

Application of e-information for Fall Armyworm control among maize farmers in Southwestern Nigeria

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ABSTRACT

This study assessed the application of electronic messages on Fall Armyworm (FAW) (*Spodoptera frugiperda*) disseminated to farmers in Southwestern Nigeria. Multi-stage sampling method was used to select 205 maize farmers. Using ex-post factor research design, electronic information on FAW were broadcast to farmers through formats such as voice calls and text messages. Each of the respondents received five batches of voice calls and text messages in English and Yoruba Languages for 2 – 3 weeks. Data were collected on the suitability of e-message, perception and constraints to electronic information use. Data collected were described and analyzed using Pearson Product Moment Correlation (PPMC) and linear regression at $\alpha_{0.05}$. Mean age of respondents was 40years and 69.3% could communicate in Yoruba while only 39.9% understood the English language. Majority of the farmers expressed unfavourable perception to the use of e-messages for FAW information. Constraints identified with e-message use were related to the poor interactivity of the medium, though suitable for 55.6% of the respondents. Level of education and perception were major determinants of the suitability of e-messages disseminated. Thus, dissemination of e-messages to farmers using local languages was advocated in agricultural interventions.

1. Introduction

Insect pests are a major menace to crop production worldwide. The outbreak of *Spodoptera frugiperda* Fall Armyworm (FAW) in the year 2016 has come with a major militating threat to maize production in Nigeria. Hectares of farmland have been destroyed by this occasional but destructive insect pest. The activity of this pest is insidious and its presence is noticed only after the havoc is done (Georgen *et al*, 2016). The pest has become a major problem for agricultural production in several nations of the world (Assefa and Ayalew, 2019). Although the level of severity of damage varies from one location to the other, the damage is a major threat to food security as it has destroyed maize farms worth millions of Naira.

Maize is a major cereal and one of the important staple crops grown by farmers in Nigeria. It is a major determinant of what constitutes household diet across all economic status in the country (Urassa, 2015). Thus, continuous attack of FAW on maize crops can be seen as a threat to national food security. The intensive control effort is therefore essential to ensuring maximum production of maize and attaining desired food security. Several concerted efforts such as the application of pesticides to control a similar pest that was successfully used for other types of pest control have been employed for FAW but proved abortive (Food and Agriculture Organisation of the United States (FAO) (2018)). This indicates that the pervasiveness of FAW can withstand the common control methods of pesticides and this has led farmers into a deeper confusion on how to control it. Some farmers and stakeholders have concluded that the pest is here to stay because of the strategic ways of the attack on tropical environments (Adesina, 2017). Different pest control methods such as cultural, biological, botanical and chemical measures have been proved effective by researchers and agricultural institutions. The careful combination of these control

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methods is called Integrated Pest Management system (IPM) which targets to reduce to the barest minimum, the heavy applications of agrochemicals on crops. Pest management is an essential component of any effort to increase food production and ensure food security (Alabi *et al.*, 2006). Malene (2017) affirms that increasing food production requires concerted efforts at supporting smallholders and family farmers to reduce pesticides and chemical use. Thus, understanding pest management should be an essential aspect of information dissemination aiming at increasing food production (Alabi, Banwo and Alabi, 2006). IPM is an effective and environmentally sensitive approach to pest management. It is safer because it places less importance on the use of heavy chemicals and emphasizes orthodox methods along with the chemicals to ensure sustainable production of healthy crops (Aktar *et al.*, 2009). IPM system aims at increasing food production and maximize farmers' income. It is not sufficient to identify these control methods alone without introducing it to the farmers. According to Toepfer et al and Adesina (2017), what is needed rapidly to address the real threat of Fall Armyworm (FAW) in Africa and bring support to farmers is a very urgent action which includes creating awareness using different methods.

