

1 **Original Research Article**
2 **Innovative Agricultural Technology**
3 **Dissemination: Finding a New Use for Motor**
4 **Tricycles**

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9 **ABSTRACT**
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Aims: Even though screening of videos to create awareness about agricultural technologies may not be a novelty, adaptation of a motor tricycle for that purpose is an innovation. The study therefore, sought to identify the awareness creation technique that is most preferred by farmers in the Northern Region of Ghana, estimate the per unit cost of creating awareness using various techniques and as well, examine the socio-economic factors that are likely to influence farmers' decision to patronize Integrated Soil Fertility Management (ISFM) video shows as an awareness creation technique.

Study design: Primary data collected through farmer interviews formed the basis for analysis in this study. Qualitative and quantitative data generated from the questionnaire administration included types and quality of awareness creation techniques utilized by farmers, farmers socioeconomic characteristics among others.

Place and Duration of Study: The study was conducted in eight districts of the Northern Region of Ghana in September 2013. The eight districts fall naturally (based on culture) into two ethnic groups, which are the Dagombas and Gonjas. The groups (Dagbon and Gonja Land) formed two strata from which respondents were sampled for the study.

Methodology:

The multi stage sampling technique was used to select 322 farmers who were interviewed. Data collected and observations made were subjected to descriptive and logit statistical analysis as well as Friedman test in order to generate results for discussion.

Results:

The Friedman test indicates that on-farm demonstration (1.49) was unanimously ranked by the respondents as their most preferred method of receiving agricultural information. On-stage drama (3.0) and radio (3.0) were ranked as the least preferred methods of receiving information on ISFM technologies in Dagbon and Gonja Land respectively. Video show (2.81) was ranked by the respondents as the third most preferred method of receiving information on ISFM technologies. Use of video show and on-farm demonstration were respectively found to be the least and most expensive methods of disseminating ISFM technologies to farmers. Whereas it costs about 1 Ghana cedi (GH¢1.09) to screen an ISFM video to a farmer, it costs about thirty times (GH¢31.10) more to expose a farmer to ISFM by establishing and managing an on-farm demonstration. Results of the logit analysis indicates that being male (0.09), belonging to a relatively large household (0.02), not having access to extension (0.20) or being relatively young (0.01) are factors that are likely to positively influence farmers' decision to patronize ISFM video shows.

Conclusion and Recommendation:

The study concludes that agricultural technology interventions should employ either on-farm demonstrations or video shows, especially when constrained to adopt only a single awareness creation technique. Projects that are cash constrained should opt for video shows by specifically relying on motor tricycle video vans in order to reduce cost. For maximum impact, female farmers, members of relatively small households and elderly farmers should be targeted. Future studies should focus on the effectiveness of different

Keywords: Ghana, Motor tricycles, Technology dissemination, Video show

1. INTRODUCTION

Awareness is a necessary condition to adoption (1; 2; 3; 4; 5). Creating awareness bridges the gap between technology development and uptake. Without dissemination, technologies generated would remain on the shelf of research institutes with little or no impact. According to (6) and (7), a major constraint limiting technology adoption is ignorance of the existence of such technologies. In Ghana, and specifically the Northern Region, interpersonal, group and mass communication methods are being used for propagating new or existing technologies among farmers. There are however, some strengths and drawbacks associated with each awareness creation technique.

Farm visits and distribution of print materials are examples of interpersonal awareness creation techniques. Intensive interactions that enhance understanding and allows for rapid feedback are some advantages of one-on-one interactions. This method is, however, expensive in terms of time (only a few individual farmers can be reached within a period), capital and other resources. On-farm demonstrations and farmer learning centres are some of the means through which extension workers reach out to farmer based organizations, nucleus or out grower farmers as well as apex farmer organizations. Group extension techniques make room for many more farmers to be reached at a time, with a higher multiplier effect as compared to interpersonal techniques. However, difficulty in organizing farmers into well-functioning groups is a drawback to this approach. Mass extension techniques such as the use of radio, television, video show and on-stage drama ensure that large numbers of farmers are reached. However, in the opinion of (8), mass methods are usually not very effective in disseminating complex technologies.

Even though several governmental and non-governmental organizations have been using a combination of awareness creation techniques to reach out to farmers in Ghana, the level of awareness and adoption rate of many improved technologies still remain low (9; 5). Arguably, the present dissemination techniques may not have had a phenomenal influence on enhancing the level of awareness of farmers in the Northern Region of Ghana.

