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RESEARCH ARTICLE

INSTITUTIONS, PRODUCTION AND MARKETING OF MAIZE IN ZIMBABWE. CASE OF MARONDERA DISTRICT OF MASHONALAND EAST PROVINCE A TWO STAGE MODEL

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ABSTRACT

This study evaluated the influence of institutions on production and marketing efficiency of A1 maize resettled farmers in Marondera district. Data Envelopment Analysis was used to determine the efficiency scores of farmers while Tobit model was used to determine institutional factors influencing technical efficiency for both production and marketing. A multistage sampling procedure was used to select 343 farmers from Marondera District. Results showed that, farmers are technically, allocatively and economically inefficient for both production and marketing stages. Farmers are performing better at production stage than at marketing technically while there is better allocative and economic efficiency at marketing stage. Formal maize markets are more efficient than informal markets. Results for determinants of technical efficiency at production stage showed that, cattle ownership, farming experience, access to credit and social capital significantly influence maize production efficiency while access to credit, access to market, distance to market and road condition influences marketing efficiency. It can be therefore, recommended to the government of Zimbabwe to improve the institutional environment and arrangement in terms of provision of better roads, access to credit, access to markets so as to improve both production and marketing efficiency. Farmers are also recommended to join or form famer organisations as this will assist in improving both production and marketing efficiency.

KEYWORDS

Technical, allocative, economic

1. INTRODUCTION

Most African nations cannot afford to ignore smallholder agriculture as there appears little immediate prospect of rural industrialization or other non-farm engines of growth. In the southern Africa for example, at the beginning of the 1990's, 85 percent of Africa's population was rural and more than a quarter of the labour force was actively engaged in agriculture, overwhelmingly on smallholder operations (United Nations Development Program cited in Delgado (1999). Smallholder agriculture is likely to remain the major source of rural growth and livelihood improvement for some time as it is very important for employment, human welfare, and political stability in sub-Saharan Africa (Dorward *et al,*. 1998 and FEWSNET, 2014)

A study carried out by FAO (2012) showed that, Zimbabwe is dominated by the agricultural sector and it plays an important role in the economy contributing 15-18 percent to Gross National Product. It also provides an income to over 75 percent of the population and in most years 95 percent of all food and beverages is produced by farmers. Agriculture is the main stay of Zimbabwean economy as it accounts for a third of formal employment and over 70 percent of Zimbabwe's population derives its livelihood from agriculture (FAO, 2012 and FEWSNET, 2014).

Despite the potential to derive livelihoods from market oriented agriculture, smallholder farmers often face a number of challenges in production and accessing high value markets.The thorny problems encountered in promoting the growth of smallholder agriculture in Africa are lack of political voice to push government to ease transport, the legal security to set up future contracts and the market information mechanisms to bargain for better prices (Juan, 2006 and Kiddy *et al.,* 2007).The emerging consensus from the shifting paradigms of how to promote growth in smallholder agriculture in Africa is that it is not easy; especially in case of the Zimbabwean A1 resettled farmers. Such development will need to overcome a number of structural constraints arising from history and geography and that it requires a pro-active policy stance that goes beyond the very necessary but insufficient-by-themselves market reforms (Delgado, 1999 and Barrett, 2007).

Markets play a pivotal role in the transformation of agricultural processes. Recognition of the potential of markets to unlock economic growth and agricultural development gave rise to market-led rural development paradigm during the 1980s (Reardon and Timmer, 2006 cited in Siziba *et al.,* 2011). Markets facilitate the mechanisms of food

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exchange, coordination and allocation of many agricultural goods and services by and between people in the economy. These markets often assume a solution to the problem of poverty among smallholder farmers. This is true as markets are increasingly seen as an adjudicator for poverty reduction process and food security among the smallholder farmers due to market led production initiatives.

Smallholder farming is the hallmark of agriculture in Zimbabwe and yet the intensity and density of poverty still remains very high even though farmers emphasize intensive agricultural practices and continuously seek to adapt to constraints and opportunities as part of their survival strategy (FAO, 2010).There are 1, 340,919 farm holdings in Zimbabwe and the smallholder farmers contribute 98% of the total farm holding with the settled A1 farmers contributing 10.7% of the total farm holding (Agricultural Statistical Bulletin, 2013). A1 model is resettlement scheme that is based on resettling families. Land was acquired by the state and apportioned into plots, and the plots re-distributed to the beneficiaries. These beneficiaries were given tenure in the form of permits, one for settlement, one for cultivation and one for grazing (Moyo, 2011). A1 model was the dominant scheme used to implement land reform policies in Zimbabwe and this accounts for about 90 percent of the overall land reform policy implementation (Deininger, Hoogeveen and Kinsey, 2002 as cited by Juan, 2006).

