The impact of food aid on maize prices and production in Swaziland

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Abstract

The objective of the study was to provide empirical evidence on whether food aid leads to depressed domestic maize prices and reduced maize production in subsequent years in Swaziland. The lack of empirical evidence has often resulted in premature negative conclusions about the impact of food aid on Swaziland's maize industry. The study used secondary national data from 1985 to 2006. Variables used in the statistical analysis included quantity of cereal food aid; quantity of commercial maize imports; quantity of locally produced maize; official maize producer price; open market maize producer price; fertilizer price; fuel price; rainfall; and total area planted to maize. The impact of food aid was measured using the reduced form market equilibrium model consisting of maize quantity and maize producer price functions, estimated simultaneously through the two-stage least squares (2SLS) method. Analytical results revealed that food aid received by Swaziland does not lower prices of domestic maize and has no significant negative effect on the quantity of maize produced in subsequent seasons.

Keywords: Food aid; Swaziland; maize prices; maize production

1. Introduction

The debate over food aid, according to Lowder (2004), dates back to 1959 from an article written by Cochrane (1959), which claimed that agricultural supplies from the United States of America could be dispensed in the form of food aid to promote economic development in poor countries. Schultz (1960) published a rebuttal of Cochrane's argument, warning that food-for-peace was likely to have an adverse impact on farmers in recipient countries (Lowder, 2004; Barrett, 1998). Schultz (1960) was so influential that even today, more than 40

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years later, disincentives for food production in recipient countries remain at the heart of every food aid debate (Tapio-Bistrom, 2001; Lowder, 2004).

Disincentive effects of food aid on domestic agricultural production may result from farm level responses to price reduction caused by increased food supplies (Clark, 2001). A recent case in Malawi provided a clear picture of how food aid could potentially impact local maize production. In the 2002/2003 marketing season, it was discovered that food aid supplies reduced demand for commercial maize, resulting in unintended excess stocks of commercial maize, which exerted a dampening effect on consumer prices during the year and producer prices for the next harvest (Jere, 2007). The negative effects of food aid may only be realised when certain conditions prevail. According to Donovan *et al*. (2006), among other conditions, food aid can have strong negative effects when:

- It is distributed during harvest time;
- Very large quantities of food aid are released directly into countries with markets that operate with similar locally produced products; and
- Poor commodity targeting is implemented, such that the food aid commodities given to households are likely to be exchanged in markets, particularly when that commodity has a local substitute and increased market supplies lower prices for the locally produced substitute.

As a result of these price effects, food aid is often perceived as a constraint to market and trade development. Traders whose businesses rely on the sale of staple foods could suffer short-term losses as a result of decreased demand, falling prices or both (Maunder, 2006). This can occur, for example, if government releases grain provided under a food aid programme into the market at below market prices. In this situation, reduced trade volumes and profitability may serve to undermine private trader confidence in the market, thereby reducing private investment and – in the extreme – lead to disinvestment and business closure (Maunder, 2006). This could affect businesses throughout the marketing chain, including importers, major millers and local retailers.

Swaziland is among the sub-Saharan countries that have been worst affected by prevailing droughts over the past five to six years. During the 2002 to 2005 production seasons, cereal food aid played a major role in filling Swaziland's maize gap following Government's appeal to the international community to assist in alleviating the negative production impacts of 2001/2002 and successive droughts that were coupled with erratic rains. The availability of emergency food aid in Swaziland led to the National Maize Corporation

(NMC) being unable to buy maize from local farmers in 2002 to 2004 because the Corporation's silos were still filled with the previous season's maize. The NMC experienced difficulties in selling maize to millers facing demand constraints because consumers were receiving food aid that included imported maize from donor agencies. The availability of imported food aid is thought to impact negatively on the domestic maize producer price, discouraging farmers from taking advantage of the rains (that sometimes come late in the production season).

Maize is the country's staple crop, and is produced by over 90% of smallholder farmers on Swazi Nation Land (FANRPAN, 2003). More than 80% of food aid received by Swaziland since 1990 came in the form of maize grain, and 71% of total food aid between 1990 and 2003 was administered under the emergency mode (WFP, 2005). Considering the extent of the alleged negative effects of food aid on domestic maize production, this study explores empirical evidence on whether food aid leads to depressed domestic maize prices and reduced maize production in subsequent years in Swaziland.

Similar studies have been carried out for sub-Saharan Africa by the World Bank (Lavy, 1990), International Food and Policy Research Institute (Abdulai *et al*., 2004), Lowder (2004), and Regional Hunger and Vulnerability Programme (Maunder, 2006), but no evidence is available specifically for Swaziland. The lack of evidence often results in premature negative conclusions about the impact of food aid on the country's maize industry.

