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Is radio an effective method for delivering actionable information for responding to emerging pest threats? A case study of fall armyworm campaign in Zambia

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Abstract

Background: The Fall Army Worm (FAW) radio campaign was implemented between November 2018 and April 2019 in key maize growing areas and locations with reported high severity of fall armyworm as identified by national stakeholders. We evaluated the effectiveness of radio mass extension campaign in achieving scale, and effect on farmers' knowledge and uptake of management practices for fall armyworm (FAW). We also assessed the factors determining farmers' participation in radio campaign, to inform future and similar campaigns.

Methods: Data were gathered through a household survey targeting locations where the campaign was implemented; and 250 male and 215 female farmers were surveyed. The study was conducted in four of the seven provinces where the campaign took place—Eastern, Luapula, Copperbelt and Southern provinces. Selection of the sample provinces was based on reported rainfall distribution during the season and severity of FAW infestation, radio coverage areas and maize growing intensities.

Results: The radio campaign reached an estimated 1.4 million farmers. Survey results show that both male and female radio listeners were significantly more aware of fall armyworm, and more likely to adopt management practices than non-radio listeners, in particular preventive measures such as frequent monitoring, intercropping and crop rotation. This means that participation in the radio-based extension campaign significantly increased farmers' knowledge and stimulated uptake of management practices for FAW. However, the survey showed that only 49% of the respondents listened to at least one FAW radio episode. Predictors of farmer participation in radio campaign were; gender, education level, and maize farm size.

Conclusions: The results imply that deliberate promotion of such programs would enhance listenership and improve interactivity while at the same time integrating other extension approaches. The integration also provides opportunities for equally reaching women as men, given the observed digital divide.

Keywords: Agricultural Information, Smallholder farmers, Fall armyworm, Zambia

Background

The invasive pest, fall armyworm (FAW) (*Spodoptera frugiperda* J.E. Smith), first presence in Africa was confirmed in 2016 (Rwomushana et al. 2018). Research

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studies estimated that maize crop losses in Africa due to fall armyworm would range between 8.3 and 20.6 million tonnes per year if management measures were not put in place (Rwomushana et al. 2018, Pratt 2017). In Zambia, the value of the 2018 annual maize crop lost due to fall armyworm was estimated at US$159million (Rwomushana et al. 2018, Pratt et al. 2017). A majority of maize farmers in Africa are smallholders who on average farm 1–2 ha. The farmers have limited access to crop pest information due to limited extension services in Africa and for them to sustainably produce maize, they need significant support to sustainably manage FAW in their cropping systems (FAO 2018, IAPRI 2016).

Invasive pests pose new challenges to farming systems, as extension workers and farmers often lack information on effective management approaches. The high mobility and quick spread of invasive pests requires wide scale information delivery to contain the problem. Current public extension services are constrained by limited capacity and resourcing. One of the challenges identified by (Emily et al. 2017) for agricultural extension is how to reach remote, rural farmers with information in a form they can understand, apply with relative ease and by so doing reap benefits.

Empirical evidence has shown that radio is the most widely used medium in much of the developing world and close to 75% of households in developing countries have access to radio (Hudson et al. 2017, Hailu et al. 2017, Kembero 2014, Duncombe 2012) and radio in Zambia is the most accessible and used medium at 68% compared to 85% in urban areas (ZICTA 2018, Masuki 2010). Besides, the continent's New Partnership for Africa's Development (NEPAD), has put as part of its priority the need to tap media such as radio and newer information and communication technologies to avail information for sustainable development and response to agricultural challenges (Africa Renewal 2005; Staatz et al. 2008, Chapota 2015, Emmanuel et al. 2013). Previous evaluation of radio effects has shown that participatory radio campaigns implemented by Farm Radio International (FRI) resulted in increased knowledge and adoption beneficial agricultural practices in six African countries (Tambo et al. 2019).

CABI, 2018—through its programme on Action on Invasive—launched FAW-specific activities in Zambia in partnership with the Ministry of Agriculture and Livestock and Zambia Agricultural Research Institute (ZARI) and other partners. The programme supported a radio-campaign targeting smallholder farmers in seven provinces in Zambia with information on FAW identification, monitoring and management. This study assesses the effectiveness of the radio campaign in reaching scale of information reach and influencing knowledge and uptake of management practices for FAW. We also evaluate factors that determine farmer participation in radio-based extension programs to support effective future programming for delivering actionable information on emerging pest threats.

