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The Impact of Farmer to Farmer Extension on Smallholder Household Grain Food Self-Sufficiency: A Case Study of Manicaland and Masvingo Provinces, Zimbabwe

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Abstract: Agriculture extension plays an important role in poverty reduction, economic growth, rural development, sustainable development and livelihoods, and household food security. The farmer to farmer extension approach is seen as one effective strategy for delivering extension services to smallholder farmers. This study sought to assess the impact of the farmer to farmer extension on household grain food self-sufficiency using a sample of 479 smallholder farmers selected randomly from 6 districts in Manicaland and Masvingo provinces of Zimbabwe. The study found that on average the sample households were food secure with a grain food self-sufficiency index of 1.20. In terms of the distribution, 51% of the sample households had grain food self-sufficiency above 100% while 29% of the households had grain food self-sufficiency below 50%. Farmer to farmer extension has a positive and significant impact on household grain food self-sufficiency. Other variables that have a positive and significant impact on household grain food self-sufficiency are farming experience, agricultural income, farm commercialization, soil fertility, household wealth, agro-ecological zone V, area planted to crops and farm profitability. On the other hand, the number of years in a farmer group, off farm sources of income for the household head, household size, access to irrigation, and private input suppliers and contractor's extension support had a negative and significant impact on household grain food self-sufficiency. Given the positive contribution of the farmer to farmer extension to household grain food self-sufficiency, the study recommends that the government put in place measures to actively promote the approach to compliment the public extension service. Farmers also need to be trained in improved farming practices so that they can increase their productivity and agricultural incomes as the study found that farmers who were profitable and earning high agricultural income were more grain food secure.

Keywords: Farmer to farmer extension, Grain food self-sufficiency, Smallholder farmers

INTRODUCTION

Household food security and food self-sufficiency are at the centre of smallholder agricultural development policy in Zimbabwe. Food security and nutrition is one of the four strategic clusters of Zimbabwe's main development policy document – the Zimbabwe Agenda for Sustainable Socio-economic Transformation (ZimAsset): 2013-2018, According to the ZimAsset policy document, the thrust of the Food Security and Nutrition Cluster is to create a self-sufficient and food surplus economy and see Zimbabwe re-emerge as the "Bread Basket of Southern Africa". The policy also ultimately seeks to build a prosperous, diverse and competitive food security and nutrition sector that contributes significantly to national development through the provision of an enabling environment for sustainable economic empowerment and social transformation.

In many developing economies, agriculture plays an important role in poverty reduction, economic growth, rural development, sustainable development and livelihoods, and household food security [1-3]. It is also the main source of income for around 2.5 billion people in the developing world [4]. As a result, the poorest half of the population in developing countries benefits significantly more from agricultural growth than growth in other sectors of the economy [5, 6]. This is so because the majority of the populations of these developing economies live in rural areas and their survival is mainly dependant on agriculture. The agricultural sector is also a major source of employment for at least 75% of the population [7].

In Zimbabwe the agriculture sector is the backbone of the economy and 80% of the population depends on it for a livelihood, contributes 15-20% of GDP, provide employment for some 70% of the population and about 60% of all raw materials for the industry. About 45% of the country's exports are of agriculture origin. However, over the past decade, Zimbabwe has been experiencing increased food and

nutrition insecurity at the household and national levels, emanating from reduced productivity and production of the main crops. Agricultural extension programs are the key primary means for assisting farmers as they provide farmers with information and technology that will in turn enable them to expand their abilities and improve production and productivity [8, 9]. Agricultural education, extension, and advisory services are a critical means of addressing rural poverty and food security through technology transfer, support to learning, assisting farmers in problem solving, and enabling farmers to become more actively embedded in the agricultural knowledge and information system [8]. Agricultural extension programs increase farm productivity by exchanging information and improving market access [8]. In general, government extension programs have emphasized increasing production, and extension is a policy tool for promoting the safety and quality of agricultural products. Thus, by promoting agricultural innovation and information, extension services can improve the livelihoods of the poor [8] and in particular, household food security and food self-sufficiency.