These farmers have an average of six hectares of arable land and have access to grazing land (Moyo, 2011). These A1 farmers account for over 20% of maize production yearly and yet they face serious production and marketing institutional challenges. Most of these A1 farmers operate largely on small scale with less sophisticated production methods. Again they operate in local markets due to lack of connectivity to more lucrative markets either at provincial, national or global levels resulting in weak incentives, investments remain low, and so does the level of technology adoption resulting in low equilibrium poverty and food insecurity as maize production is decreasing yearly and this calls for institutional reformations.

Institutions are rules that govern the behaviour of individuals and organisations in public, private and civil sectors (Kirsten *et al.*, 2006). They permit, prohibit certain actions and determine or govern the behavioural relations among individual farmers and markets. These institutions include contract and enforcement mechanisms, commercial norms and rules, and habits and beliefs (Omamo, 2006) and Dieter, 2001).

This study therefore focused on institutional factors influencing maize production and marketing for A1 resettled farmers in Marondera District. The aim is to understand how formal and informal rules affect production and marketing behavior of resettled A1 farmers in maize production and marketing as this contribute to food security in Zimbabwe.

2. Research Methodology

2.1 Description of the study area

2.1.1 Marondera District

The study was conducted in Marondera District of Mashonaland East province in Zimbabwe which is one of the nine provinces that constitutes the breadbasket of the country. Marondera District is mainly characterized by farming in the form of urban, peri-urban and rural communities constituting rural resettlements areas.

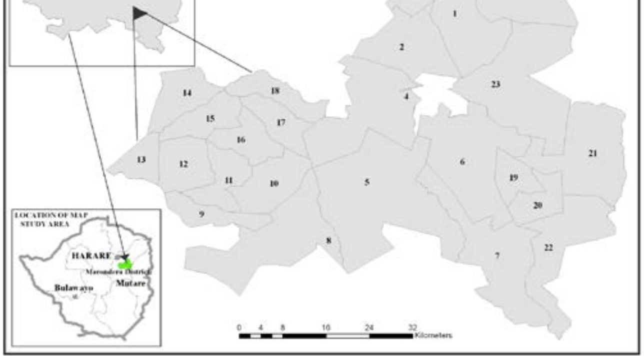

Figure 1: showing the map of Marondera District

The rural resettlement areas are made up of A1 and A2 and also sizeable numbers of commercial farms which are found in and around Marondera urban areas. The district has more A1 resettled farmers than any other district in the province. People in resettled areas rely mainly on farming and those near farms found livelihoods as farm workers. Records from Mashonaland East Province statistical office shows that Marondera District has the total population of around 118547 farmers.

The district is situated in agricultural natural region 2 with an average annual rainfall of about 500mm-1000. High rainfall and very cold temperatures are usually recorded around months of December to February and May to July (Mash East Zimstats, 2014). The month of October is warmest with an average temperature of 30.1 °C at noon. July is coldest with an average temperature of 6.5 °C at night. The district has no distinct temperature seasons; the temperature is relatively constant during the year. Temperatures drop sharply at night and increases during the day. These climatic conditions are favourable for maize production and subsequent marketing.

Marondera District has some of the most fertile lands in the province and the lands are particularly suited to grow maize and other heavy feeder crops like tobacco, paprika, tomatoes, potatoes and sorghum. The climate is classified as a humid subtropical (dry winter, hot summer), with a subtropical dry forest biozone. The soil in the area is high in lixisols (lx), soil with clay-enriched lower horizon, own cation exchange capacity and high saturation of bases which are suitable for maize production.

The distinguishing symbols of success in Marondera District are the modest houses with the asbestos roofs, sizeable herds of cattle and its ability to harvest even when there is a drought in the whole country. In times of drought, people from surrounding districts like Hwedza, Seke, Goromonzi, Murehwa and Chikomba would come to seek grain from Marondera District. The farmer manages to ride over most of the droughts by farming three main crops namely maize, beans and finger millet and these grains are supplemented by vegetables, Irish potatoes, sweet potatoes, tobacco and citrus fruits. Their main market for, tomatoes, citrus fruits, and a vegetable is Mbare Musika(Mafuse *et a.,l* 2012.). Grains are sold at Grain Marketing Board (GMB) and many other grain dealers like Manyame grain millers, Adult millers and many others

2.2 Sampling frame and sample selection

A multi-stage sampling procedure was adopted. Firstly, the study district was purposively selected owing to its largest number of resettled A1 farmers of about seven thousand and twelve farmers. The list of A1 farmers was obtained from Marondera District AGRITEX officer who works with the farmers. This was followed by stratifying the district wards using the villages with highest number of A1 farmers. Then, the villages with highest number of resettled A1 farmers were purposively selected and finally, simple random sampling was conducted within the villages.