Methodology

Fall armyworm radio campaign

The FAW radio campaign was implemented between November 2018 and April 2019 in key maize growing areas and locations with reported high severity of fall armyworm as identified by national stakeholders. The process of designing and delivering FAW campaign involved multi-stakeholders from Ministry of Agriculture, National Agricultural Research Systems (NARS), farmer organizations, dissemination partners (e.g. radio), and the national fall army worm task force. The process (Fig. 1) involved a formative appraisal to enable selection of appropriate communication channels and timing of information delivery suitable for male and female farmers. This was followed by development of a technical brief. Development of technical briefs was informed by available empirical evidence (such as the FAO and USAID/CIMMYT manuals, Farm Radio Guide), and research information from National Agricultural Research Systems (NARS). Campaign planning and implementation followed, and monitoring and learning undertaken during the period of the campaign.

The campaign messages covered FAW identification, monitoring and management practices. Delivery of messages was timed to the cropping calendar to ensure the received messages were relevant to the current agricultural activities. The radio messages were pre-recorded and translated into all the seven national languages of Zambia, as well as English, and aired on national radio Zambia National Broadcasting Corporation (ZNBC) and six regional radio stations—Breeze FM, Eastern Province; Kasempa FM, North western province; Radio Yangeni, Luapula Province; Sky FM, Southern Province; Liseli FM, Western Province; and Ichengelo radio, Copperbelt Province. Implementing partners for the FAW campaign were Ministry of Agriculture (through the National Agricultural Information Services (NAIS), Zambia Agricultural Research Institute (ZARI), National Union of Smallholder Farmers Association of Zambia (NUSFAZ), Zambia Environmental Management Agency (ZEMA), CropLife, and the University of Zambia, and CABI. The radio campaign was implemented in conjunction with agricultural extension activities.

Study area, population and sample

The study was conducted in four of the seven provinces where the campaign took place—Eastern, Luapula,

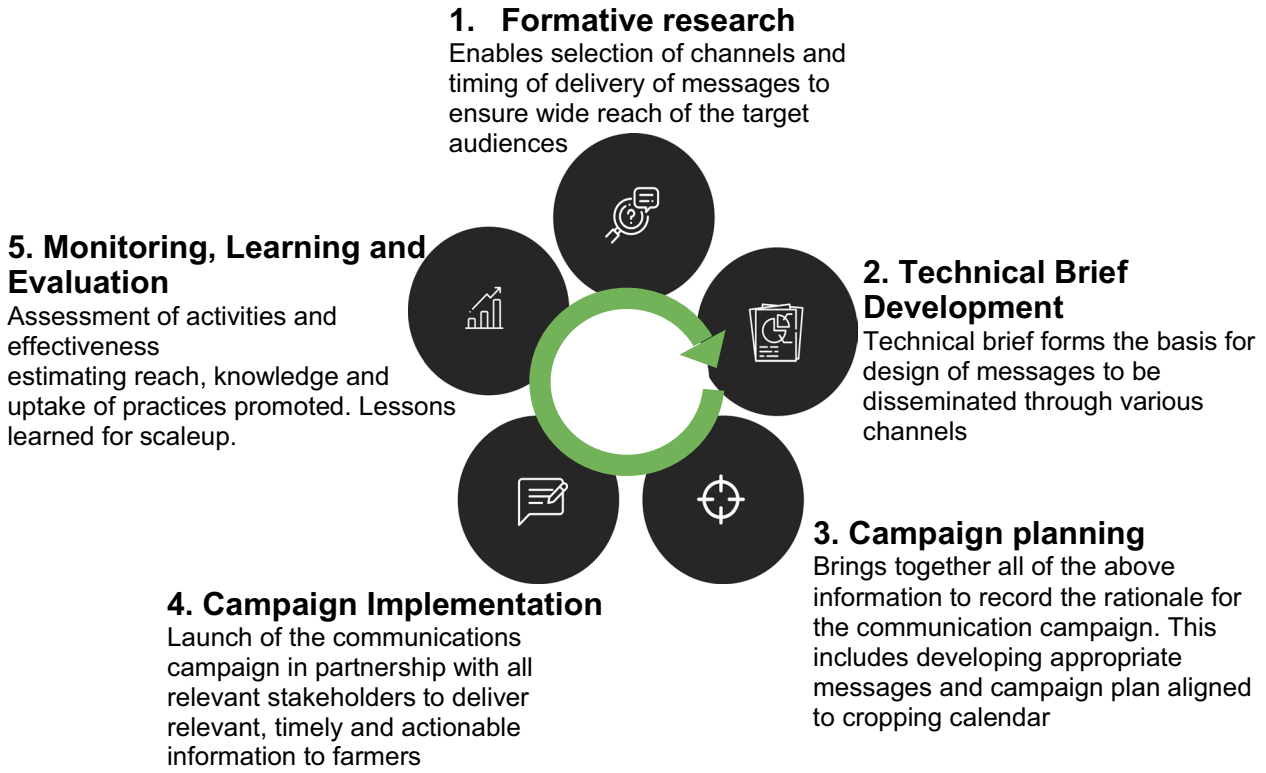

Fig. 1 campaign implementation plan

Copperbelt and Southern provinces. Selection of the sample provinces was based on reported rainfall distribution during the season and severity of FAW infestation, radio coverage areas and maize growing intensities. The northern part of Zambia enjoyed fairly higher than average rainfall amounts, whilst the southern part experienced quite dry conditions.

