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Full Length Research Paper

Maize market reforms in Zimbabwe: A case study of the implications on maize production viability and household food security of smallholder farmers in Mazowe District, Mashonaland Central Province, Zimbabwe

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Cross-sectional data of 2008 from smallholder farmers in the Mazowe District reveals a trend in maize production in the communal areas of Zimbabwe which suggests trade-offs between agricultural production of food crops, mainly maize, which is price regulated and production of non price regulated cash crops. An average maize yield of 1.6 tonnes per hectare, calculated from the households' production data was used to categorize farmers into high and low performers. Low performers, who constituted 54% of the farmers, had a yield below the average yield per hectare, and 46% of the farmers, the high performers obtained yields above the mean yield per hectare. Even though cotton, a cash crop, had a higher average gross margin per hectare than maize, the net returns per dollar spent (average gross margin per total variable cost) was higher for maize than for cotton. The paper concludes that maize market reform processes in Zimbabwe were proving to be promoting cash rather than food crop production in the smallholder farming sector. The implication for the observed decline in maize production is that the decontrol of maize needs to be adopted to give farmers incentive to continue and increase production levels of maize.

Key words: Market reforms, household, food self-sufficiency, viability, gross margin analysis, smallholder, Zimbabwe.

INTRODUCTION

One of the most contentious policy debates in Africa concerns how agricultural markets should be organized and most African governments initiated programs of agricultural market reform in the 1980s as part of economic structural adjustment programs (Jayne et al., 2002). The academic literature on agricultural market reform in Africa also ranks the most divided and inconsistent within the field of economic development. While some scholars find that market reform has generally supported agricultural growth and food security, a growing literature has explained the poor record of reform in terms of inadequate attention to the institutional foundations of markets and weak infrastructure, all of which lead to growth impeding market failures (Jayne et al., 2002).

The fundamental reason for the development of controlled, maize marketing systems in Zimbabwe, Kenya, Zambia and South Africa was the former white governments' goal of ensuring the viability of European farmers (Rukuni et al., 1994). This required, to varying

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degrees, the suppression of African maize production and trade. The system of controls had a major side-effect on urban maize consumption patterns in the region, specifically the shift from hammer- milled whole meal to more expensive, refined roller-milled meal (Jayne et al., 1995).

One critical policy issue under argument in most of these governments is the use of the liberal policy of market liberalization in food markets as being more effective than relying on state monopoly marketing boards. The role of food marketing policy is to ensure that basic foodstuffs are available at all times at affordable prices to consumers. It also ensures that a market is available for domestic food producers and that the prices that they receive are reasonable to motivate them to continue and probably increase production levels (Rukuni and Bernsten, 1988).

Most governments' target and objective is of enhancing development and production in the smallholder sector and it is characterized by the use of various policy instruments in a bid to achieve the set objective (Calvin et al., 1991). The Zimbabwean government's major objective since the post-colonial era has been to promote development in the smallholder production sector (Rukuni et al., 1994). As a result, the principal objective guiding government policies that promote this development of the smallholder sector has been the encouragement of the growth of crop production, especially maize; its staple crop (Rukuni et al., 2006).

The various policy instruments that have been used in Zimbabwe include; the use of incentive producer prices in an attempt to stimulate production, lower consumer prices to promote household food security, controlled marketing and price of maize and market liberalization policy, (Rukuni et al., 1994). According to Rohrbach (1989), some of these policies had to be discarded upon realization that they only helped to fuel the increased operational costs and created huge deficits for the state-run, sole buyer of maize, the grain marketing board (GMB).

Maize production is an important part of the smallholder farming systems economy as it meets households' requirements for food and provides a source of income from the sale of surplus (Rohrbach, 1989). Price controls on maize in Zimbabwe have been viewed by government as the solution to the problem of food scarcity and household food insecurity in the smallholder production sector as evidenced by the re-introduction of these controls in 2001 (Rukuni et al., 2006). However, a worsening food security crisis and declining maize production levels in the smallholder sector of Zimbabwe have only accompanied this re-introduction of the price controls and the apparent failure of market liberalization programs to deliver efficient markets reopened the debate on the role of government intervention versus free market forces in influencing the marketing and pricing of a commodity (FANRPAN, 2002).

In 2002, Zimbabwe suffered the largest deficit in its food production, which left the country with a crippling 70% shortfall on its annual food requirements (FAO, 2007). Regardless of this food shortage crisis, the Zimbabwean government was not forthcoming in facilitating free multiple traders and private traders who were willing and able to import grain for commercial distribution throughout the food insecurity threatened nation (FANRPAN, 2002).