2. An overview of the Swaziland maize industry

Maize is the staple food of Swaziland and is the main crop grown by the vast majority of smallholder farmers, largely for subsistence purposes. After harvesting their maize, farming households normally store their food requirements for own consumption. Any surplus is sold to formal markets, such as the National Maize Corporation (NMC), or through the informal sector. NMC is a state owned enterprise, established in 1985, primarily to guarantee an all year round competitive market for local maize producers.

There are predominantly two prices of maize in the Swaziland maize industry. The formal price that is set by the NMC has over the years remained 25 to 30% lower than prices in the informal sector (Oxford Policy Management, 1998). With a view to reducing the need to import the staple food, the Government of Swaziland uses the gazetted floor price as a tool to encourage farmers to produce maize with a view to reducing the need to import the staple food. The floor price serves as a safety net in that if farmers cannot find a better price offer elsewhere, they are assured of the minimum price that they are entitled to get for their harvest, hence it also serves as a price stabilisation instrument. This price is mainly based on the cost of bringing maize into Swaziland (import parity) plus a small compensation for the relatively higher production costs in the country (National Maize Corporation, 2005).

Despite the favourable agro-ecological conditions for maize production over much of the country, maize production in recent years has declined. Food self-sufficiency in terms of maize production has been below 60% since the year 2000. Through the Ministry of Agriculture and Cooperatives, the Swaziland Government continues to provide a number of services aimed at improving maize production. Major services include provision of tractors for land preparation at highly subsidized rates. Government also provides free research and extension services to all farmers, including maize producers.

Despite the magnitude of support offered by Government to local maize producers, the industry is faced with a number of formidable challenges. The constraints to producing maize in Swaziland, as summarized by FANRPAN (2003), are as follows:

- The average landholding size on Swazi Nation Land (SNL) is 1.7 ha, and land continues to be fragmented into even smaller units with time, due to population growth. This limits the area on which maize and other crops can be produced.
- Rain has become very erratic with prolonged dry spells. This limits soil moisture and seriously affects maize yields.
- Soil acidity or low pH reduces the availability of nutrients in the soil and causes root stunting.
- There is a high demand for tractors immediately after rains due to rain-dependent production.
- The escalating cost of production, mainly of fertiliser and seed, limits adequate application of fertiliser and seed, leading to reduced maize yields. Since land is finite and land holdings are small, the only option to increase production lies in increasing productivity of each land unit. All fertilizer is imported and transported over long distances, further compounding production costs.

3. An overview of the food aid programme in Swaziland

Although food aid programmes were not originally focused on humanitarian objectives, the intent of most food aid today is to relieve unnecessary human suffering (Barrett, 2006). The Government of Swaziland uses food aid to bridge deficits during crises. The aid comes from local resources or through assistance from the international community.

In the absence of a food aid policy in Swaziland, relief interventions are managed through the Disaster Management Act of 2006 (Government of Swaziland, 2006). Other commodities received as food aid by Swaziland, apart from maize grain, include rice, beans, corn soya blend, skim milk and vegetable oil. Forty two percent of food aid supplied to Swaziland between 1990 and 2003 came from USA. Other notable donors include the European Commission (21%), Switzerland (13%) and other countries such as Sweden, Libya, Italy, Japan, Finland and Germany (WFP, 2005).

The total number of beneficiaries in the 2006 season was around 250 000, composed mainly of households located in the Lowveld, dry Middleveld and part of the Lubombo Plateau (Government of Swaziland, 2006). These people received assistance from the Disaster Management Agency (DMA) food interventions and the Protracted Relief and Recovery Operation (PRRO) implemented by the World Food Programme (WFP). More than 71% of total food aid received by Swaziland between 1990 and 2003 was in the emergency mode (Figure 1). Project food aid accounted for 26%, whereas programme food aid accounted for only 3%. Supply of emergency food aid began to increase in 1992 in response to the drought that affected the entire Southern African region.

It has been noted that for any in-kind food aid intervention, the source of procurement remains a critical factor in determining the market and production disincentives of food aid (Maunder, 2006; Stepanek *et al*., 1997). When sufficient food is available in-country, either through domestic production or commercial imports, local procurement of food aid is preferred by recipient countries to reduce the risk of market distortions and support local trade systems (Maunder *et al*., 2006).

