



FACTORS INFLUENCING THE LIKELIHOOD OF ADOPTION OF INTEGRATED STRIGA MANAGEMENT FOR AFRICA TECHNOLOGIES AMONG SMALL SCALE MAIZE FARMERS IN BAUCHI AND KANO STATES, NIGERIA

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ABSTRACT

The study examined the adoption of integrated striga management for Africa (ISMA) technology among small scale maize farmers in Bauchi and Kano States, Nigeria. A multi-stage sampling technique was used in selecting 508 respondents from the study areas. Data were collected through the administration of questionnaire and analyzed using both descriptive and inferential statistics. The results revealed that average age of the beneficiaries and the non-beneficiaries were 39 and 38 years respectively. Majority (88.7% and 86%) of the total beneficiaries and non-beneficiaries of the ISMA project in the study area were male with an average household size, farm size and farming experience of 11 people, 3 hectares and 18 years, respectively. The results of the logistic regression revealed that, level of education and major occupation were negative and significant in influencing the likelihood of adopting ISMA technology $p < 0.01$ while distance to sources of technology was positive and significant at the same level. The major constraints to the adoption of ISMA were, inability to differentiate *desmodium* from other weeds and non-availability of materials relating to ISMA technology. It can be concluded that, level of education, major occupation and income were the factors influencing the likelihood of adopting ISMA technologies in the study area. Based on the constraints highlighted, the research recommended; more on farm trials to be conducted by extension agents in order to build the capacity of the farmers on the technology and materials for ISMA technology should be made available to the farmers by the government and other relevant agencies.

Keywords: Adoption, Likelihood, *Striga*, Management, Respondents.

INTRODUCTION

Maize is one of the most important staple foods for millions of Nigerians and other West African countries. It is one of the two most important crops after sorghum covering about 40 per cent of the area under agricultural production and its production accounts for 43 per cent of maize grown in West Africa (Iken and Amusa, 2004). Maize has been in the diet of Nigerians for centuries. It started as a subsistence crop and has gradually become a more important crop. Maize has now risen to a commercial crop on which many agro-based industries depend for raw materials (Iken and Amusa, 2004). The total land area under maize cultivation in Nigeria is above 2.5million hectares with an estimated yield of about 1.4 metric tonnes per hectare (Sadiq *et al.*, 2013). Growth in maize utilization has been driven by the rapidly increasing demand for maize as livestock feed and industrial food and non-food production. Witch weed (*Striga* Spp.), a root parasitic flowering plant, is common in Sub Saharan Africa causing severe



constraints to crop production. It survives by diverting essential nutrients, which are otherwise taken up by crops such as sorghum, millet, maize and rice (Atera *et al.*, 2011). These crops are of utmost significance to African farmers for their home consumption. The weed siphons underground water and nutrients for its growth, it withers the grain and reduced yield. In Nigeria *S. hermonthica* has invaded about 835,000 hectares of maize farmland, directly affecting approximately 20 million people (Woomer *et al.*, 2008). In the northeastern region of Nigeria, *Striga* infestation has reached epidemic level in most cereals, with over 85% of fields planted to maize infested with the parasite and crop damage ranging from 10% to 100% (Dugje *et al.*, 2006).

Adoption of agricultural technologies refers to the decision to apply a technology and continue with its use (Agbamu, 2006). The adoption occurs in three phases; acceptance, decision to use and continued use. It is generally a multi-stage process under taken most often sequentially and being influenced by a wide range of social, physical and technical aspects of farming activities and practices. According to Federal Office of Statistics (1999), smallholder farmers are farmers whose production capacity is ≤ 4.99 hectares holding. A characteristic feature of the agricultural production system in Nigeria is that a disproportionately large fraction of the agricultural output is in the hands of these smallholder farmers whose average holding is about 1.0-3.0 hectares.

