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Joubert, C.J. [1], Phahlane, N.H.[2], Jooste, A.[3], Dempers, C.[4] and Kotze, L. [5]

Contact address:
Mr C. Joubert
National Agricultural Marketing Council
Block A, 4th Floor, Mentjiesplein Building
536 Schoeman Street, Arcadia
Pretoria,0002
Tel: 012 341 1115
Fax: 012 341 1911
E-mail:christo@namc.co.za

[1] Senior Researcher, MERC Division, National Agricultural Marketing Council
[2] Economists, MERC Division, National Agricultural Marketing Council
[3] Senior Manager, MERC Division, National Agricultural Marketing Council and Affiliate Professor in the Department of Agricultural Economics at the University of the Free State, South Africa
[4] Senior Economists MERC Division, National Agricultural Marketing Council
The authors would like to acknowledge contributions made by Potato SA.
[5] Economists, MERC Division, National Agricultural Marketing Council

COMPARATIVE ADVANTAGE OF POTATO PRODUCTION IN SEVEN REGIONS OF SOUTH AFRICA

ABSTRACT

The focus of this research was to investigate the comparative advantage of the potato industry in seven potato production regions in South Africa. Potatoes are the most important vegetable crop produced in South Africa. In 2008 it contributed more than 40% to the total production of vegetables in South Africa and it accounted for more than 20% of the value of all fresh produce sold on all the major national fresh produce markets. This study uses the Resource Cost Ratio (RCR) methodology that provides an explicit indication of the efficiency with which production alternatives uses domestic resources to generate or save foreign exchange. The Nominal Protection Ratio (NPR) and Effective Protection Coefficient (EPC) were also calculated.

The results show that current policies that affects the input market for potato production in South Africa is constraining the potato industry. This was confirmed by the results obtained from the NPR and EPC analysis, and the size of the policy distortions was shown through the calculation of market and economic profitability. If current policies prevail potato production in the Eastern Free State will not have a comparative advantage, but in the absence of such policies all production regions have a comparative advantage.

1. Introduction

Comparative economic advantage (CEA) analysis evaluates the economic efficiency of alternative productive uses of scarce land, labour, capital and water resources. The option that generates the highest social gains from the use of domestic resources is considered the most efficient user of these resources (Masters, 1995; Hassan *et al*., 1999). In other words, CEA analysis allows one to capture the ability of one region to engage in production at a lower opportunity cost than another region, which is useful in determining what should be produced and what should be acquired through trade. Hassan and Faki (1993) argue that for any product to attract different resources, such as research, capital, etc, it must show a comparative advantage over alternative products that are available. Consequently, principles of CEA provide vitally important indicators to guide economic policy reforms to direct resources to their most productive use (Jooste and Van Zyl, 1999).

Various researchers assert that the key to an appreciation of comparative advantage lies in its explanation of gains from trade even if one nation can produce all commodities at lower cost than every other nation. The gains arise from increased supplies of all goods when each nation makes more efficient use of its abundant factors in the production of commodities for which the resources are best suited (Sodersten and Reed, 1980; Houck, 1986; Worley, 1996; Salvatore, 1998). There is however increasing acceptance that comparative advantage alone will not guarantee a country or firm's ability to compete in a specific market due to a myriad of complex and inter linked issues that affect modern value chains. Khemani (1997) argues that whereas comparative advantage does not lead to competitive advantage, it can be the basis on which to build competitive advantage. Worley (1996) emphasises that competitive advantage characterizes trade patterns resulting from comparative advantage coupled with policy effects, product quality differences and industry marketing skills.

From the aforementioned it is clear that by understanding the nature and drivers of comparative advantage decision makers can derive at least two vitally important issues, namely (i) policies or policy changes that can improve the comparative advantage of an industry and (ii) by addressing issues constraining the comparative advantage of an industry increase its ability to compete effectively in the market.