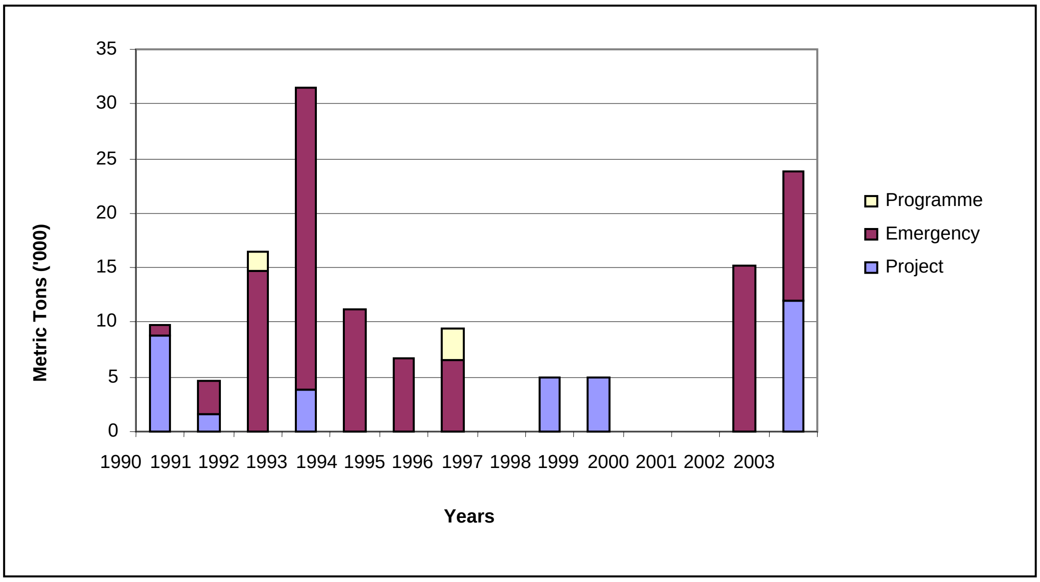

Figure 1: Cereal food aid by distribution mode supplied to Swaziland, 1990 to 2003 (WFP, 2005)

Information from WFP (2005) shows that between 1990 and 2003, 67% of total food aid supplied to Swaziland came in the form of direct transfers. Regional (triangular) purchases amounted to 17% whilst only 16% was procured from local suppliers. The argument normally made by donor agencies in justifying these statistics is that local supplies are expensive, hence they find it appropriate to buy from cheaper external sources (Mukeere & Dradri, 2006). By doing so, donors are able to cover a larger number of beneficiaries in a targeted community.

4. Recent studies on the impact of food aid on domestic agricultural production

A number of analytical tools have been used by different researchers to study the impact of food aid on agriculture. Tapio-Bistrom (2001) used a reduced-form market equilibrium model to analyse the impact of food aid on food production in Tanzania. This was a national level study that involved the use of secondary data covering the years between 1971 and 1996, and included variables such as quantity of maize produced; official and unofficial maize prices; fertilizer costs; agricultural labour costs; rainfall data; transport costs; variance of open market price; variance of food aid; total food aid and total commercial maize imported. The impact of food aid was measured using the reduced-form market equilibrium model that consisted of quantity and price functions estimated simultaneously, using the above variables through a Full Information Maximum Likelihood (FIML) method. Empirical findings did not indicate a statistically significant disincentive effect of food aid on maize production and maize producer price in Tanzania.

Lavy (1990) and Abdulai *et al.* (2004) used a vector autoregression (VAR) analysis to study the impact of food aid on food production in 33 and 42 sub-Saharan countries, respectively. Swaziland was included in the 2004 study conducted by Abdulai *et al.* (2004). Lavy (1990) used secondary data (1970 to 1987) to estimate equations for food production and food aid. Results obtained from this study showed that food aid had a significant positive effect on food production. The positive net effect of food aid on food production suggested that any disincentive induced by the additional supply of food was offset by the positive effect of food aid on food production. Lavy (1990) attributes this to the benefits of relaxed liquidity constraints and increased fertilizer consumption which, he says, outweighed price disincentives.

Abdulai *et al.* (2004) used secondary data (1970 to 2000) to estimate a vector autoregression (VAR) model for 42 sub-Saharan countries which had benefited from food aid interventions. The estimation results showed that, on average, food aid has a positive impact on food production. According o the study, the positive net effect of food aid on food production indicated that any disincentive effects due to depressed product prices induced by food aid shipments were more than offset by positive risk management and factor price effects. This is not to say that food aid is necessarily the best possible resource to use for rural development interventions, but that rural sub-Saharan Africa is so starved of resources that any reasonably well-managed aid programme can have net beneficial effects, despite the well known product market disincentive effects associated with food aid (Abdulai *et al*., 2004).

Lowder (2004) also used a vector autoregression (VAR) analysis to differentiate between the impacts of programme and emergency food aid. The sample included all 145 global food recipients between 1988 and 2001. The study found that neither programme nor emergency food aid was significantly associated with changes in domestic agricultural production.

A three-stage least squares (3SLS) method of estimation was used by Demeke *et al*. (2004) to study the effect of food aid dependency in Ethiopia at the macro-economy level. The macro-economic effect of food aid was analysed using national time series data from 1980 to 2001. The system of equations specified in the model consisted of six equations (five stochastic equations and one identity equation, describing the equilibrium between demand and supply for food aid). The equations used five endogenous variables (total quantity of local grain; per capita domestic demand for grain; per capita consumer's disposable income; commercial imports; and food grain producer price), and six exogenous variables (weather index; index for non-agricultural production; world price of food grain; food aid; retail price of food grain; and total foreign exchange flows). The equations were estimated in a linearised double-log form using 3SLS. The results of the study revealed that, at the macro-economic level, food aid increased the total domestic supply of food grains. However, a sustained increase in food aid quantity was found to have dampening effects on domestic production of food grain. Therefore, the effects of food aid on the agricultural sector appeared to be significantly negative as it put downward pressure on food grain producer prices.

