COMPARATIVE ADVANTAGE OF TOMATO PRODUCTION BETWEEN MOZAMBIQUE AND SOUTH AFRICA: AN APPLICATION OF DOMESTIC RESOURCE COST (DRC) ANALYSIS

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Abstract

The main objective of the study was to assess the comparative advantage of commercial Tomato producers in Moamba district in Southern Mozambique and South Africa. The Domestic Resource Cost (DRC) analysis derived from the Policy Analysis Matrix (PAM) was used to determine the comparative advantage of tomato production in Moamba District of Mozambique in comparison with South Africa tomato production in both fresh and summer seasons. Data were collected from twenty-seven (27) commercial tomato producers through a semi-structured questionnaire and it was validated using a focus group discussion. Using the social and private price of domestic and tradable inputs, four (4) tomato production budget tables (fresh and summer season in Moamba and fresh and summer season in South Africa) were constructed, which showed the average inputs used and average output realized per hectare. Two (2) Policy Analysis Matrices were constructed for both seasons and policy analysis indicators were calculated. The results showed that there is implicit tax on tomato production in both seasons, a negative effect of incentives on tomato policy, and domestic resource in Moamba were efficiently utilized. Therefore, Mozambique has a comparative advantage in producing tomato over South Africa. Hence, it is recommended that Mozambican government should encourage the tomato producers to produce more tomato by insuring supply of tomato production inputs and reduce import tax.

Keywords*: Comparative advantage, Policy Analysis Matrix*

Introduction

Agriculture is the hub of the Mozambican Economy and there is still a great potential for growth in the sector. Agriculture accounts for 31.9% of Gross Domestic Product (GDP) and 20% of total export value (TIA[1], 2011). The horticulture sector is an important sector in the Mozambican agriculture and it is composed of the small-scale, medium-scale and commercial farmers- with the commercial farmers producing on average 5% of the total cultivated land in

[1] TIA Trabalho de Inquérito Agrícola : This is the agricultural surveys organised by the Economic National Director in the Ministry of Agriculture in Mozambique

the Mozambique (MoEA[2], 2014). In South Africa, horticulture is also an important sector and in 1980s to 2007 horticultural productions increased from 18 percent to 26 percent as a share of total agricultural output (Kirsten *et. al.*, 2010). Amongst this horticultural group, tomato is the second most important and popular vegetable crop after potatoes in both countries. According to the International Trade Centre (ITC), South Africa exports most of its tomatoes to the Southern African Development Community (SADC) countries. Mozambique is by far the largest market for South African tomato exports with 75.3 percent share, followed by Angola (7.7 percent) and Zimbabwe (6.9 percent).

The Mozambican share in the world agricultural market is low even though the country has a great potential to generate much of its foreign exchange earnings through the exportation of agricultural commodities. The few of the country's exports were mostly directed to Europe (54% - Belgium, Netherlands and Spain) (AfDB, 2011). The Mozambican agricultural production is dependent on the importation of tradable agricultural inputs such as fertilizers, seeds and pesticides which may reflect on the prices of agricultural output. Given the world economic reform and trade liberalization, there has been change in the factor market (price) such as land and labour and change in the macroeconomic policies such as exchange rate and interest rate policies (Nguyen and Heidhues, 2004). All these and other causes will affect the cost of production and price of outputs and thereby affect the competitiveness and comparative advantage of agricultural production.

Therefore, it is suggested that, for the country like Mozambique, the main viable venue for economic growth is to build the competitiveness of the agricultural sector in the international market in general and the domestic market in particular. Despite of its large potential in tomato production, the competitiveness and comparative advantage of Tomato production activities in Mozambique are very low. There is little literature on the comparative advantage of horticultural crops between Mozambique and South Africa. The study will therefore contribute to the generation of empirical evidence on the profitability and the degree of comparative advantage of tomato production activities in Mozambique.

Objectives of study

The main objective of the study is to evaluate the comparative of commercial tomato producers in Moamba district of Southern Mozambique and South Africa. Specifically, the study will; (1) examine the current comparative advantage of tomato production activities in the study area; (2) determine the current level of protection; (3) determine the level of price distortion of tomato production.