Several steps have been taken to create awareness among farmers on related issues in the past. Such steps include the use of available communication channels through extension strategies. The information dissemination strategies embarked upon by the Nigeria agricultural agencies like the Agricultural Development Programme (ADP) right from inception were very adequate and effective until the last few years of neglect of the agricultural sector for the oil sector (Ogbalubi and Wokocha, 2013). This neglect had resulted in a retrogressing movement in the agricultural sector. Ani *et al* (2018) likewise posited that the agricultural sector in Nigeria has been performing poorly in recent years even though it remains the mainstay of the economy. Apart from the ADPs, the extension agencies like Agricultural Extension Research Liaison Services (AERLS) established purposely for extension services and extension service unit of every agricultural research institute are mandated with the responsibility of reaching out to farmers in their jurisdiction with information that is most relevant for agricultural development.

There are so many factors constraining ADPs and other extension providers from filling this gap accurately. One of such was mentioned by Haruna and Abdullahi (2013) as inadequate staff, noting that the ratio of extension worker to farm families was between 1:2000 and 1:3000 as at the year 2012 which has further worsened recently. The situation could have been fueled by the paucity of fund to agricultural extension services by the government or expected funding agencies. Farmers' inability to convert research outcomes into practices on the field can thus be explained. However, deploying modern means of information dissemination will go a long way in bridging this gap (Anunobi and Anunobi, 2018).

Use of mobile smartphones or other mobile communication devices by farmers to access information has given improvements in social relationships. Chhachhar and Hasan (2013) reiterate the importance of mobile phone use in bridging communication gaps, for increasing social cohesion and improving social relationships among farmers. Since pest control information is among some very important information that is needed by farmers (Mbagwu *et al.*, 2018), access to timely and relevant information for FAW control through the use of mobile phones will contribute significantly to food production and aid agricultural development in Nigeria. This paper thus evaluates the suitability of mobile phone use for e-alert messages and recorded voice calls to farmers in Ogun and Oyo States.

Objectives of the study

This study focused on determining the suitability of FAW e-messages through mobile phones to local farmers. Electronic information use for agricultural messages is a relative discovery. However, the use becomes very important considering the urgency attached to some agricultural information and increased knowledge in mobile phone use. The FAW infestation in maize farms can be devastating leaving most farmers confused about its appropriate control method. Specifically, the objectives of the study include:

1. Examine the personal characteristics of maize farmers in the study area,

2. Determine the perception of farmers to e-messages on FAW,
3. Determine the suitability of e-messages to maize farmers; and
4. Identify constraints in accessing e-message information through mobile phones.

The study hypothesized the inter-relationship between the suitability, constraints and the perception to e-message use by local farmers.

2. Methodology

The study was carried out in Ogun and Oyo States located in South-West Nigeria. The states constitute 30% of the total states in the region. Ogun State is between 7° 00'N and 3° 35'E. Oyo State is located between 8° 00' N 4° 00' E. Yoruba language is mostly spoken and understood by people in the states. The multi-stage sampling procedure was used for the study. The first stage involved the random selection of 30% of the six states in South-West Nigeria giving Oyo and Ogun States. In the second stage, a random selection of 10% of the Local Government Areas (LGAs) in the states was carried out, thus, four out of the 33 LGAs in Oyo State and two out of the 20 LGAs in Ogun State were selected. The LGAs sampled are Oriire, Kajola, Saki West, Ido (Oyo State); Ado Odo and Abeokuta (Ogun State). The third stage involved the purposive selection of two communities from each of the selected LGAs with more maize farmers registered under the Maize Improvement Programme of the Institute of Agricultural Research and Training. A total population size of 457 maize farmers was registered under the programme across the twelve purposively sampled communities in Oyo and Ogun states. From the list of the registered farmers, 205 farmers were sampled for this study using a simple random sampling technique. The Krejcie and Morgan (1970) table was used to determine the adequate sample size for the study.