5. Research methodology

The methodology adopted for this study is similar to that applied by Tapio-Bistrom (2001) that was applied to investigate the impact of food aid on Tanzania's maize industry. The impact of food aid on maize production in Swaziland was analysed by solving simultaneous equations (quantity function and price function) using a two-stage least squares (2SLS) method. Conventional economic theory states that aggregate demand and supply determine the market price (Cramer *et al.*, 1997). Therefore, both demand and supply specifications were used to analyse the effects of food aid on maize producer price and the quantity of maize produced in subsequent years. There are several possible techniques that can be applied to solve simultaneous equations. However, the two-stage least squares (2SLS) method, which uses a single equation framework, is preferred when the data set is not that large as it is capable of successfully eliminating the degrees of freedom problem (Wonnacott & Wonnacott, 1979:295; Bollen, 1996: 120-121). It is also an efficient estimator for reduced form equations, even in the presence of multicollinearity (Kuotsoyiannis, 1992:510). The 2SLS method may also be less sensitive to specification errors in the sense that those parts of the system that are correctly specified may not be affected appreciably by errors of specification in other parts (Kuotsoyiannis, 1992:511).

The analysis relied on secondary national data from 1985 to 2006. The year 1985 was used as the cut-off year because available records from the various data sources did not have reliable data for the years before 1985. Variables used in the analysis included quantity of cereal food aid; quantity of commercial maize imports; quantity of locally produced maize; official maize producer price; open market maize producer price; fertilizer price; fuel price; rainfall; and total area planted to maize. Data were sourced from various institutions as shown in Table 1.

All prices used in the analysis were adjusted using the national consumer price index, with 1996 being used as the base year (1996 = 100) to allow for effective computation and comparison of variables over the years under review. These include official maize producer price, open market maize producer price, fertiliser price, and fuel price. Years with rainfall that was 10% below the long-term average rainfall were assumed to be drought years.

In conducting the analysis, a production model was first developed to reliably reflect the current institutional maize market in Swaziland. This is a supply function formulated on local farmers' behaviour in the present maize marketing system. Maize farmers in Swaziland sell their produce either to the National Maize Corporation (using the gazetted price) or on the open market (receiving the open market maize price). The production (supply) function was fitted using the Ordinary Least Squares (OLS) method to ascertain its significance prior to being used in formulating the reduced form market equilibrium model.

Table 1: Variables used in analysing the impact of food aid on maize production in Swaziland

Data	Unit	Source
Quantity of cereal food aid (FA)	Metric tons	World Food Programme (INTERFAIS) and Food and Agriculture Organisation (FAO)
Commercial maize imports (I)	Metric tons	National Maize Corporation, Swaziland
Local maize production (Q)	Metric tons	Central Statistics Office and Ministry of Agriculture and Cooperatives (National Early Warning Unit), Swaziland
Official maize producer prices ($\overline{p}$)	Emalangeni* per ton	Ministry of Agriculture and Cooperatives (National Early Warning Unit), Swaziland
Open market maize producer prices ($\tilde{p}$)	Emalangeni* per ton	Ministry of Agriculture and Cooperatives (National Early Warning Unit), Swaziland
Fertilizer prices (r)	Emalangeni* per ton	Farm Chemicals, Swaziland
Fuel prices (c)	Emalangeni* per litre	Ministry of Natural Resources and Energy, Swaziland
Rainfall (D)	Millimetres	Swaziland Meteorological Station, Swaziland
Total area planted to maize (LM)	Hectares	Central Statistics Office, Swaziland

*Note: * = Swaziland currency (E1 = R1)*

The quantity of maize produced for the official market (Q) was expressed as a unction of the open-maize market price ($\tilde{p}$), lagged by one year; average fertilizer price (r); cost of fuel (c); rainfall (D) and land area under maize production (LM). The production model used the open market price, as opposed to the official market price, because it is generally higher by 25 to 30% higher than the NMC official buying price (Oxford Policy Management, 1998). Therefore, its inclusion accounted for the difference between the two prices. The maize producer price was lagged by one year since, at the time of planting, a farmer would only know the previous year's maize producer price. Other variables such as transport cost, fertilizer price and rainfall were not lagged as they represent levels of occurrence in the same season as the quantity of maize produced. For instance, if farmers plough their fields in October/November 2006, the decision would be based on the amount of rainfall received during that period and not on amount of rainfall received in October/November 2005. The same applies to prices of fertilizer and fuel.

