Understanding the Farmers' knowledge drivers: Evidence from Integrated Striga (*Striga Spp*.) Management Technology in Nigeria

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Abstract

Integrated Striga Management (ISM) project has started since 2011 and ends in 2015. Several studies are conducted to monitor and explore the impact of the project on livelihood of farmers. No study was found to examine the knowledge of the ISM technology which in turn will facilitates understanding and appropriate use of the ISM technology by farmers and give a clue for contact farmers and local extension agents on an area of emphasis for them to achieve further penetration. The study analyzed the drivers of ISM knowledge in Nigeria. Multi-stage sampling method was used that arrives at 192 farmers. Data were collected through schedule interviews by the trained enumerators. Cross tabulation, logistic regression and Tobit regression were used to achieve the objective. Majority (51.98%) of farmers were trained and had 18 good knowledge of ISM technology and 12.43% of them had very good knowledge of ISM technology. Male farmers, increasing of household size and number of training and method and result demonstration extension channels were found to be positively affecting farmers' knowledge on ISM technology in a first stage, while increase in farm size is negatively affecting it (P≤0.1). Number of training and receiving the training through method and result demonstration channels were found to be positively affecting extent of ISM technology knowledge of farmers. It was concluded that Sex, household size, number of training extension delivery methods used were the drivers of ISM knowledge while Number of training and Extension delivery method were the drivers of its intensity. The training campaign impacted the farmers' knowledge of ISM technology, this proved cost-effective. However, It's recommended that more programs could be designed that is more gender-inclusive so that females' farmers would be more incorporated into it. This should be done through more intensive extension delivery methods such as demonstrations. Also, lead farmers should be utilized for farmer-farmer extension so that training will be consistent in order to achieve more penetration.

Keywords: *Knowledge, ISM, Double hurdle model; Tobit regression; Logit regression*

Comprendre Les Moteurs des Connaissances des Agriculteurs : Preuves De La Technologie de Gestion Intégrée du Striga (*Striga Spp*.) au Nigeria

Resume

Le projet Integrated Striga Management (ISM) a débuté en 2011 et se termine en 2015. Plusieurs études sont menées pour surveiller et explorer l'impact du projet sur les moyens de subsistance des agriculteurs. Aucune étude n'a été trouvée pour examiner la connaissance de la technologie ISM qui, à son tour, facilitera la compréhension et l'utilisation appropriée de la technologie ISM par les agriculteurs et donnera un indice aux agriculteurs de contact et aux agents de vulgarisation locaux sur un domaine d'intérêt pour qu'ils parviennent à une plus grande pénétration. L'étude a analysé les moteurs de la connaissance de ISM au Nigeria. La méthode d'échantillonnage à plusieurs étapes a été utilisée et arrive à 192 agriculteurs. Les données ont été recueillies par le biais d'entretiens programmés par les enquêteurs formés. La tabulation croisée, la régression logistique et la régression Tobit ont été utilisées pour atteindre l'objectif. La majorité (51,98%) des agriculteurs ont été formés et avaient une bonne connaissance de la technologie ISM et 12,43% d'entre eux avaient une très bonne connaissance de la technologie ISM. Les agriculteurs masculins, l'augmentation de la taille des ménages et du nombre de canaux de formation et de démonstration de méthodes et de résultats se sont avérés avoir un effet positif sur les connaissances des agriculteurs sur la technologie ISM dans un premier temps, tandis que l'augmentation de la taille des exploitations l'affecte *négativement (P=0,1). Le nombre de formations et la réception de la formation par le biais de canaux de démonstration de méthodes et de résultats se sont avérés avoir un effet positif sur l'étendue des connaissances des agriculteurs en matière de technologie ISM. Il a été conclu que le sexe, la taille du ménage, le nombre de méthodes de vulgarisation de la formation utilisées étaient les moteurs de la connaissance de ISM tandis que le nombre de formations et la méthode de vulgarisation étaient les moteurs de son intensité. La campagne de formation a eu un impact sur les connaissances des agriculteurs sur la technologie ISM, ce qui s'est avéré rentable. Cependant, il est recommandé de concevoir davantage de programmes qui tiennent davantage compte du genre afin que les agricultrices y soient davantage intégrées. Cela devrait être fait par des méthodes de vulgarisation plus intensives telles que des démonstrations. En outre, les agriculteurs leaders devraient être utilisés pour la vulgarisation entre agriculteurs afin que la formation soit cohérente afin d'atteindre une plus grande pénétration.*