The Integrated Striga Management for Africa (ISMA) is a charitable programme sponsored by the Bill and Melinda Gates Foundation (BMGF). The programme provided a 4-year financial support to the International Institute of Tropical Agriculture (IITA) and other partners in 2011. The programme aimed to intensively promote proven integrated *Striga* management strategies in cowpea and maize farming systems in northern Nigeria and western Kenya, with the active participation of farmers, community-based organizations, extension workers, policy makers, and researchers. The objective of the project was to improve the livelihoods of over 25 million smallholder farmers in the immediate impact zones of the project in northern Nigeria (15 million) and western Kenya (10 million).

Maize is one of the major crops grown and consumed across all the agro-ecological zones of Nigeria. It currently account for approximately 20% of domestic food production in west and central Africa. It has achieved the highest growth rate among major crops since 1970s (Kamara *et al.*, 2006). Despite the high yield potentials of maize; its production is faced with numerous constraints. Studies of Babatunde *et al.* (2008) and Kudi *et al.* (2011) have shown that maize average yield is still low compared to its potential yield. The average yield of maize in Nigeria was 1.4 tons/ha in 2013 compared to the world average of 5.5 tons/ha (FAOSTAT, 2013). In Nigeria, *S. hermonthica* has invaded about 835 000 ha of maize, directly affecting approximately 20 million people (Woomer *et al.*, 2008). The problems of *Striga*-infested fields have been aggravated over the years as a result of the indiscriminate purchase of *Striga*-infested seeds by farmers, continuous cultivation of *Striga* susceptible varieties, uncontrolled grazing, and non-adoption of integrated *Striga* management strategies (IITA, 2014). The International Institute of Tropical Agriculture (IITA) has developed extra early maturing, striga tolerant, high yielding and draught tolerant varieties that are adapted for growth in West Africa. All these proven attributes are geared toward reducing food insecurity, stabilizes rural farm income and lessening the risk of poverty among farming households in the sub-Saharan Africa. Past studies have shown that, there are little empirical studies that assess the adoption of the integrated striga management technologies in addressing the problem of low productivity among small scale maize farmers. The above gap is what the research intends to fill. The broad objective of the study was to assess the adoption of integrated Striga management technologies



among small scale maize farmers in Bauchi and Kano States, Nigeria. The specific objectives were to:

- i) Describe the socio-economic characteristics of small-scale farmers engaged in maize production in the study area.
- ii) Determine the factors influencing the likelihood of ISMA adoption in the study area.
- iii) Describe the constraints affecting the adoption of integrated *Striga* management technologies in the study area.

The results of the research provide information on the adoption of the integrated *Striga* management in Africa on the productivity and income of small-scale maize farmers in Nigeria. It will serve as a basis for further research and guidance for policy makers in designing and fashioning out good agricultural policies. The population of the study focused on small scale maize farmers in Bauchi and Kano states because they are the beneficiaries of Integrated *Striga* Management for Africa (ISMA) technologies in Nigeria.

MATERIALS AND METHODS

The Study Area

Bauchi State lies between 9.3° and 12.3° North of the equator and longitude 8.5° and 11° east of the Greenwich Meridian. It has a total land area of 49,259.01km² which is about 5.3% of the total land mass of Nigeria, out of which only 34,481 square kilometers is under cultivation (BSADP, 2003). It has a total projected population of 6,202,101 people based on 2006 population census (NPC, 2006). The area experiences both dry and rainy seasons with a maximum rainfall of about 700 mm per annum in the north to about 1300 mm per annum in the south. The State is characterized by two distinct vegetative zones which include Northern Guinea Savannah and Sudan Savannah.

Kano State of Nigeria is located on 12°37' N, 9°29' E, 9°33' S and 7°43' W. It has a total land area of 20,760 square kilometers with 1,754,200 hectares of agricultural land and 75 000 hectares of forest vegetation and grazing area. It has a projected population of 12,444,981 (NPC, 2006). Kano has two seasonal periods, which consist of four to five months of wet season and a long dry season lasting from October to April. The average rainfall is between 63.3mm ± 48.2mm in May and 133.4mm ± 59mm in August the wettest month. The vegetation of Kano State is the semi-arid savannah. The Sudan Savannah is sandwiched by the Sahel Savannah in the north and the Guinea Savannah in the south. The two areas soil comprises of loamy, clay, sandy loamy and sandy soil which are suitable for cultivation of major crops like, groundnuts, guinea corn, cowpea, cotton, rice, beni seed, maize, cowpea, sorghum, millet, root and tubers like sweet potato, cassava etc. The states are predominantly agrarian in nature with about 80% of the inhabitants engaged in farming and its related occupations.