2.2.1 Determination of sample size and method used to collect data

An approach based on precision rate and confidence level method to determine the sample size of A1 finite farmers was used as the farmers are homogeneous in terms of the size of land and populations known (Kothari, 2004). A Sample of four hundred A1 farmers was to be randomly selected and interviewed. However, seven farmers who produced maize for consumption only were not included in the final sample of farmers as they do not market their maize.

Sampling technique of Slovin's formular was used to calculate a sample of farmers in study area. This technique allows the researcher to sample the population with some degrees of accuracy and so it gives the idea of how large is the sample size should be to ensure reasonable accuracy of results.

This formula takes into account the confidence levels and margins of error.

Slovin's formular (1960)

$$n = \frac{N}{(1 + Ne^2)}$$

Where

n = Sample of A1 resettled farmers in Marondera District
N = Total number of resettled A1 farmers in Marondera District.
e = Error tolerance to be allowed in selecting the A1 resettled farmers in Marondera District
n = 7012/(1+7012 *0.05²)
n = **400**

In this case

N = 7012 A1 resettled farmers in Marondera district
e = 95 percent which give an error margin of 0.05
Adapted from Kothari, (2004**)**

Four hundred of A1 resettled maize farmers out of seven thousand and twelve (7012) were selected and three hundred and forty –three were interviewed using structured household questionnaires. Primary data was collected through administration of well designed, comprehensive and pre-tested structured questionnaire. The questionnaire was pre-tested in different sites of the study area and modified accordingly to improve the clarity of questions and remove irrelevant questions through a survey method.

2.3 Theoretical framework

Agricultural production processes and methods transforms tangible factors/resources or inputs (raw materials) and intangible inputs (ideas, information, and knowledge) into goods and services or output (Oluwatayo *et al*., 2008). These resources both tangible and intangible can be organized to maximize or to minimize cost with an objective of maximizing profits.

In agricultural production process, a profit oriented farmer is concerned with how resources can be minimized and maximize the outputs (efficiency). Efficiency is the use of few factor inputs to achieve more outputs. The objective of efficiency provides us with some basic rules about the manner in which farmers should utilize their inputs to produce goods and services (Oluwatayo *et al*., 2008).

Efficiency has always been on the agenda of agricultural production economics literature because inputs are scarce and expensive. There is need therefore to investigate agricultural efficiency through evaluating how farmers perform under institutional environment.

Farrell (1957) explicitly decomposed overall economic efficiency into components namely technical efficiency and allocative efficiency. Profit maximisation requires a farmer to produce the maximum output given the level of inputs employed (technically efficient), use the right mix of inputs in light of the relative price of each input (input allocative efficient) and produce the right mix of outputs given the set of prices (output allocative efficient) (Kumbhaker and Lovell,2000). Technical efficiency reflects the ability of the Decision Making Unit (DMU) to obtain maximum output from a given set of inputs or to minimize inputs to produce a given bundle of output. Allocative efficiency is the ability of a DMU to use inputs in optimal proportions, given their respective prices and production technology. In this study emphasis was given to allocative efficiency, economic efficiency and then technical efficiency as explained in the following section.

2.3.1 Technical Efficiency

The ratio between the observed and potential output of a production unit) are two indicators that are widely used to provide a rigorous measure of the efficiency of production of a unit/farm (Kasim *et al,* .2014). These indicators shows the rate at which inputs are transformed into outputs or how the production system is maximising the outputs from a set of minimal inputs. In this study the resettled farmers' technical efficiency is of concern because inputs are scarce and maize production is declining yearly.

2.3.2 Allocative efficiency

In Zimbabwe inputs are expensive because resources used to manufacture inputs are scarce, hence resettled A1 famers must decide how to use those inputs for their maximum benefit. In agricultural production, when inputs like seed and fertiliser are used to produce maize, those inputs become unavailable for any other purpose. Because inputs are scarce, farmers have to decide what those inputs will be used to produce, since any input that is used to produce maize reduces the inputs available for the production of other crops like vegetables. Allocative efficiency therefore has to do with the extent to which resettled farmers make decision by using inputs up to the level at which the marginal value product (MVP) equal to the Marginal Factor Cost (MFC). This means that a farmer has to choose the inputs in optimal proportions, given their input prices to avoid misallocation or allocative inefficiency.

Allocative efficiency measures the extent to which an analyzed Diminishing Marginal Utility (DMU) produces its outputs in a production that minimizes cost of production, assuming that the unit is already fully technical efficient that is when allocative is pareto efficient (Deng and Leonard, 2008). A farmer therefore is considered to be allocative efficient in the use of production inputs if the farmer is able to equate the value of the marginal value product (MVP) of the factor to that of factor price and able to maximize profit with respect to that input.

Technical and allocative efficiency provide four ways for explaining the relative performance of farms. Firstly, a farm might show both technical and allocative inefficiency and secondly, it might be technically efficient but allocatively inefficient. The third scenario is that it may display allocative efficiency but technical inefficiency; while the fourth scenario might be both technically and allocatively efficient.