Methodology

Study Area

The study was based on the commercial farmers producing tomato in Moamba district which is located in the southern part of the province of Maputo, 75 km away from the capital city, Maputo. The study area was selected because of its accessibility, high concentration of horticultural producers, and shared border with South Africa.

Sampling Procedures

Out of forty two commercial tomato farmers, twenty seven commercial tomato farmers were interviewed because of time limitation and moreover some of the farmers were absent and out of town as at the data collection period. The study used purposive sampling technique to select Sabié and Moamba Sede villages from Moamba districts that grew tomato for commercial purposes. Primary data were collected from the commercial tomato producers of Moamba district using a semi structured questionnaire which encompasses demographic data,

[2]MoEA stands for Ministry of Economic Affairs

production data, input quantities and prices and output prices at the market. The study also conducted one focus group discussion to verify the production activities and various inputs used in tomato production in the study area. Secondary data were collected from articles, government reports, published interviews, newspaper clippings, Ministry of Agriculture and Ministry of trade and FAOSTAT for Mozambique. Data on the price trends of tomato prices from January 2013 to May 2014 in South Africa were sourced from the Africa Department of Agriculture, Forestry and Fisheries.

Methods of Data Analysis

The average tomato prices for each season were calculated by finding the total average of the monthly prices in each of the seasons (fresh and summer). These prices were computed in the system budget table to calculate total revenue and profits. Prices of inputs in South Africa were recorded from farmers who imported inputs from South Africa. The prices were calculated minus customs which are paid at the border when importing inputs from South Africa. Machinery costs and labour cost were also sourced from the Department of Agriculture and Environmental Affairs in Kwazulu Natal. The minimum agricultural wage was used to compute the cost of labour in the production process of tomato. The costs and revenues were calculated in the local currency using the exchange rate of one South African Rand (ZAR) to three Mozambican Meticals (MZM) (3 MZM = 0.09 USD).

Descriptive analysis was used to analysis the socio-economic characteristics of the commercial tomato producers while Policy Analysis Matrix (PAM) approach was used to determine simultaneously the competitiveness, comparative advantage, and the level of protection or price distortion between private and social prices of tomato production activities in the Moamba district. This approach was employed due to its simplicity and understandable nature, particularly to policy makers (Monk and Pearson, 1989).

Structure of a Policy Analysis Matrix (PAM)

The basic PAM model can be described as a product of two accounting identities, one defining the profitability identity in which profits are identically equal to revenue less costs while the other measuring divergence identity as the difference between observed parameters and parameters that would exist if distortion were removed (Monk and Pearson, 1989; Nelson and Panggabean, 1991; Yao, 1997; Seini, 2004). The PAM constitutes of four columns and three rows.

Table 1: Policy Analysis Matrix

	Revenue	Costs		Profits
		Tradable inputs	Domestic factors	
Private prices	A	B	C	D
Social (shadow) prices	E	F	G	H
Effect of Divergences	I	J	K	L

Source: Monk and Pearson (1989)

From the table above, the following calculations can be made: Private Profit (D) = A - (B + C); Social Profit (H) = E - (F + G); Output transfer (I) = A – E; Tradable input transfer (J) = B – F; Domestic factor transfer (K) = C – G; Net transfer (L) = D - H = I - (J+ K). Tradable

input includes those inputs, which can be traded in the international market (Barron-Aguilar *et al.*, 1995), e.g. imported fertilizers and seeds while non-tradable inputs are domestic factors that, basically, cannot be traded in the international market, e.g. land, labour and local capital (Pearson *et al.*, 2003). Also private prices are the actual market price while social price are the opportunity cost or shadow prices. The effect of divergences simply captures the effects of government policy and/or market failure. One of the main strength of PAM is that it allows a varying degree of desegregation of the production activities and their costs (Nguyen, 2002; Nguyen and Heidhues, 2004).

Measure of Protection and Comparative Advantage

From the PAM table, the level of protection can be calculated by the following protection coefficients; Nominal Protection Coefficient on Output (NPCO), Nominal Protection Coefficient on tradable Inputs (NPCI) and Effective Protection Coefficient (EPC) and can be calculated as: $NPCO = \frac{A}{E}$; $NPCI = \frac{B}{F}$; $EPC = \frac{A-B}{E-F}$. Also the comparative advantage of tomato production was calculated using the Domestic Resource Cost (DRC) which is a unit-free ratio that expresses the efficiency of alternative domestic production activities by indicating the total value of domestic resources required to generate or save a unit of foreign exchange. It can be calculated as: $DRC = \frac{G}{E-F}$

Results and Discussions

Socio-economic characteristics of tomato commercial farmers

Table 2 shows the socio-economic characteristics of the tomato producers.