The ex-post facto research design was used for the study. Electronic information on Fall Armyworm was broadcast to farmers through e-formats such as voice calls and text messages. Each of the respondents received five batches of voice calls and text messages in English and Yoruba Languages for 2 – 3 weeks. The intervention was implemented a few weeks after most farmers have planted their maize to coincide with the time the FAW pest is usually noticed in maize farms. The messages detailed the aetiology and different control measures of FAW infestation, emphasizing Integrated Pest Management control measures. This provided the basis employed to assess how suitable the methods were. Each of the respondents received one voice call and two messages in Yoruba and English Languages daily through their mobile phones for three weeks. The same set of farmers were interviewed 2 weeks after the last batch of messages were delivered to gauge the perception of the methods used. The farmers were interviewed on their perception of the medium utilized, major constraints to receiving messages from each medium and how suitable they perceived the medium for receiving FAW pest control messages.

Primary data collection with the use of the interview schedule was employed for the study. The interview schedule elicited information on the respondents' characteristics, perception of the e-messages broadcast, perceived suitability of the e-message for maize FAW pest management and constraints identified in its use. Suitability of the medium used was measured by listing fourteen statements peculiar to the medium used for the message broadcast and responses were obtained on a 4-point scale of very suitable, suitable, not suitable and undecided. Scores of 4, 3, 2 and 1 were awarded to the response options, respectively. Statements were ranked by their mean score to show which application is more suitable and which is not suitable for farmers. Scores of 4, 3, 2 and 1 were awarded to positive responses on the perception scale while the reverse was awarded to negative statements. Scores obtained were pooled and used to categorize the respondents into the favourable and unfavourable perception of the medium utilized using the mean score as a benchmark.

Data were summarized and described using means and percentages while Pearson Product Moment Correlation (PPMC) and linear regression analysis were used to determine the relationship between the independent variables and the suitability of the medium by farmers for FAW use.

3. Results and discussion

3.1 Personal characteristics

The mean age of the respondents as shown in Table 1 is 40 ± 8.6 years. A sizeable proportion (75.6%) were male with an average household size of 6 ± 2.3 persons. Only 10.2% of the respondents had no formal education. The majority (63.9%) could communicate in Yoruba and 39.9% could read and write in the English language. This results further confirms the dominance of male over female in farm agricultural activities. It disagrees with the general opinion that the active participators of agricultural sectors are old farmers. However, this result shows that most of the people that engage in maize farming could neither express their opinion nor decode agricultural information disseminated in the English language. This result implies that the version of Fall Armyworm information disseminated through e-messages expressed in the English language could not be well understood by the majority of the recipients. Although formal information is more appreciated in the English language in Nigeria, Popoola, (2014) explains the importance of the local language in defining peoples' reality. In line with this, FAW information disseminated and expressed in the Yoruba language could have made more meaning and impact than the English language version.

Table 1. Personal characteristics of respondents

Variables	Frequencies (percentages)	Variables	Frequencies (percentage)
Age	Mean - 40 ± 8.6	Household size	Mean- 6 ± 2.3
≤ 30	30 (14.6)	1-4	72 (35.1)
31 – 40	93 (45.4)	5-8	108 (52.7)
41 – 50	65 (31.7)	9 – 12	23 (11.2)
51 -60	14 (6.8)	12 and above	2 (1.0)
≥ 61	3 (1.5)	Ability to read and understand Yoruba	
Sex		Yes	131 (63.9)
Female	50 (24.4)	No	74 (36.1)
Male	155 (75.6)	Ability to read and understand English	
Educational level		Yes	81 (39.5)
No formal education	21 (10.2)	No	124 (60.5)
Primary Education	62 (30.2)		
Secondary Education	64(31.2)		
Post-Secondary education	58(28.3)		

3.2 Perception of farmers to e-message use on FAW information dissemination

Farmers' perception of the voice calls and text messages disseminated in both Yoruba and English languages as expressed in short statements are shown in Figure 1. The figure shows that farmers favourably perceived that recorded voice calls ($\bar{x}=4.2$) and e-text messages ($\bar{x}=4.0$) used in the dissemination project is an advancement in technology that should be embraced by all farmers. The figure further shows that not all farmers agreed that literal ability is a major factor in decoding the information disseminated through voice calls and e-text messages. Statements such as "text messages cannot be useful because it is not all farmers that can read" ($\bar{x}=2.2$) and that "voice calls do not need any literal ability which makes it the best for farmers" ($\bar{x}= 4.0$), were both expressed in positive and negative words to ascertain the relevance of the e-messages to non-literate farmers. On the other hand, statements expressing agricultural e-text message as a form of unwanted messages shows transferred

displeasure of experiences with mobile network providers. This could pose a threat to the effectiveness of text message use for agricultural information.