Mots-clés : Connaissance, ISM, Modèle à double obstacle ; régression Tobit ; Régression logit

وقد أُجريت عدة دراسات لرصد واستكشاف أثر .2015وينتهي في عام 2011منذ عام (ISM)المتكاملة Strigaبدأ مشروع إدارة
لتيسير فهم .ISMالمشروع على سبل عيش السكان الأصليين لم يتم العثور على دراسة للتحقيق في المعرفة بتكنولوجيا الإدارة
المزارعين لتكنولوجيا الإدارة المتكاملة للإدارة واستخدامها على النحو المناسب وإعطاء فكرة للاتصال بالمزارعين ووكلاء الإرشاد
في نيجيريا تم استخدام طريقة ISMالمحليين بشأن مجال التركيز عليهم لتحقيق المزيد من الاختراق حللت الدراسة دوافع معرفة
تم جمع البيانات من خلال مقابلات الجدول الزمني من قبل العدادين .مزارعًا 192أخذ العينات متعددة المراحل التي تصل إلى
من (51.98٪)تم استخدام الجدولة المتقاطعة والانحدار اللوجستي وانحدار توبيت لتحقيق الهدف تم تدريب غالبية .المدربين
المزارعون الذكور، .ISM٪ منهم لديهم معرفة جيدة جدًا بتكنولوجيا ISM 12.43معرفة جيدة بتكنولوجيا 18المزارعين ولديهم
وزيادة حجم الأسرة المعيشية وعدد التدريب، تبين أن قنوات الإرشاد الإيضاحية للنتائج تؤثر تأثيرا إيجابيا على المزارعين في المرحلة
عدد التدريب وملقيه من خلال قنوات عرض الأساليب والنتائج (P≤0.1)الأولى ، بينما تؤثر الزيادة في حجم المزرعة سلبًا عليها
واستنتج أن الجنس، .للمزارعين ISMوجد أنها تؤثر بشكل إيجابي على المدى من خلال طريقة ونتائج المعرفة التكنولوجية لقناة
في حين أن عدد التدريب ISMوحجم الأسرة المعيشية، وعدد طرق الإرشاد التدريبي المستخدمة كانت العوامل الدافعة لمعرفة
ثبت أن هذا فعال من ISMوطريقة تقديم الإرشاد كانا محركين لكثافته أثرت الحملة التدريبية على معرفة المزارعين بتكنولوجيا
حيث التكلفة ومع ذلك، يوصى بإمكانية تصميم المزيد من البرامج التي تكون أكثر شمولاً للجنسين بحيث يتم دمج المزارعات
بشكل أكبر فيه يجب أن يتم ذلك من خلال طرق تسليم تمديد أكثر كثافة مثل المظاهرات كما ينبغي استخدام المزارعين الرئيسيين
لإرشاد المزارعين بحيث يتم التدريب من أجل تحقيق المزيد من الاختراق.