Agricultural market reforms in Zimbabwe

In the late 1970s, many African countries faced a serious fiscal crisis; failing industrial sectors, stagnating agricultural sectors, declining commodity prices and climbing trade deficits had severely compromised the potential for economic growth (Kherallah et al., 2000). The crisis forced many of these countries to accept much-needed structural adjustment and stabilization programs under the guidance of the International Monetary Fund (IMF) and the World Bank. The reform programs sought to reverse balance-of-payment deficits and declining growth rates. Because of the importance of agriculture in Sub-Saharan Africa, agricultural market reforms occupied a central place in these liberalization efforts. According to Jayne et al. (1995), the agricultural reform measures were designed to do four things:

1. To eliminate government control over input and output prices;
2. To reduce exchange rate overvaluations;
3. To eliminate regulatory controls over input and output marketing and;
4. To restructure public enterprises and reduce marketing board involvement in agricultural pricing and distribution.

The expectation was that improving price incentives for farmers and reducing government intervention in the agricultural sector would be enough to generate a sizeable supply response and allow well-functioning markets to emerge quickly (Kherallah et al., 2000). Reform advocates anticipated that reform would induce agricultural growth. But, agricultural growth in most Eastern and Southern African countries in the 1990s was unimpressive, and there has been a widespread tendency to attribute this, at least partially, to the failure of agricultural reform (Jayne et al., 1995).

Government control over output price of maize in Zimbabwe was reimposed in 1998; five years after the government eliminated them under a 1993 World Bank/IMF structural adjustment loan program (Poulton et al., 2002). This economic structural adjustment program (ESAP) was implemented in Zimbabwe from 1991 to 1995 and the grain marketing board (GMB) remained the dominant buyer of grain throughout the reform process and even after the reform process. The GMB, a

government monopoly agency, buys and sells major cereals at controlled prices and the set prices discourage production hence the negative effect on availability (Mafumhe, 2010). So from the period 1998 to 2008, the government of Zimbabwe has effectively imposed government controls on the grain market.

One of the major problems emerging from the GMB's monopoly was high national food insecurity that was arising from the distorted marketing and distribution systems of the marketing board (Mudzanga and Chigwada, 2009). This has been as a result of the poor domestic producer price incentives for new farmers to expand production of food grains especially in the presence of lucrative export oriented cash crops that are sold through competitive and uncontrolled domestic channels, which has caused further reduction in maize production, thereby limiting the amount of food available on the market (African Institute for Agrarian Studies, 2006). While Zimbabwe's production of cereal crop decreased, the market reform of continued government control over producer and selling prices of maize that existed up to 2008/2009 agricultural seasons favored the production of cash crops like tobacco, cotton and horticulture (Mafumhe, 2010).

Maize production and food security in Zimbabwe

Maize is the most important cereal crop grown in Zimbabwe, ranking first in the number of producers, area grown and total cereal production and it is also the staple food crop of the nation (FAO, 2007). The production of maize is a major activity on smallholder farms, where the greater part of it is retained for home consumption and the surplus is sold.

With the advent of independence in 1980, the Government of Zimbabwe (GoZ) introduced measures to improve the production levels of resettled small holder and communal farmers which involved the increase in extension services and coverage and improved producer prices for maize (Rukuni et al., 1994). State owned agencies, such as the GMB set the conditions for expanding maize production in the communal areas. The GMB expanded its coverage of collection points and depots from three in 1987 to thirty-seven in 1991 and it announced producer prices in advance of the harvest throughout this period (Rukuni et al., 2006). This created incentives for farmers, especially the small scale commercial and communal farmers to sell their produce to the GMB, which had a monopoly in the buying and distribution of grain products (African Institute for Agrarian Studies, 2006). At first, it was cheaper for farmers to sell their maize grain and then purchase subsidized maize meal rather than withhold stocks for household consumption and pay local grinding fees.

The thrust of national policy was production of as much maize as possible and the GMB was expected to keep a large grain reserve. Government also heavily controlled producer prices and the prices of basic commodities, such as mealie meal, bread and flour. In terms of achieving national food security, this model produced success, yet the situation on the ground was that of hunger at household level, amidst plenty (African Institute for Agrarian Studies, 2006).

Large scale commercial farmers gained more from their tobacco and horticultural exports, while smallholder farmers were able to gain from growing cash crops such as tobacco, paprika and cotton (African Institute for Agrarian Studies, 2006). The debate on whether to grow cash crops rather than food crops widened. As commercial farmers moved away from maize as a commercial crop, food crop farming stagnated. This was due to the producer prices still being controlled, as the GMB through Government was slow to relinquish control over these food crops, so farmers switched to more profitable crops. The consequences of these policies on food security were not easily visible as domestic food supplies were still sufficient to cover the county's needs in most cereals, other than wheat.

Figure 1 shows the trend in national maize production over a period of 14 years, 1994 to 2007, using the Food and Agriculture Organisation of the United Nations (FAO) production data. The figure also includes respective linear regression trend line that suggests significant decline in maize production since 1994.