Table 2: Socio economic characteristics of commercial tomato producers in Moamba districts

Characteristics	Frequency	Percentage
1. Sex		
Female	5	18.5
Male	22	81.5
Total	27	100
2. Age		
19-30	1	2.9
31-65	23	65.7
>66	3	8.6
Total	27	100
3. Education level		
Primary	14	51.9
Secondary	13	48.1
Total	27	100
4. Marital status		
Married	23	85.2
Single	2	7.4
Widowed	1	3.7
Separated	1	3.7
Total	27	100
5. Occupation		
Farmer	22	81.5
Farmer and others	5	18.5
Total	27	100
6. Source of Land		
Owned	25	92.6
Association	2	7.4

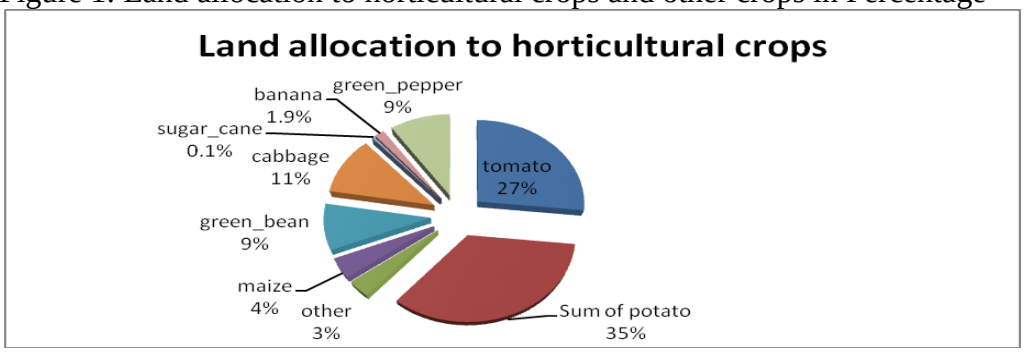
	Total	27	100
7.	Tomato Variety grown		
	HTX14	23	85.2
	Rio Grande	3	11.1
	HTX14 and Rio Grande	1	3.7
	Total	27	100

Source: Field survey, 2014

As shown in Table 2 above about 81.5 percent of the tomato producers in the study area were males, which implies that tomato production is male dominated. Also, 85 percent of the respondents were married with a mean household size of 7 which implied joint (couple) managerial decision making and the availability of family labour. About Sixty six percent were between 31 to 65 years old which implied that they are in the economically active age with a potential to increase and improve productivity. Nonetheless, result suggests that the respondents had formal education and therefore would be in the right frame of mind to accept innovation as regards to tomato production. Majority of the producers own land (92.6 percent) with a mean farm size of about 26 hectares and only about 19 percent of the farmers were involved in other businesses order than farming. Also the tomato varieties mostly used were HTX14 (85.2%) and Rio Grande (11.1%). Generally, the average wage of farm permanent worker in Moamba district of Southern Maputo, Mozambique was about 3,010 MZM /month (94.1 USD/month).

From the pie chart below, Irish potato and tomato occupy more than half (62%) of the cultivated land and the remaining percentage was used to grow other crops-cabbage, green pepper, green beans, maize, banana and others. This implied that tomatoes and potatoes were the major horticultural crops cultivated in the study area.

Figure 1: Land allocation to horticultural crops and other crops in Percentage



Source: Field survey, 2014

Measuring Profitability of Tomato Production

The two seasons (fresh and summer) of tomatoes production were used for analysis in order to better capture the comparative advantage of tomatoes. Therefore, two system tables were constructed based on these two seasons in order to generate inputs for the PAM analysis.

Tomato production in Fresh season

The farm budget for producing tomato in fresh season is shown below.

