the establishment of different maize prices in each of theregions, for each of its uses, depending on the supply, demand and transport situation.

The import structure for maize is modelled in Scenario C. Quantitative import controls and a zero rate of import tariff are modelled to determine the effects thereof on the selected key variable.

The selected key variables which are monitored to determine the effects of policy changes, include areas under production, exports and imports, prices and welfare values.

4.2 Results of policy changes

4.2.1 Changes in the objective function (Scenario A)

The model allows for the maximisation of either producer, consumer or total welfare. The basic assumption was that the 1991/92 marketing system would stay exactly the same namely a single channel fixed price system with quantitative import controls, but that the Maize Board would set its prices in such a way as to maximise the welfare of the different groups, respectively. Table 4 provides the results. Emphasis should be placed on the changes and direction of change, and not on the absolute values.

Table 4 indicates that there is no export of maize when either producer, consumer or total welfare is maximised. This indicates that export of maize cannot be done profitability, and therefore does not contribute towards the welfare of any of the specified groups as a whole (although it may actually benefit some minority group within the broad group of producers). The stopping of maize exports implies that the area under maize will have to decrease.

Maximising producer welfare

Two different trends are identified when producer surplus is maximised, namely (i) the price of yellow maize decreases and (ii) the price of white maize increases. This is consistent with the theory which dictates that for income to be maximised from sales, prices of price inelastic goods should be raised and prices of price elastic goods should be lowered. The resultant effect of such price changes in the quantity demanded hold the key to the final results. In this case, the relatively moderate decrease in the price of yellow maize of between 6 and 9 percent causes consumption to increase substantially, (elasticity - 1.404) while the relatively large increase in the price of white maize of nearly 35 percent causes the quantity consumed to only drop moderately (elasticity - 0.301). The effects of the above on consumer welfare is relatively large: welfare arising from yellow maize consumption increases by more than 10 percent, while consumer welfare resulting from white maize consumption decreases by 7.5 percent.

The effects on producer welfare (or net income) are even more drastic. The effects of the higher price for white maize (with only a relatively small decrease in quantity), higher yellow maize consumption (with only a relatively small decrease in prices) and the stopping of non-profitable exports, culminates in producer welfare increasing by more than 80 percent.

Table 4: Effects of changes in policy objectives (objective function of the model) on key variables