Conceptual framework

This paper focuses on households as a decision-making unit. This focus specifies that the households have access to a limited amount of resources that they can use in its production activities to satisfy consumption requirements and to attain a food secure status (Wyckoff and Rukuni, 1992). Conventional economic model of the household theorizes that a household has to allocate its resources in a manner that will meet its aspirations within the limits imposed by production technology, institutional and market factors (Mutamba, 1999). Figure 2 presents the conceptual framework.

Figure 2 gives a diagrammatical illustration of the factors that affect and/or influence the smallholder farmers' decision to engage in one enterprise over the other. There are various factors that influence the farmers' selection of the type of crop to produce (cash or food crop) and these include physical, institutional, economic, social and external factors (Macharia et al., 2002). Pricing policy interventions that affect household behavior in resource allocation and decision-making of the level of production also represent the institutional factors that impact on smallholder farmers' maize production levels and their levels of household food security (Arora and Alamgir, 1991).

Most policy interventions have either failed to make an

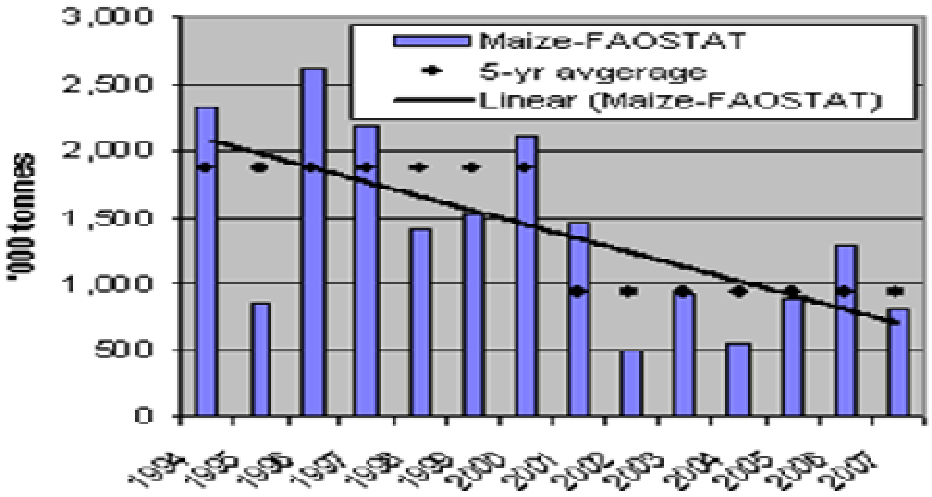

Figure 1. Maize production trends 1994 to 2007 (FAOSTAT). FAO Report (2007).