According to (10) Northern Region has perhaps the highest concentration of development projects in the country. The Agricultural Value Chain Mentorship Project (AVCMP) is one of the developmental projects being implemented (2011-2014) in the region. The Danish International Development Agency (DANIDA) is funding this project through the Alliance for a Green Revolution in Africa (AGRA). The Savanna Agricultural Research Institute of the Council for Scientific and Industrial Research (CSIR-SARI), International Fertilizer Development Centre (IFDC) and Ghana Agricultural Associations Business Information Centre (GAABIC) are grantees implementing the AVCMP. The project seeks to, among other things, increase awareness, and use of Integrated Soil Fertility Management (ISFM) technologies among smallholder farmers. To achieve this objective, (create awareness on ISFM technologies), the project has employed a combination of techniques such as establishments of on-farm demonstrations, radio broadcasts, video shows and on-stage drama.

Motorcycles and bicycles are popular means of transport in northern Ghana (11, 12). They often come in handy in terms of carting goods on a small scale. It however appears that motorcycles are mostly owned by men and the well-endowed, while the less endowed, most of whom are women, mostly own bicycles. In addition, donkey carts, tractors and trucks are

also used (by a minority) to transport goods on relatively large scale depending on ability to pay and road conditions. In recent times, motor tricycles (commonly referred to as motor king in Northern Region) are becoming an important means of transport (12). These are three wheeled, uncovered (open air) motorcycles with a trailer (cart). Even though motor tricycles are licensed to cart goods, they are increasingly being used for commercial human transport (Appendix 1).

In 2012, CSIR-SARI in partnership with Countrywise Communication Ghana under the auspices of the AVCMP muted the idea of screening ISFM videos to farmers in project communities without electricity using motor tricycles. One motor tricycle was purchased and modified to contain a Liquid-Crystal Display (LCD) projector, screen, a laptop computer and power generator (Appendix 2). In 2013, a total of 20,306 farmers (8,618 females) from sixty communities in ten districts in the Northern Region of Ghana viewed the ISFM videos in their own dialects through the use of the motor tricycle video van (Appendix 3).

The authors are not aware of any study to date on the adaptation of a motor tricycle to serve the purpose of screening ISFM technologies in farming communities. This study therefore sought to identify the awareness creation technique that is most preferred by farmers in the Northern Region of Ghana, estimate the per unit cost involved in employing the respective techniques and as well, examine the socio economic factors that are likely to influence farmers' decision to patronize ISFM video shows as an awareness creation technique. The findings of this study have implications for agricultural policy and project implementation in terms of making a choice on the awareness creation technique to adopt for agricultural technology dissemination. This study will therefore make empirical contributions to the agricultural technology dissemination literature.

2. METHODOLOGY

2.1 Study Area

The study was conducted in the Northern Region of Ghana. The region is the largest (29.5%) in the country covering a total area of about 70,384 square kilometres (13). It is bordered to the east and west by the republic of Togo and Côte d'Ivoire respectively. Upper East and West Regions border it to the north with Brong-Ahafo and Volta Regions bordering it to the south. Politically, the region has 26 administrative districts with Tamale being the regional capital (13). AVCMP is being implemented in all the districts except West Gonja, North Gonja, Bole, Sawla-Tuna-Kalba and Zabzugu-Tatale. The land is mostly low lying and drained by the White and Black Volta together with its tributaries. The climate of the region is relatively dry with two main seasons. The rainy season usually commences in May and ends in October. Mean annual rainfall ranges between 750 and 1,050 millimetres (13). The region falls within the guinea savannah zone. According to (13), majority (74%) of the people in the region are engaged in agriculture, cultivating crops such as maize, rice, soybean, yam, millet, cowpea, groundnut among others. Guinea fowls, goats, sheep and cattle are some of the livestock being kept.

2.2 Data Sources

Primary data collected through farmer interviews formed the basis for analysis in this study. Qualitative and quantitative data generated from questionnaire administration included types and quality of awareness creation techniques utilized by farmers, farmers socio-economic characteristics among others. Different sampling techniques were employed at different levels of data generation. The Northern Region was purposively selected because it is the intervention region of the AVCMP.