Measure	Item	Change in base values (%) resulting from maximising:		
		Producer surplus	Consumer surplus	Total surplus
Production data	Area under maize:			
	- Region 1:Swartland	-	-	-
	* yellow maize	-	-	-
	* white maize	-	-	-
	- Region 2:Ruêns	0	0	0
	* yellow maize	-	-	-
	* white maize	0	0	0
	- Region 3:West. Cape (rest)	-	-	-
	* yellow maize	-	-	-
	* white maize	-	-	-
	- Region 4:Northern Cape	-17.9	-15.8	-16.4
	* yellow maize	8.4	13.4	12.3
	* white maize	-32.9	-32.5	-32.8
	- Region 5:Eastern Cape	56.3	57.2	56.6
	* yellow maize	11.3	11.6	11.3
	* white maize	71.3	72.4	71.8
	- Region 6:Eastern OFS	-14.9	0.2	-10.5
	* yellow maize	-3.4	0.1	-1.2
	* white maize	-65.0	0.6	-51.1
	- Region 7:Northern OFS	-28.0	-15.0	-22.0
	* yellow maize	-12.1	40.4	-37.6
	* white maize	-38.5	-29.5	-37.6
	- Region 8:Central OFS	-66.6	-66.3	-66.5
	* yellow maize	-60.7	-60.1	-60.4
	* white maize	-74.1	-74.1	-74.1
	- Region 9:Natal	-30.3	-43.2	-32.9
	* yellow maize	-9.5	-9.5	-9.5
	* white maize	-62.9	-96.3	-69.6
	- Region 10:Eastern Transvaal	0	0	0
	* yellow maize	3.0	3.1	3.1
	* white maize	-12.9	-12.8	-12.8
	- Region 11:Northern Transvaal	-31.9	-31.1	-31.6
	* yellow maize	-56.0	-54.8	-55.5
	* white maize	-18.1	-17.4	-17.9
	- Region 12:PWV-area	-0.7	0	-0.3
	* yellow maize	1.8	2.3	2.2
	* white maize	-6.4	-5.5	-6.4
	- Region 13:Western Transvaal	-30.8	-15.7	-26.0
	* yellow maize	11.7	-31.8	22.8
	* white maize	-50.4	-37.7	-48.6
	- **Total:**	-21.5	-13.1	-18.4
	*** yellow maize**	-0.1	7.3	4.9
	*** white maize**	-41.5	-32.1	-40.2
Imports / Exports	Imports:	-	-	-
	- Yellow maize	-	-	-
	- White maize	-	-	-
	Exports:	-100.0	-100.0	-100.0
	- Yellow maize	-100.0	-100.0	-100.0
	- White maize	-100.0	-100.0	-100.0
Prices of maize (consumer price plus average transport costs for yellow maize)	Yellow maize:			
	- Region 1: Swartland	-7.5	-14.1	-12.7
	- Region 2: Ruêns	-6.7	-14.3	-12.6
	- Region 3: West. Cape (rest)	-7.7	-14.2	-12.2
	- Region 4: Northern Cape	-8.4	-16.2	-14.9
	- Region 5: Eastern Cape	- 7.7	-15.9	-14.5
	- Region 6: Eastern OFS	-8.3	-15.3	-13.6
	- Region 7: Northern OFS	-7.9	-15.9	-13.6
	- Region 8: Central OFS	-8.9	-16.0	-14.0
	- Region 9: Natal	-7.6	-15.3	-13.5
	- Region 10: Eastern Transvaal	-7.6	-15.5	-13.7
	- Region 11: Northern Tvl.	-6.5	-15.8	-14.6
	- Region 12: PWV-area	-8.2	-17.1	-15.5
	- Region 13: Western Transvaal	-8.0	-15.9	-14.6
	White maize: national	34.6	-22.2	7.2
Welfare data	Producers:	81.4	-55.2	48.5
	Consumers: Yellow	10.7	29.9	28.8
	White	-7.5	8.8	-3.9
	Total	8.8	12.9	15.9

The large increase in producer welfare, as well as the moderate increase in consumer welfare resulting from yellow maize consumption, more than compensates for the decrease in consumer welfare resulting from white maize consumption. The final result is that total welfare increases by nearly 9 percent.

The decrease in white maize consumption and cessation of exports culminate in a decrease of more than 40 percent in the area under white maize. On the other hand, the cessation of yellow maize exports is compensated for by the increase in consumption resulting from lower yellow maize prices, so that the total area under yellow maize stays roughly the same. However, because of the above trends, there are relatively large shifts in production within and between regions. In general, less white maize is planted in all regions. Some of these areas previously under white maize have subsequently switched to yellow maize production, especially in regions 10, 12 and 13.

Maximising consumer surplus

Maximising consumer surplus, results in consumers being favoured over producers - consumer prices of both white and yellow maize subsequently dropped considerably. Yellow maize prices decreased between 14 and 17 percent, while the price of white maize decreased by more than 20 percent.

These decreases in prices have positive effects on consumer welfare - consumer welfare resulting from yellow maize consumption increased by nearly 30 percent, while consumer welfare resulting from white maize consumption increased by nearly 10 percent. Producer welfare decreased drastically because of the lower prices - producer welfare is more than 50 percent lower. As the increases in consumer welfare outweigh the decrease in producer welfare, total welfare increases by 12.9 percent.

The relatively sharp price decreases cause a huge increase in the demand for yellow maize, and a relatively small increase in the consumption of white maize. The increase in yellow maize consumption is more than the decrease in production due to the stopping of exports, while the opposite situation applies to white maize. An increase in the area under yellow maize of 7.3 percent, and a decrease in the area under white maize of 32.1 percent, is the net result. This, however, impacts differently on the different regions, depending on their location, costs of production and the production risk.