Introduction

Agriculture remains the base of the Nigerian economy, providing the main source of livelihood for most Nigerians, limited adoption of research findings and technologies is noted among farmers which result into low agricultural productivity (average of 1.2 metric tons of cereals/ha) with high post harvest losses and waste (FAO, 2020). Nigerian growth is too low to lift the bottom half of the population out of poverty. The weakness of the agriculture sector weakens prospects for the rural poor, while high food inflation adversely impacts the livelihoods of the urban poor, its human capital development remains weak due to under-investment and the country ranked 152 of 157 countries (World Bank, 2019a). Productivity improvement is recommended for robust growth and job creation, and to keep an additional 30 million people from falling into extreme poverty (World Bank, 2019b). Striga is a parasitic plant that originates from African grassland but has now invaded large area of cropland which can cause up to 40-100% crop losses across millions of hectares of farmland and an annual loss, with total losses amounting to about US$1.2 billion and affecting the livelihoods of more than 25 million smallholder farmers in sub-Saharan Africa and once the field is infected, it cannot get rid of easily. One Striga spikelet can produce over 50,000 seeds–spread rapidly within the farming community and remain viable for up to 20 years under the right conditions, until when it finds conducive environment to germinate(ICRISAT, 2017; IITA, 2012a).The International Institute of Tropical Agriculture (IITA) under its Integrated Striga Management in Africa (ISMA) project chose the integrated Striga control approach which it encompasses the use of maize legume rotation and other crop management practices; striga resistant/tolerant maize and cowpeas; herbicide resistant maize and seed coating with herbicides; push-pull technology for small holder crop-livestock production; and bio-control (IITA, 2012a).This collectively called Integrated Striga Management (ISM) technology, that has been diffused in Nigeria, but are not widely available in the northern regions due to institutional bottlenecks to its effective dissemination, and as a result, farmers in these areas have continued to grow predominantly local varieties (Mignouna, Abdoulaye, Kamara & Oluoch, 2013) The process of adoption starts with a mental process whereby a person acquires enough knowledge to decide to make a change (Gars and Ward, 2019). The success of an agricultural extension program is largely determined by the level of farmers' participation (Suvedi, Ghimire and Kondylis, 2017). Agricultural extension provision is a potentially effective channel to diffuse relevant new technologies to increase productivity and alleviate rural poverty in developing nations (Nakano, Tsusaka, Aida & Pede, 2018). It increases awareness, influence the beliefs of farmers to some extent and productivity (Van Campenhout, Walukano, Nattembo, Nazziwa-Nviiri & 12 Blom, 2017; Zossou, Arouna, Diagne, and Agboh-Noameshie, 2017). But several factors such as technical language used in agricultural programme, number and form of training, socio-economic status affect farmers' knowledge of the technology which in turn affect appropriateness of use and adoption of the technology (Upadhyay, 2018; Mudege, Mdege, Abidin & Bhatasara, 2017; Naik, Srivastava, Godara & Yadav, 2016; Zossou, Arouna, Diagne & Agboh-Noameshie, 2020). That is why IITA see it worthy to embark on using several complementary extension delivery methods (radio, television, market, method and result demonstration etc.) to foster better understanding of the ISM technology. However, research on the process of acquiring agricultural knowledge in Nigerian rural areas has been sparse, even though a range of studies have been carried out on the adoption of agricultural technologies (e.g. Nwalieji, et al., 2014). ISMA project had started since 2011 and ends in 2015 no study was found to examines the knowledge of the ISM technology which in turn will facilitates understanding of appropriate use of the ISM technology by farmers and give a clue for contact farmers and local extension agents on an area of emphasis for them to achieve further penetration. The ISMA project had taught some 3,500 farmers on group dynamics, participatory approaches, modern crop management and Striga control practices in Northern Nigeria. Furthermore, the project also disseminated Striga management technologies to about 38,000 Nigerian farmers through farmer-to-farmer knowledge transfer, on-farm demonstrations, field days, and radio (IITA, 2012b).The objective of the study was to foster understanding of drivers of ISM technology knowledge. The study contributed to a literature in identifying what drives a more ISM technology knowledge of farmers and its extent which is vital for the development of appropriate technology transfer process and adoption. This is good to explore because agricultural extension services is undergoing an in depth restructuring, focused on privatizing the agricultural services in developing countries that is characterized by a low literacy level.