Eight districts were purposively sampled for this study. These districts fall naturally into two groups (based on ethnicity/culture) which are the Dagombas and Gonjas. The study area was therefore stratified based on the two (natural ethnic) zones, i.e. Dagbon and Gonja Land. Using the simple random sampling technique, two and three districts were sampled from the Gonja and Dagbon zones, respectively. Twenty and twelve communities exposed to all the awareness creation techniques were randomly sampled in the Dagbon and Gonja zones respectively.

In creating ISFM awareness at the community level, the project does not limit any of the interventions to only beneficiary farmers or farmer groups. In other words, on-farm demonstrations, radio broadcasts, on-stage drama and video shows are opened to all farmers at the community level. Indeed, the communities are informed before the commencement of any awareness creation effort. A list of farmers was generated at the community level after which ten farmers (average) from each selected community were sampled through simple random sampling technique. The number of farmers interviewed in the Dagbon and Gonja zones was 190 and 132 respectively, making up 322 respondents enumerated for the study. In addition, a staff of CSIR-SARI involved in the AVCMP was interviewed in order to gain insight into the various awareness creation techniques employed, their cost and number of farmers reached.

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127 **2.3 Method of Analysis**

128 **2.3.1 Descriptive Analysis**

129 Narratives of the different awareness creation techniques including per unit cost as well as a
130 description of the explanatory variables included in the logit models were obtained using
131 descriptive statistics. The categorical and continuous explanatory variables in the model
132 were further subjected to the Binomial Test and Independent Sample T-Test respectively, in
133 order to determine statistical differences between farmers who patronized the ISFM video
134 shows against those who did not.

135 **2.3.2 Ranking of Awareness Creation Techniques**

136 Following from (14), farmers ranking of their most preferred methods of receiving ISFM
137 information were subjected to the Friedman test which evaluates the hypothesis that;

138 H_0 : There is no difference in farmers ranking of awareness creation techniques

139 H_1 : There are differences in farmers ranking of awareness creation techniques

140

141 The Friedman statistic is computed using equation 1.

$$142 \quad M = \frac{12}{nk(k+1)} \sum R_j^2 - 3n(k+1) \quad (1)$$

143 Where k = number of awareness creation techniques

144 n = number of farmers

145 R_j = sum of the ranks for the j^{th} awareness creation technique

146 A decision was reached by comparing the computed statistic, M , with a critical value
147 obtained from the chi-squared (χ^2) distribution table with $k-1$ degrees of freedom.
148 Analysis of the rankings was done for both the combined dataset and the zonally
149 disaggregated data.

150

151 **2.3.3 Factors that Influence Farmers' Decision to Patronize ISFM Video Shows**

152 In modeling the socio-economic factors that are likely to influence farmers' decision to
153 patronize ISFM video shows, the study employed the logit model. This is because a farmer

faces a binary choice, to either patronize the ISFM video show or otherwise. Following from (15), the probability of a farmer patronizing the ISFM video show can be expressed mathematically as;

$$Y_i^* = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_i X_i + U_i \quad (2)$$

Where Y_i^* is a latent variable depicting the decision by the i^{th} farmer to patronize the ISFM video show. U_i is a random error term with a normal distribution. The coefficients β_0 and β_i are a vector of parameter estimates.

The study however considered the marginal estimates of the model for discussion. Its ability to provide the magnitude of change is an advantage that the marginal effect has over coefficient estimate. If a farmer patronizes the video show, then $P_i = 1$ and this transforms equation (2) into $Y_i^* = \ln\left(\frac{1}{0}\right)$. Alternatively, if a farmer does not patronize the show, then

$$P_i = 0 \text{ and this transforms equation (2) into } Y_i^* = \ln\left(\frac{0}{1}\right).$$

The model was estimated through the maximum likelihood method while enabling the robust standard error command. Empirically, the logit model is stated as follows;

$$Y = \beta_0 + \beta_1 \text{Age} + \beta_2 \text{Sex} + \beta_3 \text{HHSize} + \beta_4 \text{Educ} + \beta_5 \text{Area} + \beta_6 \text{FBO} + \beta_7 \text{Ext} \quad (3)$$

A description of the explanatory variables is presented in appendix 6.

