Scholars Journal of Agriculture and Veterinary Sciences **e-ISSN 2348–1854**
Sch J Agric Vet Sci 2017; 4(6):214-222 **p-ISSN 2348–8883**

(An International Publisher for Academic and Scientific Resources) DOI: 10.36347/sjavs.2017.v04i06.001

Farmer to Farmer Extension and Adoption of Improved Farming Practices: Evidence from Manicaland and Masvingo Provinces of Zimbabwe

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Abstract: The farmer to farmer extension support is increasingly being supported in Zimbabwe as a strategy to complementing the public extension service in delivering extension support to smallholder farmers. Despite this increasing support, development practitioners and traditional conservative extensionists still doubt the effectiveness of the model in promoting technology adoption, agricultural productivity and development. This study sought to assess the impact of the farmer to farmer extension approach on improved farming practices adoption amongst 479 smallholder farmers selected randomly from 6 districts in Manicaland and Masvingo provinces of Zimbabwe. The study found that 80.6% of the sample farmers indicated adopting improved farming practices and the most widely adopted technologies were conservation farming related technologies, crop management practices related technologies, soil fertility management related technologies and farming as a business. Results of the binary logistic regression show that the farmer to farmer extension approach positively and significantly influences the adoption of improved farming practices. Other extension related variables that positively and significantly affect adoption of improved farming practices are the number of years of receiving extension support by the household and agricultural extension training. However, private input suppliers and contractors extension has a negative and significant effect on adoption of improved farming practices. The study recommends that the government actively pursue increasing coverage of the farmer to farmer extension support and should also put in place measures to continually upgrade the skills of extension farmers.
Keywords: Farmer to farmer extension, Improved farming practices adoption, Smallholder farmers

INTRODUCTION

Farmer to Farmer (F2F) extension approach is increasingly gaining recognition and support in the Zimbabwean smallholder agricultural sector, The F2F extension approach was introduced as part of the participatory extension approaches in 1998. With the declining public expenditure towards agriculture extension that the country has been experiencing in recent decades and the underdeveloped private extension system, development practitioners see the F2F extension approach as a viable strategic option for complementing Zimbabwe's overburdened and chronically underfunded public extension and advisory services in increasing its extension coverage particularly for smallholder farmers. Although the F2F extension approach is relatively new to Zimbabwe, it however dates back to at least the 1950s [1].

Access to extension services is critical in promoting adoption of modern agricultural production technologies because it can counter balance the negative effect of lack of years of formal education in the overall decision to adopt some technologies [2]. The provision of extension services facilitates the adoption of improved technologies through awareness creation, acquiring knowledge and skills, dissemination of information, and providing training that eventually aid in increasing agricultural productivity. Access to extension services therefore creates the platform for acquisition of the relevant information that promotes technology adoption. Access to information through extension services reduces the uncertainty about a technology's performance hence may change individual's assessment from purely subjective to objective over time thereby facilitating adoption. This means that farm households are more likely to adopt modern agricultural production technologies if they have access to extension services [3].

The actually adoption of the improved practices and technologies that are promoted through provision of extension services is conditioned by several household and farm level factors such as: (i) Human capital (gender of household head, age of household head, education level of household head, household education level, household labour and skills); (ii) Physical capital (land size, livestock ownership, household assets; access to irrigation, off-farm income, and distance to markets); (iii) Social capital (membership in farmers' organizations; tenure; and

affiliation to leadership); (iv) Access to extension services and access to quality extension; and (v) Others (soil fertility and slope of land).