Materials and Method

Study Area

The ISMA project was implemented in Kenya and Nigeria. In Nigeria, two states (Bauchi and Kano) were selected for the project. The study location was Bauchi state in which five Local Government Areas were selected for the project (i.e. Alkaleri, Bauchi, Dass, Toro and Ganjuwa). Nigeria is a country in the tropical zone of West Africa and lies between latitude of 4˚N and 22 14˚N, longitude of 2˚ 2′E and 14˚ 30′ (Nigerian Embassy in Sweden, 2019). The country has a total land area of 910,768 km^2, water area of 13,000km^2 and population of 195.874 million with population density of 204.28/km^2 and annual growth rate of 2.71% (World Bank, 2018). Maize fields affected by Striga in Nigera account for about 34% of land infested in Africa 2 (Baiyegunhi, et al., 2019). It is most severe in the northern region where it occurs on 835,000 ha causing annual maize losses of an estimated 505,308 tons valued at the US $205.66 million per year (Baiyegunhi, et al., 2019). Bauchi state having a total land area of 49,259 square kilometres, representing about 5.3% of Nigeria's total land mass. Of this land mass, about 34,481 square kilometres is under cultivation 7 and one of the most infested state with Striga (BSADP, 2019; Baiyegunhi, et. al. 2019).The state has a population of 6 million inhabitants with 46.73% of 4-9 year age group and adult literacy among female of 85.92%.The state has 55 different tribal groups with different occupational pattern and belief also with high level of ethnic interaction most especially intermarriages and festivities, Hausawa and Fulani are the most prominent tribe and Hausa language is the common language of communication (NBS, 2018).

Sampling Technique

The sampling approach was adapted from baseline survey of the ISM project in which multistage sampling procedure was used. The first stage involved the purposive selection of Bauchi State based on the importance of maize and cowpea production and level of Striga infestation. The second stage involved the selection of five Local Government Areas (LGA) in the selected state based on the biophysical survey proceeding of the baseline survey. The biophysical survey was to determine Striga incidence and infestation in targeted selected project areas, based on a "three-stage sampling technique" comprising: selection of grid cells on digital maps of target LGAs; selection of communities within grid cells; and selection of farms within communities and grid cells. Grid cells measuring 10 km × 10 km each were superimposed on the Google maps of Bauchi States. In each LGA, five grid cells were randomly selected. In each grid cell, a 6 community closest to the centre of the cell was selected. Starting from the centre of each selected community, the crop fields were systematically sampled at 5-km intervals along a transect in each of the four cardinal points of the community. The position of the community and farms sampled were recorded using the Global Positioning System (GPS) model. The third stage involved preselected LGAs that were Striga-infested maize and cowpea growing areas. The sampling frame including all households in the surveyed villages was developed by extension agents in collaboration with community heads in each community as a source list and this stage involved a random selection of farm households through a random number generator available in Microsoft Excel RAND. Lastly 8 households were randomly selected from each 10 surveyed community. Thus, a total of 192 households were retained for the study. Fifteen questionnaires were dropped due to inappropriate fillings, making 177 maintained for the study.

Methods of Data Collection

Data were collected through a schedule interview by the trained enumerators which were designed to assess the determinants of knowledge of ISM in Bauchi State, Nigeria.

Methods of Data Analysis

Data were analysed using both descriptive and inferential statistics. Descriptive statistic (cross tabulation) was used to describe the study sample, while inferential statistic (double hurdle model) was used to analyse drivers of knowledge. In a first hurdle, logistic regression was used, the mathematical expression of the relationship in its non-linear form (sigmoid curve) is

$$\frac{Pi}{1-Pi} = \frac{1+\exp(Zi)}{1+\exp(-Zi)} \quad \ldots (1)$$

When transform into linear is $Li = \ln[\frac{Zi}{(1-Pi)}]Zi \quad \ldots (2)$

In this case, Pi/(1 − Pi) is the probability ratio that the farmer will access ISM knowledge to the probability that farmer will not access ISM knowledge. This means endogenous variable is binary and it has two values 1 and 0. If a farmer accessed ISM knowledge its value is 1 and 0 for the respondent who does not had ISM knowledge. Logistic regression model estimates is;

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots \beta_9 X_9 + \varepsilon \ldots (3)$$

Where;

Y= dependent variable (Dummy: accessed ISM training =1 otherwise=0)

β_0 = constant

$\beta_1 - \beta_{11}$ = logistic regression coefficients

X_1= age (in years)

X_2= sex (male=1, otherwise=0)