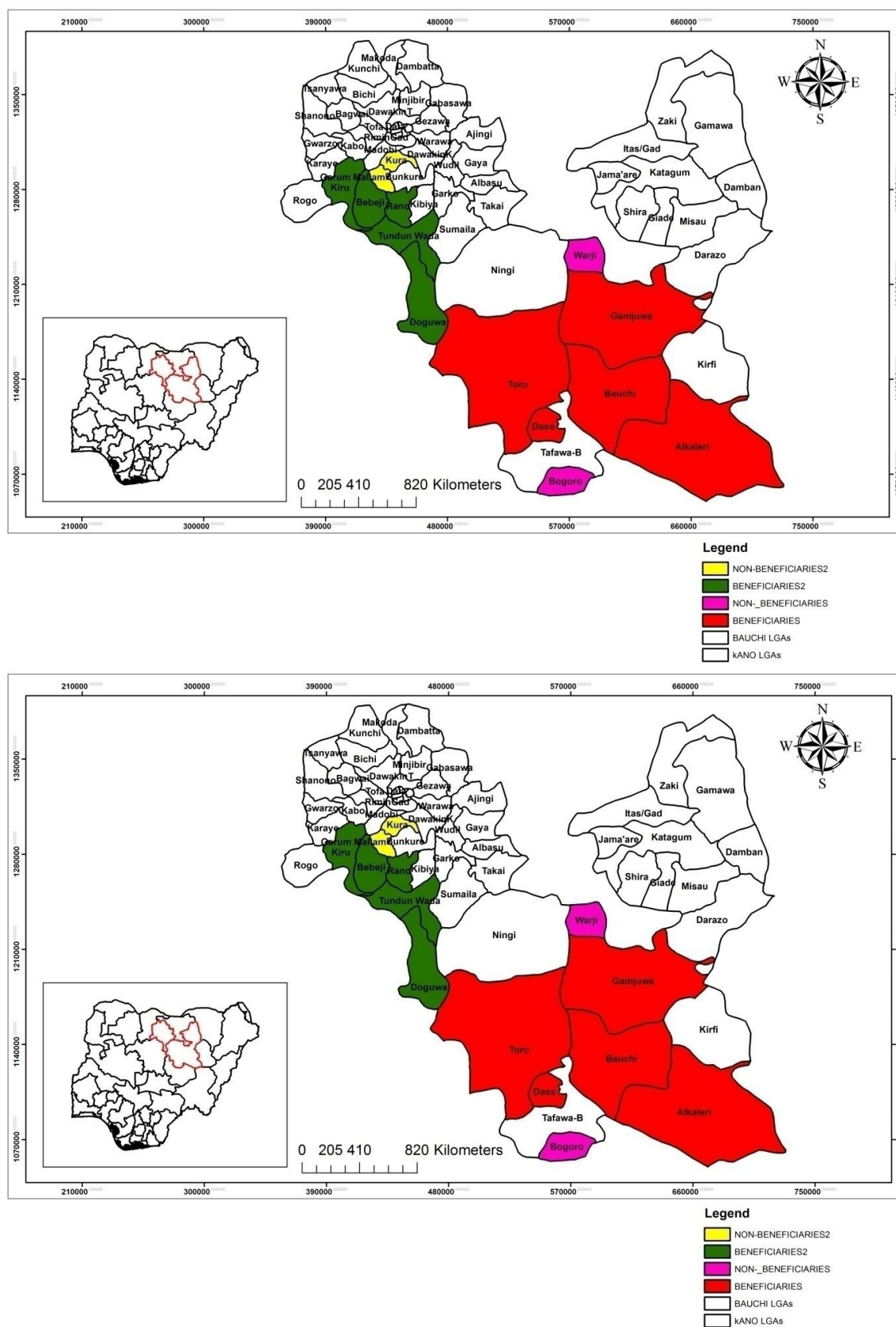


Figure 2: Map of Bauchi and Kano States



Sampling Technique and Sample Size

A multi-stage sampling technique was employed in selecting the respondents. In the first stage 10 local government areas that participated in the ISMA project and 4 non-participating local governments two from each state with potentials of maize production were purposively selected. In the second stage, one district was randomly selected from the selected local government areas. In the third stage, from each of the selected districts 4 communities were randomly selected. In the final stage, from each of the selected local government area 10 % of the registered maize farmers were randomly selected from the sampling frame obtained from the Maize Farmers Association of Nigeria (MAN). The sample size for the study was 508 maize farmers randomly drawn from the study area.

Data Collection

Data for the research were collected through the administration of structured questionnaire to the respondents randomly selected from the study area.

Analytical Technique

Combinations of different statistical tools were used in analyzing the data for this study. The tools include both descriptive and inferential statistics. The descriptive statistics used includes; frequency, percentages and Binary logistic regression.

Logit Model was used to identify the factors that influence the likelihood of adoption of ISMA technologies by farmers. Earlier studies (Idrisa *et al.*, 2010) used Logit model to identify factors affecting the likelihood of adoption of improved technologies. The explicit form of the Logit model is presented as:

$$Y_i = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + u \dots (1)$$

where;

Y is the likelihood of adoption leveled as Adopt

Y_i (adoption) = observed response for the i th respondent, which is in binary form: $Y_i = 0$ non adopters and $Y_i = 1$ for adopters.

$Y_i = 1$ (only farmers who planted at least 10% of their total land area with ISMA technologies)

$Y_i = 0$ (for any farmer that has less than 10% of their farm under ISMA technologies)

$X_1, X_2, X_3, \dots, X_n$, n= number of explanatory variables included in the model.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