The categorization of respondents based on the expression of perception to e-alert use for FAW messages in Figure 2 gives a mean perception of $\bar{x}=38.10$. A little above average (54.0%) of the respondents had perception scores below the meanwhile only 46.0% had scores above the mean. This result suggests that almost half of the respondent had the unfavourable perception of the use of e-alert messages for Fall Armyworm information dissemination. Electronic message dissemination is an advancement in farmers' use of ICTs (Zahedi and Zahedi, 2017). This is because, over the years, farmers' use of modern communication for agricultural information has been limited to the traditional ICTs which include the radio, television and probably phone calls. Thus, baseline understanding of communication used for agricultural information in the past could have dissuaded most of the farmers from accepting electronic information as most suitable for control of FAW.

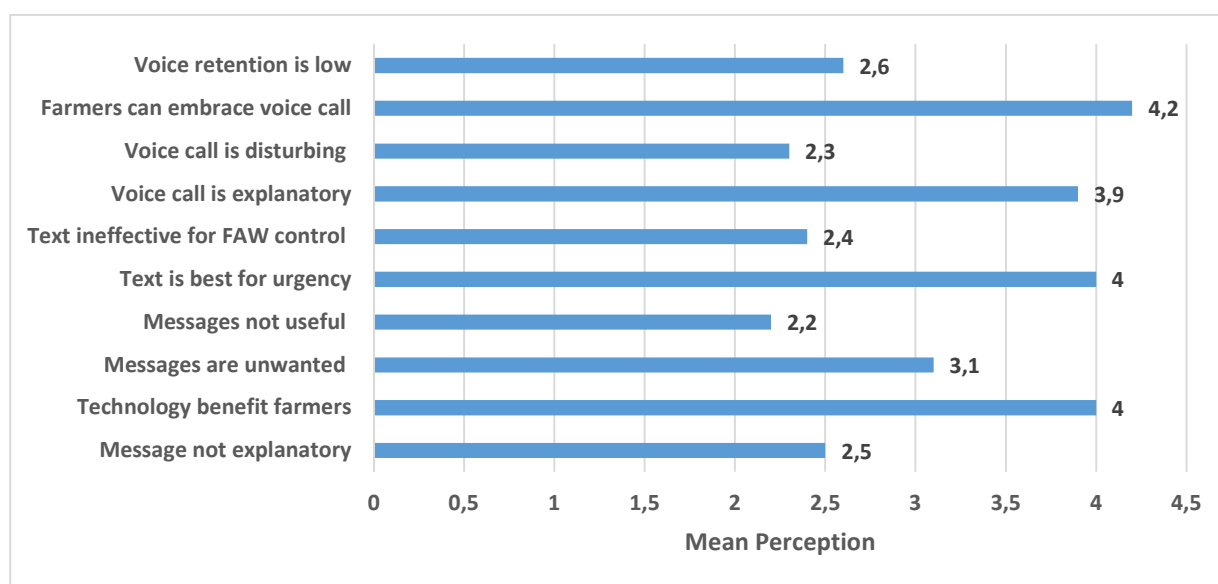


Figure 1. Farmer's perception of e-message use for FAW information dissemination

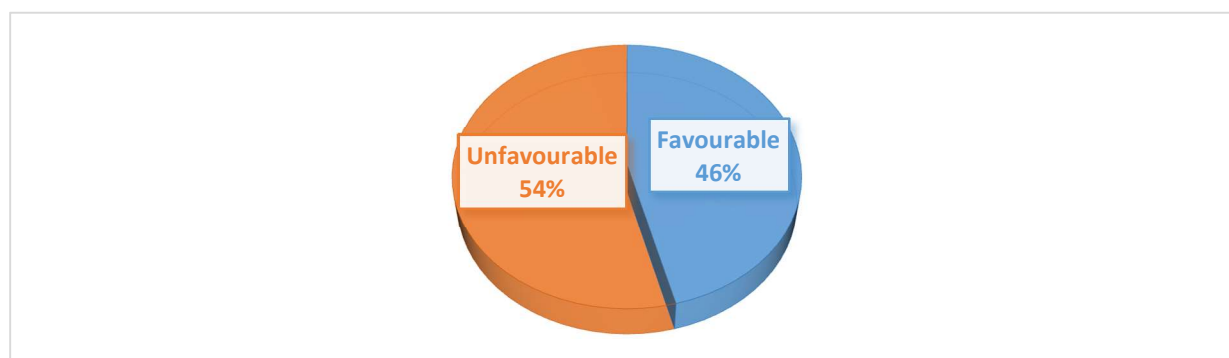


Figure 2. Farmers level of perception of e-message use for FAW information dissemination

3.3 Constraints associated with E-Alert use among farmers in South-West Nigeria

Table 2 shows the constraints identified by respondents. The constraints are grouped accordingly under the two methods used for the dissemination. The first three ranked constraints: “no room for conversation in voice call thereby making it a one-way communication”, “inability to retain the message for use after the call” and “the fear of picking calls from an unknown number” having mean scores of

2.81, 2.78 and 2.78, respectively, are under the recorded voice calls. The least constraint for the voice call related to the time wasted in picking the call ($\bar{x} = 2.01$). The identified highly ranked constraint shows indications of the need for interaction either with the message or disseminator. It can also be inferred from the result that farmers need better opportunity to interact with the source of the FAW information probably to express the grief of loss caused by the pest, or to ask further questions about the pest. This indicates that poor interactivity of the voice calls was a challenge to receiving information using