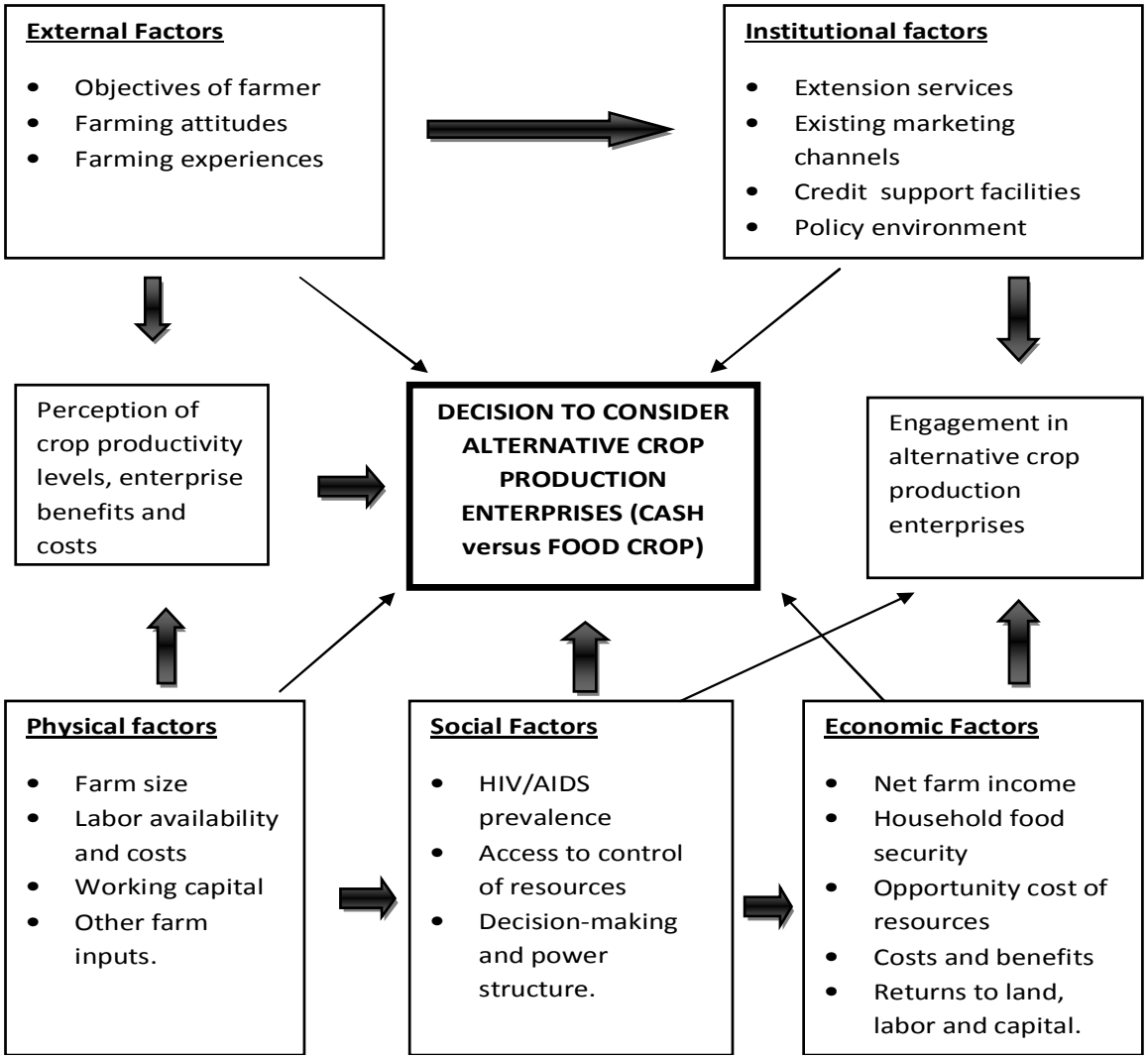

Figure 2. Conceptual model of farmers' choice decisions. Modified from Macharia et al. (2002).

impact or have had counter-productive effects on the welfare of rural households and the environment (Rukuni et al., 1994). Mutamba (1999) argues that these policy failures have been a result of the lack of understanding of how rural households arrive at decisions as producers and consumers and that this has severely undermined efforts to influence behaviors through policy. It is against such a theoretical background that the study seeks to understand how smallholder maize production under the price regulation compares with the production of a non-price regulated crop.

This paper examines the effect that government intervention in the pricing of maize has on the maize production levels of the smallholder farmers. The analysis is based on the amount of maize output produced by the smallholder farmers, the percentage of households that are able to produce enough for their own consumption and the land allocations between maize and a market liberalized cash crop. The assumption is that the controlled pricing of maize, being a form of market reform, is the major contributor to declining production and a vehicle in worsening the food insecurity status in Zimbabwe.

The objective of this paper therefore, is to investigate the impact that government intervention in the agricultural marketing of the maize crop has on production levels, viability and household food self- sufficiency of the smallholder farmers. This is done by, firstly identifying the key factors influencing the level of maize production among the smallholder farmers and their decision to expand production. Secondly, by evaluating the profitability and viability of maize production compared to production of a non-price regulated crop grown by the smallholder farmers (cotton), and lastly by analyzing the relationship between the level of maize production and household food self-sufficiency status among the smallholder farming households.

METHODOLOGY

Study area

Mazowe District is an area located in Mashonaland Central Province of Zimbabwe in agro-ecological region 2; receiving average rainfall of 750 to 1000 mm per year and it is a region where farmers produce most of the country's maize output. Mashonaland Central Province is a major cropping and livestock production area and Mazowe district in particular is a prime agro-ecological zone of Zimbabwe.

Research data and analysis

This paper uses primary data collected from the study area. The unit of analysis in this study was the household and simple random sampling was used to select households. The sample size was 90 smallholder farmers. Data collected was for the 2006/2007 season and land allocation data for the 2007/2008 season was collected also for comparison with the previous (2006/07) season. Data was run in statistical packages for social scientists (SPSS).

An ordinary least squares regression analysis was done to determine whether the various independent factors were statistically significant variables in explaining the variations in the maize productivity of the households. Gross margin analysis was used to determine the profitability and viability of the maize and cotton production activities. The food security statuses of the households were estimated from the calculation of food self-sufficiency (FSS) indices, which is a ratio of a household's total grain requirement per year to the household's total grain supply (output). This FSS was used as a proxy measure of the households' food security status.