In this study, a two-step procedure was employed to analyse production and marketing efficiencies which includes allocative, economic and technical. Farmers were grouped into two groups based on the market to which they sell their maize. The markets are either formal or informal. From each group of farmers, economic efficiency was conducted and then regressed against a number of institutional factors. The scores from the DAE was the dependent variable while the hypothesized institutional factors were the explanatory variables or independent variables. Economic efficiency was analysed by Data Envelopment Analysis (DEA) Model and is described below**.**

2.4 Data Envelopment Analysis (DEA) Model

To evaluate the economic efficiency of maize production and marketing among the A1 resettled farmers, an approach that incorporates multiple performance criteria was required so; DEA was used. The problem with respect to efficiency in maize production is that, beside direct outputs, which are delivered directly to the market, a farm also produces output that is input to a farm in the next stage. These intermediate outputs are intermediate inputs to the farm in the adjacent stage, next to the direct inputs. DEA allows inclusion of various dimensions, for example, economic and environmental performance; therefore, it was employed in this study.

DEA is a linear programming-based and non-parametric technique for evaluating the relative efficiency of each member of a set of organizational units (Charnes *et al*., 1978). The idea of DEA is to estimate a frontier that envelops all the input/output data with those observations lying on the frontier considered technically efficient. DEA estimates a production frontier using information on inputs and outputs by enveloping the observed combinations of inputs and outputs. The envelopment technique implies that all best performers along the different dimensions are used to form the production frontier through local linear interpolation. Given maize production frontier, these best maize performers will be located on the frontier while the least performers will be located on the interior of the production function. The best performer are said to be technically efficient because they maximize outputs subject to inputs constraints. They attempt to minimize the amounts of inputs necessary to produce a given amount of outputs.

DEA was proposed by Charnes *et al,*. (1978) and later developed further by Fare *et al*,.(1994) and it uses linear programming to construct a piece-wise efficient frontier with the best performing farm businesses of the sample used.

According to Zhu (2003), DEA has numerous modelling advantages. DEA takes a systems approach, which means that it takes into account the relationship between all inputs and outputs simultaneously. Production efficiency were based on information from marketing channels. DEA does not require a parametric specification of a functional form to construct the frontier like Cobb Douglas and its modifications, translog, stochastic frontiers and other parametric models like corrected ordinary least squares (Jill ,2006). Thus, there is no need to impose unnecessary restrictions on the functional forms that very often become a cause of distorted efficiency measures. However, DEA has the disadvantage of being a deterministic approach, which implies that statistical noise may be confounded with inefficiency (Zhu, 2003).

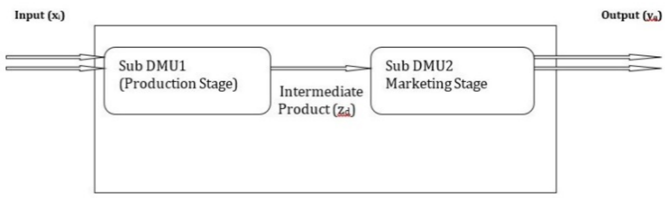

Figure 2: Two stage model

Source: Lu (2006)

Following Lu (2006), the classical DEA model was extended to two-stage model as shown in Figure 2. Inputs were fed into production operations (DMU1). The A1 maize farmers' producers are envisioned as the DMUs, with production stage as sub-DMU1 and marketing stage as sub-DMU2. In the first stage, A1 resettled farmers use farmland, inputs in the inform of seed, fertilizers, pesticides, herbicides, labour, insecticides, transportation, and managerial inputs to produce certain quantity of maize (intermediate products), then at the second stage, the maize was sold at the market place to gain income. The first Sub-DMU consumes inputs x_i obtained from input supply chains to produce intermediate products z_d. These, in turn, are the inputs to the second Sub-DMU, which were used to produce the DMU's final outputs. Information for marketing stage comes from marketing related variable costs. These costs were identified through chain mapping and the costs are food, transportation, both hired and owned, labour. The economic efficiency of each chain were examined in Sub DMU2.The advantage of the two-stage model is that, it is capable to evaluate the relative efficiencies of each DMU and each of its sub-DMUs in production and marketing processes.

2.4.1 Mathematical representation of the DEA Model

The mathematical specification of the input-oriented model where the inputs are minimized and the outputs are kept at their current levels is as follows:

$$\begin{aligned}
&\theta^* = \min \theta \\
&\text{subject to} \\
&\sum_{j=1}^{n} \lambda_j x_{ij} \le \theta x_{io} \qquad i = 1,2,\ldots,m; \\
&\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{ro} \qquad r = 1,2,\ldots,s; \\
&\sum_{j=1}^{n} \lambda_j = 1 \\
&\lambda_j \ge 0 \qquad j = 1,2,\ldots,n.
\end{aligned} \tag{1}$$

Adapted from Giang Thi Ngan Dao (2013), Banker *et al,*. (1984) Charnes *et Al,*. (1978).