The focus of this research was to investigate the comparative advantage of the potato industry in seven potato production regions in South Africa. Potatoes are the most important vegetable crop produced in South Africa. In 2008 it contributed more than 40% to the total production of vegetables in South Africa and it accounted for more than 20% of the value of all fresh produce sold on all the major national fresh produce markets (DAFF, 2009). Exports of potatoes to Mozambique, Angola, Zambia and Zimbabwe have grown by 85% from 14 478 tons in 2001 to 26 822 tons in 2008 (World Trade Atlas, 2008). Exports to these countries represented 93% of the total exports of potatoes by South Africa in 2008.

2. Methodology and Data collection

According to Hassan and Faki (1993), measures of economic efficiency include the Net Social Profitability (NSP), Value Added (VAD), Domestic Resource Cost (DRC) and Resource Cost Ratios (RCR). The DRC methodology provides the analytical tool for an empirical evaluation of economic efficiency among alternative enterprises. Hassan *et al*., (1999) states that DRC indicates how much foreign exchange is saved by producing a good domestically instead of importing it. According to Bruno (1967) it can be used as an ex ante measure of comparative advantage to determine which among a set of alternative production activities is relatively efficient for a country or region in terms of contribution to national income. An alternative measure of economic efficiency that is easier to interpret is the RCR. Resource cost ratios provide an explicit indication of the efficiency with which production alternatives uses domestic resources to generate or save foreign exchange (Morris, 1990), thus serving as a relative indicator of the degree of efficiency.

According to Hassan and Faki (1993), the major difficulty that arises when using the DRC and RCR methods is the valuing of inputs and outputs, especially when choosing the appropriate opportunity cost of both non-tradable and tradable. This difficulty is mainly due to an absence of markets in the case of non-tradable and often the lack of correspondence of prices of tradables to their true economic value. Both methods therefore distinguish between social or economic and market (private) prices.

In this study, RCR measures of the CEA will be calculated to measure the degree of efficiency among the alternative potato production regions in South Africa. In addition, policy ratio measures, such as the Nominal Protection Ratio (NPR) and Effective Protection Coefficient (EPC) will also be calculated and interpreted. The RCR value is interpreted as follows:

- $0 < RCR < 1$: Value of domestic resources used in producing potatoes is less than the value of foreign exchange earned or saved; thus there is a comparative advantage.
- $RCR > 1$: Value of domestic resources used in producing potatoes exceeds the value of foreign exchange earned / saved, thus no comparative advantage.
- $RCR < 0$: More foreign exchange used in the production of the commodity than what the commodity is worth; thus there is a net loss of foreign exchange and no comparative advantage.

2.1 Agro-ecological delineation

Hassan and D'Silva (1993) provide the reasons for the importance of conducting CEA analysis within an agro-ecological framework. They concluded that agricultural production is primarily a biological process that is highly dependent on the prevailing biophysical conditions. Agricultural suitability reveals the similarity in natural resource endowments and production potential, and hence complimentarity or competitiveness in trade, between countries. In this research variations within agro-ecological zones (AEZ), due to variations in technology, climate, etc., was captured by coding different production systems as distinct activities. Variations in resource endowments will be reflected in the relative rental values of those resources in the different regions.

Potatoes are produced in 16 regions of South Africa and can be produced all year round. Data pertaining to commercial enterprise budgets for the seven largest regions were gathered on a regional basis by Potato South Africa. These regions represent 72% of the total potato production in South Africa (Potato SA, 2008). The contribution of each region is as follows: Limpopo (21%); Sandveld (15%); Western Free State (13); Eastern Free State(11%); Kwazulu Natal (8%); Mpumalanga (7%); and North West (4%).

Variations in market and infrastructural factors will be reflected in prices and transportation costs. These variations will be captured by defining a central market node for every zone at which all trade will be assumed to take place. Consequently, prices and transport costs between these market centres (nodes) will reflect the opportunity cost of producing a commodity locally versus importing it from another region/zone or from outside the country.