The result in Table 1 reveals that, the average age of the beneficiaries and the non-beneficiaries were 39 and 38 years, respectively. The results also show that, majority of the beneficiaries (77.4%) and non-beneficiaries (89.9%) were within age brackets of 18-47 this indicates that the respondents in the study area were in their energetic and active age to participates agricultural activities. The results also reveal that, majority of the beneficiaries (88.7%) and non-beneficiaries (86%) of the ISMA project in the study area were males.

The results from Table 1 further reveals that, majority (78.8%) of the beneficiaries were married while only 22.2% of the respondents were single 15.8% widowed 2.3% and divorced 3.1%, respectively. Similarly, almost all (92.4%) of the total non-beneficiaries were married while only 7.6% were single, widowed and divorced, respectively. This implies that most of the respondents have responsibilities and this can serve as motivational factor for them to accept new technologies in order to improve their output as well as their livelihood. The results also show that more than half (57.1%) of the beneficiaries of ISMA technology had a household size 1-10. It also shows that, 31.9% and 10.3% had a household size of 11-20 and 21-30 respectively with an average of 11 people per household belonging to both respondents



in the study area. Similarly, majority (89.7%) of the non-beneficiaries had a household size of 1-10 people per household while remaining 10.3% of the total respondents had a household size range of 21-40 people. The findings as presented in Table 2 further reveals that, 49% of the beneficiaries of ISMA technology had informal training with regards to level of education while 42.6%, 6.9% and 1% attended primary, secondary and tertiary institutions respectively as their level of education. On the other hand, majority (60.7%) of the non-beneficiaries attended primary while 36.4% attended informal schools as their level of education. The results also show that, the average farm size of the respondents in the study area was 2 hectares. The implication is that farmers with larger farm holding are more likely to adopt ISMA compared to those with small farms size. This is based on the fact that; they can sacrifice some part of their land to practice new technology while their production process is going on.