Where,

θ^* = the efficiency score of the DMU under analysis,

Y_r = the vector of outputs for DMU

n = number of DMUs under analysis;

*-+λ (*j* = 1,2,...n) = the respective weights for output *i*and input *r* (2)

(*r* = 1, 2,…,*s*) = possible outputs achievable by the DMU (3)

(*i*= 1, 2,…,*s*) = possible inputs achievable by the DMU Banker *et al,*. (1984) Charnes *et Al,*. (1978).

2.5 Factors influencing production and marketing efficiency among A1 farmers

There are so many approaches that have been used to identify factors influencing maize production and marketing efficiency. These methods however, vary with methodology used. A two-step procedure is a mostly followed method, in which the production efficiencies scores or marketing efficiencies are estimated and the scores are taken as dependent variables. These scores will be regressed against a number of independent variables which are hypothesized to influence production or marketing efficiency.

Regression methods used are the ordinary least square (OLS), logistic, Probit and Tobit models. To analyse this objective, a two-step procedure was employed. Production and /marketing efficiencies which includes allocative , economic and technical efficiencies were regressed against a number of institutional factors .The scores from the DAE is the dependent variable while the hypothesized institutional factors were the explanatory variables or independent variables. Since the production and marketing efficiency scores lie between 0 and 1, a Tobit model was used to analyse the data as the dependent variable does not have a normal distribution. The production and marketing efficiency scores are continuous so Logit and Probit, models cannot be used as they are used when the dependent variable takes two values (Gujarati,2004). Tobit regression model seems to offer the best preferred option.

2.6 Tobit model

The statistical model was proposed by James Tobin (1958) to describe the relationship between a non-negative dependent variable *yi* and an independent variable (or vector) *xi*. This model is for metric dependent variable which can be observed from above or below. It is also a nonlinear model and similar to the Probit model. It is estimated by using maximum likelihood estimation techniques. It is also called a censored regression model, designed to estimate linear relationships between variables when there is either left or right-censoring in the dependent variable (also known as censoring from below and above, respectively). Censoring from above takes place when cases with a value at or above some threshold, all take on the value of that threshold, so that the true value might be equal to the threshold, but it might also be higher (Bruin, 2006). In the case of censoring from below, values that fall at or below some threshold are censored. Greene (1993) argues that it is more suitable to have data censored at 0 than at 1.A Tobit model censored at zero shall be used to examine factors explaining differences in production efficiency for resettled A1 farmers.

The model is as follows:

$$E = E^* = Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + U$$

*If E**> 0 *E* = 0 *if E* ≤ 0 ≤ 0

Where:

E is the technical, allocative and economic production or marketing efficiency.

*E** is the latent variable. β are unknown parameters, μ is a disturbance term.

3. Results

Table 1: Channel scores for technical, allocative and economic efficiency						
markets	**Production stage**			**Marketing stage**		
	Technical efficiency	**Allocative efficiency**	**Economic efficiency**	**Technical efficiency**	**Allocative efficiency**	**Economic efficiency**
Informal	0.545	0.924	0.503	0.579	0.935	0.541
Formal	1.000	1.000	1.00	1.000	1.000	1.00
Mean	0.773	0.962	0.743	0.789	0.967	0.763

Table 1 showed the results of the DEA and Two-stage value model. Results showed that the informal markets are less efficient as compared to formal markets both at production and marketing stage. Results for the mean technical, allocative, and economic efficiency indices for informal markets are 77 %, 96 %, and 74% for production stage while the marketing stage mean technical, allocative, and economic efficiency indices are 79 %, 97% and76% respectively. Two-stage model infers maize producers in Marondera District are performing much better for marketing than production for informal markets while the formal markets are efficient (100%) at both production and marketing stage.

Thus, the results from both production and marketing stage, showed some considerable levels of inefficiencies in maize technical efficiency both for production and marketing stages, while allocative efficiency is the best of the three efficiencies for maize production and marketing.

The results, however, showed that there is still some considerable level of inefficiencies in the use of inputs for the output levels. High allocative efficiency scores for both stages imply that A1 farmers are quite price-sensitive to the input prices. The overall economic efficiency was low for both production and marketing stages implying that inputs were not optimally allocated for production and marketing by A1 farmers.

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The relatively high levels of technical efficiencies for formal markets defies the notion that informal supply chains in Zimbabwe are more efficient than the formal chains (Mujeyi,2010). This study showed that well regulated markets are more efficient than the informal markets that are not well regulated (Rukuni *et al,*. 2006).