In functional form the quantity of maize produced for the official market was represented as follows:

$$\log Q_t = \alpha_0 + \alpha_1 \log \tilde{p}_{t-1} + \alpha_2 \log c_t + \alpha_3 \log r_t + \alpha_4 D_t + \alpha_5 \log LM_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where: ε_t = Error term

A reduced-form market equilibrium model was then developed based on the production model, where a quantity function and price function were expressed and solved simultaneously. The equilibrium model was developed in two stages:

In stage one, the two functions are expressed, where the quantity variable is a function of price and price is also a function of quantity.

$$\log Q_t = \alpha_0 + \alpha_1 \log \tilde{p}_{t-1} + \alpha_6 \log c_t + \alpha_2 \log r_t + \alpha_3 \log FA_{t-1} + \alpha_4 D_t + \alpha_5 \log LM_t + \varepsilon_t \ldots\ldots\ldots\ldots(2)$$

$$\log \tilde{p}_t = \beta_0 + \beta_1 \log Q_{t-1} + \beta_2 \log I_{t-1} + \beta_3 \log FA_{t-1} + \beta_4 \log \bar{p}_{t-1} + u_t \ldots\ldots\ldots\ldots(3)$$

Where:
ε_t and u_t = Error terms

The main purpose of stage one was to obtain a reduced form of the quantity function and price function.

Equation (3) leads to:

$$\log \tilde{p}_{t-1} = \beta_0 + \beta_1 \log Q_{t-2} + \beta_2 \log I_{t-2} + \beta_3 \log FA_{t-2} + \beta_4 \log \bar{p}_{t-2} + u_{t-1} \ldots\ldots\ldots\ldots(4)$$

Substituting (4) in (2) gives:

$$\log Q_t = \alpha_0 + \alpha_1\beta_0 + \alpha_1\beta_1 \log Q_{t-2} + \alpha_1\beta_2 \log I_{t-2} + \alpha_1\beta_3 \log FA_{t-2} + \alpha_1\beta_4 \log \bar{p}_{t-2} + \alpha_1 u_{t-1} + \alpha_2 \log r_t + \alpha_3 \log FA_{t-1} + \alpha_4 D_t + \alpha_5 \log LM_t + \alpha_6 \log c_t + \varepsilon_t \quad (5)$$

$$\log Q_t = \{\alpha_0 + \alpha_1\beta_0\} + \alpha_1\beta_1 \log Q_{t-2} + \alpha_1\beta_2 \log I_{t-2} + \alpha_1\beta_3 \log FA_{t-2} + \alpha_1\beta_4 \log \bar{p}_{t-2} + \alpha_2 \log r_t + \alpha_3 \log FA_{t-1} + \alpha_4 D_t + \alpha_5 \log LM_t + \alpha_6 \log c_t + \{\alpha_1 u_{t-1} + \varepsilon_t\} \quad (6)$$

$$\log Q_t = \hat{\prod}_{10} + \hat{\prod}_{11} \log Q_{t-2} + \hat{\prod}_{12} \log I_{t-2} + \hat{\prod}_{13} \log FA_{t-2} + \hat{\prod}_{14} \log \bar{p}_{t-2} + \hat{\prod}_{15} \log r_t + \hat{\prod}_{16} \log FA_{t-1} + \hat{\prod}_{17} D_t + \hat{\prod}_{18} \log LM_t + \hat{\prod}_{19} \log c_t + \hat{u}_t \quad (7)$$

Equation (2) leads to:

$$\log Q_{t-1} = \alpha_0 + \alpha_1 \log \tilde{p}_{t-2} + \alpha_2 \log r_{t-1} + \alpha_3 \log FA_{t-2} + \alpha_4 D_{t-1} + \alpha_5 \log LM_{t-1} + \alpha_6 \log c_{t-1} + \varepsilon_{t-1} \quad (8)$$

Substituting (8) into (3) gives:

$$\log \tilde{p}_t = \beta_0 + \beta_1\alpha_0 + \beta_1\alpha_1 \log \tilde{p}_{t-2} + \beta_1\alpha_2 \log r_{t-1} + \beta_1\alpha_3 \log FA_{t-2} + \beta_1\alpha_4 D_{t-1} + \beta_1\alpha_5 \log LM_{t-1} + \beta_1\alpha_6 \log c_{t-1} + \beta_1 \varepsilon_{t-1} + \beta_2 \log I_{t-1} + \beta_3 \log FA_{t-1} + \beta_4 \log \bar{p}_{t-1} + u_t \quad (9)$$

$$\log \tilde{p}_t = \{\beta_0 + \beta_1\alpha_0\} + \beta_1\alpha_1 \log \tilde{p}_{t-2} + \beta_1\alpha_2 \log r_{t-1} + \beta_1\alpha_3 \log FA_{t-2} + \beta_1\alpha_4 D_{t-1} + \beta_1\alpha_5 \log LM_{t-1} + \beta_1\alpha_6 \log c_{t-1} + \beta_2 \log I_{t-1} + \beta_3 \log FA_{t-1} + \beta_4 \log \bar{p}_{t-1} + \{\beta_1 \varepsilon_{t-1} + u_t\} \quad (10)$$

$$\log \tilde{p}_t = \hat{\prod}_{20} + \hat{\prod}_{21} \log \tilde{p}_{t-2} + \hat{\prod}_{22} \log r_{t-1} + \hat{\prod}_{23} \log FA_{t-2} + \hat{\prod}_{24} D_{t-1} + \hat{\prod}_{25} \log LM_{t-1} + \hat{\prod}_{26} \log c_{t-1} + \hat{\prod}_{27} \log I_{t-1} + \hat{\prod}_{28} \log FA_{t-1} + \hat{\prod}_{29} \log \bar{p}_{t-1} + \hat{u}_{2t} \quad (11)$$