Many practitioners particularly the traditional conservative extensionists still doubt the effectiveness of using farmers as extension agents to complement the public extension service. The promotion of the approach 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 agricultural technology adoption and agricultural productivity. The purpose of this study was to assess the impact of F2F extension approach on adoption of improved farming practices by 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 Binary Logistic model was used to assess the impact of F2F extension approach on the adoption of improved farming practices by the sample farmers. Following Hill and Kau in 1973 [4] and Pindyck and Rubinfeld in 1998 [5], the study uses the threshold decision-making theory. The theory indicates that when farmers are faced with a decision to adopt a technology or not, there is a certain threshold which is dependent on a set of farmer factors [3]. At a certain level of stimulus below the threshold, no adoption is observed while at the critical threshold level, a reaction is stimulated – in this case technology adoption.

Given that the dependent variable is binary, the Logistic regression was employed to estimate the impact of F2F extension approach on a farmer's decision to adopt improved farming practices. The Logit model has been widely used in similar studies exploring the determinants of farmers' decision in adoption studies [6]. The regression coefficients are estimated through an iterative maximum likelihood method. The model dependent and independent variables are 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 binary logistic Regression Variables

Variable	Description	Variable Measurement	Hypothesis
DEPENDANT VARIABLE			
$TECH_{ADOPT}$	Household adopted at least one improved farming practice/agriculture technology	Dummy: 1= yes, 0= otherwise	
INDEPENDENT / EXPLANATORY VARIABLES			
HHGENDER	Gender of household head	Dummy: 1= male, 0= otherwise	-/+
HHAGE	Age of household head	Years	-
HHSEDUC	Household head has attained at least secondary education	Dummy: 1=Yes, 0=otherwise	
HMSEDUC	Household members with secondary education	Number of members	+
HHEMOFFY	Household head has off-farm source of income	Dummy: 1=Yes, 0=otherwise	-/+
HHSIZE	Household size	Number of people in a household	-/+
CRPINT	Cropping intensity	Area cultivated divided by the available arable land	+
FARMGV	Agricultural income as measured by the gross value of farm output	Total value of farm output in $	+
$EXTN_{YRS}$	Years receiving agriculture extension services	Number of years	+
EXT_{TRAIN}	Household participated in extension training	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	+
EXT_{NGO}	Household receiving extension support from non-governmental organisations	Dummy: 1= yes, 0= otherwise	+
$EXT_{QUALVGD}$	Household perceive public extension to be of very good quality	Dummy: 1= yes, 0= otherwise	+
AER_I	Farm in agro-ecological region I	Dummy: 1= yes, 0= otherwise	+
AER_III	Farm in agro-ecological region III	Dummy: 1= yes, 0= otherwise	+
$DIST_{TROAD}$	Distance from farm to nearest tarmac road	Distance in kilometres	-

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Sample Households

The summary statistics for the sample are provided in Table 4 below. 81% of the sample households indicated that they had adopted at least one improved agricultural practice from amongst the improved technologies that were being promoted by the extension services. The average age of the head of household for the sample farmers was 49.80 years and 61% of the sample households were male headed. 42% of the head of households have attained at least secondary level education while 65% of the head of households also had off-farm sources of income. The average household size for the sample farmers was 5.87 members and the average number of other household members with at least secondary education apart from the head of household was 1.69.

14% of the sample farmers were located in agro-ecological zone I while 12% were located in agro-ecological zone III. The average distance of the farms from the nearest tarred road was 13.89 kilometres. The average agricultural income as measured by the gross value of farm output for the 2014/2015 agricultural season was USD 944.47 and the average number of years of receiving agricultural extension by the sample households was 7.51 years. 12% of the farmers indicated receiving extension support from non-governmental organisations, 1% from private input suppliers and contractors and 43% from other farmers. 45% of the farmers indicated that they had received agricultural extension training while 40% of the farmers perceived the extension support they were receiving from the public extension services to be of high quality.