Table 2: Institutional factors influencing technical efficiency of maize production

	Technical		Allocative		Economic	
Variable	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
Cattle ownership	-0.4905	0.000***	0.0018	0.7161	-0.013535	0.5839
Farming experience	1.6553	0.000***	0.0114	0.7059	-0.001292	0.7998
Access to credit	0.0012	0.0687*	-0.0049	0.1887	-0.0129	0.2715
Access to training	-0.008	0.425	0.0687	0.1173	-0.0372	0.3663
Social capital	0.0064	0.036**	-0.0558	0.1337	-0.0752	0.007**
Access to information	-0.016	0.323	-0.0030	0.7769	0.0009	0.0420*
Contract farming	0.0942	0.416	-0.0079	0.0418*	-0.0056	0.0004**
Distance to input market	0.0495	0.549	-0.0131	0.008**	0.0034	0.8777
Area planted to maize	-0.0371	0.1104	0.0003	0.1683	0.0003	0.0022**
Quantity of seed used	0.0116	0.376	0.0013	0.017*	0.0010	0.1882
Constant	0.1239	0.3893	-0.0811	0.0000	0.0292	0.2473

Sources of data: survey 2017.

*represents 10% interval ** represents 5% interval *** represent 1% interval respectively

Table 2 above shows two-limit Tobit regression results of technical, allocative and economic efficiency scores against institutional variables that are hypothesised to significantly influence maize production efficiency. The Tobit model results showed that nine out of ten variables were statistically significant at influencing maize production efficiency of A1 farmers. These include cattle ownership, farming experience, access to financial credit and (member of farmer organisation) which was used as a proxy indicator for social capital, access to information, contract farming, distance to input market, area planted to maize and quantity of seed used. Access to training was the only variable which does not affect production efficiency in the area of study. Negative sign meant that variable had the effect of reducing technical efficiency thereby increasing farmers' production efficiency. A positive coefficient on the other hand indicates the propensity of increasing inefficiency which reduces farmers' production efficiency.

3.1 Cattle ownership

Number of cattle owned showed a negative coefficient of (0.49) and significantly influences technical efficiency at 1 percent interval. The results showed that, increasing the number of cattle owned by one would increase technical efficiency by 4.9 percent. This means that increasing number of cattle owned would reduce technical inefficiency of farmers as they would do land preparation on time. They will not wait to hire cattle for drought power and this saves time and money. Similar studies done by Sibiko *et al* .,(2013) , also show that ownership of assets like cattle can help in provision of income that enhances the available of other capital and improves farming investments.

3.2 Farming experience

Farming experience in maize production showed a positive coefficient (1.655385) and positively influences technical efficiency. The positive sign of experience in the efficiency model shows that, maize farmers who are more experienced are technically efficient. This can be attributed to the fact that, these A1 farmers were producing maize before they were resettled under the fast track land distribution programme. They have spent years on producing maize and hence they are willing to adopt new farming innovation and modern techniques of maize production. This result is similar to the study conducted by Mahesh *et al.,* (2017), who found that, farming experience increase technical efficiency of maize production.

3.3 Access to credit

Access to credit was found to have the expected positive sign and significant at 5 percent interval. Access to financial credit is one the most limiting factor in maize production because these settled A1 farmers lack title deeds that is required by financial organisation as collateral. This has contributed immensely to technical inefficiency as credit is expected to reduce the financial problems most farmers usually face especially in purchasing inputs like maize seed, fertiliser, topdressing fertiliser and payment of labour. Access to financial credit would expedite preparation of land and purchase of all inputs needed for maize production before the onset of rains. Inputs for production.

3.4 Social capital

Social capital, which is measured by whether a farmer is in farming organisation or associations or not was found to be influencing technical and economic efficiency positively at 1and 5 percent interval with a positive coefficient of (0.006) for technical and a negative coefficient of (-0.075) for economic efficiency. The results suggest that, farmers who belonged to farmer organisation, associations or farming clubs are more likely to benefit from better access to inputs such as improved maize varieties fertilisers, herbicides, production information and sharing labour through localised labour sharing innovations like' humwe'. The negative coefficient in economic efficiency implies that, farmers become more efficient as they share ideas of production and working together. A study conducted by Chepng'etich, *et al., (*2015,) showed that farmers who belong to a farmer organisation benefit on improved farming practice.

3.5 Access to information

Access to information has a positive sign and a significance value of (0.000956) (0.0420) respectively. Access to maize production information plays an important role on maize production as this assists in using modern technologies and use of modern inputs which increases maize productivity. Farmers get information from various sources of information like watching and listening to programmes from television and radio. Programmes such *Murimi wanhasi* on television disseminates important information on maize production.

