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Analysing chicken meat production comparative advantage of South Africa

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The study examined the relative efficiency of producing chicken meat in South Africa, in 2017, and its comparative advantage in chicken meat production in Southern African Development Community (SADC). The study used the Policy Analysis Matrix (PAM) to calculate the net financial and economic profitability, Nominal Protection Coefficient of output (NPCO), Nominal Protection Coefficient of input (NPCI), Effective Protection Co-efficient (EPC), Private Cost Ratio (PCR) and Domestic Resource Cost (DRC). Data used in this study was taken from the statistics collected by the Department of Agriculture, Forestry and Fisheries (DAFF) and South African Poultry Association (SAPA). The findings, based on the indicators of NPCI, EPC and PCR conclude that the existing government policy environment tends to protect the interest of the chicken meat producers at the production level. The DRC results indicated that South Africa had comparative advantage of producing chicken meat in 2017.

Key words: Domestic resource cost, policy analysis matrix, private cost ratio.

INTRODUCTION

The South African gross value of agricultural products was projected to be over R 246 billion in 2016. A bigger share came from the animal products sector. The sector contributed 46.9% (R 117 billion), 30% was from horticultural products and 23.1% was contributed by field crops ((Department of Agriculture Fisheries and Forestry) (DAFF), 2017).

The South African broiler industry contributed R37 billion, which formed 16.5% of the overall agricultural production output in the financial year 2014/15 (Joubert, 2017). About 108,000 indirect and direct jobs in South Africa are provided by the chicken meat production industry and related value chain industries (DAFF, 2016).

The chicken meat value chain integrates into other value chain industries, for example, maize production since maize is used as feed to chicken (Joubert, 2017).

Chicken meat end products are categorised into five categories, namely live, fresh, frozen, offal and Individually Quick Frozen (IQF) chicken meat. Blood and feathers are the only non-edible parts of the chicken products (Lubinga et al., 2018). The non-edible parts are taken to rendering plants for further processing. The industry is highly competitive with a few commercial chicken meat producers and a large number of small scale chicken meat producers (Lubinga et al., 2018).

Poultry meat is believed to be a cheap source of

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protein as opposed to livestock products. Other people are also of the view that poultry meat is a healthy substitute of protein as compared to red meat. In 2016, over 935 million chickens were slaughtered in South Africa. The number of chickens slaughtered is 3.1% less than those slaughtered in 2015 (DAFF, 2017).

The production of white meat has increased in South Africa in previous years. Per capita consumption has increased too. In 2001, only 869,000 tons of white meat was produced. The quantity has since increased in 2016 to 1,704,000 tons. During the same period, total consumption has also increased to 2,200,000 tons from 938,000 tons. Per capita consumption also shows a positive growth to 40.04 kg in 2017 from 21.48 kg in 2001. The per capita consumption growth of white meat is more than what was recorded for red meat in the same period. Per capita consumption for red meat increased from a total of 18.96 kg in 2001 to only 27.74 kg in 2017 (DAFF, 2017).

Louw et al. (2011) identified the quality, consistency and cost of feed as the main contributing input, a major challenge to South African chicken meat producers. However, the price of soybean is the main factor underlying the general costs of feed. This influences the competitiveness of South African chicken meat producers. In terms of ratio, soybean cake is roughly around 18% of the total weight of the chicken feed ration. Both the US and Brazil are net exporters of soybean cake while South Africa is a net importer (DAFF, 2017).

The South African local crushing industry has started to increase the production volume of soybean cake locally. This suggests that whereas the price of soybean cake trades at export parity levels in Brazil and the US, the South African price of soybean cake trades at import parity levels (Schmidhuber, 2008).

The South African chicken meat industry is an important subsector within South African agriculture. It is the single largest contributor to total gross agricultural production. The industry provides an affordable source of protein, thus making it an important contributor to the country's food security. As a strategic sector of the economy, the flow of chicken imports into South Africa recently has threatened the sustainability of the sector and its ability to compete on the international markets (Bureau for Food and Agricultural Policy (BFAP), 2016).