The study population comprised of maize growing farmers in the selected provinces. A representative sample of camps was obtained using the government extension criteria, based on whether it is a maize growing area, suffered FAW attacks in the previous season and whether the key radio stations used in the campaign covered these areas. Respondent households were randomly identified following a road network and interviewing one farmer and skipping the next farmer. In instances where the farmer was missed, a repeat was done the next day. Information was gathered from both the radio listeners and non-listeners who were selected based on information from radio coverage areas and a filter question on radio listenership. Moreover, a filter question was included to establish if the household had grown maize in the November 2018–April 2019 growing season, and only those who had grown maize in the referred season were interviewed. A total of 465 farm households (250 male and 215 female) were interviewed across the four provinces.

Data were collected through a structured questionnaire administered by trained enumerators. The questionnaire had components on participation in the FAW campaign; household socio-economic characteristics; maize production details; knowledge of and attitude towards FAW management; adoption of interventions for FAW management; access and proximity to institutional support services; and use of pesticides.

Data collection was done through face to face interviews using the Open Data Kit (ODK) platform deployed on tablet computers. Before the data collection exercise, training was done using both the paper and the online versions of the questionnaire to ensure that the questions and objectives of the study were clearly understood by the enumerators. The questionnaire was pre-tested in Kafue district of central province and corrections done. ODK inbuilt data validation features were used to guarantee data quality. The data were received in near real-time on an aggregate server, quality checks done and feedback provided to the field team leaders. This further ensured quality control at the field level. The base production season was November 2018 to April 2019, thus all data collected referred to this season. Before

interviews, enumerators obtained verbal consent from the respondents.

Empirical methods

The purpose of the study was to assess the effect of FAW radio campaign in achieving scale of farmer reach and influence on farmers' knowledge and practices for fall armyworm management. These attributed were compared between campaign participants (listened to radio campaign) and non-participants (those that did not listen to the radio campaign). Three key knowledge questions were assessed; identification, monitoring and management. Farmers were asked a series of questions to assess their knowledge on specific aspects of FAW identification, monitoring, and management. Respondents gave their subjective rating on a 2-point scale; 1 = agree and 2 = disagree. The knowledge statements were coded by assigning 1 to correct responses and 0, otherwise. Using Principal Component Analysis (PCA), indices for the three knowledge categories were developed. In order to estimate the effect of radio participation on the knowledge questions, multiple regression models were estimated with indices for identification, monitoring, and management as the dependent variables. The model was specified as;

$$y_i = \alpha_i + \beta x_i + \gamma FAW_i + \varepsilon_i \quad (1)$$

where y_i is an index for the knowledge questions for household *i*, Independent variables included; FAW_i and is a vector for participation in the FAW campaign (1 = yes, 0 = otherwise), and ε is the error term. Other explanatory variables, *x* were included in the model; socio-demographic characteristics (sex of respondent, age category, education level, household size, farm size), and location of respondent *i*.

We further estimated the factors that determine a farmer's participation in a radio campaign, to guide design of future campaign programs. Probit regression model was estimated. The probit model assumes that while we only observe the values of 0 and 1 for the variable *Y*, there is a latent, unobserved continuous variable *Y'* that determines the value of *Y*. Thus, for this study we assume that participation in radio campaign (*Y'*) can be specified as follows:

$$Y_i' = \Delta_i + \beta x_i + u_i \quad (2)$$

And that:
$Y_i = 1$, if $Y' > 0$
$Y_i = 0$, otherwise.

Where x_i is a set of explanatory variables for respondent *i*, β represent a vector of unknown parameters, and *u* represent a random disturbance term.

Data analysis

Data analysis was done using Stata 15 statistical package. Pearson X^2, Principle component analysis, multiple regression models and t-test were used to test significance of proportions and means across the campaign participants and non-participants.