2.2 Calculation of shadow prices for tradable and non-tradable components

In order to conduct CEA analysis it is important to distinguish between the market value of an input and output and the social (or economic) value thereof (note the social or economic value is also commonly referred to as shadow prices). Due to market failure and government intervention, market prices often do not reflect the scarcity value of goods and services. It is therefore necessary to calculate the economic price (shadow price) of goods and services. Hence, market prices are those prices that prevail in a market where market failure and government intervention influences prices.

In addition, it is also necessary to distinguish between tradables and non-tradables inputs and outputs. According to Dasguptha (1972) tradable goods and services as those goods or services that are, or can be, traded on international markets without the interference of governments, monopolies or other restrictive behaviour. Hansen (1978) define non-tradable goods and services as those goods and services for which the production cost and international transport cost is too high to make exports profitable, but too low to justify imports.

Calculation of the economic prices of tradable and non-tradable inputs and outputs presents several challenges. For instances there is no market for some non-tradables or there may be a lack of information on prices that do exist for both tradable and non-tradables. In order to derive the shadow prices of tradables and non-tradables, different methods and techniques were used.

2.2.1 Shadow pricing of tradables: Fertilisers, pesticides and commodities

In this study the world price approach was used as the principle method to estimate the economic prices of tradables. In this regard the conversion method and the tariff protection method were used to calculate the economic price of tradables. Ward and Deren (1991) states that the conversion method entails that the world price of goods and services are determined and adjusted with the cost-insurance-and-freight component of imported goods and services.

This approach is denoted by the following equation:

$$CIFW_{ij} = (IntP_{ij} + TransC_{ij} + Ins_{ij}) \times ExhR_{ij}$$

Where;

$CIFW_{ij}$	=	Cost-insurance-freight-value of imports in domestic prices;
$IntP_{ij}$	=	International market price in US $;
$TransC_{ij}$	=	Transport cost;
Ins_{ij}	=	Insurance;
$ExhR_{ij}$	=	Exchange rate in Rand/US$;
i	=	product identification; and
j	=	year.

The tariff protection rate is an indication of the percentage deviation of domestic prices from international prices. The shadow price calculation, using the tariff protection method, is denoted by the following equation (Bradfield, 1987):

$$W_p = D_p/(1 + T_{pr})$$

Where:

W_p	=	World price;
D_p	=	Domestic price; and
T_{pr}	=	Tariff protection rate expressed as a percentage.

2.2.2 Shadow price of fuel

In order to calculate the shadow price of fuel one has to take into account the pump price of fuel and any levies and taxes that may have an influence on the price the consumer pay for the fuel. A similar methodology to that of Conningarth Consultants (1995) was used to calculate the shadow price of diesel. Table 1 shows the calculation of the conversion factor for diesel that was used to convert the market price of diesel to reflect its economic value in 2008.

Table 1: Calculation of the adjustment factor for diesel

Item	Unit	2008
Pump price	c/l	851.00
Minus: Taxes, customs		
Fuel taxes	c/l	-111.00
Customs and excise	c/l	-4.00
Other charges (pipe line levy, slate levy	c/l	-90.90

Shadow price	c/l	645.10
Factor adjustment		**0.76**

2.2.3 Shadow pricing of non-tradables

In any production process the use of non-tradable inputs is plentiful. In this study labour, land, water and electricity were regarded as non-tradable.

2.2.3.1 Labour

According to Bradfield (1987), there are three types of labour, namely skilled labour, semi-skilled labour and unskilled labour. The conventional approach is, however, to distinguish only between skilled and unskilled labour. Distortions in the labour market, which cause the price of labour to deviate from its marginal product, necessitate the calculation of shadow prices for labour. Harberger (1972) emphasized that when the economy is characterised by under-employment and unemployment, the shadow price for labour needs to be calculated in order to properly reflect the opportunity cost of labour.