Chicken imports into South Africa have increased by an annual average of more than 10% since 2001 (Joubert, 2017), which has been one of the critical factors underpinning questions related to competitiveness. An increase in imports would suggest that there is a need for expansion of local production if producers were able to compete more successfully with imported products (Joubert, 2017).

In 2016, it is estimated that broiler, hatchery and rearing industries employed 14,250 people, the processing sector employed a total of 27,122 people, and the broiler distribution industries employed 5,975 people.

The grand total of employment within the broiler industry is 47,347 employees. These jobs are threatened by an influx of chicken meat imports which are cheaper than the locally produced chicken meat (SAPA, 2017).

The industry's application by the South African Poultry Association (SAPA) for an increase in the import tariff protection was granted in 2013. According to Davids et al. (2013), the amount of imports that come into South Africa duty-free, restricts the impact of the tariffs on the local production prices. This raises a question regarding the comparative advantage of South African chicken meat production.

Van Rooyen et al. (1999) explained a comparative advantage as to how can a country benefit from production and trade through the most optimum and efficient use of the available resources. Competitive advantage shows how industries optimise opportunities in an environment to create and continue with a sustainable business, which results in a sustainable industry (Van Rooyen et al., 1999).

This study, therefore, attempted to suggest a possible solution to job losses in the poultry industry, in South Africa by doing a comparison on the competitive advantage of chicken meat production in South Africa against its SADC counterparts. Such information is missing in the SADC trade and the availability of this information would be of help for policy makers when it comes to designing a policy that can protect the interest of chicken farmers in South Africa. On the basis of this, the objectives of the current study are to:

i) Analyse the comparative advantage of chicken meat production in South Africa.
ii) Analyse the competitiveness of chicken production in South Africa.
iii) Assess the effect of government policies on chicken production in South Africa.

METHODOLOGY

Study area

The study was conducted in South Africa, which is the southernmost country in Africa. It is bounded to the south by 2,798 km of coastline of Southern Africa stretching along the South Atlantic and Indian Oceans to the north by the neighbouring countries of Namibia, Botswana and Zimbabwe and to the east and northeast by Mozambique and Swaziland. South Africa is the largest country in Southern Africa and the 25th-largest country in the world by land area and, with close to 56 million people (Wikipedia, 2019).

Data collection

The study used secondary data which was obtained from the South African Poultry Association, Department of Agriculture, Fisheries and Forestry (DAFF) and also from own calculations where necessary. The data collected included input requirements, market

Table 1. PAM framework.

| Parameter | Revenues | Production costs | | Profits |
		Tradable inputs	Domestic factors	
Private price	A	B	C	D
Social price	E	F	G	H
Divergence	I	J	K	L

Source: Monke and Pearson (1989).

prices for inputs and outputs, transportation cost, returns and subsidy from chicken meat production in South Africa for the year 2017.

Data analysis

Different approaches have led to the measurement of comparative advantage in agriculture being developed. In the past, attempts to measure comparative advantage in agricultural production directly using economic models were practised by many researchers. They used to capture the interaction of national resources, production technology, product demand, and government interventions in measuring the comparative advantage. Some of the developed models were built to answer specific questions about agricultural production. Those models required a large investment in data collection and analysis. As a result, those models were appropriate primarily for academic research or high-stakes investment decisions and policy choices (Masters and Winter-Nelson, 1995).

The Policy Analysis Matrix (PAM), developed by Monke and Pearson (1989) is one of the approaches developed in a systematic way. It includes all data needed to calculate the Producer's Subsidy Equivalent (PSE), Net Social Profits (NSP), Domestic Resource Costs (DRC), and the Social Cost Benefits (SCB) (Monke and Pearson, 1989).