Table 4: Summary Statistics of the Sample Households

Variable	Mean	Std. Deviation
$TECH_{ADOPT}$	0.81	0.396
HHGENDER	0.61	0.489
HHAGE	49.80	15.271
HHSEDUC	0.42	0.494
HMSEDUC	1.69	1.522
HHEMOFFY	0.65	0.476
HHSIZE	5.87	2.390
CRPINT	1.02	0.709
FARMGV	944.47	2207.499
$EXTN_{YRS}$	7.51	9.308
EXT_{TRAIN}	0.45	0.498
EXT_{F2F}	0.43	0.495
$EXT_{INPUTSC}$	0.01	0.091
EXT_{NGO}	0.12	0.327
$EXT_{QUALVGD}$	0.40	0.490
AER_I	0.14	0.345
AER_III	0.12	0.329
$DIST_{TROAD}$	13.89	17.331

Extent of Adoption of Improved Farming Practices by Sample farmers

80.6% of the sample farmers indicated that they had adopted improved farming practices (Figure 1). The adoption of improved farming practices is almost similar across gender with 82% of the male headed households indicating having adopted improved farming practices compared to 79% for female headed households.

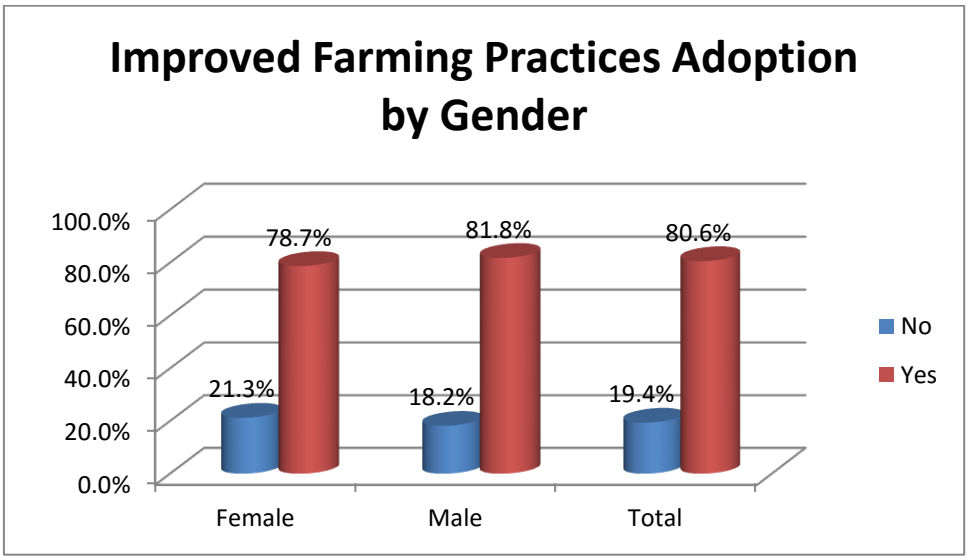

Fig 1: Improved farming practices adoption by gender

An analysis of the open-ended responses to the question about effects of extension on technology adoption by the sample farmers is shown in the word cloud (Figure 2) in which conservation farming related technologies, crop management practices related technologies, soil fertility management related technologies and farming as a business are the most widely adopted by farmers.