3. RESULTS AND DISCUSSION

3.1 Examination of Different Awareness Creation Techniques

3.1.1 On-Farm Demonstration

Majority of the farmers interviewed received information on ISFM technologies through on-farm demonstrations. About 59% and 78% of farmers in the Dagbon and Gonja zones respectively, reported participating in on-farm demonstrations. Establishment of on-farm demonstrations by the AVCMP (improved rice management, improved soybean management, importance of certified seed, effects of fertilizer and inoculant under different management, ISFM for upland rice, effects of urea super granule on productivity and nitrogen use efficiency of rice, and ISFM for maize) and other development projects could account for the popularity of on-farm demonstrations in the study area. CSIR-SARI's efforts at strengthening its out-station in East Gonja coupled with AVCMP's successful establishment of a farmer learning centre, could explain the high patronage of on-farm demonstrations by farmers in the zone. The decision on the type of demonstration to host is jointly determined by the host Farmer Based Organization (FBO), Extension Service and Research (or a project). The demonstrations were implemented by farmers with technical and logistical backstopping from research and extension. On-farm demonstrations are practical (hands-on), participatory (interactive) in nature and can be utilized by other farmers in a 5 kilometre radius. Its main drawbacks are that it is seasonal, not easy (in terms of resources) to replicate in every community and only a few technologies can be demonstrated at a time.

3.1.2 Radio

Radio may be referred to as the internet of Africa (16). It provides a platform for sending and receiving information. AVCMP has an alliance with 4 FM broadcasting radio stations (Radio Savannah at Tamale, Radio Kitawoln at Saboba, Bishara FM at Tamale and Simli Radio at Dalun). These stations are partnered to broadcast at least one hour agricultural program a week, between 6:30 and 9:00 pm. There are however, several other radio stations in Northern Region that air agricultural programs either in collaboration with a project or as part of their corporate social responsibilities. Besides supporting its partner stations with resource personnel (from Research and Extension), the AVCMP organizes periodic field visits for the stations to gather feedback from their listeners. About a quarter (26%) of farmers in the Gonja zone listened to agricultural programs on radio and about 82% of the respondents in the Dagbon zone tuned in to agricultural programs on radio. The high quality of radio signals, coupled with predominant use of 'Dagbanli' (the local dialect in the Dagbon zone) for agricultural programs could be accounting for the popularity of radio within the area. An advantage of radio is its ability to create awareness on different themes in different languages within a relatively short period. It is perhaps the quickest way of creating awareness. Limitations of radio include its reliance on technology by both the station and its listenership; farmers have to rely on their imaginative powers since it is only audio and farmers have to be attentive since items and concepts may not be repeated.

3.1.3 On-Stage Drama

Dissemination of agricultural technologies through on-stage drama does not seem to be very popular in the study area. However, recording on-stage drama and playing it on radio appears to have been used in the past to disseminate agricultural information. The AVCMP reported supporting the staging of many more dramas in the Dagbon zone as compared to the Gonja area, hence it is not surprising that many more farmers in the Dagbon zone (13%) reported witnessing on-stage drama relative to the Gonja zone (5%). Stage drama is capable of drawing large crowd since it is performed free of charge. It is also able to connect better with farmers in their local dialects. The demerits of this method however include logistical challenges in moving crew members from one point to another as well as the challenge of dramatizing technical concepts. In addition, controlling members of the audience poses huge challenge.

3.1.4 Video

Even though video screening, as an awareness creation method for agricultural technologies may not be a novelty, adaptation of the motor tricycle for that purpose is an innovation. About 21% and 28% of farmers in the Gonja and Dagbon zones respectively, reported receiving agricultural information through video shows. Video shows make learning fun; it is audio-visual and the videos can be paused or replayed at the behest of the farmers. Use of motor tricycles makes it possible for ISFM videos to be screened in difficult terrains where electricity is lacking and the road network is poor. Farmers do not pay before viewing the ISFM videos. According to (17) one advantage of video show is its ability to overcome distortions associated with information ownership since community members are able to receive the same information at the same time. Involvement of the agricultural extension service in screening of the videos appears to be minimal. According to (18), even though the use of videos does not require face-to-face presentation by skilled trainers, it has the power of generating discussions (peer learning) among farmers after the show. The interactions could continue into several months in Ghana because of the country's stronger social capital (19).