2.2.3.1.1 Unskilled labour

Conningarth Consultants (1995) is of the opinion that the employment of unskilled labour will entail fewer or no opportunity costs. The classic position has been that unskilled labour should have a shadow wage of zero (Sassone and Schaffer, 1978) or close to zero (Dasgupta and Pearce, 1972). This is, however, unrealistic, since one will only work if there is some form of reward attached to the work, such as money, food, etc.

Conningarth Consultants (1995) state that the shadow wage of rural labour in slack seasons may be taken as roughly the equivalent of three kilograms of grain per day. Using this methodology, they calculated the shadow price adjustment factor for unskilled labourers in the agricultural sector to be 0.609. Hence, the shadow wage adjustment factor for unskilled labourers used in this study was taken as 0.609.

2.2.3.1.2 Skilled labour

For purposes of the study, skilled agricultural workers are classified as those workers who can drive tractors or operate machinery. It is also assumed that skilled labour is in full employment, whilst this is not the case for unskilled labour. This means that the market wage rate for skilled labours closely approximates the social opportunity cost. The shadow wage adjustment factor for skilled labour used in this study was therefore zero.

2.2.3.2 Electricity

One can argue that electricity should be regarded as a tradable input since electricity is supplied from South Africa to neighboring countries. According to Jooste and Van Zyl (1999) the scale of distribution is very small and in some cases certain areas in South Africa do not have access to this luxury. Hence, over the short term electricity can be regarded as a non-tradable.

Conningarth Consultants (1995) calculated the shadow selling price of electricity in South Africa. The shadow conversion factor calculated by them suggests that electricity was

subsidized in South Africa. They calculated a shadow conversion factors of 1.26 and was used in this study.

2.2.3.3 Land

Gittinger (1982) defined the economic cost of land (opportunity cost) as the net value of production forgone when the use of land is changed from its "without" use to its "with" use; measured in border prices. In the absence of a market value that reflects the opportunity cost to use land, Monke and Pearson (1986) state that the rental value can be used instead. This statement is echoed by Tsakok (1990) who mentions that if there is a competitive market in renting or leasing land, the analyst can consider the rental value as indicative of the contribution of land to the alternative output. For purposes of this study, rental values for land were calculated as 4 per cent of the market value of land in different regions. This is consistent to the findings of Van Schalkwyk and Van Zyl (1994).

2.2.3.4 Water

Water in South Africa can be regarded as one of the most scarce resources available. This means that one unit of water used in one sector reduces the water available to be used in other sectors by one unit. Hence, one can attach a scarcity value to water which relates to its opportunity cost.

Since there is not a market for water in South Africa it is necessary to estimate its scarcity value. Hassan *et al*. (1996) calculated the scarcity value of water for dryland production to be R0,35 per m^3. Various other scarcity values have been calculated by, amongst others, Viljoen *et al.* (1992), Hassan and Van der Merwe (1997) and Louw and Van Schalkwyk (1997). The estimated scarcity values by these authors ranged from R0,50 to R6,00 per m^3. Viljoen *et al.* (1992) estimated the scarcity value of water in terms of its net contribution towards the production value in the Vaalharts River basin, whilst Hassan and Van der Merwe (1997), as well as, Louw and Van Schalkwyk (1997) estimated the scarcity value of water in respect of high value long term crops. Since these values does not conform to short term crops in the latter case, and since in the former case the methodology used relates to the total production value, it was decided to adapt the R0,35m^3 estimated by Hassan *et al.* (1996) with the inflation rate index.