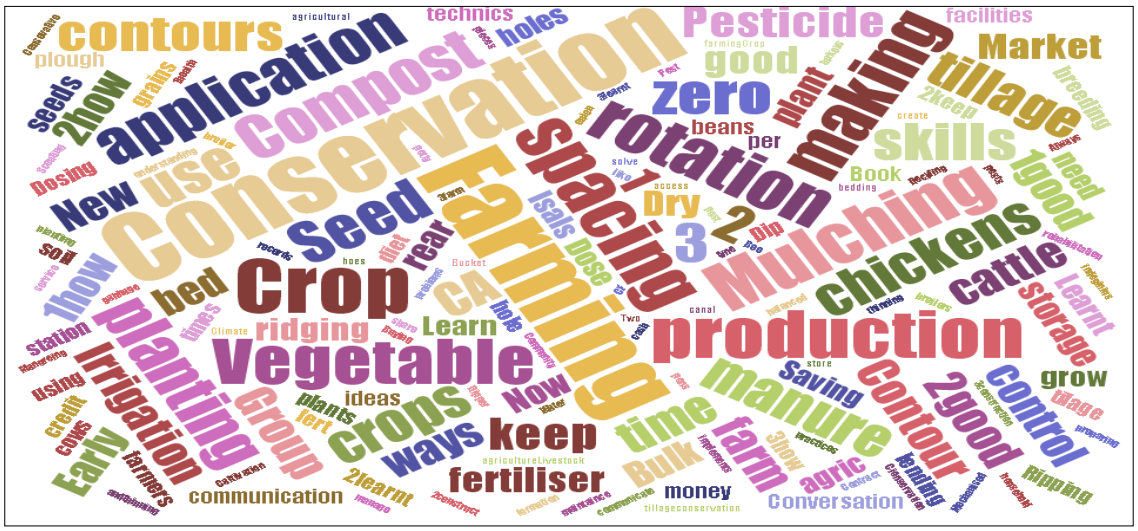

Fig 2: Extension Contribution to Agriculture Technology Adoption Word Cloud

Zaka, Mutasa and Bikita districts have the highest proportion of farmers who indicated to have adopted improved farming practices at 97.4%, 92.2% and 87.1% respectively while Chiredzi district has the lowest number at 59.8% (Figure 3).

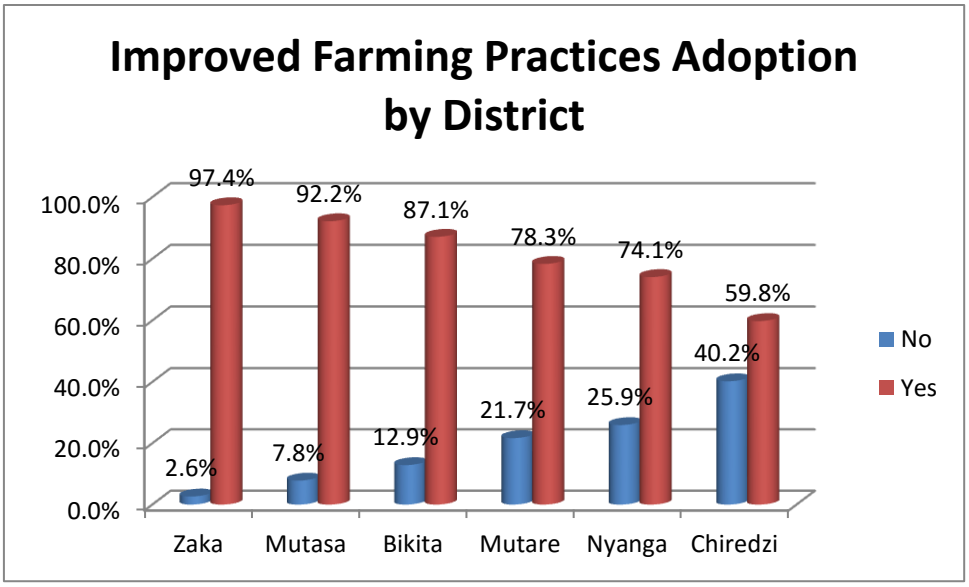

Fig 3: Improved farming practices adoption by district

In terms of agro-ecological zones, the highest proportion of farmers who indicated adopting improved farming practices are in agro-ecological Zone III and I at 98.3% and 92.4% respectively while the lowest is in agro-ecological zone V.

