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COMPARATIVE ADVANTAGE OF THE PRIMARY OILSEEDS INDUSTRY IN SOUTH AFRICA

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Given South Africa's poor resource endowments coupled with the ongoing deregulation and liberalisation of agriculture, it is of the utmost importance that resources are used in the most optimal manner to ensure international competitiveness. Since oilseeds constitute one of the most important field crops in South Africa, the comparative economic advantages (CEA) of sunflower seeds, groundnuts and soya-beans were calculated for different regions classified as low yielding, high yielding and irrigation areas. The results show that (a) the extent of developing new cultivars with improved yield potential will largely determine the comparative advantage of oilseeds in areas where agro-ecological conditions are poor; (b) distortionary policies on the input side is one of the main factors influencing the comparative advantage of the primary oilseeds industry; (c) the introduction of a water rate will have serious implications for irrigated oilseeds; and (d) increased efficiency forms the basis for being competitiveness.

1. INTRODUCTION

Comparative advantage measures the efficiency with which domestic resources are used to produce commodities. Given South Africa's poor resource endowments, it is of the utmost importance that resources are used in the most optimal manner. Producers who utilise their resources more efficiently will maximise returns. Comparative economic analysis furthermore provides valuable information to policymakers regarding the competitive nature of an industry. For example, where industries show that they have a comparative advantage over imported commodities government ought to create the environment for such industries to compete fairly internationally. Hence, the aim of this paper is to provide information on the comparative advantages that may or may not exist in the primary oilseeds industry.

2. METHODOLOGY AND DATA USED

Tsakok (1990) mentions that to assess comparative advantage, analysts employ the concept of opportunity cost (the cost of a resource of not being available for the production of something else). According to Tsakok (1990) the following four steps are used to assess comparative advantages:

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i) the opportunity cost of foreign exchange - its scarcity value to the domestic economy - must be determined;

ii) the value added component in foreign and border prices is computed;

iii) the cost of the primary production factors or domestic resources used in production is calculated[1]; and

iv) the domestic resource cost and the net benefits are compared.

This procedure to compare the costs with benefits for a certain production activity is used as a measure of efficiency. The most common methodology associated with the calculation of the level of efficiency with which resources are used is called the Domestic Resource Cost ratio (DRC). Tsakok (1990) states that the DRC compares the opportunity costs of domestic production to the added value that it generates. Furthermore, according to Monke and Pearson (1989) the DRC also serves as a proxy measure for social profits when systems producing different outputs are compared for their relative efficiency. Moreover, the concept of DRC relates to a measure of real opportunity cost in terms of total domestic resources of producing (or saving) a net marginal unit of foreign exchange (Bruno, 1967). Tsakok (1990) proposes the following mathematical notation for calculating DRC's:

$$DRC_i = \frac{\sum_{j=k+1}^{n} a_{ij}V_j}{P_i^b - \sum_{j=1}^{k} a_{ij}P_j^b}$$

where

a_{ij}, 1 to k	=	coefficients for traded inputs;
a_{ij}, k+1 to n	=	coefficients for domestic resources and non-traded intermediary inputs;
V_j	=	shadow price of domestic resource or non-traded input;
P_j^p	=	border price of traded output; and
P_i^b	=	border price of traded input.

A ranking of numerical values generated by the DRC methodology is indicative of the varying levels of efficiency of domestic production or of its international competitiveness. The exchange rate used must be the opportunity cost benchmark. DRC's should be interpreted as follows (Tsakok, 1990):

DRC < 1:	Indicates that the economy saves foreign exchange from local production, because the opportunity cost of its domestic resources is less than the net foreign exchange it gains (in exports) or saves (in substituting for imports). It also indicates efficiency and international competitiveness.
DRC > 1:	Indicates that the economy is incurring costs in excess of what it gains or saves from production in terms of net foreign exchange.
DRC = 1:	Indicates that the economy on balance neither gains or saves foreign exchange through domestic production.