Results and discussion

Respondent characteristics

Table 1 shows respondent characteristics. On average, the household size was 7 persons. A majority of the respondents (48%) had attained secondary level of education, 42% primary level, and 5% had no formal education which is below the national literacy level average of 53%. A majority of farmers (86%) who participated in the FAW

Table 1 Household characteristics

Characteristics	Total sample	Non listeners	Radio listeners	Female	Male
HH members (#)	7.0 (0.1)	6.7 (0.3)	7.1 (0.2)	6.9 (0.2)	7.1 (0.2)
HH members full time on farm (#)	4.4 (0.1)	4.3 (0.2)	4.4 (0.1)	4.3 (0.2)	4.5 (0.1)
Age of HH head (years)	52.2 (0.6)	50.7 (1.2)	52.9 (0.8)	51.1 (0.9)	53.2 (0.9)
Total farmed land (acres)	6.3 (0.4)	5.7 (0.8)	6.6 (0.5)	5.4 (0.5)	7.1 (0.6)
Education level (%)					
None	5	3	10	6	5
Primary school	42	41	47	49	36
Secondary school	48	51	42	40	56
University	3	3	1	4	2
Vocational	2	2	0	2	1
Suffered FAW last season	349	88	86	88	87

HH: household

*Std error in parenthesis

campaign had experienced FAW on their farms during the November 2018–April 2019 cropping season, compared to 88% of the non-campaign participants.

On average, male farmers had more land for all activities compared to female farmers (7 acres compared to 5). Radio campaign participants (who are we refer as radio listeners) had more land for all activities (6.6 acres) compared to non-listeners (5.7 acres). Both household head and spouse worked most of the time on their farms. This was confirmed by the study where most of the household heads (92%) work on the farm full time and 6% part-time while 95% of the spouses of the household head worked full time on the farm while 4% work part-time. The average age of the household head was 51 years for the female heads and 53 years for the male heads.

Farmer participation in radio campaign on FAW

Farmer reach with radio messages was estimated based on radio coverage and signal strength, total potential adult population, total potential rural population, as well as proportion of maize growers. This approach has been used before for example Farm Radio International (Hudson et al. 2017, Wanyama et al. 2015), to map audience coverage and reach. In our analysis, we include a factor of proportion of respondents in the broadcast areas who listened to at least one radio episode on FAW during the campaign season, to estimate actual reach. Figure 2 shows mapping of radio reach in Zambia based on signal strength and population within the radio coverage that were used for computation of reach figures for the radio campaign. Where tower data were not available, for example Radio Yangeni and Sky FM, the broadcasters were asked to provide an estimate of their listenership based on their experience and research. The adult population in Zambia is 52% according the national bureau of statistics, and from our survey, 49% of the respondents listened to at least one episode of the FAW campaign during the 2018/19 cropping season. Table 2, shows the estimation of reach based on the statistics estimates, a total of 1.4 m people were reached with fall armyworm messages via radio. While it is not possible to disaggregate public service message and radio viewership/listenership by gender and age, it is estimated that about 40%

Table 2 Estimated farmer reach with fall armyworm radio messages in Zambia

Variable	Number
Rural population in radio coverage	5,602,825
People who listened to radio campaign (49%)	2,745,384
Less population below 14 years (48%)	1,427,600
Estimated reach—Radio	1,427,600
Female (40%)	542,488
Male (60%)	885,112

Seven radio stations were used, some urban and others rural. For urban-based radio stations, their estimated rural listenership was 55.9%, and proportion of the population growing maize was 98%, which were also factored into the final computation of reach. See Additional files 1, 2

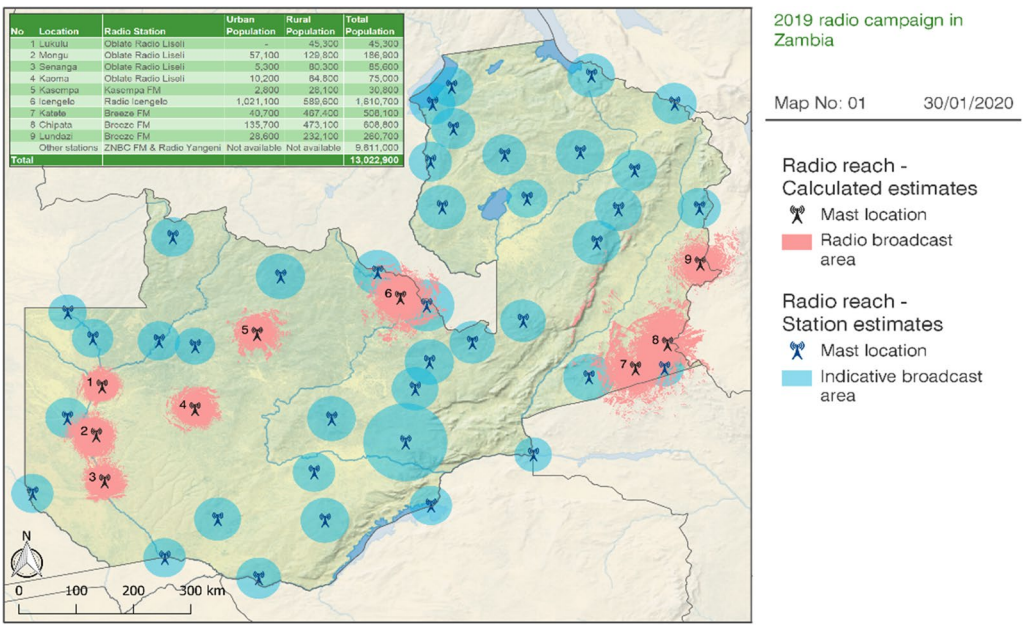

Fig. 2 Radio signal coverage for Breeze FM, Icengelo FM, Kasempa FM, and Liseli FM in Zambia and population reached based on radio signal strength. Map curtesy: T. Beale (CABI)