Regression analysis

A regression model was used in the analysis to examine the factors that affect maize productivity and hence also food security. The paper assumed the following regression model:

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \cdots\cdots\cdots + \alpha_{10} X_{11} + \mu_i$$

where, Y = maize output (ton/hectare) 2007, X_1 = area planted under maize (2006/2007), X_2 = area planted under cotton (2006/2007), X_3 = total area of land owned, X_4 = total maize output (2006/2007), X_5 = draft power ownership (2006/2007), X_6 = total labor used per tonne, X_7 = household size, X_8 = age of household head, X_9 = sex of household head, X_{10} = output price of maize, X_{11} = output price of related good (cotton), α_0, α_1-α_{11} = regression model parameter estimates

μ_i = random error term.

The estimated equation in the foregoing is a linear production function representing the relationships among a collection of the economic variables in this analysis. The relationships are specified based on the economic theory of the firm. The household in this case is likened to a firm. Consider a household or firm which uses *n* inputs to produce a single output, in this case, maize. For *i* = 1,...., n, let x_i denote the amount of input *i*. The vector (x_1,....,x_n) is called an input bundle. The household's production function assigns to each input bundle (x_1,.....,x_n) the maximal output y=f (x_1,....,x_n) that it can achieve from that input bundle. The production function in this analysis is a multivariable function which seeks to find out the effect of changes in the amounts of more than one input (Simon and Blume, 1994). The general specification of the linear production function for the households is as follows:

$$y = a_1x_1 + a_2x_2 + \ldots\ldots\ldots + a_nx_n$$

Auxiliary regressions

An important assumption of the linear regression model is that there is no exact linear relationship(s), or multicollinearity, among explanatory variables (Gujarati, 1999). As many of the explanatory variables are determined simultaneously, correlation between the variables is possible hence auxiliary regressions were estimated to determine the degree of multicollinearity amongst the multiple explanatory variables. Auxiliary regression is one of some of the rules of thumb, or indicators that will provide us with some clue about the existence of multicollinearity in concrete applications (Gujarati, 1999).

Since multicollinearity arises because one or more of the explanatory variables are exact or near exact linear combinations of other explanatory variables, one way of finding out which X variable is highly collinear with other X variables in the model is to regress each X variable on the remaining X variables and to compute the corresponding R^2. Each of these regressions is called a subsidiary or an auxiliary regression, auxiliary to the main regression of Y on all Xs. The estimated R^2_i will range between 0 and 1. If an X

Table 1. Testing the significance of R^2_i values from the auxiliary regressions.

X	Value of R^2_i	Value of F test	Is F significant?
X_1	0.40	60.77	Yes**
X_2	0.06	0.63	No
X_3	0.27	2.97	Yes**
X_4	0.47	69.20	Yes*
X_5	0.12	0.99	No
X_6	0.09	0.74	No
X_7	0.15	1.50	No
X_8	0.02	0.48	No
X_9	0.03	0.52	No
X_{10}	0.01	0.44	No

*, 5% significance level; **, 10% significance level.

variable is not a linear combination of the other Xs, then R^2_i of that regression should not be statistically different from zero by using the F test results.

From the results presented in Table 1, the 3 explanatory variables whose F test values are significant have R^2 values that do not suggest any perfect or exact collinearity as the values are not highly close to one, and according to Gujarati (1999), if the objective of the study is to estimate a group of coefficients fairly accurately as is the objective of this study, this can be done as long as collinearity is not perfect. Hence, the degree of multicollinearity in the explanatory variables is not perfect nor near perfect collinearity.

Gross margin analysis

Gross margin analysis was used to compare the returns between engaging in maize production (a price regulated cropping enterprise) and cotton production (a non-price regulated cropping enterprise). Gross margin analysis is useful for production cycles of less than a year as it enables costs and returns to be directly linked to the enterprise. Gross margin is the difference between the total sales and the variable costs (Kilmer and Armbruster, 1987).

Gross margin = Total sales (gross income) – Variable costs

Where: Gross income = Total volume of output (Q) x price (P) and Variable costs include the costs of inputs such as fertilizer, seed, crop chemicals, labor costs, marketing costs, etc that would have been incurred in the production process until the produce has reached the market.

Assuming that fixed costs stay constant, that is, no fixed costs are paid, the gross margin is the amount at the household's disposal, and an increase in gross margin will raise the profit by exactly the same amount (Nhundu et al., 2010). In the short run, an enterprise will be worth keeping, as long as its gross margin is positive. However, it would be more profitable in the long run to replace such enterprises with those that realize higher gross margins.

Food self-sufficiency index

Food self-sufficiency is calculated as the ratio of a households total grain production to their total grain requirement (FAO, 2001). In calculating the annual grain requirement for the different age categories, the assumption was that the labor equivalent units can be used in the same proportion and thus be used to represent the food grain requirement equivalents ratios for each category of age groups (Mudimu and Bernsten, 1989).