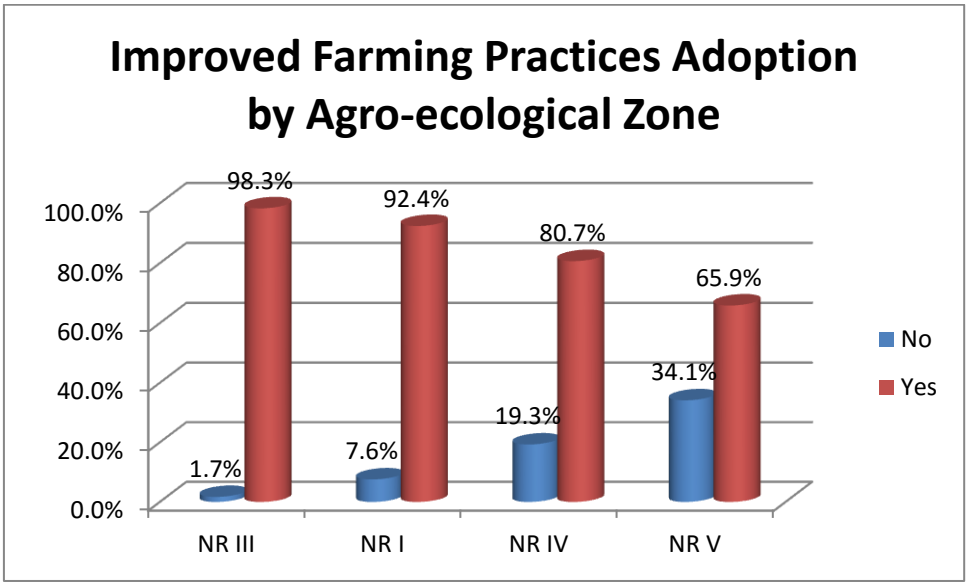

Fig 4: Improved farming practices adoption by agro-ecological zone

Impact of Farmer to Farmer Extension Approach on Improved Farming Practices Adoption

The estimates of the logistic regression are shown in Table 5 below. The variables that do not significantly influence adoption of improved farming practices by the sample households are sex of the head of household (HHGENDER), head of household having attained at least secondary level education (HHSEDUC), head of household having off-farm sources of income (HHEMOFFY), and non-governmental organization extension support (EXT_{NGO}).

Table 5: Binary logistic regression estimates of impact of F2F extension approach on technology adoption

Independent Variables	B	S.E.	Wald	Sig.	Exp(B)
HHGENDER	0.285	0.296	0.929	0.335	1.330
HHAGE	-0.020	0.009	4.499	0.034**	0.980
HHSEDUC	-0.425	0.320	1.757	0.185	0.654
HMSEDUC	0.197	0.117	2.834	0.092*	1.217
HHEMOFFY	0.337	0.276	1.486	0.223	1.400
HHSIZE	-0.137	0.072	3.549	0.060*	0.872
CRPINT	0.415	0.245	2.878	0.090*	1.515
FARMGV	0.000	0.000	3.234	0.072*	1.000
$EXTN_{YRS}$	0.056	0.021	7.095	0.008***	1.057
EXT_{TRAIN}	0.570	0.294	3.763	0.052*	1.768
EXT_{F2F}	1.158	0.543	4.540	0.033**	3.182
$EXT_{INPUTSC}$	-2.877	1.444	3.966	0.046**	0.056
EXT_{NGO}	-0.434	0.421	1.061	0.303	0.648
$EXT_{QUALVGD}$	-0.529	0.282	3.505	0.061*	0.589
AER_I	1.147	0.556	4.246	0.039**	3.148
AER_III	2.749	1.025	7.189	0.007***	15.621
$DIST_{TROAD}$	-0.031	0.007	18.534	0.000***	0.970
Constant	1.927	0.732	6.931	0.008	6.870

Note:
***indicates that the coefficient is statistically significant at 1% level.
**indicates that the coefficient is statistically significant at 5% level
*indicates that the coefficient is statistically significant at 10% level.