Table 1: Distribution of Respondents base on their Socio-economic Characteristics

Variables	Beneficiaries n= 392			Non-beneficiaries n= 107		
	Frequency	%	Mean	Frequency	%	Mean
Age (years)						
18-28	60	15.3	39	22	20.6	38
29-38	116	29.6		49	45.8	
39-48	126	32.1		25	23.4	
49-58	66	16.8		23	21.5	
> 58	23	5.9		4	3.7	
Sex						
Male	348	88.7		92	86.0	
Female	44	11.3		15	14.0	
Marital status						
Single	62	15.8		1	0.9	
Monogamous married	140	35.7		75	70.1	
Polygamous married	169	43.1		24	22.4	
Widowed	9	2.3		2	1.9	
Divorced	12	3.1		5	4.7	
Household size						
1-10	224	57.1	11	96	89.7	11
11-20	125	31.9		6	5.6	
>20	43	10.9		5	4.7	
Level of education						
Informal education	194	49.5		39	36.4	
Primary education	167	42.6		65	60.7	
Secondary education	27	6.9		1	0.9	
Tertiary education	4	1.0		2	1.9	
Farm size (Ha)						
<1	1	0.2	3	2	1.8	3
1-2	104	26.6		18	16.8	
3 and above	287	73.2		87	81.3	
Farming experience						
1-10	133	33.9	18	63	58.9	18
11-20	120	30.6		21	19.6	
21-30	92	23.5		18	16.8	
31-40	40	10.2		5	4.7	
>41	7	1.7				
Major occupation						
Farming	273	69.6		79	73.8	
Artisan	14	3.6		5	4.7	
Hunting	12	3.1		1	0.9	
Civil servant	69	17.6		19	17.8	
Trading	22	5.6		2	1.9	
Student	2	0.5		1	0.9	
Total farm income (₦)						
<50,000	58	14.9		26	24.3	
51,000-100,000	94	24.0		36	33.6	
101,000-150,000	59	15.1		22	20.6	
151,000-200,000	53	16.0		10	9.3	
>200,000	118	30.0		13	12.1	

Source: Field Survey, 2018

The findings also reveal that, both the beneficiaries' non-beneficiaries had an average of 18 years of maize farming experience. The implication of this finding is that farmers with lower age of farming experience have higher tendency of adopting new technologies than those



with higher age. The results in Table 1 reveals that majority of the beneficiaries (69.6%) and the non-beneficiaries (73.8%) of the ISMA technology had farming as their major occupation while the remaining respondents falls in to different types of occupation which includes; artisan, hunting, trading and civil service, respectively.

The results in Table 2 show that, 30% of the beneficiaries of ISMA technology had income of more than ₦200, 000 in the previous farming season. It was also found that, 24%, 16%, 15% and 14.9% had income of between ₦51,000 – ₦100,000, ₦151, 000, - ₦200,000, ₦101,000 – ₦150,000, and less than ₦50,000 naira, respectively. Similarly, 33.6% of the non-beneficiaries of the technology had income of ₦51,000 – ₦100,000 in the previous farming season while 24.3%, 20.6%, 12.1% and 9.3% had income of between less than ₦50,000, ₦101,000 – ₦150,000, greater than ₦200,000 and ₦151,000 – ₦200,000 Naira, respectively. This implies that the beneficiaries received more income than the non-beneficiaries.

The results from Table 2 reveal that 81.1% of the beneficiaries of ISMA technology in the study area had access to credit, only 18.9% of the total beneficiaries reported that they had no access to credit. The results also reveal that, 51.4% of the non-beneficiaries agreed that, they had access to credit while 48.6% of them agreed on the contrary. The implication is that access to credit determines the buoyancy of the farmer to meet the financial needs of the innovation. The results as presented in Table 2 further reveals that, Majority of the beneficiaries (85.7%) and non-beneficiaries (81.3%) were members of one organization, cooperative society or the other.