In an attempt to increasing extension coverage for the smallholder sector, the Zimbabwean government, with the support of international development organisations, has been actively promoting the use of lead farmers as extension agents. The origins of the farmer to farmer extension (F2F) approach dates back to the 1950s and its promotion in Zimbabwe is based on success stories that have been witnessed in other countries particularly in Asia. Very few local empirical studies have been carried out in Zimbabwe to assess the impact of the F2F extension approach in promoting household food security and food self-suffiency, agricultural technology adoption and agricultural productivity. The purpose of this study was to assess the impact of F2F extension approach on household grain food self-sufficiency of smallholder farmers in Manicaland and Masvingo provinces of Zimbabwe.

METHODOLOGY

Study Area, Population and Sample

This study is based on survey data collected in March 2015 from the 6 districts that Deutsche Geselischaft fur Internationale Zusammenarbeit GmbH (GIZ) is implementing the Agricultural Innovation Support Project (GIZ AISP). These are Nyanga, Mutasa and Mutare districts in Manicaland province; and Chiredzi, Zaka and Bikita districts in Masvingo province. The population in the six districts was 30,000 farming households. Using the Raosoft sample size calculator (www.raosoft.com/samplesize.html), the minimum sample size target for the household survey was set at 350 households. This target sample size was based on achieving a 5% margin of error and a 95% confidence level.

To arrive at the sample households, a multi-stage random sampling technique was employed. First, two wards were randomly selected in each of the district. This was then followed by randomly selecting 2 farmer groups from each of the selected wards. One group selected was for farmers who had benefitted from GIZ AISP support through improved extension services and the other group was for non-beneficiary farmers. Lastly, all available farmers in each selected group were interviewed. A total of 479 farmers were interviewed using a structured questionnaire and the sample distribution by district and agro-ecological region are presented in Tables 1 and 2 below.

Table 1: Sample distribution by gender by district

Gender	District						Total
	Nyanga	Mutasa	Mutare	Chiredzi	Zaka	Bikita	
Female	33	26	23	45	26	35	188
	40.7%	40.6%	38.3%	46.4%	34.2%	34.7%	39.2%
Male	48	38	37	52	50	66	291
	59.3%	59.4%	61.7%	53.6%	65.8%	65.3%	60.8%
Total	81	64	60	97	76	101	479

Table 2: Sample distribution by Agro-ecological Region

Agro-Ecological Region (AER)	Frequency	Percent
AER_I	66	13.8
AER_III	59	12.3
AER_IV	228	47.6
AER_V	126	26.3
Total	479	100

Data Analysis

The study used both descriptive and inferential statistics. Descriptive statistics were used to analyze the socioeconomic characteristics of the respondents. The simple regression model was used to assess the impact of F2F extension approach on household grain food self-sufficiency of the sample farmers. The Grain Food Self Sufficiency Index (GFSSI) is used as a proxy

measure for household food security. The minimum amount of grain required to sustain a healthy life for an adult male is estimated at 155 kilograms per year [10, 11]. The GFSSI is computed as:

$$GFSSI = \frac{\text{Grain Production (Kg)}}{\text{Household Annual Grain Requirements (Kg)}}$$

A GFSSI of less than 1 means grain from own production is not enough to meet household annual grain needs. A GFSSI equal to 1 means grain from own production exactly meet household annual grain needs. A GFSSI of greater than 1 means grain from own production is more than enough to meet household annual grain needs. The model dependent and independent variables are used to assess the impact of the F2F extension on household grain food self-sufficiency is described in the Table 3. The *a priori* or hypothesized impact of the independent variables on the dependent variable is also shown. A (+) means the independent variable is expected to have a positive impact on the dependent variable while a (-) means the independent variable is expected to have a negative impact on the dependent variable.