Farmers receiving extension support under the farmer to farmer (F2F) extension support were more likely to adopt improved farming practices when compared to farmers receiving extension support from public extension services. For a farmer receiving extension support from other farmers, the odds of the household adopting improved farming practices increases by a factor of 3.182 and are significant at the 5% level of significance when compared to farmers receiving extension from the public extension service. This is mainly because the F2F extension approach allows farmers to learn from their counterparts and it

also allows for a more practical approach to learning as farmers have an opportunity to see the benefits of the technologies from fellow farmers promoting them. This finding demonstrates that the F2F approach is an effective approach to complementing the government public extension system in technology diffusion and farmer training. This finding supports the finding of Ssemakula and Mutimba in 2011 [7] who also found that the farmer to farmer extension approach resulted in more technology uptake and thus better production and increased food availability for farmers in Masaka and Tororo districts of Uganda. Mugisha *et al.;* in 2004 [8] also found that the farmer to farmer extension approach was positively correlated with adoption in agroforestry Uganda.

Other factors that significantly affect adoption of improved farming practices by the sample households are age of the head of households (HHAGE), other household members with at least secondary level education apart from the head of household (HMSEDUC), household size (HHSIZE), cropping intensity (CRPINT), agricultural income as measured by the gross value of farm output (FARMGV), number of years of receiving extension support by household ($EXTN_{YRS}$), whether the household has received agricultural extension training (EXT_{TRAIN}), whether the household has received extension support from private input suppliers and contractors ($EXT_{INPUTSC}$), whether the household perceive the extension support they receive from the government public extension services to be of very high quality ($EXT_{QUALVGD}$), location in agro-ecological zone I (AER_I), location in agro-ecological zone III (AER_III) and location of farm from the nearest tarred road ($DIST_{TROAD}$).

The probability of adopting improved farming practices decreases with age of the head of household. A one year increase in the age of the head of household reduces the probability of the household adopting improved farming practices by a factor of 0.02 and the result is significant at 5% level of significance. Older farmers are more risk averse. This result is supported by Diro *et al.;* in 2017 [9], Okon and Idiong in 2016 [10], Dehinenet in 2014 [11] and Asiedu-Darko in 2014 [12]. Households with other members with at least secondary education apart from the head of household are more likely to adopt improved farming practices. Units increase in the number of members with at least secondary level education increases the probability of adopting improved farming practices by the household by a factor of 0.217 and the result is significant at 10% level of significance. Education allows members to have a better understanding of new technologies. This result is supported by Okon and Idiong in 2016 [10], Cukur in 2016 [13] and Asiedu-Darko in 2014 [12].

Household size negatively influences adoption of improved farming practices and the result is significant at 10% level of significance. As the household size increases by one unit, the odds of the household adopting improved farming practices increases by a factor of 0.872. The implication is that households with larger families are not likely to adopt improved farming practices and this result is consistent with Dube in 2017 [14] and Challa and Tilahun in 2014 [15].

Cropping intensity positively influences the adoption of improved farming practices and the result is significant at 10% level of significance. A unit increases in the cropping intensity increases the probability of adopting improved farming practices by a factor of 1.515. This implies that households with high cropping intensity are more likely to adopt improved farming practices. Agricultural income positively influences the adoption of improved farming practices. A unit increase in agricultural income increases the probability of adopting improved farming practices by a factor of 1.0 and the result is significant at 10% level of significance. Thus households earning high incomes from farming operations are more likely to adopt improved farming practices. This maybe because they can afford to buy the technologies. This result is supported by Dehinenet, *et al.;* in 2014 [11]. A unit increase in the number of years a farmer has received agricultural extension positively and significantly influences the probability of adopting improved farming practices by a factor 1.057 and the result is significant at 1% level of significance. The result suggests that farmers need time to evaluate and adopt new technologies. Farmers who have received agricultural training are more likely to adopt improved farming practices when compared to farmers who have not received any training and is significant at 10% level of significance. The odds indicates that the probability of a farmer who has received agricultural training adopting improved farming practices is 0.768 higher than that of a farmer who has not received training. This finding is also supported by Diro *et al.;* in 2017 [9]. Farmers receiving extension support from private input suppliers and contractors are less likely to adopt improved farming practices when compared to farmers receiving extension support from the public extension service and the result is significant at 5% level of significance. The odds show that the probability of a farmer receiving extension support from private input suppliers and contractors adopting improved farming practices is 0.944 lower when compared to that of a farmer receiving extension support from the public extension service. This may be attributed to the fact that private-led extension support is still in its infancy and is generally focused on a few specific commercial crops.