Maximising total surplus

Maximising total surplus combines both the above two approaches in that it takes both producers and consumers into consideration. The key in the maximisation of total welfare is that yellow maize prices decrease considerably (more than 12 percent), while the price of white maize increases moderately (7.2 percent). This behaviour is again explained by the differences in price elasticity of demand for the two commodities: yellow maize is relatively price elastic, while white maize is relatively price inelastic.

The above price effects cause consumer welfare resulting from yellow maize consumption to increase drastically by nearly 30 percent, while the consumer welfare resulting from white maize consumption decreases only moderately by less than 4 percent. The higher white maize price (with a small decrease in consumption) and yellow maize consumption (with a small decrease in price) cause producer welfare to increase with nearly 50 percent. The final result is that total welfare increases by more than 15 percent.

The price regimes for yellow and white maize, as well as the unprofitability (and subsequent cessation) of maize exports, drive the production trends observed in Table 4. Lower prices of yellow maize cause relatively large increases in the consumption thereof which overshadows the loss in export quantities. The trend is, however, the other way round for white maize. The price increase for white maize causes a small decrease in consumption which, combined with the loss of export quantities, cause a relatively large decrease in the area under white maize production. The reduction in the area under white maize of roughly 40 percent, and the increase in area under yellow maize production of nearly 5 percent, have a net effect of a decrease in the total area under maize of just below 20 percent. As in the previous cases, this impacts differently on the production of maize in each region and within regions.

4.2.2 Changes in the marketing system (Scenario B)

The situation in the previous section refers to the single channel fixed price scheme as it was operated by the Maize Board (with no maize imports). One of the most important issues here is that producer (and consumer) prices of maize are fixed at the same level for the country as a whole with no (or very little) price variation (consumer prices do vary in the model, but only due to transport cost differences while the actual prices essentially stay the same). In this section the single channel fixed price system is replaced by a freer market system which allows for differentiated maize prices across regions. However, maize imports are still not freely allowed. Table 5 provides the results.

The general trends in Table 5 are similar to those in Table 4. The difference, however, lies in that the variation within and between specific regions is much more accentuated when the effective cross-subsidisation resulting from pan-territorial pricing is removed. The differences in results thus stem from accounting fully for the comparative advantages of regions with respect to yields, costs, risk and location (transport costs) relative to the consumption points. Results differ substantially from the base scenario, but only moderately from the results presented in Table 4, except for the interregional effects.

Maximising total surplus

Similar to scenario A, yellow maize prices decrease considerably (between 5 and 18 percent), while the price of white maize increases moderately (5.4 percent). This behaviour is again due to the differences in price elasticity of demand for the two commodities. These price effects cause consumer welfare, resulting from yellow maize consumption, to increase drastically by more than 35 percent, while the consumer welfare, resulting from white maize consumption, decreases only marginally (-0.9 percent). Also similar to the situation in the previous section, producer welfare increases, moderately by 20.6 percent. The final result is that total welfare increases by more than 18 percent, largely due

Table 5: Effects of a freer marketing system for maize with differential pricing between regions on key variables (no imports allowed)