This significance value on access to information therefore, indicates that there is enough evidence to support that access to information significantly influences production efficiency of A1 farmers. Positive sign indicates positive relationship between access to information maize production efficiency. The results are in line with (Ogeto *et al*,.2012) who noted that access to information had a positive influence on Sorghum production efficiency in Kenya.

3.6 Contract farming

Farmers under Contract Farming are more efficient in their optimal allocation of resources while minimizing waste and inefficiency in their maize production (Bidzakin *et al*.,2018). This is because contract farming provides services not readily available to maize farmers in Zimbabwe. This is evidenced by negative and significant values of (-0.0079) (0.0418*) (-0.005661) (0.0004**) for allocative and economic efficiency respectively. In reality, A1 farmers frequently face serious problems getting inputs and market, indicating the need for intervention by all maize stakeholders such as the government or by farmers' organizations.

3.7 Distance to input market

Distance to input market distance contributes negatively and significantly to allocative inefficiency or it can increase allocative efficiency. Total kilometres travelled to buy inputs by A1 farmers influence allocative efficiency partially because resettled A1 farmers live far away from Marondera town .The other reason could be due to transport expensiveness. Respondents revealed that transport is expensive due to road conditions. Most roads are badly damaged by rains though they were tarred by former white commercial farmers. The resettled A1 farmers depend on District Development Fund (DDF) to repair the damaged roads which has not been done due to financial problems. This study supports (Lubis *et al*., 2014) who also found that distance input to market increase the efficiency.

3.8 Area planted to maize

The area planted to maize, was a variable measured in total hectares of the farm that was used to plant maize in 2016/17 season. This variable has a positive and significant relationship with economic efficiency. This illustrates that the scale of operations matters on how resources are allocated. In general, total area used for maize production plays an important role on how farmers allocate the inputs given inputs are scarce commodities. Studies by (Karimov, 2014) and (Adzawla *e t al*., 2013) also found out that total area put under cultivation influences production efficiency of Cotton in Uzbekistan and in Northern Ghana respectively.

3.9 Quantity of seed used

The positive coefficient for quantity of maize seed used by A1 farmers is surprising, since a high seed rate application negatively affect the output. This is because high seed application rates would result in higher plant densities, or overcrowding, which would have a negative effect on output (Mango *et al*., 2015). One possible explanation for this relationship could be that A1 farmers do not have enough money to purchase seed required, and hence apply seed at below-optimum rates. If this farmers could get assistance in form of seed from Government, NGOs or they form farmers organisation and share the resources so that they can increase seed rate, maize output would increase .See (Mango *et al*., 2015) who also found similar results on stochastic frontier analysis of technical efficiency in smallholder maize production in Zimbabwe: The post-fast-track land reform outlook.

Table 3: Institutional factors influencing technical efficiency of maize marketing

	Technical		Allocative		Economic	
Variable	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
Farming experience	-0.0094	0.6325	-0.0126	0.4775	-0.0050	0.000**
Access to training	0.0056	0.614	0.0040	0.3137	0.0354	0.530
Access to credit	-0.0027	0.000***	-0.0035	0.000**	-0.0395	0.040*
Access to information	0.0081	0.510	0.0133	0.0061**	0.0335	0.529
Social capital	-0.0243	0.6617	0.0239	0.8218	-0.0121	0.669
Access to market	0.0378	0.009***	1.4350	0.0495*	0.0110	0.314
Contract farming	-0.0334	0.1236	-0.0160	0.8184	0.0008	0.936
Distance to market	0.0654	0.0293*	0.0631	0.000**	0.0023	0.000**
Road infrastructure	-0.0031	0.004***	-0.0061	0.0450*	0.0054	0.1749
Constant	0.0250	0.258	0.657578	0.0000	4.700	1155

Sources of data: survey 2017.*represents 10% interval ** represents 5% interval,

*** represent 1% interval.

The able 3 above shows two-limit Tobit regression results of technical efficiency scores against institutional variables that are hypothesised to significantly influence marketing efficiency. The Tobit model results showed that, six out of nine variables were statistically significant at influencing marketing efficiency of A1 farmers. These include Access to credit, Access to market, distance to market and road infrastructure, farming experience and access to information.

3.10 Access to credit

Access to credit was presented as dummy variable in the model; i.e., 1 having had access to credit and 0 otherwise. Its coefficient was negative for technical, allocative and economic efficiency and it affected efficiency significantly. The negative coefficient of access to credit means that the use of credit tends to result in decrease of technical efficiency. The results are consisted with literature which shows that access to credit promote technical efficiency (Samuel *et al*,.2017) , (Macharia *et al.,* 2014) and (Kasim *et al* .,2014**).** If the credit obtained by farmers were invested in the farm, it is expected that it would lead to higher levels of technical efficiency since the farmers would be able to pay all its marketing expenses. The negative coefficients in the model however, may suggest A1 farmers' fungibility due to poor maize market performance leading to diverting the money to better livelihood options.