X_3= farming experience (years of farming)

X_4= education (years of formal education)

X_5= household size (number of people)

X_6= farm size (in hectares)

X_7= group membership (member=1, otherwise=0)

X_8= number of training (in number)

X_9= preferred extension channel (1= television (base outcome), 2= method demonstration, 3= result demonstration, 4= field day, 5= radio, 6= print media)

While in the second hurdle Tobit regression model was used. The second hurdle which estimates the extent of ISM knowledge farmers accessed, it will be estimated using Tobit regression truncated at zero. It is expressed as;

$KNWint_i = KNWint_i^{*}$ if $KNWint_i^{*} > 0$ and $KNWint_i^{*} = 0$ if otherwise $KNWint_i^{*} = x'i\beta + ui$

Where $KNWint_i^{*}$ is the observed response on how much farmers accessed ISM knowledge, χ is the vector of farmer characteristics, β is a vector of parameters and $u_i$is the error term which is randomly distributed. The empirical model of the truncated regression model (Tobit model) is specified for this study as;

$$KNWint_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots \beta_9 X_9 + \varepsilon \quad \ldots(4)$$

Where;

$KNWint_i$ = dependent variable (continuous: ISM knowledge score in a scale of 5; there are 5 components of ISM technology, appropriate description of each attracts on mark)

β_0 = constant

$\beta_1 - \beta_{11}$ = Tobit regression coefficients

X_1= age (in years)

X_2= sex (male=1, otherwise=0)

X_3= farming experience (years of farming)

X_4= education (years of formal education)

X_5= household size (number of people)

X_6= farm size (in hectares)

X_7= group membership (member=1, otherwise=0)

X_8= number of training (in naira)

X_9= preferred channel (1= television (base outcome), 2= method demonstration, 3= result demonstration, 4= field day, 5= radio, 6= print media)

Result and Discussion

Socio-economic Characteristics of Farmers for Continuous Variables

The result (Table 1a) revealed that average age of farmers was found to be 45 year with a standard deviation of 9.6. The standard error of 9.66 depicts a little dispersion within farmers' ages. This revealed that farmers were in their active age to make appropriate decision concerning acquiring desired ISM technology knowledge. The minimum and maximum household sizes of the respondents were and 40 people respectively with a mean of 12 people. The standard deviation was found to be 6.92. This showed that the farmers had large family size with a wide dispersion within them. The average farming experience was found to be 22 years with a standard deviation of 13.53. The minimum and maximum farming experience was found to be 1 and 18 respectively. This showed that the farmers had enough farming experience with wide dispersion within them. The average year of formal education was found to be 9 years with a standard deviation of 5.81. The minimum and maximum years of formal education were 0 and 18 years. This revealed that averagely farmers had some secondary school education with little dispersion within them. The average farm size was found to be 4.34 ha with a standard deviation of 3.19. The 14 minimum and maximum farm sizes of the farmers were 0.24 and 16 respectively. This revealed that averagely the farmers are small scale in their production. The standard deviation depicts a wide dispersion within the farmers in regards to farm size.

Table 1a: Socio-economic characteristics of farmers for continuous variables (n=174)

Variable	Mean	Std. Dev.	Min	Max
Age	45.19	9.66	25	80
Household size	12.27	6.92	1	40
Farming experience	21.63	13.53	1	75
Years of formal education	8.73	5.81	0	18
Farm size	4.34	3.19	0.25	16

The Table 1b represents qualitative socio-economic characteristics of farmers in the study area. Most (90.23%) of farmers were found to be males. This showed that males dominated the farming activity in the study area. This is probably due to the fact that the culture restricted the females with economic activities within the homes in the study area. The Table further revealed that most (91.38%) farmers were married; this showed that the farming activity in the study area was dominated by married people. This might be due to the burdens that a family people have; they were trying to cater for it. Majority (75.87%) of farmers were members of a group, this revealed that farmers in Nigeria were joining groups to derived benefit such as training and other improved agricultural practices (Komolafe, et al., 2020).The result further showed that majority (75.14%) had some formal education in Nigeria. This revealed that majority of farmers had some literacy level and are rational in their choices of improved agricultural practices to be learnt and adopted in their respective farms.