The Policy Analysis Matrix (PAM)

The PAM approach is based on the estimation of budgets using market prices and social opportunity costs. Benefits, costs and profits are determined in a systematic way: firstly, using budgets derived through market prices, and secondly, using social opportunity costs. Inputs are sub-divided into tradable and domestic. Table 1 presents the PAM approach. Matrix entries A, B, and C are the sum of products of market prices and quantities. Entries E, F, and G use the same quantities but are valued at social opportunity costs or shadow prices. The bottom row is the difference between the other two rows. The last column is the benefits minus costs. Thus, the PAM is a double-entry accounting system of identities, with no behavioural equations. The behavioural content of the PAM has embodied in the shadow prices used and in the interpretation of the matrix (Monke and Pearson, 1989).

The Policy Analysis Matrix (PAM) is computational framework, delivered by Monke and Person (1989) and augmented by Masters and Winter-Nelson (1995) for measuring input use efficiency, comparative advantage among commodities and the degree of government interventions (Joubert, 2017).

The study used Policy Analysis Matrix (PAM) to analyse the competitiveness and comparative advantage and the effect of government policies on chicken production in South Africa. The PAM is a Matrix of two accounting identities; one set defining profitability and the other defining the difference between private and social values of a commodity system. The framework of the PAM is shown in Table 1.

The approach used in Policy Analysis Matrix begins with the calculation of existing levels of private (actual market) and social (efficiency) revenues, costs, and profits. This calculation reveals the extent to which actual profits are generated by policy transfers rather than by underlying economic efficiency. A PAM contains two cost columns, one for tradable inputs and the other for domestic factors. Production costs included feeds and medicine as tradable inputs while domestic factors included labour (Monke and Pearson, 1989).

The following ratios were calculated from the Policy Analysis Matrix:

Private Cost Ratio (PCR)

The Private Cost Ratio (PCR) is used in measuring competitiveness. It shows the private efficiency of the producers and is an indication of how much one can afford to pay domestic factors (including a normal return to capital) and still remain competitive. The PCR will be used to achieve the second objective (Monke and Pearson, 1989).

PCR= (Private domestic factors)/ (Private revenues-Private tradable inputs) = C/(A-B).

When PCR>1, it indicates that the resource cost is greater than the value added and thus, it is not profitable to process the commodity. If PCR<1, it indicates that the value added is greater than the resource cost thus, it is profitable. If PCR=1, it indicates the breakeven point.

Social profitability

The social profitability is a measure of comparative advantage and efficiency because inputs and outputs are valued in prices that reflect scarcity values. It is the difference between revenue and costs of domestic factors and tradable inputs prices at social opportunity cost (social values). Social values provide a benchmark policy environment for comparison as these were considered those that would hypothetically occur in free market without policy intervention (Monke and Pearson, 1989). The social profitability will be used to achieve the first objective.

Social profit (H) = Social revenues – Social tradable inputs – Social domestic factors = E-F-G

When (H>0), it indicates that the system uses scarce resources efficiently and the commodity has a static comparative advantage. If (H<0), it indicates that the sector cannot sustain its current output without assistance from the government, with a resulting waste.

Domestic Resource Cost (DRC)

The Domestic Resource Cost (DRC) is a measure of relative

efficiency of domestic processing by comparing the opportunity cost of domestic processing to the value generated by the product. The ratio can be used to compare different economic activities in terms of social cost of domestic resource employed in earning or saving a unit of foreign exchange. The DRC will complement the study in achieving the first objective. The relationship between DRC and comparative advantage is straight forward and expressed as:

DRC= (Social domestic factors)/ (Social revenues-Social tradable costs) = G/ (E-F)

If DRC<1, the chicken meat production in South Africa enjoys a comparative advantage as compared to its SADC counterparts. If DRC>1, it signifies that the country has a disadvantage in the production of chicken meat as compared to its SADC counterparts. When DRC = 1, the economy neither gains, nor saves foreign exchange through domestic processing (Monke and Pearson, 1989).