2.2.4 Shadow price of the Rand (exchange rate)

It is commonly known that the South African Rand rarely reflects its true value in term of other currencies. The reasons for this state of affairs are plenty and include, amongst others, perceptions of investors, monetary controls and interventions by the South African Reserve Bank, the political climate, etc. Hence, it is necessary to calculate the “true” or shadow value of the exchange rate. In this study, the buying power parity (BPP) approach was used to calculate the economic value of the South African Rand. This approach implies that changes in relative prices of a country’s goods and services are reflected by changes in the exchange rate. This entails that relative price changes between countries are used to calculate the shadow exchange rate. Since it is practise in South Africa to value the South African Rand against the US Dollar, the producer price index of the US was used to calculate the shadow exchange rate of the Rand (Bradfield, 1987).

The calculation of the shadow exchange rate is denoted by the following equation:

$$SE = (PI_{SA}/PI_{FC}) / E_{bj}$$

Where:

SE	=	Shadow exchange rate;
E_{bj}	=	Base year exchange rate;
PI_{SA}	=	Producer price index for South Africa; and
PI_{FC}	=	Producer price index for the USA.

Bradfield (1993) states that a practical problem in the calculation of the shadow exchange rate is the choice of a realistic base year. According to him, the base year must adhere to the following practical requirements:

- the economic growth rate must be stable or near to the long term growth rate of the economy;
- the balance of payments must be near equilibrium;
- there should not have been any major economic or political crisis in the world;
- there must be domestic political stability;
- international economics must be relative stable;
- the rate of unemployment must not be excessively high; and
- the inflation rate must not deviate to much from the long term trend in inflation.

According to Bradfield (1993), the only year which conforms to a large extent to these requirements in South Africa is 1975, and was hence used in this study. The shadow exchange rate for South Africa was calculated to be R7.18 in 2008. According to this the South African Rand was undervalued in 2008.

2.3 The tradable/non-tradable composition of the value of inputs and products

After examining the input-output table of South Africa (Bradfield, 1993), stated that most inputs used in the South African economy consist of tradable and non-tradable components.

The following derivation can be made from this:

- the production of tradable goods and services require non-tradable inputs;
- the production of non-tradable goods and services require tradable inputs;
- tradable goods and services require tradable inputs; and
- non-tradable goods and services require non-tradable inputs.

The costs of tradable inputs often include substantial amounts of inputs that are not available on international markets such as transportation, electricity, labour etc. Therefore, after all market and economic input cost categories are standardised, they should be allocated to domestic factor (non-tradable) and tradable input components. The non-tradable components are then added to the cost of the domestic factors (Monke & Pearson, 1989). The non-tradable component in tradable inputs was calculated by Jooste & Van Zyl (1997) and was used in this research (see Table 3).

Table 3: Tradable and non-tradable components

	% Tradable	% Non-tradable
Fertilizer and pesticides	80%	20%
Other purchased inputs	90%	10%
Fixed cost of machinery	95%	5 %
Variable cost of machinery	50%	50%
Contract services	95%	5%
Transport	60%	40%
Admin & Insurance & other overheads	40%	60%

Source: Jooste & Van Zyl (1997)

Figure 1 shows the total production cost for the seven potato production regions included in this study, as well as the tradable and non-tradable costs of production. Reasons for variations between regions are determined by the variability in labour cost, transportation to the market where produce are sold and proximity of input suppliers. Production cost in Limpopo and North West amounted to approximately R78 000 per ha in 2008. Tradable components, which consist of, amongst others, machinery, fertilizer and, pesticide cost makes the largest contribution to the tradable component of potato production. The total cost of domestic resources is made up of factors such as cost of domestic resources (labour cost, water tariff and land) and the non-tradable component of fertilizer and pesticide inputs.