Table 1b: Socio-economic characteristics of farmers for qualitative variables (N=174)

Variable		Freq.	%
Sex	Male	157	90.23
	Female	17	9.77
Marital status	Married	159	91.38
	Single	10	5.75
	Divorced	2	1.15
	Widowed	3	1.72
Group membership	Member	134	75.87
	Not member	42	23.86
	No formal education	44	24.86
Formal Education	Have formal education	133	75.14

ISMA Knowledge Level of Trained and Untrained Farmers

Table 2 represents a cross tabulation of ISMA's knowledge score of farmers by training status. No (0%) farmer among the trained ones lack knowledge of the ISM technology but untrained farmers accounted for 6.22% of farmers that had no knowledge of the ISM technology. Trained and untrained farmers accounted for 15.25% and 14.12% fair knowledge of ISM technology respectively. None (0%) of untrained farmers had good knowledge of ISM technology but more than half (51.98%) of farmers had good knowledge of ISM technology among the trained ones. Untrained farmers accounted for 0% of farmers that had very good knowledge while trained farmers accounted for 12.43% of farmer that had very good knowledge. This showed that training campaign had good impact on the farmers' knowledge and there was little informal diffusion of ISM technology among the farmers that gave fair knowledge of ISM technology to untrained farmers. The informal diffusion of ISM technology after the ISM project showed that, the project had staying power. In other words, the ISM technology had come to stay; important benefits are generated by adoption of ISM technology that is why farmer-farmer extension exists. This would convince donors that the training program was cost-effective. This is in line with Carrión Yaguana, et al. (2016) who found that farmer-farmer extension of integrated pest management (IPM) exist within potato farmers in Carchi, Ecuador and Jørs, et al. (2016) who found that farmer-farmer extension exists between trained and untrained farmers but trained IPM farmers performed better than the untrained farmers in Bolovia.

Table 2: **Distribution of farmers based on ISM knowledge** n=177

Level of Knowledge	Untrained (%)	Trained (%)	Total (%)
No Knowledge	6.22	0	6.22
Fair Knowledge	14.12	15.25	29.37
Good Knowledge	0	51.98	51.98
Very Good Knowledge	0	12.43	12.43

Drivers of ISM Technology Knowledge

Table 3 presents the analysis on drivers of knowledge of farmers and its intensity. The likelihood ratio chi-square test was 31.64, significant (P≤0.01) as proved by the log likelihood of -19.62. Sex, household size, number of training and preferred channel was found to be positively significant (P≤0.1, P≤0.1, P≤0.01 and P≤0.1 respectively) while farm size was found to be negative but significant (P≤0.1) in a first hurdle. While also, the likelihood ratio chi-square test was 31.64 significant (P≤0.01) as proved by the log likelihood of -287.77. Number of training and preferred channel was found to be positively significant (P≤0.01, P≤0.1, and P≤0.1 respectively). Sex was found to be positively significant (P≤0.1) in a first hurdle, this revealed that if farmer is a male there is likelihood of having ISMA technology knowledge almost 15% higher than their female counterpart. This showed that the dissemination of ISMA technology is gender bias. This is probably due to the perception of men as household heads and women as carers or helpers coupled with low literacy and education level, and extension workers dominated by men which very often affected women's ability to access training and information. This corroborates the findings of Mudege, *et. al.* (2017) who found that the perception of male as household heads and female as carers or helpers who are also illiterate and ignorant, negative stereotypical perceptions about women by their husbands and extension workers and Institutional biases within extension systems reproduce gender inequality by reinforcing stereotypical gender norms often has implications on women's ability to access training and information in Malawi. The household size was also found to be positively significant (P≤0.1), this showed that if household increases by one person, the ISMA knowledge increases by 1.47 if other variables were held constant. This is probably due to the fact farmers with a more household had more burdens to cater for, that makes them to strives to learn more improved technologies for cater for their food needs. This agrees with Zossou, et. al. (2020) who found household size to be affecting knowledge acquisition by West African Rice farmers. Number of training was found to be positively significant (P≤0.01) in both hurdles, this showed that if training increases by one, the knowledge about ISMA technology will increases by 4.32 and the extent of knowledge will increases by 0.24 out of 5 if other variable were held constant. This is probably due to the fact that repetitions make learning permanent. That was why farmers chose a technology that teaches them to have in-depth understanding of the content of the technology. This is in line with the findings of