Divergence/Policy transfer

The measurement of divergence and transfer effect of policies is carried out in the third (bottom) row of the Policy Analysis Matrix. The divergence between the observed private (actual market) price and the estimated social (efficiency) price must be explained by the effects of policy or by the existence of market failures. Distorting policies that lead to inefficient use of resources enhances the stated divergence (Monke and Pearson, 1989).

SRP= (Divegence profits)/ (Social revenues) = L/E

Effective Protection Coefficient (EPC)

The EPC measures the value-added in market prices, about the value-added in economic prices, that is, it measures the degree of policy transfer from product market-output and tradable-input policies.

EPC = (Market Income – Tradable Market Expenditure)/ (Economic Income – Tradable Economic Expenditure)

If the EPC is higher than one (>1), it indicates that the market profit is higher than it would have been if no commodity policies had been in place. Thus, it indicates that policies are in place that increase profits artificially (Monke and Pearson, 1989). The EPC will be used for the third objective.

Nominal Protection Coefficient for outputs (NPCo)

An NPCo greater than one (>1) shows that policies have increased the market price to levels higher than the economic price. Thus, if the domestic price is constantly higher than the economic or shadow price (international price), it indicates that policies on the domestic market because prices being paid by domestic consumers to be higher than they would have paid in the absence of such policies. Hence, a NPCo greater than one (>1) indicates that consumers are indirectly taxed (Monke and Pearson, 1989).

Nominal Protection Coefficient for inputs (NPCi)

The NPC on tradable inputs (NPCi), defined as Market Tradable Inputs/Economic Tradable Inputs, shows the degree of tradable-input transfer. A NPC on inputs of greater than 1 (>1) shows that policies are increasing input costs more than the world prices

(Monke and Pearson, 1989).

The Policy Analysis Matrix was used to calculate income (revenue), profits and cost items at the farm level to produce 1 tonne of chicken meat in South Africa in 2017. In the undistorted market, the efficient values of inputs and output are meant to lead to the highest possible levels of national income. Social profits are derived from the difference between social or economic revenues and costs. This measures economic efficiency. New investments and technologies reduced the social costs, increased social profits and therefore improved the effectiveness of production (Monke and Pearson, 1989).

It is important to understand the grouping of economic/social profitability's of agricultural systems to correctly measure the economic efficiency (Monke and Pearson, 1989).

Market/private income was calculated as an average income per tonne per year. This represents the average income for the year 2017. The income was derived from several enterprise budgets compiled in South Africa. Values of the second row are computed by adjusting the individual components of the first row, using economic prices. As proxy for the economic prices, world market prices adjusted to their import and export parity price are used. Opportunity costs are used to estimate the domestic factors of production.

Social values are calculated, in the case of exported goods in F.O.B. (Free On Board) prices and import goods in C.I.F (Cost, Insurance, Freight) prices. This is necessary in order to validate that the social prices are out of policy interventions and in the assumption of competitive markets for inputs and outputs.

In the second row, outputs (E) are valued at C.I.F. prices, inputs (F) are valued according to F.O.B. prices and international prices are used since the products are traded at world prices.

RESULTS AND DISCUSSION

The results are presented in Tables 2 and 3.

Market/Private profitability

In 2017, the South African chicken meat production shows a market/private profit of R19921.05 per tonne. Private profitability was calculated as follow: R 34830- R 12392.32 - R 2516.63 = R 19921.05 in 2017. The industry shows profitability.

Private Cost Ratio (PCR)

The South African chicken meat production industry in 2017 shows a PCR with the figure of 0.11. The value is smaller than one (>1), which indicates that the industry adds value, therefore, has a competitive advantage.

Economic/social profitability

The South African chicken meat production industry's economic profit for 2017 is R 678.48 per tonne. This indicates high margins, which occurs as a result of the output prices of final products keeping up with the cost to produce the final product.

Table 2. Policy Analysis Matrix (PAM) results.