Therefore, fitting Ordinary Least Squares (OLS) on (7), gives:

$$\log \hat{Q}_t = \hat{\prod}_{10} + \hat{\prod}_{11} \log Q_{t-2} + \hat{\prod}_{12} \log I_{t-2} + \hat{\prod}_{13} \log FA_{t-2} + \hat{\prod}_{14} \log \bar{p}_{t-2} + \hat{\prod}_{15} \log r_t + \hat{\prod}_{16} \log FA_{t-1} + \hat{\prod}_{17} D_t + \hat{\prod}_{18} \log LM_t + \hat{\prod}_{19} \log c_t \quad (12)$$

Fitting OLS on (11), gives:

$$\log \hat{\tilde{p}}_t = \hat{\prod}_{20} + \hat{\prod}_{21} \log \tilde{p}_{t-2} + \hat{\prod}_{22} \log r_{t-1} + \hat{\prod}_{23} \log FA_{t-2} + \hat{\prod}_{24} D_{t-1} + \hat{\prod}_{25} \log LM_{t-1} + \hat{\prod}_{26} \log c_{t-1} + \hat{\prod}_{27} \log I_{t-1} + \hat{\prod}_{28} \log FA_{t-1} + \hat{\prod}_{29} \log \bar{p}_{t-1} \quad (13)$$

In stage two, the estimated values of quantity and price were then substituted in the original equations (2) and (3) before estimating the second OLS to obtain the final results. The specifications were as follows:

Substitute lagged (13) into (2) and lagged (12) into (3) to obtain:

$$\log Q_t = \alpha_0 + \alpha_1 \log \hat{\tilde{p}}_{t-1} + \alpha_2 \log r_t + \alpha_3 \log FA_{t-1} + \alpha_4 D_t + \alpha_5 \log LM_t + \alpha_6 \log c_t + u^*_{1t} \quad (14)$$

and

$$\log \tilde{p}_t = \beta_0 + \beta_1 \log \hat{Q}_{t-1} + \beta_2 \log I_{t-1} + \beta_3 \log FA_{t-1} + \beta_4 \log \bar{p}_{t-1} + u^*_{2t} \quad (15)$$

Results obtained from stage two were then used to detect the effect of food aid and other variables on the quantity of maize produced (14) and maize producer price (15).

6. Results and discussion

6.1 Maize production model

As shown in Table 2, the model was significant at the one percent level of probability and explained 64% of total variation in maize production. Average fuel price and average fertilizer price were not significant. The open market price and area of land planted to maize were significant ($p < 0.1$) with price showing a negative sign that was against *a priori* expectations. This may be due to the effects of frequent droughts experienced in Swaziland over the study period that led to declining maize quantity as a result of reduced yields and total area planted. The results are in line with observations made by FANRPAN (2003) that maize prices increased in response to the shortage of the staple crop. As expected, rainfall was significant ($p < 0.05$), confirming that the majority of local farmers heavily rely heavily on rainfall to increase maize production. Total maize production is also positively influenced by the total area of land planted to maize.

Table 2: Estimating the maize production function for Swaziland, 1985 to 2006

Variable	**Unstandardised coefficients**		**Standardised coefficients**	**t**	**Sig**	**Collinearity statistics**	
	B	**Std. error**	**Beta**			**Tolerance**	**VIF**
Constant	8.808	3.651		2.412	80.029		
Open market price lagged by one year	-0.430	0.227	-0.361	-1.892	0.078*	0.664	1.506
Average fuel price	0.167	0.183	0.184	0.909	0.378	0.592	1.689
Average fertilizer price	-0.254	0.326	-0.155	-0.780	0.448	0.615	1.626
Rainfall	0.217	0.087	0.451	2.511	0.024**	0.751	1.332
Amount of land planted to maize	0.503	0.244	0.336	2.061	0.057*	0.911	1.098
ANOVA						**Model summary**	
Model	**Sum of squares**	**df**	**Mean square**	**F**	**Sig.**	R^2	DW
Regression	0.731	5	0.146	5.253	0.006**	0.636	2.061
Residual	0.418	15	0.028				
Total	1.149	20					

*Note: *,** and *** indicate statistical significance at 10%, 5% and 1%, respectively*