Measure	Item	Change in base values (%) resulting from maximising:		
		Producer surplus	Consumer surplus	Total surplus
Production data	Area under maize:			
	- Region 1:Swartland	-	-	-
	* yellow maize	-	-	-
	* white maize	-	-	-
	- Region 2:Ruêns	0	0	0
	* yellow maize	-	-	-
	* white maize	0	0	0
	- Region 3:W. Cape (rest)	-	-	-
	* yellow maize	-	-	-
	* white maize	-	-	-
	- Region 4:Nothern Cape	-20.3	-15.8	-16.1
	* yellow maize	10.4	13.4	13.2
	* white maize	-37.8	-32.5	-32.8
	- Region 5:Eastern Cape	56.5	57.2	56.6
	* yellow maize	11.3	11.6	11.6
	* white maize	71.6	72.4	71.8
	- Region 6:Eastern OFS	-14.7	0.2	-11.3
	* yellow maize	-3.1	0.1	-0.2
	* white maize	-65.4	0.6	-59.8
	- Region 7:Northern OFS	-27.6	-15.0	-22.5
	* yellow maize	13.6	40.4	37.1
	* white maize	-38.4	-29.5	-38.1
	- Region 8:Central OFS	-66.4	-66.3	-66.4
	* yellow maize	-60.2	-60.1	-60.3
	* white maize	-74.1	-74.1	-74.1
	- Region 9:Natal	-31.5	-30.2	-30.2
	* yellow maize	-11.5	-9.5	-9.5
	* white maize	-62.8	-62.8	-63.7
	- Region 10:Eastern Transvaal	2.4	3.8	3.7
	* yellow maize	5.8	7.7	7.7
	* white maize	-12.1	-12.8	-12.8
	- Region 11:Northern Transvaal	-32.3	-31.1	-31.9
	* yellow maize	-55.6	-54.8	-55.0
	* white maize	-19.0	-17.4	-18.7
	- Region 12:PWV-area	0	0	- 0.1
	* yellow maize	2.5	2.3	2.3
	* white maize	-5.9	-5.5	-5.8
	- Region 13:Western Transvaal	-29.7	-15.7	-22.4
	* yellow maize	14.4	31.8	27.1
	* white maize	-50.1	-37.7	-45.3
	- Total:	-20.8	-11.8	-16.7
	*** yellow maize**	1.5	8.6	7.2
	*** white maize**	-41.6	-30.9	-39.1
Imports/ Exports	Imports:	-	-	-
	- Yellow maize	-	-	-
	- White maize	-	-	-
	Exports:	-100.0	-100.0	100.0
	- Yellow maize	-100.0	-100.0	100.0
	- White maize	-100.0	-100.0	100.0
Prices of maize (consumer price plus average transport costs for yellow maize)	Yellow maize:			
	- Region 1: Swartland	-6.5	-9.9	-8.7
	- Region 2: Ruêns	-5.7	-12.0	-8.8
	- Region 3: W. Cape (rest)	-7.3	-11.3	-9.3
	- Region 4: Northern Cape	-10.2	-12.5	-12.3
	- Region 5: Eastern Cape	-5.7	-11.8	-9.1
	- Region 6: Eastern OFS	-12.8	-18.1	-15.3
	- Region 7: Northern OFS	-12.8	-18.5	-15.6
	- Region 8: Central OFS	-13.5	-18.6	-16.5
	- Region 9: Natal	-4.2	-11.3	-8.6
	- Region 10: Eastern Transvaal	-10.5	-20.5	-16.3
	- Region 11: Northern Transvaal	-3.3	-7.5	-5.8
	- Region 12: PWV-area	-13.2	-14.5	-13.9
	- Region 13: Western Transvaal	-11.1	-20.2	-18.0
	White maize: national	33.6	-22.2	5.4
Welfare data	Producers	60.4	-61.3	-2.8
	Consumers: Yellow	12.9	38.0	35.7
	White	-2.3	9.0	5.0
	Total	10.3	16.2	18.5

to the increase in consumer welfare associated with yellow maize consumption.

The price regimes for yellow and white maize now differ much more than in the previous scenario. This is the key to understanding the process, and in predicting changes in production, etc.

4.3 Changes in import control and a freer marketing system (Scenario C)

Scenario C allows for the free importation of yellow maize under a tariff regime rather than the use of quantitative import restrictions. As several authors have already indicated, it will be difficult for single channel fixed price schemes to exist and continue under tariffication of imports of the commodity in question. Scenario C builds on Scenario B. The free importation (with import tariffs) of yellow maize thus goes with a freer market for all maize as described in Section 4.2. In order to illustrate the effect of yellow maize imports, a zero (0 percent) tariff level was assumed. Free importation of yellow maize within a freer market situation was thus allowed. Table 6 provides the results.

The results in Table 6 again follow the general trends displayed in Tables 4 and 5. The difference here stems from the fact that yellow maize is supplied to Regions 1 and 2, and in the case of maximisation of producer surplus also to Region 3, from imports rather than from domestic consumption. This causes changes in regional prices and a decrease in the domestic production of yellow maize, which again causes some shifts in the regional production patterns of both white and yellow maize.