Parameter	Revenue (R)	Cost (R)		Profit (R)
		Tradable inputs (R)	Non-tradable inputs (R)	
Market/private prices	34830	12392.32	2516.63	19921.05
Economic prices	23675.92	20982.44	2015	678.48
Effect of divergences and efficient policy	11154.08	- 8590.12	501.63	19242.57

Source: Own calculation (2017).

Table 3. Ratio indicators for comparison.

Private Cost Ratio (PCR = $\frac{C}{A-B}$)	0.11
Social profit (E – F – G)	678.48
Domestic Resource Cost Ratio (DRC = $\frac{G}{E-F}$)	0.75
Nominal Protection Coefficient on Tradable Outputs (NPCO= $\frac{A}{E}$)	1.47
Nominal Protection Coefficient on Tradable Inputs (NPCI= $\frac{B}{F}$)	0.59
Effective Protection Coefficient (EPC= $\frac{(A-B)}{(E-F)}$	8.33
Profitability Coefficient (PC= $\frac{D}{H}$)	29.36

Source: Own calculation (2017).

Domestic Resource Cost ratio (DRC)

The DRC for the South African broiler industry is 0.75, which is less than 1, and indicates that South Africa has got a comparative advantage as compared to other SADC countries. Tsakok (1990) argues that the level of comparative advantage is greater if the DRC ratio is close to zero.

Policy transfer

Nominal Protection Coefficient for outputs (NPCo)

The NPC of output is 1.47, which is greater than 1 (>1), and indicates that the private price of chicken meat in South Africa is greater than the SADC price and that policies have caused domestic output price of the poultry industry in South Africa to be approximately 47% higher than the SADC price (Mahlanza et al., 2003).

Nominal Protection Coefficient for inputs (NPCi)

An NPC of inputs is 0.59, which is less than 1 (<1) and indicates that the inputs are subsidized.

Effective Protection Coefficient (EPC)

The EPC measure for the South African chicken meat production in 2017 is 8.33. When an EPC is greater than one (>1), it shows that profits are higher than they would be when there is no commodity policy in a country. It further means that the net impact of government policy influences the product markets using outputs prices on the price of inputs (Yao, 1997).

Profitability Coefficient (PC= D/H)

The results show a profitability coefficient of 29.36. When the profitability coefficient is greater than 1 (>1), it indicates that the current policy implications are an incentive to chicken meat production in South Africa in 2017.

Conclusion

By applying the Policy Analysis Matrix (PAM) approach to analyse the comparative advantage of the South African chicken meat production, the study showed that the chicken meat in 2017 had a comparative and competitive advantage. Moreover, it was found out that that government policy had positive impacts on the chicken meat producers. It even enhanced the competitiveness of the South African chicken meat in 2017. Since PAM analysis could not capture the potential changes in prices and productivity, the results of scenarios are subject to changes in market conditions. The three hypotheses

were completely rejected based on the reasons provided below. The study has recommended to government and chicken meat producers to increase the production of local chicken meat.

The hypothesis that South Africa does not have a comparative advantage in chicken meat production is rejected based on the explanation given below.

Indicators of protection and comparative advantage were used in the analysis. In analysing the relationship between world prices and domestic prices for output and inputs, the NPC was used to see the extent of protection in the sector. From the analysis, the NPC on output was found to be 1.47, indicating that domestic broiler meat prices are 47% higher than the SADC prices. On inputs used, the research indicated an NPCI of 0.59, implying that domestic prices are 41% higher than social prices. The comparative advantage of an agricultural system is indicated by the value of the Domestic Resources Cost Ratio (DRC). Based on the DRC of 0.75, the result indicates that chicken production in South Africa has a comparative advantage.

The hypothesis that South Africa's chicken meat production industry is not competitive is rejected based on the following explanation.