The average grain or cereal food requirement per year used was 250 kg per capita according to FAO (2007). A food self-sufficiency ratio equal to one implies that households' total grain production is able to equally suffice the households total grain requirement for the year and that there is no surplus (FAO, 2001). A food self-sufficiency index that is greater that one indicates that the household is food self-sufficient because its total grain production will be able to supply over and above its total grain requirement for the year. The converse is true for a food self-sufficiency ratio less than one. Therefore, in the context of household food security, the food self-sufficiency ratio or index is often taken to indicate the extent to which a household relies on its own production resources, that is, the higher the ratio the greater the self-sufficiency (FAO, 2001).

RESULTS AND DISCUSSION

Households' characteristics of crop production and performance

The 90 farmers that were interviewed in the study area grew mainly three crops, that is, maize, cotton and soybean, where cotton was the dominant cash crop grown by smallholder farmers in the district. Table 2 shows the average number of hectares allocated to the two crops, maize and cotton in the two agricultural seasons 2006/2007 and 2007/2008. In the 2006/2007 cropping season, maize was allocated the highest average area under cultivation with 1.61 ha of land being devoted to maize production per household as compared to cotton which was allocated an average of 0.5 ha of land per household. The average farm size for the sample of farmers was 3.22 ha per farmer.

These results also show that there was a drop in the mean area allocation to maize from 1.61 ha in the 2006/2007 season to 1.42 ha in the 2007/2008 season, amounting to a 12.042% decline. For cotton, there was a major boost in the average area under cotton production from 0.5 ha in the 2006/2007 season to 1.54 ha in the

Table 2. Average areas planted to maize and cotton and in 2006/2007 and 2007/2008.

Crop	Area planted 2006/2007 (Ha)	Area planted 2007/2008	Paired sample T-test value	Probability	Change in mean area (%)	Average Yield (tons) 2006/2007	Average price/ton ZW$ 2006/2007
Maize	1.61	1.42 Ha	1.390	0.173*	-12.04	2.323	4,200,000
Cotton	0.50	1.54 Ha	-7.295	0.000***	208.40	0.516	6,500,000

***, 1% significance level; *, 10% significance level; ZW$ = Zimbabwean Dollar.

Table 3. The regression model analysis and estimated parameters.

Independent variable	Parameter estimates	T-statistic	Probability
Constant	-5.029	3.791	0.001***
Area planted to maize	-0.829	-5.624	0.000***
Area planted to cotton	-0.397	-3.783	0.047**
Total arable area owned	-0.066	-0.529	0.601
Total output of maize	0.856	7.600	0.000***
Draft power owned	0.293	2.477	0.020**
Total labor per hectare	0.174	1.464	0.155*
Household size	0.212	1.885	0.070*
Age of household head	-0.329	-3.255	0.003***
Output price of maize	0.945	8.566	0.000***
Output price of cotton	-1.280	-8.879	0.000***
Sex of household head	-0.024	-0.232	0.818
Education level of head	0.895	6.796	0.000***

R^2 = 0.770; Adjusted R^2 = 0.702; Durbin Watson statistic = 2.379. ***, **, *, statistical significance at 1, 5 and 10% levels, respectively.

2007/2008 season amounting to a 208.4% increase in the average area under cotton production.

The paired sample t-test shows that there is a significant difference in the average area put under cotton production between the two seasons (2006/2007 and 2007/2008) with a t-statistic value of -7.295. It was therefore concluded with 99% confidence that area planted to cotton increased significantly. The paired sample t test also showed that it could be concluded with 90% confidence that there was a significant decline in the average area planted to maize in the two seasons (2006/2007 and 2007/2008).

From the decrease and increase in the cropping areas for maize and cotton respectively, as highlighted in the Table 2, it may be suggested from basic economic theory of supply that the output price for each commodity could have been one of the determinant factors in the farmers' production decision. From the economic theory of supply, as product price increases, production allocation and production of that particular product also increases.

Regression analysis

The econometric results of the regression model are presented in the Table 3. The dependent variable is maize output measured as tonnes per hectare. The model was a multiple regression analysis. The variables in the model that affect household maize productivity are area planted under maize, area under cotton, total output of maize, draught power ownership, total labour hired, household size and age of the household head as highlighted in Table 3. Each parameter estimate measures the relationship or contribution of each variable to the maize productivity level per household.

The results indicate R^2 is 0.770, implying a degree of 77.0% relationship among the independent variable. The adjusted R^2 shows that 70.2% of the variables can explain the model and the higher the adjusted R^2, the more significant the model. A Durbin Watson statistic of 2.379 which is closer to 2 indicates or gives more evidence in favour of no autocorrelation in the model. Therefore, the variables can significantly explain the model. From the results, three of the variables that are statistically significant are negatively related to the dependent variable. These three are area under maize cultivation, age of the household head and the output price of a related good (cotton). This negative relationship implies that if area under maize production is increased the maize yield per hectare (productivity) will decrease. This negative relationship is contrary to theory which expects that as area under production increases,

Table 4. Households' characteristics and maize performance.