of the population reached were women and that 48% were under 35 years of age. The estimate does not include secondary reach e.g. information sharing within the family, farmer groups or social clubs, which is common in rural setting. Figure 3, shows a comparing of the FM radio mostly listened to and where the FAW message was received from, by the listener categories, where ZNBC Radio 1, is the most listened followed by ZNBC Radio 2 but this differed by province where Icengelo is listened more in Copperbelt.

Probit regression model was used to assess factors affecting farmer participation in radio campaign. The dependent variable took the form of 1, if farmer listened to at least one radio episode on fall armyworm and 0, otherwise. Table 3 shows results of the logit model. Data showed that gender of respondent and land under maize cultivation had positive and significant effects on farmer participation in the radio campaign. Gender of respondent was significant ($P > 0.05$) in influencing farmers decision to take part in the of radio campaign. Relative to the base province, Luampula had a positive and significant influence to the radio listening at 5% level. This may be attributable to the number of FM radio stations covering the province. On the other hand, compared to the base age of above 60 years, the age between 36 and 60 and those 35 years and below, had a positive and a significant influence on farmers participation in FAW radio campaign at 5% level of significance, (Table 3). Education levels relative to the base level had no influence on participation on the radio campaign by farmers except the primary education that was shown to positively influence participation at 10% level of significance. It therefore implies that, gender has a positive influence on radio listening in Zambia and while developing and intervention on this nature, gender ought to be considered.

Farmer knowledge of fall armyworm

Table 4 shows results of the knowledge questions—identification, monitoring and management. Overall, farmers responded correctly to most of the FAW knowledge questions, but farmers who listened to radio had higher knowledge scores generally compared to those that did not. On FAW awareness, data showed a significant difference ($P < 0.05$) between radio listeners and non-listeners. More radio listeners (86%) than non-listeners (80%) agreed that FAW can cause 100% damage and loss on maize and that the signs of FAW damage include small pinholes. Conversely, more non-listeners (45%) than listeners (36%) agreed that FAW is spread through infested seeds respectively significant at 10% level. There was however no significant difference between the proportions of listeners and non-listeners that said FAW only attacks maize.

The results show a significant difference in knowledge on FAW management, between the two groups ($p < 0.01$), with 88% of the listeners and 76% of non-listeners agreeing that early planting at the onset of rains can help reduce FAW incidence. Further, 68% of listeners and