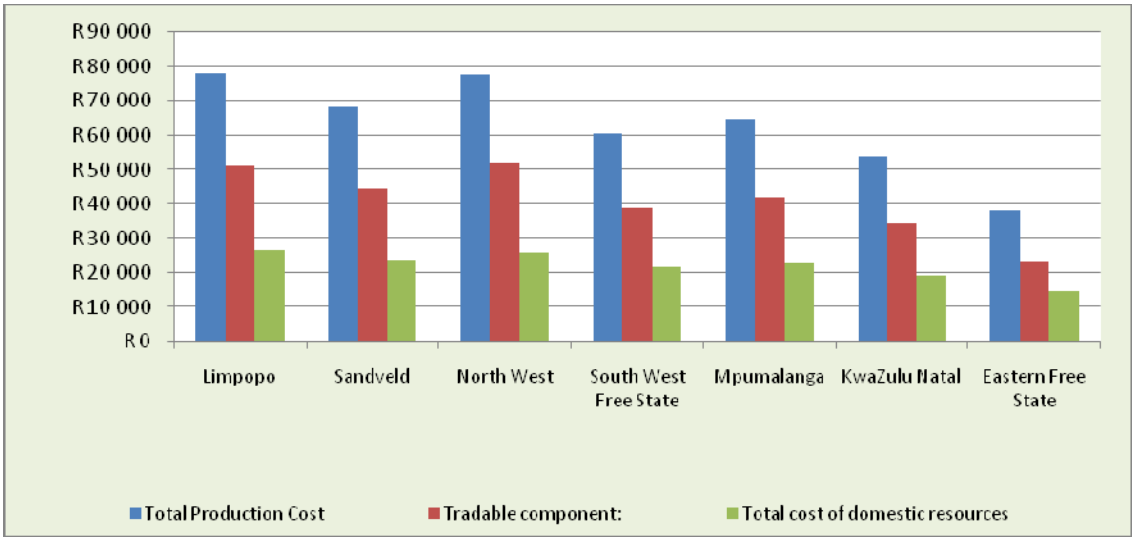

Figure 1: Production cost, tradable and domestic resources
Source: PSA, 2009 and own calculations

3. Results

3.1 Market vs economic profitability

Table 4 shows the market and economic profitability for irrigation and dry land potato production in the different potato production regions. The overall private (market) profits shows fairly good private profitability (D>0) for most regions; North West had the highest profits of R26 128/ha in 2008. However, the Eastern Free State experienced losses.

The economic profitability of potato production shows a much improved situation with all regions being profitable. This is indicative that there are policies affecting the prices of inputs and outputs in the production of potatoes that negatively affect the ability of producers to be more profitable. The difference between market and economic profitability ranges between R8 233/ha and R17 728/ha. Stated differently, in the absence of policies that cause prices to differ from their economic value, potato production in South Africa will be more profitable. This is a prerequisite for sustainable potato production in South Africa.

Table 4: Market and economic profitability and policy measures in the regions

	Limpopo	Sandveld	North West	South West Free State	Mpumalanga	KwaZulu Natal	Eastern Free State
	Potato (Irrigation)			Potato (Dry land)			
	Revenue						
Market Prices	3385	5732	26128	19157	11709	16976	-5084
Economic Prices	20978	21597	43856	31476	22039	23180	3149
Policy measures							
Impact of policy measures	-17593	-15865	-17728	-12319	-10331	-6204	-8233

3.2 Nominal Protection Ratio (NPR) and Effective Protection Coefficient (EPC)

The NPR and EPC measure the magnitude of policy distortions. The NPR indicates the magnitude of the impact of policies that causes a divergence between the market price and the social price of a commodity, i.e. it indicates the degree of output transfer. The NPR in all regions is greater than one. A NPR greater than one indicates than policies increased the market price to levels higher than the economic price. Thus, if the domestic price is constantly higher than the economic price (international price) it indicates that policies on the domestic market causes prices being paid by domestic consumers to be higher than what they would have paid in the absence of such policies. Hence, a NPR greater than one also indicates that users are taxed. Table 5 shows that the NPR for tradable outputs is equal to one, which indicates that there are no policy measures in place that causes the market price of potatoes to deviate from its economic value. However, the NPR for tradable inputs confirms that there are policy measures in place that causes the market price of inputs to deviate from their economic value. In this case such policies are putting a burden on potato producers.