Farmers who rate the public extension quality as very good are less likely to adopt improved farming practices when compared to farmers who rate it as good and the result is significant at 10% level of significance. The probability of adopting improved farming practices

reduces by a factor of 0.589 for farmers who rate the public extension service to be very good when compared to farmers who rate it to be good. Farmers located in agro-ecological zones I and III have higher probabilities of adopting improved farming practices and the coefficients are significant at 5% level and 1% level respectively. The odds indicates that the probability of a farmer located in agro-ecological zone III adopting improved farming practices is 2.148 higher when compared to that of a farmer located in agro-ecological zones IV and V while that of a farmer located in agro-ecological zone III is 14.621 higher when compared to a farmer in agro-ecological zones IV and V. This may imply that farmers in agro-ecological zones I and III are more prepared to take risk and adopt new technologies as the chances of failure are lower as these agro-ecological zones are better endowed for farming when compared to the drier agro-ecological zones IV and V.

Location of the farm from the nearest tarred road also negatively influences adoption of improved farming practices. A unit increase in the distance of location of the farm from the nearest tarred road reduces the probability of adopting improved farming practices by a factor of 0.970 and the result is significant at 1% level of significance. Distance of the farm from the nearest tarred road affects farmers' access to both input and output markets. Thus farmers located in more remote areas are less likely to access markets for improved technologies and at the same time are more likely to face challenges in marketing the surplus production arising from increased production as a result of adopting improved farming practices. Thus distance from the tarred roads deters farmers from adopting improved farming technologies. This finding is supported by Diro *et al.;* in 2017 [9] who found that distance to the main market affected the adoption and degree of adoption of soybean in Ilu-Ababora Zone of Southwestern Ethiopia.

CONCLUSION AND RECOMMENDATIONS

The farmer to farmer extension support is increasingly being supported in Zimbabwe as a strategy to complementing the public extension service in delivering extension support to smallholder farmers. Despite this increasing support, development practitioners and traditional conservative extensionists still doubt the effectiveness of the model in achieving technology adoption, agricultural productivity and development. This study sought to assess the impact of the farmer to farmer extension approach on improved farming practices adoption amongst 479 smallholder farmers selected randomly from 6 districts in Manicaland and Masvingo provinces of Zimbabwe.

The study found that 80.6% of the sample farmers indicated adopting improved farming practices and the most widely adopted technologies were conservation farming related technologies, crop management practices related technologies, soil fertility management related technologies and farming as a business. Results of the binary logistic regression show that the farmer to farmer extension approaches positively and significantly adoption of improved farming practices. Other extension related variables that positively and significantly affect adoption of improved farming practices by the sample households are the number of years of receiving extension support by household and agricultural extension training. However private input suppliers and contractors extension has a negative and significant effect on adoption of improved farming practices.

Non-extension related factors that positively and significantly affect adoption of improved farming practices are education level of household members other than that of head of household, cropping intensity, agricultural income as measured by the gross value of farm output, location in agro-ecological zone I, location in agro-ecological zone III and location of farm from the nearest tarred road. Age the head of households and household size negatively and significantly affect adoption of improved farming practices. The study recommends that the government actively pursue increasing coverage of the farmer to farmer extension support and should also put in place measures to continually upgrade the skills of extension farmers.

ACKNOWLEDGEMENTS

The author is grateful to Agricultural Input Support Programme (AISP) Zimbabwe for sponsoring the field data collection exercise, the smallholder farmers in the six study districts of Manicaland and Masvingo provinces for sparing their time during survey and questionnaire administration, and to the government extension service (Agritex) and AISP team for the logistical support during the field work.

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