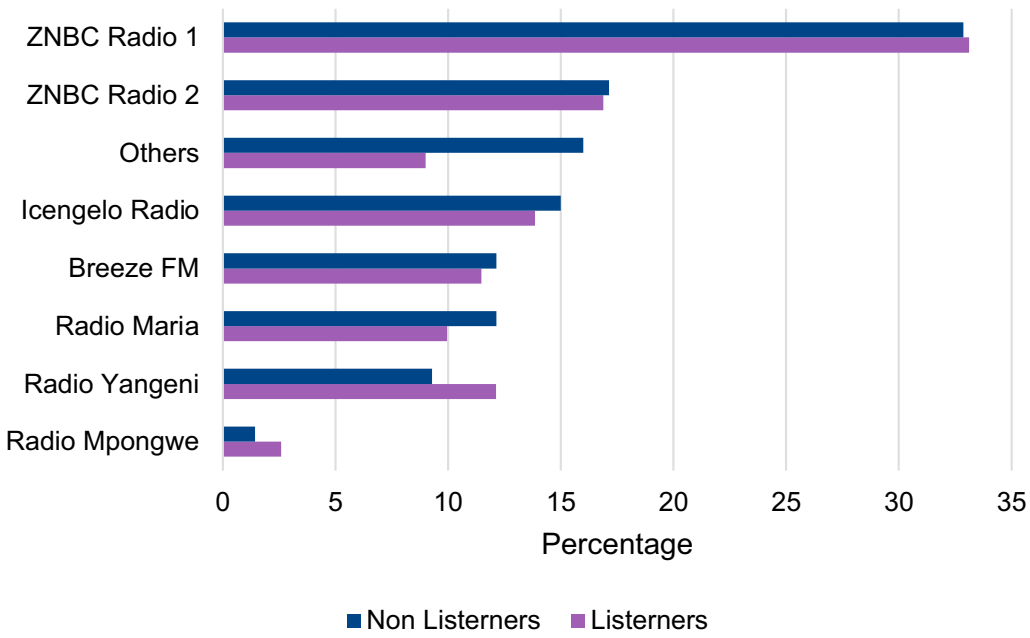

Fig. 3 Comparing radio mostly listened to by both categories

Table 3 Factors influencing participation in radio campaign

Participation in Radio campaign	Coef	Std. Err	P-value
Respondent gender (male = 1)	0.14	0.044	0.002***
Total number of HH members	0.00	0.008	0.701
Land under Maize (ha)	0.03	0.017	0.055*
Suffered FAW last season (yes = 1)	0.04	0.067	0.564
Province: Copperbelt	0.03	0.098	0.735
Province: Luampula	− 0.24	0.101	0.019**
Province: Eastern	− 0.02	0.096	0.845
Age: between 36 and_60 years	− 0.11	0.053	0.031**
Age: Under_35 years	− 0.16	0.076	0.040**
Number of HH members working full time on the farm	0.00	0.027	0.886
Own mobile phone (1 = Yes)	0.03	0.062	0.626
Belong to farmers group (1 = yes)	0.11	0.067	0.104
Education of HH head Primary (1 = Yes)	0.37	0.204	0.074*
Education of HH head Secondary (1 = Yes)	0.10	0.168	0.563
Education of HH head university (1 = yes)	0.04	0.104	0.674
Constant	0.14993	0.155	0.333

***Significant at 1%, ** significant at 5% level, * significant at 10% level

Southern province was set as the base, Age above 60 set as base, and Vocational education as base

43% of the non-listeners agreed that crop rotation can help reduce FAW infestation. However, there was no significant difference between the two groups on the statements that FAW can be managed through hand picking and crushing on small scale, where 58% of both groups agreed. When it came to monitoring, the two groups differed significantly ($p < 0.001$) on the statement that it is important to visit the maize farm 2–3 weeks after planting and to continue monitoring every 3 days, with 92% and 75% of the listeners and non-listeners agreeing, respectively. There was however no significant difference between the two groups on the statement that monitoring FAW is done by walking along edges of maize fields, with 42% of the listeners and 43% of the non-listeners agreeing.

Fall armyworm management practices used by farmers

Campaign messages on management practices included both prevention and direct control. Prevention approaches are aimed at reducing the chances of the pest attacking the field, while control relates to practices to reduce impacts of the pest once already in the field. Results show that both groups of farmers employed different FAW prevention and control practices with radio listeners more likely to adopt management practices than non-radio listeners, particularly preventive measures such as frequent monitoring, intercropping and rotating crops in their fields. Whilst the use of pesticides by radio listeners was higher (Fig. 4). There was no significant difference between radio listeners and non-radio listeners in using biological methods for controlling FAW. This may mean that there is a knowledge gap in Zambia in regard to the use of biological methods in managing FAW infestations. This is an opportunity for both government and development partners to intervene and avail these technologies which are friendlier to human health, environment and are sustainable. Both male and female farmers showed awareness of FAW and implementation of management practices as promoted by the radio campaign albeit with some differences. More male farmers than female were more likely to apply pesticides, while women were more likely to use agronomic and cultural practices than men for the control of FAW. Other studies have also noted differences in practices employed by male and female farmers for FAW management (Kansiime et al. 2019; Tambo et al. 2020), which is largely attributed to differentials in access to resources, inputs and decision making.

Regression results of factors affecting farmer knowledge and management of FAW are shown in Table 5. The results show that participation in the radio campaign by listening to the radio was positively associated with outcomes on FAW identification, monitoring and management. The result is consistent with previous studies e.g. (Adamides and Stylianou 2018; Tambo et al. 2019), who found that radio contributed significantly to farmers' agricultural knowledge. Hudson et al. (2017) show that the percentage of radio listeners implementing at least one agricultural practice was 2.7 to 2.9 times the percentage of non-listeners in Uganda and Tanzania respectively.