Table 3: Definition of regression Variables

Variable	Description	Variable Measurement	Hypothesis
DEPENDANT VARIABLE			
GFSSI	Household food security	Measured by the grain food self-sufficiency index (GFSSI	
INDEPENDENT / EXPLANATORY VARIABLES			
HHGENDER	Gender of household head	Dummy: 1= male, 0= otherwise	-/+
YRSFGROUP	Period of membership into farmer group	No. of years farmer is member of farmer group	+
HHEMOFFY	Household head has off-farm source of income	Dummy: 1=Yes, 0=otherwise	-/+
HHSIZE	Household size	Number of people in a household	-/+
YRSFARM	Farming experience	Number of years farming	+
FARMGV	Agricultural income as measured by the gross value of farm output	Total value of farm output in $	+
FCOMM	Level of household agricultural commercialization. Households who sell less than 60 percent of their produce are classified as non-commercialized and those who sell at least 60% of their produce are commercialized	Dummy: 1= commercialized, 0= otherwise	+
IRRIG	Household access to irrigation	Dummy: 1= yes, 0= otherwise	+
EXT_{F2F}	Household receiving farmer-to-farmer extension	Dummy: 1= yes, 0= otherwise	+
$EXT_{INPUTSC}$	Household receiving extension from input suppliers and contractors	Dummy: 1= yes, 0= otherwise	+
$SOILFERT_{HIGH}$	Farm natural soil fertility is high	Dummy: 1= yes, 0= otherwise	+
$ASSET_{INDEXT}$	Measure of household wealth or wellbeing	Measured using a Household Asset Index	+
AER_V	Farm in agro-ecological region V	Dummy: 1= yes, 0= otherwise	-
AREAPLANT	Total area cultivated	Measured in hectares	+
GM_{PER_HA}	Farm profitability	Farm gross margin measured in $ per ha	+
$DIST_{MKT}$	Distance from farm to nearest major market town	Distance in kilometres	-

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Sample Households

Table 4 below presents the socio-economic characteristics of the sample households. 61% of the sample households were male headed with an average household size of 5.87. 65% of the heads of households had off farm sources of income and the average farming experience was 20.52 years.

Table 4: Summary Statistics of the Sample Households

Variable	Mean	Std. Deviation
GFSSI	1.20	2.928
HHGENDER	0.61	0.489
YRSFGROUP	2.57	4.187
HHEMOFFY	0.65	0.476
HHSIZE	5.87	2.390
YRSFARM	20.52	14.653
FARMGV	944.47	2207.499
FCOMM	0.19	0.396
IRRIG	0.11	0.319
EXT_{F2F}	0.43	0.495
$EXT_{INPUTSC}$	0.01	0.091
$SOILFERT_{HIGH}$	0.25	0.434
$ASSET_{INDEXT}$	10.93	5.160
AER_V	0.26	0.441
AREAPLANT	1.76	1.744
GM_{PER_HA}	104.73	1617.735
$DIST_{MKT}$	92.52	24.825

The average cropping area for the sample households was 1.76 hectares and only 11% of the sample households had access to irrigation. 43 % of the sample households were receiving extension support through the farmer to farmer extension approach, 1% were receiving extension support from private input suppliers and contractors and only 19% of the sample households were practising commercial farming. The average agricultural income as measured by the gross value of farm output was US$944.47 and the average gross margin per hectare was US$104.73

Household Food Security

The average grain food self-sufficiency index (GFSSI) for the sample households was 1.20 and this shows that on average the sample households were grain food secure (Table 4). The percent distribution of the GFSSI is presented in Figure 1. About 51% of the households had a GFSSI above 100% while 29% of the households had a GFSSI below 50%. The percent distribution of the GFSSI for male headed households was almost similar to that of female headed households.