The results from Table 2 show that 51% of the beneficiaries and non-beneficiaries in the study area had an average of 7 years of group membership in the study area. The findings from Table 2 show that, more than half (52.3%) of the beneficiaries had contact with extension agents fortnightly. The findings further reveal that 40.1% of the beneficiaries had contact with extension agents weekly and only 7.7 % of the beneficiaries met with extension agents on monthly basis. On the hand majority (56.1%) of the non-beneficiaries of the technology had contact with extension agents on monthly basis while 25.2% and 18.7% of the remaining non beneficiaries met with their extension agents fortnightly and weekly, respectively. This implies that contact with extension agent will enhance the ability of farmers to understand and properly utilize the ISMA technology in the study area.

Table 2: Distribution of Respondents Base on their Institutional Variables

Variable	Beneficiaries (n = 392)			Non-beneficiaries (n = 107)		
	Frequency	%	Mean	Frequency	%	Mean
Access to Credit						
Yes	318	81.1		55	51.4	
No	74	18.9		52	48.6	
Group Membership						
Yes	336	85.7		20	81.3	
No	56	14.3		87	18.7	
Years of group membership						
0-5	200	51.0	7	80	74.9	7
6-10	104	26.5		21	19.7	
11-15	48	12.2		3	2.8	
16-20	28	7.1		2	1.7	
>20	12	3.1		1	0.9	
Contact with Extension Agent						
Weekly	157	40.1		20	18.7	
Fourth nightly	205	52.3		27	25.2	
Monthly	30	7.7		60	56.1	

Source: Field Survey, 2018

Results of Factors Influencing the Likelihood of Adoption of ISMA technology

The log likelihood of -92.404 and probability Chi² of (25) 86.25 with pseudo R² of 0.2786 which was significant at 1% level of probability justifies the fitness of the model in explaining all the explanatory variables that estimate the likelihood of adopting ISMA technology among farmers. The results from Table 3 revealed that level of education was significant at 5% with negative coefficient implying that as more formal education is acquired the likelihood of adopting ISMA technology decreases in comparison with non-formal education. The negative effect exerted by education is contrary to expectation that people with higher level of education are expected to have higher probability of adopting new technologies than those with low level of education.

The finding affirmed that of Mohammed *et al.* (2014) which posited that, level of education was negative and statistically significant on extent of adopting DT maize. This implies that, ISMA technology is not complex to require formal education to be practiced by farmers in the study area. Distance to source of technology was significant at p<0.05 level of probability in influencing the likelihood of ISMA technology adoption. This implies that as distance to sources of technology increases the likelihood of adoption decreases. This is not in conformity with *a priori* expectation; farmers that are close to sources of technology have higher likelihood of adopting the technology than those that are far. This base on the assumption that respondents that are close to sources of technology find it easy to make enquiries vis-à-vis access material related to the technology.

Table 3: Factors of Influencing the Likelihood of Adopting ISMA Technology

Variables	Odds ratio	Robust Std Error	Z
Sex	.7544749	.8200468	-0.26
Age	.9570519	.0271306	-1.55
Marital status			
Monogamously married	3.150817	2.407107	1.50
Polygamously married	3.087664	2.757637	1.26
Widowed	1.18963	1.771376	0.12
Divorced	3.457838	3.874376	1.11
Education			
Primary	0.2463849	.520919	0.47
Secondary	-2.366355	0.750626	-3.15**
Post-Secondary/Tertiary	-1.863834	1.04318	-1.79*
Household Size	1.003409	.0396367	0.09
Farm Size	1.196187	.2178357	0.98
Farming Experience	1.025762	.271551	0.96
Distance to Source of Technology	1.090416	.0462908	2.04*
Major occupation			
Artisan	.7413001	.632148	-0.35
Hunting	.2684346	.2047487	-1.72
Civil Service	.235423	.1298282	-2.62**
Trading	.1135663	.0694937	-3.55***
Total farm Income			
51,000-100,000	3.099634	1.884379	1.86
101,000-150,000	2.298521	1.523096	1.26
151,000-200,000	2.042171	1.303272	1.12
>200,000	7.089719	5.747354	2.42**
Contact with Extension			
Forth nightly	1.817222	.8633522	1.26
Monthly	.7046706	.5229682	-0.47
Access to Credit	.946872	.5332702	-0.10
-cons	6.739094	18.71673	0.69
Wald Chi ² (25)	86.25		
Prob > Chi ²	0.0000***		
Log likelihood	92.404093		