the method. This result implies that the impact expected with the use of recorded voice calls for FAW information dissemination is limited by poor interactivity of the method. On the other hand, the highest constraint associated with the use of e-alert (text messages) was the poor literacy challenge of the respondents ($\bar{x}=2.71$) which was closely followed by the inability of the text message to contain all the FAW information required ($\bar{x}=2.58$). The least constraint associated with the use of text is the inability of farmers phone to receive the message ($\bar{x} = 2.11$). Corroborating this finding, Etwire *et al* (2017) found that text messages are sometimes not self-explanatory or elaborate; hence, farmers, especially, those not literate are unable to process and use the information provided. Also, Ogbeide and Ele (2015) posited that the use of text messages is impacted by the level of literacy and specific knowledge of the technology. The less dissatisfaction expressed for the timing of the call implies the high relevance of the FAW information at the beginning of the maize planting season.

In overall, only 49.3% of the respondents expressed severe constraints in the use of mobile phones for e-alert messages. This implies that at least, an average number of the farmers received and understood the voice call and also received, read and understood the message sent on Fall Armyworm.

Table 2. Distribution of respondents based on their expression of constraints to e-alert message use for FAW information

S/NO	Constraints	Mean	Rank	
	Voice calls			
1.	Fear of picking calls from an unknown number	2.78	2	
2.	It's a waste of time	2.01	13	
3.	It's a one-way information process.	2.81	1	
4.	The expression is unclear	2.37	11	
5.	The calls always come during busy hours	2.45	9	
6.	Lack of trust in the message	2.50	7	
7.	Inability to retain the message for use after the call	2.78	2	
8.	It contains too many terminologies and careless words	2.51	6	
	Text			
9.	The message is too short	2.48	8	
10.	Non-literate challenge	2.71	4	
11.	Application is not fit for my phone	2.41	10	
12.	FAW information not complete in a text	2.58	5	
13.	My phone application cannot receive such a message.	2.11	12	
	Category	Scores	Frequencies	Percentages
	Less constraints	15.0 – 35.0	104	50.7
	More Constraints	35.1 – 52.0	101	49.3