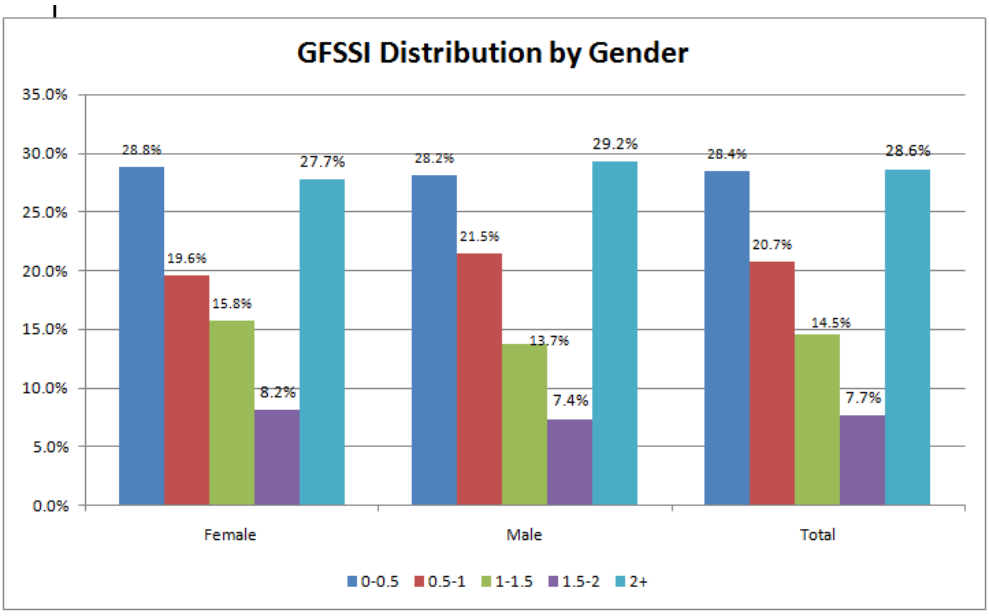

Fig 1: Percent Distribution of Household Gross Food Self Sufficiency Index by Gender

Impact of Farmer to Farmer Extension on Household Food Security

The model parameter estimates along with the related standard errors and t-ratios are presented in Table 4. The variables that did not significantly affect household grain food self-sufficiency are the gender of the head of household and the distance of the farm from the nearest market town.

Table 4: OLS regression estimates of impact of farmer to farmer extension on household grain food self-sufficiency

Variable	B	S.E	T	Sig.
CONSTANT	2.155	0.793	2.716	0.007
HHGENDER	0.229	0.222	1.033	0.302
YRSFGROUP	-0.051	0.025	-2.052	0.041
HHEMOFFY	-0.491	0.226	-2.173	0.030
HHSIZE	-0.357	0.047	-7.580	0.000
YRSFARM	0.015	0.007	1.982	0.048
FARMGV	0.000	0.000	4.959	0.000
FCOMM	1.066	0.283	3.769	0.000
IRRIG	-0.596	0.334	-1.785	0.075
EXT_{F2F}	0.468	0.215	2.174	0.030
$EXT_{INPUTSC}$	-2.854	1.293	-2.207	0.028
$SOILFERT_{HIGH}$	0.780	0.259	3.012	0.003
$ASSET_{INDEXT}$	0.041	0.021	1.968	0.050
AER_V	0.680	0.390	1.745	0.082
AREAPLANT	0.637	0.073	8.733	0.000
GM_{PER_HA}	0.000	0.000	1.879	0.061
$DIST_{MKT}$	-0.008	0.007	-1.277	0.202
R^2 = 0.445				
Adj. R^2 = 0.425				

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1781.829	16	111.364	22.609	0.000[b]
	Residual	2221.441	451	4.926		
	Total	4003.27	467			
a. Dependent Variable: GFSSI						

As expected a priori, household grain food self-sufficiency was higher for farmers receiving extension support from other farmers and the result is significant at 5% level of significance. Farmers who were receiving extension support from other farmers had a grain food self-sufficiency index which was 0.468 units higher than that of farmers receiving extension support from the public extension services. This result is supported by Hussein and Janekarnkij in 2013 and Hasan in 2011 [12, 8]. Thus farmer to farmer extension is an effective extension strategy for promoting rural household food security and food self-sufficiency. On the other hand, farmers receiving extension support from private input suppliers and contractors were found to have a GFSSI which was 2.854 units less than that of farmers receiving extension from the public extension services and the result is significant at 5% level of significance. Although this finding is unexpected, it can be explained by the fact that private input suppliers and contractors tend to promote high value crops like horticulture and tobacco and not traditional grain food crops.

The number of years a farmer spends as a member of a farmer group significantly and negatively affects household grain food self-sufficiency and the result is significant at the 5% level of significance. This finding was unexpected and this may be explained by the fact that farmers who are members of farmer groups may be relying more on the social safety networks established through these groups to meet their grain food requirements than from own grain food production [13]. A one year increase as a member of a farmer group reduces the household GFSSI by 0.051 units. Off farm sources of income for the head of household also negatively and significantly affects household grain food self-sufficiency and the result is significant at 5% level of significance. Farmers who had off farm sources of income had a GFSSI index which was 0.491 units lower than that of farmers with no off farm sources of income. This may be explained by the fact that farmers with off farm sources of income rely less of own grain food production to meet the household grain food requirements as they can purchase grain on the market to supplement own production.