Household characteristics (averages)	Low performers	High performers	T- value	Probability
Percentage of farmers	54	46		
Age of household head	52	48	0.808	0.425
Household size	4	5	-2.024	0.051**
Draught power owned	2	2	-0.047	0.963
AN fertilizer kgs/ha	10.97	20.83	-0.893	0.378
Compound D fertilizer kgs/ha	26.93	35.42	-0.388	0.701
Farm size (ha)	3.60	2.84	2.087	0.045**
Maize seed (kgs/ha)	16.93	21.98	-1.983	0.056**
Yield in (tonnes)	2.09	2.74	-1.806	0.080*
Area under maize	2.03	1.22	2.722	0.010***
Maize Yield/ha (productivity)	0.94	2.25	-9.826	0.000***

***, **, *- indicate statistical significance at 1, 5 and 10% levels, respectively.

productivity should increase. A likely explanation for this scenario is the fact that as area put under production increases, holding all other variables constant such as fertilisers, labour input and draft power, the returns per unit increase in area under production falls. This means that the households experience diminishing marginal returns in their maize yield per hectare with any additional increase in the input area under maize production.

The negative relationship between age of household head and maize productivity implies that as the household head gets older this negatively influences production decisions and if the price of cotton, a related good goes up, farmers shift to cotton production and production of maize decreases. The output prices in this estimated regression equation do not vary other than by year.

Households' maize productivity performances

In the 2006/2007 agricultural season, there were certain policy implementations by the government of Zimbabwe in response to food insecurity. These policy responses included; the program Operation Maguta, which subsidized farmers in inputs such as seeds and fertilizers. The mechanization programme was also launched by government in 2007 providing agricultural equipment and implements to farmers. Even though such policy responses were implemented, not every farmer had access to the inputs.

An average maize yield of 1.6 tons per hectare, calculated from the households' 2006/2007 production data was used to categorize the 90 farmers into high and low performers. It was interesting to note also that even though the quantities of fertilizers and maize seed used in these farmers maize production were far below average rates per hectare, the farmers were still able to produce an average yield of 1.6 tons per hectare. This average yield of 1.6 tons/ha was three times the national average yield per hectare of 0.49 tons per hectare and the Mashonaland Central provincial average maize yield of 0.82 tons per hectare that were estimated by FAO for 2006/2007 agricultural season. A possible reason to explain such a relatively high level of output was that the study area has very fertile soils and good rainfall.

Low performers, who constituted 54% of the farmers, had a yield below the average yield per hectare, and 46% of the farmers, the high performers obtained yields above the mean yield per hectare. Table 3 compares the means of the various household characteristics for the low performing maize producers and the high performing producers to determine the significance of the household characteristics in explaining differences between households' productivity.

The values in Table 4 are results of the comparison of means between low performers and high performers in maize productivity. It is important to note that in this estimation of the performance of these two differentiated groups of households, there is the assumption that the land quality is homogenous or that at the most, the differences if any, are insignificant and thus highly negligible. This assumption draws from the fact that all the households' land falls under the same climatic conditions and soil types as they are in the same agro-ecological region. Hence the interpretation of the coefficients and mean values in Table 4 focuses on identifying which of the listed factors are significant in explaining the differences in performance. The table also presents the t-values and probabilities of the comparison of these means. From the table, it can be observed that six out of the ten tested variables had a significant impact on the corresponding tested variables.

The results indicate that there is a significant difference in the average maize yield per hectare (productivity) between the low and high maize performers. It was therefore concluded with 99% confidence that the productivity levels between the two groups were significant. The other variables that were of significance in distinguishing the

Table 5. Comparison of households' food self-sufficiency levels.

Variable (averages)	High food self sufficient households	Low food self sufficient households	T- Value	Probability
Percentage of farmers	37	63		
Age of household head	50	50	0.083	0.934
Farm size (Ha)	3.19	3.30	0.258	0.798
Household size	4	5	1.863	0.071*
Area under maize (Ha)	1.50	1.39	-0.713	0.481
Maize yield in (tonnes)	3.31	1.85	-4.971	0.000***
Maize yield/ha	1.95	1.30	-2.644	0.012***
Number of meals/day	3	2	-1.742	0.091*

***, **, *, Statistical significance at 1, 5 and 10% levels, respectively.

level of performance amongst the 90 farmers were the average household size, average farm size, the average maize yield and the average area put to maize production.

Household characteristics and the level of food self-sufficiency

The farmers were categorised into low food self-sufficient and highly food self-sufficient households. This classification was based on households' average food self-sufficiency index equal to 1.28 calculated from the data of the sampled households. Food self sufficiency index is calculated as the ratio of a households total grain production quantity to their total grain requirement, as mentioned previously.