$$\bar{x} = 35.1 \pm 8.3$$

3.4 Suitability of E-Messages Use to maize farmers

Table 3 shows the distribution of maize farmers according to the suitability of the electronic methods used for the dissemination of Fall Armyworm information. The relevance of the message to maize production was very satisfactory to 48.3% of the respondents and length of the text message was suitable for 49.3% while the English version of the voice call, receiving calls from an unknown number and

inability to retain the message in recorded voice call was not suitable for 41.1%, 40.5% and 38.0% of the respondents, respectively. This result suggests that the use of recorded voice call for the agricultural message was not suitable to most of the respondents, unlike text message. The result implies that despite the relevance of the Fall Armyworm message to the farmers, disseminating the information in the English language made the whole process not suitable to some farmers. A higher percentage of the recipient, who was satisfied with most features in recorded voice call is expected. This is because the method of dissemination is relatively newer than the text message method and thus still begging for wide acceptability. The non-suitability of English language used for the voice call might not imply an inability to understand English but may indicate non-acceptance of the language for disseminating the important agricultural message to farmers.

Categorization of respondents on how suitable the e-messages were to them shows that 55.6% of the respondents found the method as very suitable for use for agricultural messages. Based on the result, about an average of maize farmers would accept e-messages in subsequent information dissemination. According to Mbagwu *et al.* (2018), farmers desire more use of information communication tools because it helps to provide timely agricultural information needed for better farm productivity. Emphasizing the level of acceptability of mobile phone applications among rural dwellers, Uduji *et al.* (2018) found that mobile phones in Africa have evolved from simple communication tools to service delivery platforms. In line with these findings, the advancement in the features of mobile phones which makes it relevant to provide important agricultural messages would have spurred the indication of its suitability for use among farmers.

Table 3. Suitability of e-message use by maize farmers

Statements	Very suitable	Suitable	Undecided	Not Suitable
Length of message for each text	43(21.0)	101(49.3)	39(19.0)	22(10.7)
Speed of the text	56(27.3)	90(43.9)	44(21.5)	15(7.3)
Language used for dissemination	53(25.9)	98(47.8)	33(16.1)	21(10.2)
Inability to see the disseminator	35(17.1)	52(25.4)	54(26.3)	64(31.2)
Message				
The relevance of the message	99(48.3)	68(33.2)	28(13.7)	10(4.9)
The simplicity of expression for understanding	53(25.9)	89(43.4)	51(24.9)	12(5.9)
Time of dissemination	73(35.6)	68(33.2)	50(24.4)	14(6.8)
Presenting the information in bits	56(27.3)	67(32.7)	47(22.9)	35(17.1)
Voice call				
Calling with an unknown number	35(17.1)	59(28.8)	28(13.7)	83(40.5)
English version of the message	48(23.4)	49(23.9)	23(11.2)	85(41.5)
Yoruba version of the message	88(42.9)	71(34.6)	24(11.7)	22(10.7)
Voice used for the call	54(26.3)	95(46.3)	30(14.6)	26(12.7)
Inability to retain the call message	35(17.1)	61(29.8)	31(15.1)	78(38.0)
Time of call	49(23.9)	45(22.0)	51(24.9)	60(29.3)
Suitability level using mean score	Scores	F	%	
Not suitable	16.0 – 37.89	91	44.4	
Suitable	37.90 – 56.0	114	55.6	

$$\bar{x} = 37.9 \pm 7.6$$

3.5 Hypothesis: There is inter-relationship between constraints, perceptions expressed and suitability of e-messages among maize farmers

Table 4 shows the result of the bivariate correlation between constraints, perception to e-message use in mobile phone and suitability of the process to farmers. Perception of farmers to e-message use was significantly related to the suitability of use at 1% although negatively correlated. This implies that the stronger the farmer's perception, the lower the suitability expressed. The relationship between

constraints and suitability was not significant. The constraints encountered were not strong enough to deter farmers from future use of e-message for agricultural information. However, the negative correlation between farmers' perception of e-message use and suitability of the method indicate that lower suitability was associated with favourable perception. This could be related to dissatisfaction with the functionalities of individual phones which was an intervening variable in the study. Ryan and Ascigil (2001) report that perception improves with the knowledge thus, repeated use of e-message for FAW control could have a low impact as perception becomes more favourable. The findings could also imply the need for a more sophisticated mobile phone that can allow for message processing in subsequent dissemination effort.