3.11 Access to market

As expected, access to market has a significant and positive impact on technical and allocative efficiency of maize marketing because farmers need to get their products to market and receive equitable price treatment. They also need access to up-to-date market pricing information. Access to markets is also important to farmers because well functioning markets provide transparent information, fair prices, reduced speculation as well as providing co-operative approaches to marketing and this explains why the there is a positive relationship between technical and allocative efficiency and market access. This positive relationship means that farmers wants the services of maize markets because there has been no proper co-ordination of markets for the resettled farmers in terms of prices , payment and storage facilities. This study is in congruent with (Adetol *et al*., 2014) who found out that market access had significant impact on marketing efficiency.

3.12 Distance to market

A two limit Tobit model showed that, distance to market significantly influences the marketing efficiency. The results showed that distance to market or total number of kilometres travelled to maize markets is the most important factor affecting technical ,allocative and economic efficiency with the highest coefficient of (0.065452).This shows that A1 maize farmers travels long distances to sell their maize. This is attributed to the fact that A1 resettled farmers were resettled far away from the markets. Having near maize markets will increase the chances of a farmer to improve the technical efficiency.

3.13 Farming experience

The estimate for farming experience is negative and significant for economic efficiency. This result suggests that, the more experienced a farmer is the higher the chances of that farmer being more efficient

(Nyarko,and Owusu,2014).This can be explained by the fact that Agricultural marketing is a very risky business done under risky environmental conditions such as price fluctuations for the informal market, unstable currency and fluctuating of demand and supply of maize for both informal and formal market. Experienced farmers who have marketed the same crop over a long period of time are able to make accurate predictions on when supply of maize to market and the quantities that would make profits. This finding is similar to findings of (Nyarko, and Owusu, 2014) also found that experience in marketing rice pay-off well.

3.14 Access to information

Access to market information is an important input for making marketing decisions in and finance, has historically been very costly in Africa South of the Sahara (Tadesse and Bahiigwa,2014). Farmers who want to sell their products have to search for the right price, the right buyer, the right standards and grades of the product. All these searches are costly (Tadesse and Bahiigwa, 2014). The expensiveness of searching marketing information by A1 farmers, explains the positive and significant of variable access to market information. Access to market information has a positive influence on allocative efficiency. This can be explained by fact that market information is not readily available to A1maize farmers though Marondera District is endowed with all mobile network such as ECONET, Netone and Telecel .The major factor for influencing allocative efficiency could be that, right marketing is expensive so farmers cannot afford to get important information on prices, grades and right buyers.

3.15 Road infrastructure

Negative and significant (-0.0031) (-0.0061) relationship was found between technical and allocative efficiency and road infrastructure. This result is however, not in line with our hypothesis that good road infrastructure were expected to influence technical and allocative efficiency positively. The negative relationship between the variable and technical and allocative efficiency means that road infrastructure increases technical and allocative inefficiency. This means that farmers incur more costs on marketing because the roads are bad whether tarred or gravel. Farmers therefore put more effort to reach the maize markets with more losses due to bad roads which were damaged by rains and no improvement has been done. The results are consisted with (Rajeev Kumar Panda and Sreekumar, 2012) and (Adetola *et al*., 2014) who found that road infrastructure influences marketing efficiency of smallholder farmers.

4. Conclusion and Recommendation

A1 farmers are technically, allocatively and economically inefficient for both production and marketing stages. Farmers are performing better at production stage than at marketing technically while there is better allocative and economic efficiency at marketing stage. Cattle ownership, farming experience, access to financial credit and (member of farmer organisation) which was used as a proxy indicator for social capital, access to information, contract farming, distance to input market, area planted to maize and quantity of seed used influenced production efficiency. Access to training was the only variable which does not affect production efficiency in the area of study. Marketing efficiency was influenced by Access to credit, Access to market, distance to market and road infrastructure, farming experience and access to information.

It can be therefore, recommended to the government of Zimbabwe to improve the institutional environment and arrangement in terms of provision of better roads, access to credit, access to markets, providing information on maize production and marketing using different platforms that are accessible and affordable to A1 farmers so as to improve both production and marketing efficiency. Farmers are also recommended to join or form farmer organisations as this will assist in improving both production and marketing efficiency. Farmers are recommended to use formal channel of marketing because they are more efficient than informal channel. An *efficient marketing system* is crucial for getting the right products to the right place at the right time and helps A1 farmers to stay competitive and maximise revenue. The government is therefore, recommended to correct inefficiencies and ineffective institutions that has given rise to more informal activities that has disrupted efficient formal market systems built over many years. It is also recommended to private companies and NGOs to offer contract farming to A1 maize farmers as this will help them to increase total area put under maize production, access to market, access to credit, and access to information and reduces long distances to purchase inputs.

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