3.2 Farmers Ranking of Different Awareness Creation Techniques

Application of the Friedman test to the dataset (combined or disaggregated into zones) indicates that there are differences in farmers' ranking of the four awareness creation

techniques (Table 1). The chi square values were significant at each level of analysis. On-farm demonstration was unanimously ranked by the respondents as their most preferred method of receiving agricultural information. In addition to obtaining practical knowledge on ISFM technologies, farmers who host on-farm demonstrations receive input support. They also retain the harvest from the demonstration plots. Farmers may therefore prefer on-farm demonstrations because they get to hear, see, feel and taste the effects of technologies being demonstrated. On-stage drama and radio were ranked as the least preferred methods of receiving information on ISFM technologies in Dagbon and Gonja land respectively. This confirms the findings of (20) who reported that radio and public meetings were ranked as the least preferred means of receiving agricultural technologies by smallholder farmers in western Kenya. Signals of most radio stations (located in Tamale) were reported to be either weak or absent in some parts of Gonja land. The low ranking of radio could also be because it is not visual. Some farmers in Gonja land also complained that the time allocated for agricultural programs (usually 1 hour) was inadequate thereby limiting interactions during phone-in segments.

Most farmers in Dagbon were of the opinion that the entertainment value of on-stage dramas tend to outweigh their ISFM dissemination value. It appears that ISFM concepts are difficult to dramatize orally without using many graphics. Another drawback of on-stage drama is its tendency to attract untargeted individuals such as children, traders among others. These individuals do not only crowd out the targeted farmers but also make so much noise that the cast may not be heard. In addition, on-stage dramas tend to provide little opportunity for farmers to seek clarifications on unclear concepts and terms. Video shows seem to be a source of entertainment and knowledge hence farmers are able to relax and learn in the evening after a hard days' work. The respondents ranked video show as their third most preferred method of receiving information on ISFM technologies. Unlike on-farm demonstrations for example, where selection to participate may be biased, any farmer can practically attend a video show (17). In terms of both present and future preference for means of receiving agricultural information, farmers in Pakistan expressed divergent views by ranking radio ahead of video shows (21).

Table 1: Farmers Ranking of Different Awareness Creation Techniques

Awareness Creation Technique	Mean Rank		
	Dagbon	Gonja Land	Overall
Demonstrations	1.47	1.52	1.49
Radio	2.64	3.00	2.79
Video	2.88	2.95	2.81
On-stage drama	3.00	2.54	2.91
Test statistics			
N	190	132	322
Chi-Square	168.983	118.966	271.207
df	3	3	3
Asymp. Sig	0.000	0.000	0.000

3.3 Cost Analyses of the Different ISFM Creation Techniques

Analysis of the awareness creation methods in terms of generation cost, number of beneficiaries reached and per unit cost is presented in Table 2. In the observation of (8), cost-effective techniques are necessary to ensure widespread adoption of agricultural technologies. Establishment and maintenance of on-farm demonstration was found to be the most expensive method for ISFM technology dissemination. The cost of inputs and services, supervision and field days for 100 on-farm demonstrations was found to be GH¢125,000. Usually, the host FBO provides land and labour as contributions for the on-farm demonstrations. Expenditure lines for radio broadcast include quarterly allowances (airtime was free due to a memorandum of understanding), review meetings as well as material support. The cost for 150 radio broadcasts was found to be GH¢26,000. An amount of GH¢22,050 was spent to produce, film and screen ISFM videos in farming communities, with crew members often hosted (for a night) after a show at the community. Likewise, the cost of producing and performing on-stage drama (contracted to a drama troupe) in eight strategic locations was found to be GH¢1,488.

Available data suggests that video screening, as an awareness creation technique is capable of drawing large crowd, hence reaching the largest number of farmers in a given period. The study revealed that 20,306 farmers patronized the ISFM video shows in 2013. In central Benin, (22) and (17) reported that video shows were able to reach three times more the number of women processors reached through conventional training workshops. Even though radio is expected to reach a large number of farmers, it was estimated that only 20,000 farmers were effectively reached through radio broadcasts in 2013. A total of 4,019 farmers (mostly members of FBOs) participated in field day activities or hosted on-farm demonstrations. About 2,467 farmers also witnessed at least one drama staged to illustrate ISFM technologies. The dramas were mostly planned to coincide with market days in order to improve on patronage.