Table 4. Relationship between constraints, perception and suitability to e-message by maize farmers

Variable	r-value	p-value	
Perception	-0.33	0.00	Significant @ 0.01 level
Constraints	-0.08	0.29	Not significant

3.6 Determinants of Suitability of e –Messages among maize farmers

Table 5 shows the variables that determined the level of suitability of e-messages to farmers use. The table shows that out of the nine variables that directly correlate with suitability, only educational level ($\beta = 0.22$; sig < 0.05) and perception ($\beta = -0.31$; sig < 0.05) were best determinants of the suitability of e-message dissemination through mobile phone to farmers. It further shows that all the variables regressed on suitability gave a coefficient of the determinant (R^2) of 0.55, indicating that all the variables influenced suitability up to 55.0% of the chances available. Likewise, the perception of e-alert message use for information dissemination by farmers had a higher (31.0%) magnitude of influence than farmers' level of education (22.0%). This result affirms the importance of education in accessing electronic information among farmers (Aldosari et al, 2019). The implication of this finding is critical. Khapayi and Celliers (2019) reported that low educational level is among the key factors that challenge farmers from adopting innovations and expansion. In line with this finding, the continuous use of e-message for maize farmers sensitisation and information dissemination might lower the quick response expected in the control of FAW. On the other hand, the result emphasized the need for positive perception towards e-message use in mobile phones. Perception plays a strong role in the decision-making process and it is informed by many factors including culture and education (Ryan and Ascigil, 2001). It also contributes a lot to the success or failure achieved in the adoption of any intervention. The intervention using e-messages is relatively new among farmers in Nigeria, thus, an unfavourable perception might not be too far from expectation (Ryan and Ascigil, 2001). This situation is expected to improve after several subsequent uses.

Table 5. Contributions of variables to the level of suitability of e-message for FAW control

Variables	Beta	T	sig
Age	0.005	-0.062	0.95
Sex	0.018	0.255	0.79
Major source of income	0.59	0.766	0.44
Educational level	0.22	2.887	0.004*
Ability to read and write English	0.13	1.90	0.06
Ability to read and write Yoruba	0.07	1.06	0.29
Household size	0.03	0.32	0.74
Perception	-0.31	4.23	0.00*
Constrains	0.02	0.31	0.75
Variables	Beta	T	sig
Age	0.005	-0.062	0.95
Sex	0.018	0.255	0.79

$R=0.39(a)$, $R^2 = 0.55$; adjusted $R^2 = 0.31$; standard error = 7.16: *significant @ 5%

4. Conclusion and Recommendations

The use of e-messages in mobile phone for FAW information was suitable for most maize farmers. Receptivity and use of e-messages in voice call attracted more constraints than in text messages. Level of literacy was a major challenge to using text message information. Most farmers were not favourably persuaded to use e-messages for agricultural information because of their previous experiences of disturbances associated with such use by mobile communication service providers. The correlation between maize farmers perception to e-message use and suitability of its use was significant. The study concludes that the applicability of e-messages for FAW information was dependent on the level of education and the perception expressed by the recipients. Thus, the study recommends that:

- E-alert messages are employed by agricultural institutions and development agencies to disseminate agricultural information to farmers owing to the urgency and high importance of agricultural information.
- New modalities are introduced into the recorded voice calls to make it more interactive by giving room for feedback from farmers.
- Most maize farmers are not sufficiently skilled in education to transcribe e-information. It is therefore important to complement e-messages with other communication tools such as radio and pictorials for enhanced effectiveness.

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