The CERES-Maize crop growth model used by the Grain Crops Institute at Potchefstroom was used in this study to simulate maize production for the six northern provinces for the period 1960 to 1998. The production potential of sunflower seeds, soya-beans and groundnuts was then estimated from simulated maize cropping by using regression analysis to establish low and high yielding areas. Information regarding enterprise budgets was sourced from the different Provincial Departments of Agriculture and several co-operatives, whereas information on tariffs was obtained from the Department of Trade and Industry.

3. VALUATION OF VARIABLES

From the above methodology it should be obvious that it is necessary to value inputs and outputs according to their shadow prices (also social or economic prices), i.e. those prices that will prevail in the absence of any policy or other distortions. The derivation of the shadow prices of tradables and non-tradables is discussed below.

- *Tradable inputs*

The world price approach was used as the principle method to estimate the economic prices of tradables such as fertilisers, pesticides and commodities. In this regard the *conversion method* and the *tariff protection method* are used to calculate the economic price of tradables (see Ward & Deren, 1991 and Bradfield, 1987).

In order to calculate the shadow price of fuel (diesel) a similar methodology to that of Conningarth Consultants (1995) was used. The shadow conversion factor for diesel was calculated at 0.71.

- *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. The shadow price for unskilled labour was taken at 0.609, as suggested by Conningarth Consultants (1995). Skilled labour was assumed to be in full employment, whilst this is not the case for unskilled labour. This means that the market wage rate for skilled labour closely approximates the social opportunity cost, and hence a shadow wage adjustment factor of zero was used. Conningarth Consultants (1995) calculated a shadow conversion factor of 1.26 for electricity in South Africa, and was hence used in this study. Tsakok (1990) 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 with the findings of Van Schalkwyk and Van Zyl (1994).

Since there is no 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 35 cents per m^3. 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 50 cents to R6,00 per m^3. Viljoen *et al* (1992) estimated the scarcity value of water in terms of its net contribution towards 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 do 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 adjusy the 35 cents per m^3 estimated by Hassan *et al* (1996) with the inflation rate index. This assumption is not entirely correct, but after discussions with, amongst other, Mullins (2000) it became clear that the additional effort to estimate the scarcity value of water in the different regions used would defeat the purpose of this study.

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 (Bradfield, 1987). The shadow exchange rate for South Africa was calculated to be R5.14 in 1999. According to this the South African Rand was under valued in 1999. Apart from the fact that changes in the exchange rate influence the world price at which commodities are imported or exported, they also have an influence on the price of inputs used in the production of these commodities. Hence, the price of tradable inputs must, therefore, also be adjusted with the exchange rate. In order to incorporate the impact of exchange rate changes on tradable inputs, the exchange rate elasticities calculated by Liebenberg (1990) were used. The change in the exchange rate is, however, not reflected in non-tradable inputs.

The tradable/non-tradable composition of the value of inputs and products was calculated by Jooste and Van Zyl (1999) and was used in this study.

4. COMPARATIVE ECONOMIC ADVANTAGES

The comparative economic advantages (CEA) of sunflower seeds, groundnuts and soya-beans were calculated for different regions classified as low yielding, high yielding and irrigation areas. Tables 1 to 3 shows the absolute and relative comparative advantage of the different oilseed crops. By taking opportunity cost into account, i.e. the returns foregone by producing one crop instead of another, one is able to measure the relative comparative advantage of a crop.

For the low yielding areas groundnuts (KwaZulu-Natal) and soya-beans (Mpumalanga) have a comparative disadvantage. With respect to the rest they all show comparative advantages although some, e.g. sunflower under irrigation in Vaalharts, is relatively close to not having a comparative advantage. The reason for the identified regions with comparative disadvantages can be attributed to the interaction of low yields realised by these crops and inputs used. In other words, the opportunity costs associated with the production of groundnuts in KwaZulu-Natal and soya-beans in Eastern Mpumalanga are too high. Domestic resources could be used more efficiently to produce something else.

In terms of relative comparative advantage, groundnuts is ranked first in all areas. However, the production of groundnuts is limited only to specific areas in the country due to, for example, climatical factors. Hence, it was decided to recalculate the relative CEA omitting groundnuts. If this is done, sunflower in low and high yielding areas are ranked first, whilst soya-beans has a relative CEA in irrigation areas.