Maximising producer surplus

The important feature here is that the demand for yellow maize in Regions 1, 2 and 3 is satisfied by importing maize. This implies that the price of yellow maize in these regions is equal to the landed costs of yellow maize plus the transport and handling costs. The import of yellow maize decreases the domestic supply, and thus has dramatic effects on the area under yellow maize. While the total area under white maize decreases by relatively the same amount as under Scenario B (42.2 percent), the decrease for yellow maize relative to Scenario B is large, namely just under 20 percent (as opposed to an increase in area under yellow maize under Scenario B, of 1.5 percent).

The lower demand for domestic yellow maize does not only result in a smaller area under yellow maize, but also in lower prices, especially in those regions that previously supplied Regions 1-3 with yellow maize. All the regions are, however, affected by these changes. Although the area under white maize and relative prices for white maize do not differ much from that in Scenario B, there are some shifts where yellow maize is substituted for white maize in the areas where it has a comparative advantage.

Although the producer surplus still increases, the increase (just more than 40 percent) is not as dramatic as in Scenario B due to the smaller area under yellow maize (and maize in total) and the lower price of yellow maize. Consumer welfare, resulting from the consumption of yellow maize, increases due to the lower maize prices and the larger consumption relative to Scenario B, while that for white maize stays relatively constant. Gains in yellow maize consumer welfare outweigh losses in white maize consumer welfare, so that there is an overall gain in total welfare of more than 11 percent.

Maximising consumer welfare

Results closely follow the trends described above. The demand for yellow maize in Regions 1, 2 and 3 is satisfied from imports, which create a situation similar to that described above. In the case of Natal, (Region 9) yellow maize produced in the Eastern Transvaal could be competitive against imports.

Maximising total welfare

Results again follow the trends already described above. It is important to note that as this Scenario is the one best describing a free marketing system with no statutory controls, it can also be used as a benchmark for calculating the social costs in terms of the opportunity costs to the economy as a whole, as well as to each particular group.

4.4 Summary : Social costs of different policies

As indicated earlier, the model provides welfare values for consumers and producers on a regional basis which allows for the determination of winners and losers given specific policy changes on a regional basis. As this involves a lot of detail which was not the objective, only the welfare positions and social costs borne by consumers and producers as groups are analysed. However, there are also winners and losers within groups, especially as regional impacts differ, as illustrated in the tables.

The data provided in Tables 4 - 6 provide the basis for the calculation of the welfare values and social costs calculations associated with the different policies which are given in Tables 7 and 8, respectively.

Table 7 provides the welfare values for producers (as a group), consumers of maize (broken down in white maize and yellow maize consumers) and total welfare, resulting from maize production and consumption, for each of the policy scenarios described. Table 8 expresses these as social costs by using the free market scenario (maximisation of total welfare with a free market system and free imports of maize as depicted by Scenario C) as basis. Again the emphasis must be on the change and the magnitude of the change, rather than on the absolute values.

Table 7 shows that the highest total welfare is obtained when maximising total welfare under Scenario C, that is a free market for maize with no restrictions on importation. In Table 8, this scenario refers to no social costs, and no welfare transfers from one group to another. All other policies are associated with winners and losers: winners are indicated by positive amounts and losers by negative amounts. The interpretation of these numbers are as follows: if the amount is positive, it implies a net gain to that group. However, if the amount is negative, it implies a loss to that group. The last row, total welfare, represents the social costs associated with each policy. As indicated above, only

Table 6: Effects of imports of yellow maize on the key variables assuming a zero tariff rate and a freer market for maize with differential pricing