6.2 Impact of food aid on quantity of maize produced

This model includes a food aid variable, namely 'quantity of food aid lagged by one year'. The results presented in Table 3 indicate that the model was significant ($p < 0.05$) and explained 87% of total variation in quantity of maize produced. Although the Durbin Watson (DW) statistic appeared to be within the inconclusive range, the function, however, showed no sign of multicollinearity (VIF) amongst the explanatory variables. Average fertilizer price and rainfall were not significant. The open market price was significant ($p < 0.05$) although the coefficient had a negative sign. The results are consistent with observations made by FANRPAN (2003) that, since the onset of drought in the Southern African region, maize prices have increased due to shortage of white maize as a result of a decrease in the total area planted. As expected, the amount of land planted to maize was significant ($p < 0.05$), implying that total production increases as more land is planted to maize.

Table 3: OLS results for analysing impact of food aid on quantity of maize produced, Swaziland, 1985 to 2006

Variable	Unstandardised coefficients		Standardised coefficients	t	Sig	Collinearity statistics	
	B	Std. error	Beta			Tolerance	VIF
Constant	3.667	4.434		0.827	0.446		
Estimated open market price lagged by one year	-1.432	0.512	-1.002	-2.796	0.038**	0.202	4.941
Average fertilizer price	0.107	0.384	0.059	0.278	0.792	0.579	1.726
Quantity of food aid lagged by one year	0.220	0.092	0.580	2.377	0.063*	0.438	2.285
Rainfall	0.056	0.166	0.112	0.334	0.752	0.231	4.338
Amount of land planted to maize	1.103	0.350	0.818	3.155	0.025**	0.387	2.585
Average fuel price	0.527	0.213	0.561	2.469	0.057*	0.503	1.988
ANOVA						**Model summary**	
Model	**Sum of squares**	**Df**	**Mean square**	**F**	**Sig.**	R^2	DW
Regression	0.622	6	0.104	5.576	0.040**	0.870	2.890
Residual	0.093	5	0.019				
Total	0.714	11					

*Note: *,** and *** indicate statistical significance at 10%, 5% and 1%, respectively*

Average fuel price was also significant ($p < 0.10$) with a positive coefficient, which was against *a priori* expectations. The positive sign could be an indication that, despite increase in fuel costs, farmers continue to use tractor-drawn implements for maize production. The observation could be justified, as the tractor hire service is highly subsidized by Government. Over 90% of maize producers are found on Swazi Nation Land (SNL) and rely heavily on the Government tractor hire service for land preparation (Oxford Policy Management, 1998; FANRPAN 2003). Government hire charges have remained almost 60% lower than those of the private sector since 1980 when the programme, for the first time, was fully embraced under the Government recurrent budget (Government of Swaziland, 2003).

The food aid coefficient was significant ($p < 0.1$) with a positive sign, suggesting that food aid has a positive influence on domestic maize production. This observation is consistent with the findings of Lavy (1990), Tapio-Bistrom (2001) and Abdulai *et al.* (2004). Demeke *et al.* (2004), however, found a negative relationship between food aid and food production. In the case of Swaziland, this could be an indication that the gradual shift by donors (including WFP) towards local procurement of maize for emergency interventions encourages those farmers who are still capable of producing maize under the prevailing conditions to produce even more (National Maize Corporation, 2005). These farmers are taking full advantage of the increasing maize producer price in local markets. The Swaziland Government is also encouraging donors to prioritise local markets for sourcing food aid commodities in order to improve local production (Government of Swaziland, 2005).

6.3 Impact of food aid on maize producer price

As shown in Table 4, the maize open market producer price model (based on equation 15) was not significant, and none of the explanatory variables were significant. Therefore, no conclusion could be drawn on the relationship between food aid and maize producer price at this stage.

Recognising the low degrees of freedom in the analytical results, an attempt was made to eliminate variables with parameter estimates that were not significant, at least at the 20% level of probability in the first stage of the analytical process (equation 1, see also Table 2). Consequently, two variables, namely average fuel price and average fertilizer price, were eliminated. The original analytical framework was maintained, meaning the impact of food aid on maize quantity produced and maize producer price was analysed in the same format as in the first attempt, but this time with the exclusion of average fuel price and average fertilizer price. Tables 5 and 6 present the results obtained after excluding the two variables.

Following the exclusion of the two variables, the quantity function remained significant ($p < 0.05$), showing no sings of multicollinearity (VIF) or serial correlation (DW). The model explained 68% of total variation in maize production. From a total of four explanatory variables, three were significant with their coefficients showing signs consistent with *a priori* expectations. As expected, the amount of land planted and rainfall were significant ($p < 0.05$) and their coefficients were positive. This indicated that an increase in amount of rainfall and total land planted is likely to increase total maize production at the end of the season.