The determination of profit received by chicken meat producers in South Africa is a straightforward and important initial result of the PAM approach. The results indicate if the farmers are currently competitive. The competitiveness of the South African chicken meat production is measured by the private profitability (D) or Private Cost Ratio (PCR). The PCR of the South African chicken meat production in 2017 is 0.11. This result indicates that South African chicken meat production is profitable and thus competitive.

The hypothesis that Government's policy interventions do not affect chicken meat production in South Africa is rejected based on the explanation given below.

Regarding the total effects of government intervention in the output of chicken meat production in South Africa and tradable input markets, the study estimates the value of EPC= 8.33. The EPC is greater than 1, implying that the overall impact of the existing policy results in a net positive incentive to produce chicken meat in South Africa.

Recommendations

To the government

Increase chicken meat exports: The newly merged Department of Agriculture, Land Reform and Rural Development (DALRRD) should prioritize the support of chicken meat producers in South Africa since it is productive; to save the jobs this industry is currently offering and creating new jobs. The Department of Trade and Industry and Economic Development should facilitate talks with SADC counterparts to increase exports to the region taking advantage of the Free Trade Areas (FTA) policy that allows zero tariffs on intra exports.

The emergency of transboundary diseases: Broiler production is always under threat from diseases such as Newcastle disease and, more recently, Highly Pathogenic Avian Influenza (HPAI). Vaccines need to be made available to contain the threat. These measures depend on the strength of the veterinary service, which needs restoration.

Monopolistic behaviour in broiler production: The DALRRD should put in place policies to increase the number of participants in the broiler supply chain through expansion of broiler producer base, focusing on smallholder producers through provision of suitable financing, improved production and supply of day-old chicks, promotion of full utilization of production capacity at the newly resettled farms, training of new entrants into the industry, production of self-help production manuals and improvement of broiler extension services.

Currently, in South Africa there are few commercial companies that produce chicken meat in the value chain. This may result in the establishment of cartels that extract monopoly rents from society. Therefore, there is a serious need to promote the manufacture of appropriate technology or promote the existing technological efficiency for small to medium commercial broiler enterprises. Formal marketing systems in rural areas can help the industry to develop hygienic slaughter facilities, improve feeding systems and farmer training and the promotion of the use of green energy like solar in rural area. The DALRRD should speed up the development of Agri-Hubs to supply these functions.

To producers

Increase production: The chicken meat production in South Africa needs to be expanded to enhance the industry. The main target should be on smallholder farmers. They should get access to the following services: suitable financing, improved production and supply of day-old chicks, promotion of full utilization of production capacity at the newly resettled farms, training of new entrants into the industry, production of self-help production manuals and improvement of broiler extension services.

Policy implications

The results of the study indicated that the country has a comparative advantage in broiler production as indicated by the DRC. This implies that it is economical to produce locally and save foreign currency from importing broiler products. The NPCs for both output and inputs show that

prices of tradables are higher on the domestic markets than on the world market. Therefore, the distortions in the domestic economy are making production costs expensive. On the other hand, the domestic prices for outputs are higher than the world prices and therefore attract imports. Domestic consumers are therefore paying more than what they ought to be paying. There is therefore a need for policies that will protect the local production, like tariffs or subsidies.

Areas of further research

The PAM is a partial equilibrium model which does not capture the linkages between broiler and other products that are either compliments or substitutes to broiler meat such as beef, pork and non-meat foods like vegetables. The analysis is only applicable at sectoral and commodity levels and therefore does not provide a complete picture of the economy wide effects following policy changes. A study on the linkages between broiler and these will help determine policy options in the face of broiler meat supply to the SADC region.

Limitations

Historical data is used in PAM and therefore, does not take into consideration the recent changes. PAM is constructed for a given period of time to trace the evolution of policy effects.

When the Domestic Resource Coefficient (DRC) is calculated in the PAM, it does not take into account the costs of domestic factors and that can lead to understating the social profitability of activities that make intensive use of domestic resources.

Shadow prices are complex and difficult to calculate. It is very important that the researchers do the calculations correctly.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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