*** = significant at 1%, ** = significant at 5% *Sig. at 10

Source: Field Survey, 2018

The logit regression result further reveals that, trading and civil servant among the estimated major occupation were negatively significant at $p < 0.1$ and $p < 0.01$, respectively. This implies that as trading and civil servants increases in comparison to farming as major occupation, the likelihood of adoption decreases. This is based on the fact that; adoption is expected from farmers whose primary occupation is farming. Respondents with other exogenous income apart from farming tend to show negative attitudes towards adopting ISMA technology. The result implies that ISMA technologies are suitable for maize farmers that are constraints by resources.

In addition, the result (Table 3) reveals that, farm size was positive and also significant at 5%. This implies that, as farm size increases, adoption of ISMA technology increases. This is because farmers with large farm size can afford to devote part of their maize farms for ISMA



technology without significantly affecting the total land left for the production of the other crops while small land holders cannot. This is in tandem with findings of Idrisa *et al.* (2014) in their work analysis of adoption of draught tolerant maize and its effects on food security among farmers, they reported that, Farmers that have higher income levels were in a better position to afford inputs in the form of seeds, fertilizers, herbicides or machinery.

Constraints to the Adoption of ISMA Technology

The results in Table 4 present the reasons for inability of the respondents to adopt and make continuous usage of ISMA technology in the study area. The results reveal that more than half (56.6%) of the respondents relate factors that limit their usage of ISMA technology to inadequate information about the technology which make it very difficult for the respondents to implement the technology was ranked 1st. In ability of the respondents to differentiate other weed varieties from *Desmodium* which is used in push pull method was ranked 2nd with 52.8 %. This indicates that farmers that resort to use of the above method find it difficult to use in the technology controlling *Striga*. This is in line with the *apriori* expectation of the theory of perceived attributes which asserted that complexity, i.e., difficulty in putting technology in to practice is one of the attributes that stop farmers from adopting a technology. The non-availability of materials associated with the technology was ranked 3rd and 52.6%, respectively. The Table further reveals that, 49% of the total respondents attribute their limitation to the use of ISMA technology to high cost of seeds which was ranked 4th. It also shows that non availability of the seeds when needed by the farmers was ranked 5th with 44%. Some of the respondents complained of poor yield of the *Striga* resistant and tolerant as the reason for its poor adoption by the farmers which was ranked 6th.

Table 4: Constraints to Adoption of ISMA Technology

Variables	*Frequency	Percentage	Ranking
Inadequate information	222	56.6	1st
Difficulty of differentiating <i>Desmodium</i> from other varieties of weed	207	52.8	2nd
Non-availability of materials	206	52.6	3rd
High cost of seed	192	49.0	4th
Non availability of seed	174	44.4	5th
Poor yield of the improved variety	169	43.1	6th

*Multiple Response

Source: Field Survey, 2018

CONCLUSION AND RECOMMENDATIONS

Based on the findings it can be concluded that, level of education, distance to source of technology, major occupation, farm size, farming experience and total farm income were the factors influencing the likelihood of adopting of ISMA technology by the respondents in the study area. In line with the constraints highlighted in this research, the following recommendations were made;

1. There is need for wider sensitization by the government agencies more especially ADPs to create awareness on the *Striga* management through the use of effective extension services.
2. Farm trials should be conducted to farmers by extension agents at regular basis to enable them, differentiate some of the grasses used in suppressing *Striga* or reducing it seed bank from the weed.



3. Materials needed for the control of the Striga should be made available by the stakeholders at farm centers, certified agro-dealers and other marketing outlets in order to make it easy for farmers to procure and use them.
4. The price of the Striga resistant and tolerant maize varieties should be made affordable to the small-scale farmers.

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