Table 3: Private and Social Price in fresh season

Tradable inputs	Quantity in Mozambique	Quantity in South	Private Price	Social Price	Cost in Mozambique	Cost in South

	(a)	Africa (b)	(Mts) (c)	(Mts) (d)	(Mts) (e)=(a)*(c)	Africa (Mts) (f)=(b)*(d)
Fertilizer(kg/ha)						
- NPK	200	200	12	11.4	2400	2280
- UREA	350	350	6.48	6.156	2268	2154.6
- Calcium Ammonium Nitrate	300	300	4.35	4.1325	1305	1239.75
- Mono ammonium Phosphate	300	300	4.26	4.047	1278	1214.1
Seedling (plant/ha)	23500	23500	1.35	1.35	31725	31725
Customs	31725		0.05		1586.25	
Pesticides						
- Mancozeb (kg/ha)	144	144	75	71.25	10800	10260
- Cipemetrina (liter/ha)	150	150	8	7.6	1200	1140
- Acefate (liter/ha)	2100	2100	4	3.8	8400	7980
- Ag-Tap (kg/ha)	150	150	10	9.5	1500	1425
- Tamarom (liter/ha)	350	350	10	9.5	3500	3325
- Abamectin (liter/ha)	350	350	5	4.75	1750	1662.5
- Metamidophos (liter/ha)	270	270	20	19	5400	5130
- Agrimek (liter/ha)	400	400	10	9.5	4000	3800
Fuel (Liter/ha)	99.76	69.76	38.6	43.2	3851	3014
Non-tradable inputs						
- Labor (/ha)	4	4	3010	6824.46	12040	27297.84
- Tractor Service (hr/ha)	9.58	9.58	776	704.3	7524.8	6747.1719
- Land (ha)	0	0	0	0	0	0
- Transportation (trip)	11		9046		16123.69	
Output						
- Tomato (kg/ha)	48290	48290	9	11.87	434610	573202.3

Source: Field survey, 2014

Mozambican land's are for the government and it's free of charge. From Table 3, the productivity of tomato in fresh season was 48,290 kg/ha. The yield data were validated by checking with agricultural technicians and some selected farmers in Moamba district. From the Table 3, the PAM for the fresh season was completed and shown in Table 4.

Table 4: Policy Analysis Matrix for tomato in fresh season

	Revenue	Costs		Profits
		Tradable inputs	Domestic factors	
Private prices	434610	101063	64382.39	269164.624
Social(shadow) prices	573202.300	98640	34045.012	440517.656
Effect of Divergences	-138592.300	2423.354	30337.3781	-171353.030

Source: Field survey, 2014

The value of the Net Private Profit (269,164.624MZM per hectare**)** indicated that the profit margin was large and highly competitive given the current technologies, prices for inputs and

outputs and policies. The second row provides the net social profit (440517.656MZM per hectare) of tomato production using the social prices while the last row provides with the effects of divergences in Moamba tomato production as compared with international price which could be as a result of policy distortion, tax, subsidy and many more policy implications.

Tomato production in summer season

The farm budget for producing tomato in summer season is shown below.

Table 5: Private Prices in summer

Tradable inputs	Quantity in Mozambique (a)	Quantity in South Africa (b)	Private Price (Mts) (c)	Social Price (Mts) (d)	Cost in Mozambique (Mts) (e)=(a)*(c)	Cost in South Africa (Mts) (f)=(b)*(d)
Fertilizer(kg/ha)						
- NPK	200	200	12	11.4	2400	2280
- UREA	350	350	6.48	6.156	2268	2154.6
- Calcium Ammonium Nitrate	300	300	4.35	4.1325	1305	1239.75
- Mono ammonium Phosphate	300	300	4.26	4.047	1278	1214.1
Seedling (plants/ha)	23500	23500	1.35	1.35	31725	31725
Custom	31725		0.05		1586.25	
Pesticides						
- Tamarom (liter/ha)	700	700	10	9.5	7000	6650
- Cupravit (kg/ha)	144	144	75	71.25	10800	10260
- Stuart (liter/ha)	2400	2400	4	3.8	9600	9120
- Diper- Dip (liter/ha)	1050	1050	10	9.5	10500	10500
- Ag-Tap (kg/ha)	300	300	10	9.5	3000	2850
- Agromectin (liter/ha)	480	480	20	19	9600	9120
- Agrimek (liter/ha)	800	800	10	9.5	8000	7600
- Acefate (liter/ha)	4200	4200	4	3.8	16800	15960
- Abametin (liter/ha)	700	700	5	4.75	3500	3325
Fuel (Liter/ha)	99.76	69.76	38.6	43.2	3850.736	3013.632
Non-tradable inputs						
- Labor (/ha)	4	4	3010	6824.46	12040	27297.84
- Tractor (hr)	9.58	9.58	776	3104	7524.8	6747.172
- Land (ha)	0	0	0	0	0	0
- Transportation (trip)	11		9046		16123.7	
Output						
- Tomato (kg/ha)	47460	47460	26.2	17.59	1243452	834821.4