Table 1: CEA analysis for low yielding areas

Description	North-Eastern Free State	Eastern Free State	Central Free State	North Eastern Kwazulu-Natal	Eastern Mpumalanga	South Mpumalanga
	Sunflower Dryland	Sunflower Dryland	Groundnuts Dryland	Groundnuts Dryland	Soya-beans Dryland	Sunflower Dryland
Absolute CEA	0.59	0.42	0.47	1.17	1.14	0.69
Rel. CEA	1.79	1.33	0.81	1.91	3.35	1.99
CEA excluding groundnuts						
Rel. CEA	1.36	0.73	nc	1.64	2.55	1.52

Table 2: CEA analysis for high yielding areas

Description	Eastern Kwazulu-Natal	Eastern Free State	Central Free State	North Eastern Free State	Southern Mpumalanga	Central Mpumalanga
	Soya-beans Dryland	Sunflower Dryland	Soya-beans Dryland	Groundnuts Dryland	Soya-beans Dryland	Sunflower Dryland
Absolute CEA	0.37	0.26	0.25	0.16	0.32	0.33
CEA - excluding groundnuts						
Rel. CEA	2.52	2.65	2.67	0.42	2.75	2.54
Rel. CEA	1.04	0.99	1	nc	1.07	1.02

Table 3: CEA analysis for oilseeds irrigation

Description	Eastern Kwazulu-Natal	North Eastern Free State	Vaalharts Northern Cape Province	Vaalharts Northern Cape Province	Central Northwest Province
	Soya-beans Irrigation	Sunflower Irrigation	Groundnuts Irrigation	Sunflower Irrigation	Sunflower Irrigation
Absolute CEA	0.46	0.58	0.32	0.88	0.48
Rel. CEA	2.39	2.96	0.51	4.54	2.45
CEA - excluding groundnuts					
Rel CEA	0.97	1.25	nc	1.91	1.03

5. SENSITIVITY ANALYSIS

Changes in the agro-economic environment take place continuously. These changes will definitely influence the comparative advantage status of crops. For example, a change in the exchange rate will influence the import parity of a particular crop, which will again influence its ability to compete. CEA provides the tools to measure such effects. Tables 4 to 6 show the influence of changes in the exchange rate and input costs on the comparative advantage of the different products. It is clear that a 20 per cent depreciation in the exchange rate will favour domestic producers. In fact, groundnuts in KwaZulu-Natal and soya-beans in Mpumalanga both showing a comparative

disadvantage in Table 1 now have a comparative advantage. Tables 5 and 6 also show large improvements in terms of comparative advantages. An appreciation in the exchange rate will have the most devastating effect in lower yielding regions. Only two crops maintained their comparative advantage. The situation is less harmful in higher yielding areas and for irrigation. This emphasises the fact that producer induced efficiency (choice of cultivars, management, etc.) should be the basis for comparative economic advantage. It is clear when comparing Table 4 with Table 5 that low yielding areas are much more sensitive to changes in input prices. It clearly indicates the higher risk involved in producing oilseeds in low production potential areas since two areas were rendered uncompetitive.

Table 4: Sensitivity analysis for low yielding areas

Description	North-Eastern Free State	Eastern Free State	Central Free State	North Eastern Kwazulu-Natal	Eastern Mpumalanga	South Mpumalanga
	Sunflower Dryland	Sunflower Dryland	Groundnuts Dryland	Groundnuts Dryland	Soya-beans Dryland	Sunflower Dryland
CEA - 20% depreciation	0.44	0.33	0.37	0.83	0.69	0.50
CEA - 20% appreciation	1.08	0.64	0.78	2.61	8.25	1.36
CEA - 20% increase in input costs	0.82	0.50	0.56	1.70	1.65	0.93

Table 5: Sensitivity analysis for high yielding areas

Description	Eastern Kwazulu-Natal	Eastern Free State	Central Free State	North Eastern Free State	Southern Mpumalanga	Central Mpumalanga
	Soya-beans Dryland	Sunflower Dryland	Soya-beans Dryland	Groundnuts Dryland	Soya-beans Dryland	Sunflower Dryland
CEA - 20% depreciation	0.29	0.21	0.20	0.14	0.25	0.27
CEA - 20% appreciation	0.55	0.36	0.37	0.21	0.48	0.49
CEA - 20% increase in input costs	0.43	0.30	0.28	0.18	0.37	0.39