Table 4 Summary statistics for FAW knowledge questions and scores (% correct responses)

Variable (%) (Correct response = 1)	Overall	Radio listeners	Non-listeners	Sig
Awareness				
FAW attacks Only Maize	33	34	32	ns
FAW spread through infested seeds	40	36	45	*
FAW spread through vegetative materials	40	41	38	ns
FAW can cause 100% damage and loss on Maize	83	86	80	***
FAW attacks all stages of Maize	83	87	79	***
Older FAW caterpillar have Y shaped	46	55	38	ns
Signs on FAW damage include small pinholes	92	93	91	***
Heavily infested plants have moist sawdust	95	97	92	***
Management practices				
Hand picking and crushing on small scale	58	58	58	ns
FAW can be managed through cultural methods/bio pesticides/chemicals	64	68	59	ns
Act to control FAW when > 10 plants out 50 have signs	53	59	47	*
Early planting at the onset of rains can prevent FAW	82	88	76	***
Crop rotation can help reduce FAW	55	68	43	***
Intercropping maize with beans can help reduce FAW	26	33	20	ns
Regular weeding of farm can help prevent FAW	67	80	55	***
Pesticides for FAW control are not dangerous for Humans	81	82	80	ns
Important to use PPE when mixing or spraying pesticides	94	97	90	***
Empty pesticide containers can be reused	85	89	82	**
Do no spray pesticides when maize is mature or cob drying	65	66	64	ns
Mix different pesticides to make them more effective	65	70	60	*
Monitoring				
Early FAW detection allow early management	92	94	91	ns
Important to visit maize farm 2–3 weeks after planting	84	92	75	***
Important to continue monitoring every 3 days	88	95	81	***
To monitor FAW walk along edges of maize fields	43	42	43	ns
To monitor for FAW, examine 50 plants/acre in 5 different locations	50	52	48	ns
Knowledge scores				
FAW awareness	64	66	61	ns
FAW management practices	66	72	61	**
FAW monitoring	71	75	68	ns
Overall FAW knowledge score	67	71	63	*

*** Significant at 1%, ** significant at 5% level, * significant at 10% level

This shows that the radio campaign had positive effects in increasing awareness and facilitating farmers' decisions to take up promoted FAW practices.

Household size was positively associated with FAW identification and management, while age of farmer (36 and 60 years) was positively associated with proper FAW identification in comparison to younger or older farmers. This implies that farmers aged between 36 and 60 years were more likely to monitor their maize farms for FAW compared to other age categories. Geographically, farmers in Eastern and Luapula provinces had lower knowledge bases on FAW compared to Southern province. While gender of respondent showed no significant effect on FAW knowledge bases, management practices tended to differ between men and women. Gender of respondent showed no significant influence on FAW awareness, monitoring and management highlight the potential of this approach to enhancing women's participation and access to information.

Conclusion

This study assessed the effectiveness of radio campaign in achieving scale of farmer reach, and influencing farmer knowledge and practices for FAW management. A multi-stakeholder radio campaign was implemented during the November 2018-April 2019 cropping

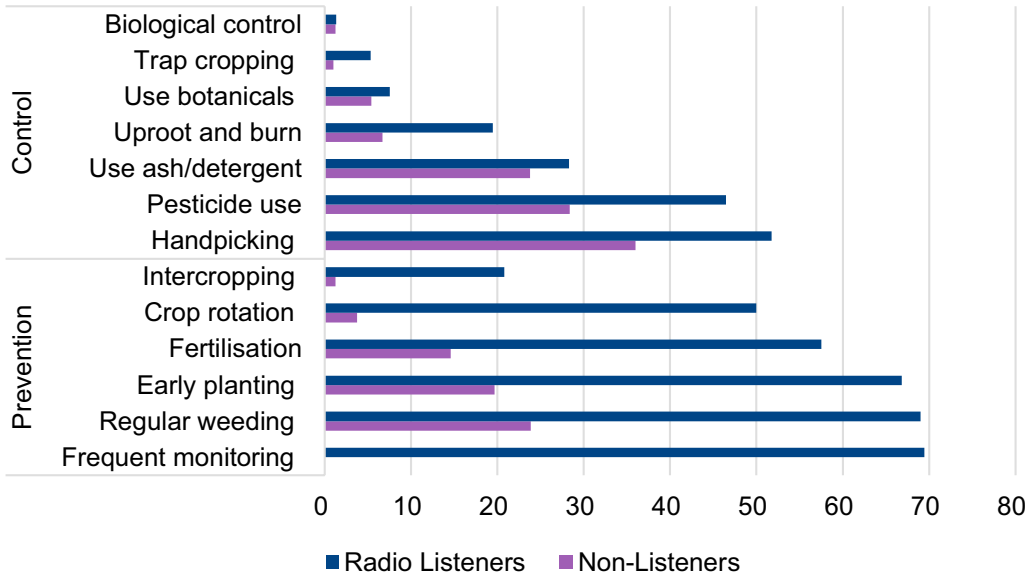

Fig. 4 FAW prevention and control methods between radio listeners and non-radio listeners