Zossou, et. al. (2020) who found that number of training was affecting knowledge acquisition of rice farmers in West Africa. Among the preferred channel by farmers in a first hurdle, Method demonstration was found to be positively significant (P≤0.1), this showed that farmers that preferred Method demonstration were doing better than those that preferred television. In the second hurdle, Method demonstration was found to be positively significant (P≤0.1), this showed that farmers that preferred Method demonstration were more knowledgeable than those that preferred television in terms of extent of knowledge. This showed that those that preferred Method demonstration were better in terms of both knowledge and its intensity. This is might be due to more sense organs were employ in the learning process when using Method demonstration than the television. This connotes Niu & Ragasa (2018) who found that more intensive learning mode are more effective than the lesser ones. Result demonstration was found to be positively significant in a second hurdle, this showed that those that preferred result demonstration were better up in the extent of ISMA knowledge. This revealed that farmers that preferred result demonstration were doing better than those that preferred television in terms of extent of knowledge. This showed that those that preferred result demonstration were better in terms of both knowledge and its intensity. This might be due to more sense organs were employ in the learning process when using Method demonstration than the Result demonstration. This connotes Niu & Ragasa (2018) who found that more intensive learning mode are more effective than the lesser ones. No difference was found between Field day, Radio and Print media with Television in terms of both knowledge and its intensity.

Table 3: **Determinants of Knowledge of ISMA Technology**

	First hurdle		**Second hurdle**	
Variable	**Odds Ratio**	**z-value**	**Coef.**	**t-value**
Age	0.98 (0.07)	-0.22	0.02 (0.02)	1.00
Sex	14.92 (24.41)	1.65*	0.16 (0.43)	0.38
Household size	1.47 (0.30)	1.90*	0.00 (0.02)	-0.10
Farming experience	0.99 (0.05)	-0.23	0.02 (0.01)	1.51
Years of formal education	1.10 (0.08)	1.36	0.03 (0.02)	1.30
Farm size	0.64 (0.16)	-1.78*	-0.45 (0.28)	-1.60
Group membership	0.62 (0.55)	-0.54	-0.05 (0.04)	-1.19
Number of training	4.32 (2.52)	2.51***	0.24 (0.09)	2.71***
Preferred channel				
Method demonstration	8.98 (11.61)	1.70*	0.80 (0.44)	1.81*
Result demonstration	-	-	1.03 (0.58)	1.78*
Field day	5.28 (6.04)	1.46	0.13 (0.43)	0.30
Radio	-	-	0.43 (0.44)	0.97
Print media	0.85 (1.62)	-0.08	-0.65 (0.99)	-0.66
Constant	0.01 (0.03)	-1.17	1.31 (1.09)	1.20
LR chi^2 (11)	31.64***		30.22**	
Log likelihood	-19.62		-287.76903	
Pseudo R^2	0.45		0.0499	
Sigma			1.46 (0.09)	

Conclusion and Policy Recommendation

Based on the above findings it can be concluded that Sex, household size, number of training and extension delivery methods used were the drivers of Integrated Striga Management knowledge while Number of training and Extension delivery method were the drivers of its intensity. The training campaign impacted the farmers' knowledge of Striga Management; this proved it to be cost-effective.

It's then recommended that more programs could be designed that is more gender inclusive so that females farmers would be more incorporated into it so that their Striga Management knowledge could be improved which subsequently would foster their adoption and productivity. This subsequently will enhance their income and food security. This should be done through more intensive extension delivery methods such as demonstrations. Also, lead farmers should also be utilized for farmer-farmer extension so that training will be consistent in order to achieve more penetration.

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