Household size was found to negatively and significantly affect household grain food self-sufficiency and the result is significant at the 1% level of significance. An additional household member reduced GFSSI by 0.357. Thus households with larger families are more grain food insecure and this result is supported by Joshi and Joshi in 2016 [14], Harris-Fry *et al.;* in 2015 [15] and Muhoyi *et al.;* in 2014 [17].

Farming experience was found to have a positive and significant impact on household grain food self-sufficiency and the result is significant at 5% level of significance. A one year increase in farming experience increases the household's GFSSI by 0.015. Households who were earning higher agricultural incomes were found to be more food secure. A dollar increase in agricultural income positively and significantly affects the household's GFSSI and the result is significant at 1% level of significance. This may be because households earning higher agricultural incomes are able to invest in more food security enhancing technologies than households earning low incomes. This finding is supported by Hussein and Janekarnkij in 2013 [12] and Arene and Anyaeji in 2010 [17]. Commercialized farms were found to be more grain food secure than non-commercialized farms. A household practicing commercial agriculture had a GFSSI which was 1.066 units higher when compared to a household that was not practicing commercial agriculture and the result is significant at 1% level of significant. This result may be explained by the fact that commercialization of production enables households to earn incomes that they can then use to purchase improved farming technologies that will in turn assist them to improve their household food security.

Farmers with access to irrigation were found to have a GFSSI which was 0.596 units less than that of farmers with no access to irrigation and the result is significant at 10% level of significance. Although this finding is unexpected, it can be explained by the fact that most farmers with access to irrigation grow high value horticultural crops and not low value traditional grain crops. They then use the money they get from selling these high value crops to purchase grain to meet their grain food requirements. Households farming farms with high natural soil fertility had a GFSSI which was 0.78 units higher when compared to farmer's farms with low natural soil fertility and the result is significant at 1% level of significance. Thus high soil fertility enhances productivity and this result is supported by Abdulla in 2015 [18] and Muhoyi *et al.;* in 2014 [16]. Household wealth also positively and significantly influenced GFSSI and the result is significant at 5% level of significance. A unit increase in the household asset index increases the GFSSI by 0.041 units and this result is supported by Harris-Fry *et al.;* in 2015 [15].

Famers located in agro-ecological zone V had a GFSSI which was 0.680 units higher when compared to farmers located in other agro-ecological zones. Although generally farmers in agro-ecological zone V are expected to be less food insecure given the dry climatic conditions experienced in this region, this result tend to suggest that they are producing more small grains and this then increases their grain self-sufficiency when compared to farmers in the other regions who tend to rely more on maize production for their household grain food security. Area planted to crops was also found to positively and significantly influence household food grain food self-sufficiency and the result is significant at 1% level of significance. A hectare increase in area planted increases the GFSSI by 0.637 units. This result is supported by Muhoyi *et al.;* in 2014 [16]. Farm profitability was also found to positively and significantly improve household grain food self-sufficiency and the result is significant at 10% level of significance. Thus farms earning higher gross margins per hectare have more income to invest in improved farming technologies that help improve household food security.

CONCLUSION AND RECOMMENDATIONS

This study sought to assess the impact of the farmer to farmer extension on household grain food self-sufficiency. The study found that on average the sample households were grain food secure with a grain food self-sufficiency index (GFSSI) of 1.20. In terms of the distribution of the GFSSI, 51% of the sample households had a GFSSI above 100% while 29% of the households had a GFSSI below 50%.

Farmer to farmer extension had a positive and significant impact on household grain food self-sufficiency. Other variables that positive and significantly influenced household grain food self-sufficiency were farming experience, agricultural income, farm commercialization, soil fertility, household wealth, agro-ecological zone V, area planted to crops and farm profitability. On the other hand, variables that were found to have a negative and significant impact on household grain food self-sufficiency were the number of years in a farmer group, off farm sources of income for the household head, household size, access to irrigation, and private input suppliers and contractor's extension support.

Given the positive contribution of the farmer to farmer extension to household grain food self-sufficiency, the study recommends that the government should put in place measures to actively promote farmer to farmer extension to compliment the public extension service. Farmers also need to be trained in improved farming practices so that they can increase their productivity and incomes from agriculture as the study found that farmers who were profitable and earning high agricultural income were more grain food secure.

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