Measure	Item	Change in base values (%) resulting from maximising: Producer surplus	Consumer surplus	Total surplus
Production data	Area under maize:			
	- Region 1:Swartland	-	-	-
	* yellow maize	-	-	-
	* white maize	-	-	-
	- Region 2:Ruêns	0	0	0
	* yellow maize	-	-	-
	* white maize	0	0	0
	- Region 3:W. Cape(rest)	-	-	-
	* yellow maize	-	-	-
	* white maize	-	-	-
	- Region 4:Northern Cape	-17.9	-15.8	-16.4
	* yellow maize	8.4	13.4	12.3
	* white maize	-32.9	-32.5	-32.8
	- Region 5:Eastern Cape	56.3	57.2	56.6
	* yellow maize	11.3	11.6	11.3
	* white maize	71.3	72.4	71.8
	- Region 6:Eastern OFS	-32.2	-15.9	-23.4
	* yellow maize	-32.7	-26.4	-27.4
	* white maize	-29.9	30.0	-5.9
	- Region 7:Northern OFS	-37.0	-27.5	-33.3
	* yellow maize	-10.8	0.9	0.1
	* white maize	-43.9	-34.9	-42.0
	- Region 8:Central OFS	-66.6	-66.3	-66.5
	* yellow maize	-60.7	-60.1	-60.4
	* white maize	-74.1	-74.1	-74.1
	- Region 9:Natal	-30.3	-43.2	-32.9
	* yellow maize	-9.5	-9.5	-9.5
	* white maize	-62.9	-96.3	-69.6
	- Region 10:Eastern Tvl.	-20.8	-19.1	-19.3
	* yellow maize	-22.7	-20.6	-20.8
	* white maize	-12.9	-12.8	-12.8
	- Region 11:Northern Tvl.	-31.9	-31.1	-31.6
	* yellow maize	-56.0	-54.8	-55.5
	* white maize	-18.1	-17.4	-17.9
	- Region 12:PWV-area	-0.7	0	-0.3
	* yellow maize	1.8	2.3	2.2
	* white maize	-6.4	-5.5	-6.4
	- Region 13:Western Tvl.	-38.9	-18.6	-30.0
	* yellow maize	-11.1	12.9	10.4
	* white maize	-51.7	-33.1	-48.6
	- **Total:**	-31.1	-21.3	-26.4
	* **yellow maize**	-19.2	-11.4	-12.3
	* **white maize**	-42.2	-30.6	-39.6
Imports / Exports	Imports:			
	- Yellow maize	595775[1)]	579263[1)]	579263[1)]
	- White maize		-	-
	Exports:	-100.0	-100.0	100.0
	- Yellow maize	-100.0	-100.0	100.0
	- White maize	-100.0	-100.0	100.0
Prices of maize (consumer price plus average transport costs for yellow maize)	Yellow maize:			
	- Region 1: Swartland	-18.8	-18.8	-18.8
	- Region 2: Ruêns	-14.3	-14.3	-14.3
	- Region 3: W. Cape (rest)	-10.4	-14.2	-12.2
	- Region 4: Northern Cape	-11.2	-16.2	-14.9
	- Region 5: Eastern Cape	-8.0	-15.9	-14.5
	- Region 6: Eastern OFS	-13.9	-20.8	-16.4
	- Region 7: Northern OFS	-13.1	-21.0	-18.7
	- Region 8: Central OFS	-14.0	-18.6	-16.5
	- Region 9: Natal	-7.6	-15.3	-13.5
	- Region 10: Eastern Tvl.	-12.9	-20.8	-16.3
	- Region 11: Northern Tvl.	-6.5	-15.8	-14.6
	- Region 12: PWV-area	-13.4	-17.1	-15.5
	- Region 13: Western Tvl.	-10.6	-20.2	-18.0
	White maize: national	33.6	-22.2	5.4
Welfare data	Producers	40.7	-67.1	4.3
	Consumers: Yellow	25.0	47.1	46.0
	White	-7.8	9.4	-0.9
	Total	11.7	20.1	21.3

1) Note: Represent imports of yellow maize in tons.