Households with a food self-sufficiency index below the average food self-sufficiency index of 1.28 were classified as households that were lowly food sufficient and thus assumed to have a low food security status. Those households that had a household food self-sufficiency index greater than 1.28 were classified as highly food self-sufficient households that were highly food secure.

Results shown in Table 5 indicate that four out of the seven examined factors are of significant value in distinguishing between low and high food self-sufficient households. These variables are household size, maize yield, maize yield per hectare (productivity) and the number of meals per day. The t-test carried out showed that the above-mentioned factors exhibit significant differences in the means between the two groups. In terms of the differences in average maize yield between the two groups of households, it can be concluded that maize yield is an important variable in distinguishing between low and high food secure households because of the high significance of the t-value. This therefore implies that whatever factors affect the households' level of food production also directly affects their food sufficiency levels and hence food security situations, which is not always obvious neither is it always linearly correlated. Because of the exhibit of such a discernible pattern in these results, an estimation of the model residuals was done and it showed that the residuals were randomly distributed.

Gross margin analysis

Table 6 shows the households' average gross margins for maize and cotton. Based on these average gross margin values, cotton production was a more profitable enterprise than maize as the gross margin for cotton was higher than for maize per hectare. But in terms of viability, by using the gross margin per total variable costs calculation (GM/TVC), which calculates the returns per dollar spent, maize proved to be a more viable enterprise than cotton per hectare of production. Maize had a net return of ZW$7.88 compared to ZW$4.53 for cotton, for every ($) dollar spent in production. Comparing the variable cost outlays for the two crops, cotton does have a higher variable cost outlay most probably because of the more variable inputs that are required in cotton production and in addition cotton production is more labour intensive than maize production. This explains why the returns per dollar spent in cotton production are lower whilst the net returns per dollar spent in maize production are almost double the returns realized in cotton production.

Conclusion

Despite the fact that maize was observed to be a more viable production activity than production of cotton by earning ZW$7.88 for every dollar spent in production compared to ZW$4.53 for cotton from the GM/TVC calculations, maize production was falling as revealed from a comparison of two agricultural seasons' land allocations in the study. The likely trade-off that the households' faced was that the production of maize, a food crop for food security, meant forgoing the production

Table 6. Gross margins for maize and cotton.

Gross margin	Maize	Cotton
Average yield t/ha	1.6 ton	1.19 ton
Price ZW$/ton	4,200,000.00	6,500,000.00
Average gross income	6,720,000.00	7,735,000.00
Average variable cost ZW$/ha	756,860.00	1,399,106.00
Gross margin ZW$/ha	5,963,140.00	6,335,894.00
GM/TVC	7.88	4.53

Survey data.

of cotton a cash crop for financial security given also that cotton had a better producer payment system than maize. Although maize was a more viable enterprise, it has the disadvantage in its marketing system unlike cotton in that, the monopoly state-run marketing board pays farmers late and a poor remuneration for their maize deliveries. Maize market reform processes in Zimbabwe were therefore found to be promoting cash rather than food crop production in the smallholder farming sector.

Also, from the regression analysis of factors affecting the smallholders' maize productivity, the education level of the household head was found to be one of the significant factors, hence the engagement in cotton production which proved to be a less viable production enterprise than maize production may be a result of lack of knowledge by the farmers of the net returns to production for the two crops besides their gross margin analyses. Hence there is a crucial need for extension services to offer such knowledge to the farmers.

In terms of the households' food self-sufficiency status, the households were grouped into two categories for analysis; those who were high food self-sufficient and the low food self-sufficient, based on the sample's calculated average food self-sufficiency index of 1.28. Results indicated that 63% of the households had FSS indices below the estimated average and only 37% of the households had FSS indices above 1.28. This led to the conclusion that since the majority of the interviewed households, which is 63%, were not sufficiently able to provide for themselves food to last throughout the whole year, food insecurity could therefore be regarded as relatively high.

RECOMMENDATIONS

The slow pace in smallholder sector development in Zimbabwe can be attributed to challenges and trade-offs faced by households' in engaging in either food or cash crop production as revealed by the research paper. The recommendation is therefore that governments, in partnership with public and private institutions should work together in defining and implementing comprehensive strategies for the development of the smallholder maize production sector to encourage sustainable production. Such strategies should include the following components:

1. To motivate and improve price incentives for farmers, a reduction/removal of government intervention in the agricultural sector would be necessary as this would help to generate a sizeable supply response and allow well-functioning markets to emerge quickly thereby promoting maize (food) production in the country.
2. Crop diversification to enhance farmers' incomes and viability levels and promote both household food and financial security, more exposure to extension services and lastly, policy makers need to also ensure that local pricing system of maize is a true reflection of the world market prices.

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