An increase in water rates will influence the comparative advantage of oilseeds (Compare CEA in first row of Table 3 with last row in Table 6). In fact, it has been shown that in some cases dryland production may get a comparative advantage over irrigated oilseeds. This has serious implications for production decisions. For example, if the increase in water tariffs renders oilseed production noncompetitive in some areas, those producers will have to change to alternative crops. This may entail new production infrastructure that necessitates large capital investments. Producers might find it difficult to make such investments. Such changes may also influence the domestic production capacity. Taking into account the contribution of oilseeds to gross production value this may become a serious issue. Hence, the issue of water rates must be handled with great care.

Table 6: Sensitivity analysis for oilseeds irrigation

Description	Eastern Kwazulu-Natal	North Eastern Free State	Vaalharts Northern Cape Province	Vaalharts Northern Cape Province	Central Northwest Province
	Soya-beans Irrigation	Sunflower Irrigation	Groundnuts Irrigation	Sunflower Irrigation	Sunflower Irrigation
CEA - 20% depreciation	0.34	0.42	0.26	0.65	0.37
CEA - 20% appreciation	0.70	0.91	0.43	1.48	0.71
CEA - 20% increase in input costs	0.51	0.65	0.36	1.02	0.54
Increase in water cost to R0,50mm	0.58	0.72	0.37	0.96	0.61

6. CONCLUSION

The main conclusions drawn from this paper are as follows:

- The extent of developing new cultivars with improved yield potential will largely determine the comparative advantage of oilseeds in areas where agro-ecological conditions are poor.
- Distortionary policies on the input side is one of the main factors influencing the comparative advantage of the primary oilseed industry.
- Some regions are much more sensitive to changes in exogenous factors than others, mainly due to their input use.
- Low yielding areas are very sensitive to changes in yield which increases the risk of farming with oilseeds in such areas.
- Although a depreciation will benefit producers over the short term, it should be noted that the exchange rate may not sustain comparative advantages that may exist. Real increases in efficiency lie within the management boundaries of the farmer.

- The introduction of a water rate will have serious implications for irrigated oilseeds. In some cases irrigated oilseeds may lose their comparative advantage to dryland production.

NOTE:

1. *Domestic resources are valued in shadow prices.*

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MEASURING THE RETURNS TO PUBLIC SECTOR CROP R&D IN TANZANIA, 1970-99

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This paper is the first attempt at a Malmquist total factor productivity (TFP) index for maize and wheat production in Tanzania, for the period 1970-1999. Productivity grew at 1.4% per annum, due to improvements in efficiency of 2.5% per annum, combined with technological regression at -1% per year over the period. An evaluation of the effectiveness of public sector R&D investment in wheat and maize productivity shows that R&D investment has had a rate of return (ROR) of between 57 and 64% for both crops over the period.

1. INTRODUCTION

There is now a vast amount of empirical evidence on growth in productivity as well as the contributions of domestic research efforts in determining productivity growth in the agricultural sector. These studies have generally been used to determine the effectiveness or value for money of domestic agricultural research policy, in order to justify public sector R&D investment in the agricultural sector. Indeed, empirical studies in both the developed and developing countries have generally advocated support for public sector R&D investment based on market failure arguments and the evidence that the ROR to such investments were high and indicative of under-investment in the sector (Echeverria, 1990). But to date no such information has been available for Tanzania. Thus, for the first time, this paper presents empirical evidence on the rate and sources of productivity growth for wheat and maize in Tanzania, with particular attention focused on estimating the ROR to public sector investment.

This paper does three things. First, it estimates a Malmquist productivity measure for wheat and maize. Second, the Malmquist TFP index is decomposed into its technical and efficiency change components. Third, productivity change is then explained by the lagged effects of public agricultural R&D. The outline of this paper is as follows. The second section provides an overview of previous evaluations of the effectiveness of public

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