Table 5 Factors affecting FAW awareness, monitoring and management

Variable	Identification		Monitoring		Management	
Independent variables	**Coef**	**Std. Err**	**Coef**	**Std. Err**	**Coef**	**Std. Err**
Land planted with Maize (ha)	0.05	0.047	0.02	0.041	0.03	0.050
Radio listening frequency	0.02	0.053	−0.07	0.046	−0.03	0.056
Respondent gender (male = 1)	0.13	0.125	0.02	0.109	0.11	0.132
Total number of HH members	0.03*	0.021	−0.01	0.019	0.05**	0.023
Listened to radio (1 = Yes)	0.41*	0.15	0.20*	0.130	0.74***	0.159
Education of HH head Primary (1 = Yes)	−0.4	0.289	−0.08	0.251	−0.07	0.306
Education of HH head Secondary (1 = Yes)	−0.27	0.298	−0.16	0.259	0.10	0.315
Education of HH head university (1 = yes)	−0.18	0.568	0.10	0.493	0.11	0.600
Belong to farmers group (1 = yes)	0.13	0.186	0.23	0.162	0.03	0.197
Own mobile phone (1 = Yes)	−0.06	0.172	−0.07	0.150	−0.02	0.182
Number of HH members working off-farm	0.09	0.074	0.06	0.064	−0.20***	0.078
Aged: Under 35 years	0.3	0.212	−0.43**	0.184	−0.27	0.224
Aged between 36 and 60 years	0.31**	0.146	0.00	0.127	0.02	0.155
Province: Eastern	−0.81***	0.266	−0.63***	0.231	−0.78***	0.281
Province: Luapula	−0.27	0.283	−1.76***	0.246	−0.97***	0.299
Province: Copperbelt	0.13	0.273	−0.29	0.237	−0.38	0.289
Constant	−0.41	0.429	0.76**	0.372	−0.29	0.453

*** Significant at 1% level, ** significant at 5% level, *Significant at 10% level

Southern province was set as the base, Age above 60 set as base and Vocational education as base

season, reaching an estimated 1.4 million farmers (40% female, and 43% aged below 35 years) with information on FAW identification, monitoring and management. Partnerships with various stakeholders facilitated knowledge exchange, and provided a useful platform for continued improvement of knowledge related to fall armyworm and further dissemination through other platforms (using the technical brief and the basis).

Survey results showed that both male and female radio listeners were significantly more aware of fall armyworm,

and more likely to adopt management practices than non-radio listeners, in particular preventive measures such as frequent monitoring, intercropping and crop rotation. This implies that participation in the radio-based extension campaign significantly increased farmers' knowledge and stimulated uptake of management practices for FAW. Radio also achieved a larger reach than would have been possible with face-to-face extension approaches in the same period of time. Thus, utilization of radio can be important in tackling threats of invasive pests like FAW, whose spread is fast, requiring speed and wide coverage of management information.

Gender of respondent showed no significant influence on FAW knowledge base, highlighting the potential of radio in enhancing women's participation and access to information. And consistent with other studies, there were differences in practices used by male and female farmers for the management of FAW, an indication of differences in access to inputs and resources. This implies the need to support access to inputs and technologies alongside provision of information/extension advice.

However, results showed that just about ½ of respondents in communities covered by radio were able to listen to at least one radio episode on FAW. Gender of respondent, education level, and maize farm size were significant predictors for farmer participation in radio campaign. This suggests the need to deliberately promote radio programs if listenership is to be enhanced. This can be done through integration of extension approaches including use of ICTs, interactive radio programming, and other inter-personal approaches. The integration of approaches may also be an effective strategy for equally reaching women as men, given the observed digital divide. Interactivity of extension approaches has been found to increase learning and adoption of new practices (Hudson et al. 2017).

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s43170-021-00053-8.

Additional file 1. The radio campaign schedule

Additional file 2. Estimation of reach

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Authors' contributions

HR: Data analysis and writing. MKK: supported data cleaning, analysing, interpretation of the data. IM: Paper review and a bit of data analysis. DO: Reviewed the paper to check Campaign context. JAT: Paper review especially on models used. CMB: Logistics in data collection. NAP: Logistics in sata collection and paper review. GC, MM, DC: Paper review country context. TD: Paper review on campaign logic. JG: Paper review gender component. All authors read and approved the final manuscript.

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Availability of data and materials

The data that support the findings of this study are available on request from the corresponding author [Harrison Rware]. The data are not publicly available due to [state restrictions e.g. "them containing information that could compromise research participant privacy/consent"].

Declarations

Ethics approval and consent to participate

This paper is generated using data from an ongoing project on FAW campaign in Zambia. We are using different methods to reach to the farmers with FAW messages and the paper is presenting some of the lessons from the research as approved by the project committee. Roger Day email r.day@cabi.org is the project executive.

Consent for publication

Before collecting the data used in this paper, the identified respondents, (farmers), were asked give their consent of participating in the survey before they were interviewed. They were explained about the survey, purpose and objectives and then a question was paused to them, if they would want to take part and they answered Yes/No.

Competing interests

The authors declare that they have no competing interests.

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