The EPC measures the value-added in private prices relative to the value-added in world prices. If the EPC is lower than one it indicates that private profits is lower than what it would have been if no policies were in place. Thus, it indicates that policies are in place that decreases profits artificially. The EPC's in all regions are lower than one confirming that policies in the input market for potato production constrains the industry. Policy effects include tariffs on inputs or ingredients of inputs such as pesticides and fungicides and taxes in the fuel industry.

Table 5: Market and economic profitability and policy measures in the regions

	Limpopo	Sandveld	North West	South West Free State	Mpumalanga	KwaZulu Natal	Eastern Free State
Revenue (R/ha)							
Market Prices	81 413	74 062	103 932	79 812	76 626	70 973	33 190
Economic Prices	81 413	74 062	103 932	79 812	76 626	70 973	33 190
Effect of divergences & efficient policy	0	0	0	0	0	0	0
Tradable Inputs(R/ha)							
Market Prices	51239	44380	51771	38943	42079	34826	23532
Economic Prices	42970	37224	43968	35062	38943	33270	20918
Effect of divergences & efficient policy	8270	7157	7803	3881	3136	1556	2615
Policy measures							
Nominal Protection Coefficient (NPC) on tradable outputs (A/E)	1	1	1	1	1	1	1
Nominal Protection Coefficient (NPC) on tradable inputs (B/F)	1.19	1.19	1.18	1.11	1.08	1.05	1.12
Effective protection coefficient ((A-B)/(E-F))	0.78	0.81	0.87	0.91	0.92	0.96	0.79

3.3 Comparative economic advantages

Table 6 shows the comparative economic advantage of the seven potato production regions. As mentioned earlier a RCR of less than one indicates that a crop have a comparative advantage over products imported from overseas. If the RCR is greater than one such a crop has a comparative disadvantage. If current policies prevail potato production in the Eastern Free State will not have a comparative advantage. However, in the absence of such policies the RCR's show that all production regions have a comparative advantage. The North West Province has the highest comparative advantage. The opportunity costs associated with the production of potatoes in Eastern the Free State are the highest of all regions.

Table 6: Resource Cost Ratio for the seven potato production regions

	Limpopo	Sandveld	North West	South West Free State	Mpumalanga	KwaZulu Natal	Eastern Free State
Market Price							
Value added:	30174	29681	52161	40869	34547	36147	9658
Total cost of domestic resources	26790	23950	26034	21712	22839	19171	14741
Resource cost ratio	0.89	0.81	0.50	0.53	0.66	0.53	1.53
Economic Price							
Value added:	38 444	36 838	59 964	44 750	37 683	37 703	12 272
Total cost of domestic resources	17 466	15 241	16 108	13 274	15 644	14 523	9 123
Resource cost ratio	0.45	0.41	0.27	0.30	0.42	0.39	0.74

4. Conclusion

The focus of this research was to investigate the comparative advantage of the potato industry in seven potato production regions in South Africa. The main conclusions drawn from this research is that current policies that affects the input market for potato production in South Africa is constraining the potato industry. This was confirmed by the results obtained from

the NPR and EPC analysis, and the size of the policy distortions was shown through the calculation of market and economic profitability. It was further shown that if current policies prevail potato production in the Eastern Free State will not have a comparative advantage, but in the absence of such policies all production regions have a comparative advantage.

Noteworthy is that for certain inputs, such as water and electricity, the economic cost was greater that the market cost to properly reflect their scarcity value. The expectation therefore was that this would have a significant impact on the economic profitability of potato production, but the impact of policies on other input categories overshadowed the higher cost of electricity and water. This has important implications since in an environment where there is increasing pressure to increase the cost of electricity and water, it will have a significant impact on the potato industry if other policies are not addressed simultaneously that are currently putting pressure on the profitability of this industry. In fact, this is also applicable to other agricultural production activities.

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