Source: Field survey, 2014

From Table 5, the productivity of tomato in summer is 47,460 kg/ha. The yield data were validated by checking with the village leader in Moamba. The information from Table 5 was used to complete the policy analysis matrix for producing tomato in summer season.

Table 6: Policy Analysis Matrix for tomato production in summer (Mts/ha)

	Revenue	**Costs**		**Profits**
		Tradable inputs	**Domestic factors**	
Private prices	1243452	154113	97262.99	992076.024
Social(shadow) prices	834821.400	151689.632	34045.012	649086.756
Effect of Divergences	408630.600	2423.354	63217.978	342989.268

Source: Field survey, 2014

The net private profit (992076.024MZM/ha) in the summer season of tomato production indicates that the profit margin is large and therefore tomato production in Moamba district is highly competitive given the current technologies, prices for inputs and outputs and policy. Table 6 showed that private profitability was higher than social profitability which was due to price variation although the overall market profits show fairly good private profitability. Since, the social profitability (649,086.756MZM) was positive, that means Moamba farmers had comparative advantage in producing tomato than South Africa. On the other hand, social profitability is greater than private profitability in the fresh season (table 4) due to price variation. Hence, the result from both fresh and summer PAM tables showed that tomato production had a positive social profit and hence it is competitive and has comparative advantage.

Policy Indicators

Table 7 below shows the values of calculated policy indicators derived from the PAM tables.

Table 7: Summary of PAM indicators

Season	NPCO	NPCI	EPC	DRC
Summer	1.489	1.016	1.595	0.050
Fresh	0.758	1.025	0.703	0.072

Source: Field survey, 2014

The NPCO in the fresh season (0.758) means that farmers receive an actual price that is 24.2% lower than the true price. This implies that there is implicit tax on the tomato production in the fresh season and that the private price is lower than the social (shadow) price. In the summer season, NPCO (1.489) was greater than one, indicating that consumers were indirectly taxed and that policy increased output prices by 48.9% because world prices do not set domestic prices. However, the value of NPCI for summer and fresh season were

1.016 and 1.025 respectively which is greater than unity. This implies indirect taxes on tradable inputs and thus, government policies did not support tomato production inputs in the market. The EPC in the fresh season(0.703) is less than unity and indicates that value added at market prices were lower than the value added at South Africa market. This implied that there is a negative effect of incentives on tomato policy and thus no export subsidy to tomato producers in Moamba district in fresh season. The EPC in summer season is greater than one (1.595), which means that the net impact of government policy and tradable input price policy, influences product markets. The domestic resource cost (DRC) coefficient had values less than one (0.050 and 0.072) which indicates that tomato production in Moamba is competitive and has comparative advantage in both seasons given current technologies, output values, input cost, and policy transfers.

Conclusion and Recommendations

Mozambique has a great potential in tomato production and from PAM analysis, the results showed that Mozambique has a comparative advantage over South Africa in producing tomatoes in both seasons. However, there are negative policy distortion effects, low protection and low subsidy provided for the tomato producers. Some of the divergence between private and social values, which shows the net effect of policy distortion and market failures, were positive which indicated that commercial farmers were implicitly taxed. Therefore we recommend that Mozambican farmers should be encouraged to expand tomato production given that it is competitive and has a comparative advantage while South Africa should focus on other crops production where they have comparative advantage over. Also farmers should be exposed to more lucrative markets especially internationally because penetrating in other markets means processing and value addition thereby taking into account issues of quality and customer preferences. Also, government should implement price ceiling and floor prices of tomato to reduce the amount of imported tomatoes during the summer season when the prices are relatively high in Mozambique in comparison to South Africa.

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