The open market maize producer price was also significant ($p < 0.1$) with a negative coefficient. As already explained, this may be due to the effects of the frequent droughts experienced in Swaziland over the study period that led to declining maize quantity, as a result of reduced yields, total area planted and higher prices. Although the food aid coefficient remained positive, the variable, however, was not significant this time. An important observation though is that, despite not being significant, it is still evident from the results that food aid does not have a negative relationship with domestic maize production.

Table 4: OLS results for analysing impact of food aid on maize open market producer price, Swaziland, 1985 to 2006

Variable	**Unstandardised coefficients**		**Standardised coefficients**	**t**	**Sig**	**Collinearity statistics**	
	B	**Std. error**	**Beta**			**Tolerance**	**VIF**
Constant	10.173	5.337		1.906	0.098		
Estimated quantity of maize lagged by one year	0.687	0.730	0.578	0.941	0.378	0.264	3.793
Commercial maize imports lagged by one year	-0.893	0.565	-1.021	-1.580	0.158	0.238	4.202
Quantity of food aid lagged by one year	-0.097	0.117	-0.302	-0.830	0.434	0.754	1.327
Official maize market price lagged by one year	-0.017	0.402	-0.014	-0.042	0.967	0.899	1.113
ANOVA						**Model summary**	
Model	**Sum of squares**	**Df**	**Mean square**	**F**	**Sig.**	R^2	DW
Regression	0.158	4	0.040	0.766	0.580	0.304	1.211
Residual	0.362	7	0.052				
Total	0.520	11					

Table 5: OLS results for analysing impact of food aid on quantity of maize produced, Swaziland, 1985 to 2006 (after eliminating fuel price and fertilizer price)

Variable	Unstandardised coefficients		Standardised coefficients	T	Sig	Collinearity statistics	
	B	Std. error	Beta			Tolerance	VIF
Constant	1.013	4.341		0.233	0.821		
Estimated open market price lagged by one year	-0.000	0.000	-0.384	-1.918	0.087*	0.895	1.117
Quantity of food aid lagged by one year	0.067	0.088	0.184	0.762	0.466	0.619	1.617
Rainfall	0.269	0.104	0.523	2.583	0.030**	0.876	1.141
Amount of land planted to maize	0.852	0.343	0.622	2.485	0.035**	0.572	1.747
ANOVA						**Model summary**	
Model	**Sum of squares**	**df**	**Mean square**	**F**	**Sig.**	R^2	DW
Regression	0.576	4	0.144	4.714	0.025**	0.677	2.258
Residual	0.275	9	0.031				
Total	0.851	13					

*Note: *,** and *** indicate statistical significance at 10%, 5% and 1%, respectively*

The maize producer price function, as shown in table 6, was not significant, even after eliminating the two variables. None of the explanatory variables were also significant, including the quantity of food aid.

Table 6: OLS results for analysing impact of food aid on maize open market producer price, Swaziland, 1985 to 2006 (after eliminating fuel price and fertilizer price)

Variable	Unstandardised coefficients		Standardised coefficients	t	Sig	Collinearity statistics	
	B	Std. error	Beta			Tolerance	VIF
Constant	10.089	5.064		1.992	0.087		
Estimated quantity of maize lagged by one year	0.603	0.547	0.555	1.102	0.307	0.376	2.662
Commercial maize imports lagged by one year	-0.807	0.451	-0.922	-1.789	0.117	0.359	2.788
Quantity of food aid lagged by one year	-0.075	0.117	-0.233	-0.643	0.541	0.730	1.369
Official maize market price lagged by one year	-0.031	0.394	-0.026	-0.079	0.939	0.896	1.116
ANOVA						**Model summary**	
Model	**Sum of squares**	**df**	**Mean square**	**F**	**Sig.**	R^2	DW
Regression	0.173	4	0.043	0.870	0.527	0.332	1.308
Residual	0.347	7	0.050				
Total	0.520	11					

7. Conclusions and recommendations

The results of this study indicate that maize production in Swaziland is responsive to maize producer price in a manner that is consistent with observations made in the Southern African region. The occurrence of drought has seen an increase in maize producer prices as a result of reduced maize yields and total area planted. The 2SLS regression analysis further showed that the availability of food aid in Swaziland did not significantly influence maize producer prices. Rather, the results infer that the demand for food aid, caused by drought, seems to encourage farmers who are still capable of producing to take advantage of higher maize market prices. In conclusion, the results showed that food aid received by Swaziland does not depress domestic maize prices and reduce production in subsequent years.

Notwithstanding the results of this study, it is worth noting that Swaziland still faces a challenge in reducing the food sufficiency gap. Insufficient available maize is produced and available, creating demand for food aid. This can be addressed, to some extent, by introducing and scaling up food security programmes with a balanced mix of interventions that increase food production, increase food availability and access, and also raise the real incomes of the poor.

As this study was based on national secondary data, there is a need for analysing the effects of food aid on food production at household level. In order to fully address the current food aid debate, the household study should also analyse the likely effects of possible targeting weaknesses in the food aid programme.

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