Table 7: Welfare values associated with each of the simulated policy scenarios (R million)

Welfare Item	Base solution (current policies)	Scenario A: Current policy environment - Maximise:			Scenario B: Freer market system with no imports			Scenario C: Freer market system with free importation		
		Producer welfare	Consumer welfare	Total welfare	Producer welfare	Consumer welfare	Total welfare-fare	Producer welfare	Consumer welfare	Total welfare
Producer welfare	427.1	774.8	191.3	634.2	685.1	165.5	515.2	601.1	140.7	445.6
Consumers:										
- Total	4407.4	4484.4	5268.6	4968.9	4646.4	5460.5	5209.9	4799.4	5666.6	5419.3
- Yellow	2243.2	2482.7	2914.5	2889.4	2532.6	3095.1	3065.2	2804.5	3299.4	3274.4
- White	2164.2	2001.7	2354.1	2079.5	2113.8	2365.4	2144.7	1994.9	2367.2	2144.9
Total welfare	4834.5	5259.2	5459.9	5603.1	5331.5	5626.0	5725.1	5400.5	5807.3	5864.9

Table 8 : Social costs and welfare transfers associated with each of the simulated policy scenarios (R million)

Welfare Item	Base solution (current policies)	Scenario A: Current policy environment - Maximise:			Scenario B: Freer market system with no imports			Scenario C: Freer market system with free importation		
		Producer welfare	Consumer welfare	Total welfare	Producer welfare	Consumer welfare	Total welfare	Producer welfare	Consumer welfare	Total welfare
Producer welfare	-18.5	329.2	-254.3	188.6	239.5	-280.1	69.6	155.5	-304.9	0
Consumers:										
- Total	-1011.9	-934.9	-150.7	-450.4	-772.9	41.2	-209.4	-619.9	247.3	0
- Yellow	-1031.2	-791.7	-359.9	-385.0	-741.8	-179.3	-209.2	-469.9	25.0	0
- White	19.3	-143.2	209.2	-65.4	-31.1	220.3	-0.2	-150.0	222.3	0
Total welfare	-1030.4	-605.7	-405.0	-261.8	-533.4	-238.9	-139.8	-464.4	-57.6	0

the totally free market option with free imports has no social costs attached.

Table 8 also clearly illustrates that social costs are higher under Scenario A than with Scenario B, which in turn has higher social costs than Scenario C. Differences between winners and losers also tend to diminish as one moves towards fewer controls or distortions (from Scenario A to Scenario B to Scenario C).

5. Conclusions

Maize is the most important raw material in the stockfeed industry, supplying close to 70% of protein raw materials. As this was supplied through a single channel maize marketing system of the Maize Board, regional demand and supply were not reflected in regional prices. This created distortions that had a heavy impact on the livestock industry, via the stockfeed market and on other agricultural industries

A sectoral linear programming model was developed to simulate the impact of different maize policies, especially on the yellow maize consumers i.e. the livestock industry. It was found that the livestock industry (via the stockfeed market), were the major losers of the single channel marketing system (base scenario). The livestock industry (yellow maize consumers) also lose heavily under Scenario A and B, although the situation tends to become better as the market becomes freer. The livestock industry, as yellow maize consumers, are only in a relatively good position when yellow maize can be imported and regional prices reflect supply and demand.

Lastly, Scenario A and to a lesser extent Scenario B clearly favours producers over consumers. Previous marketing controls were thus effecting transfers from consumers to producers. This can be seen by comparing the similar columns of each scenario.

The results of the application of the model on the different policy scenarios, indicate clearly that the single channel maize marketing system "taxed" the yellow maize users, i.e. livestock industry to the benefit of maize producers and white maize users. The social cost of this policy was quite big - more than one billion rands. Of this amount, producers contributed R18.5 million, yellow maize consumers contribute over a billion rands and white maize consumers gained R19.3 million. Maize producers and specifically yellow maize consumers (the livestock industry) were the losers, while white maize consumers were winners.

The negative impact on regions of the single channel marketing system, is also clearly illustrated. The social cost of this policy on the livestock industry in a regional perspective, is also severe.

The results of the three policy scenarios indicate that a movement to a freer maize marketing system, with regional prices and allowing imports - is the policy where social costs will be minimised. Maize producers and consumers, especially the livestock industry, will be better off - even if this mean the scaling down of maize planted, to stop the export of maize (done at a big social cost). Even a freer marketing system, without allowing imports, will reduce the total social cost substantially of the current system and benefit the livestock industry.

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