The use of video and on-farm demonstration was found to be the least and most expensive strategies for disseminating ISFM technologies to farmers. Whereas it cost about GH¢1.0 to screen an ISFM video to a farmer, it costs about thirty times more to achieve the same result using an on-farm demonstration. Meanwhile, (23) suggests that demonstration is the most cost-effective extension dissemination method relative to farm visit, group meeting, field day, workshop, seminar and tour. The findings of this study is consistent with (19) who noted that videos are a low cost interactive training methods well suited for disseminating technical information to farmers with low levels of literacy. It has also been reported (8) that per unit cost of employing electronic media as a dissemination strategy is lower than the use of field days and farmer field schools.

Table 2: Per Unit Cost Analysis of Different Awareness Creation Techniques for 2013

Awareness Program	Total Cost (GH¢*)	No. of Beneficiaries (GH¢)	Per Unit Cost
Video show using motor tricycle	22,050	20,306	1.09
Radio programs	26,000	20,000 ^a	1.30
On-stage drama	14,880	2,467	6.03
On-farm demonstrations	125,000	4,019	31.10

^aThe data is a conservative estimate

*1US\$ = 2.1GH¢

3.4 Socio-economic Characteristics of Respondents

Demographic statistics of the farmers sampled are presented in Table 3. The proportion of males (72.8%) who patronized ISFM video shows was significantly higher than the proportion of males (64.3%) who did not patronize the show. It appears that males have more freedom to embark on night-outs (when these shows are often screened) relative to their female counterparts, reinforcing the wide held perception of male dominance in the study area. Besides promoting ISFM technology in the communities, video shows serve as source of entertainment especially for men. It also creates the opportunity for farmers to meet and interact. The female farmers may not necessary value this opportunity since it is common for them to meet and interact while performing chores such as fetching firewood, water and gathering of wild fruits (*Butyrospermum parkii* and *Parkia biglobosa*).

The level of education was found to be generally low across the sample. Farmers who had some formal education (17.4%) but did not patronize the ISFM videos were significantly higher than their counterparts (12.3%) who patronized the shows. It is estimated (13) that about 16% of the people in Northern Region can read and write in English. This however did not affect the shows in any way since the videos were recorded in the local dialect. A contrary argument is that educated farmers may already be familiar with videos and projectors hence they may not be too eager to see ISFM video shows, which leaves the uneducated group as the main patrons. Moreover, educated farmers may be able to read and understand ISFM concepts from print material and as well understand radio programs aired in English.

About 59% (63%) of farmers who patronized (did not patronize) the ISFM video show belonged to a farmer based organisation (FBO). In terms of numbers, there is no significant difference between farmers who viewed the ISFM videos and their colleagues who did not. FBOs are usually the point of contact for the video crew members in the communities. Furthermore, FBOs act as hosts for ISFM demonstrations and are mostly the target for participatory learning and action research on ISFM. Farmers who had access to research or extension services and patronized the shows (46.9%) were not significantly different from their colleagues who did not patronize (77.6%).

The mean age of farmers who patronized the ISFM video shows is 37 years, which is significantly lower than their colleagues who did not patronize (39 years) the show. It is popularly believed that technology appeals more to younger people as compared to the elderly. Moreover, responsibilities tend to increase with age. These factors may have an effect on the decision by the elderly to patronize the shows or otherwise.

On the average, the household size of farmers who viewed the ISFM video (15 members) was significantly larger than those who did not watch (10 members). According to (13), households in the Northern Region are generally larger than the national average, which can be attributed to polygamy, high fertility and commonness of the extended family system in the area. Farmers from larger households may be more willing to seek new technologies (which could potentially improve their output) due to the number of people that have to be fed. Members of a large household may have different preference for receiving agricultural information including the use of video show.

On average, the respondents cultivate less than 3 hectares of land. They seem to be generally homogenous in nature, producing mostly on subsistence basis. This characteristic of the respondents is in conformity with findings of (24) who reported that about 90% of farmers in Ghana are smallholders.

370 **Table 3: Descriptive Statistics of Respondents**

Variable	Patronized Video Shows	Did not Patronize Video Shows
	Percent	
Male	72.8***	64.3***
Received formal education	12.3***	17.4***
Member of FBO	59.3	63.1
Have working relationship with research or extension	46.9	77.6
	Mean	
Age	36.7*	39.3*
Household size	14.6***	10.3***
Area under cultivation	2.6	2.3

371 * and *** denotes P < 0.1 and P < 0.01 respectively

372

373 **3.5 Factors Influencing Farmer's Decision to Patronize ISFM Video Shows**

374 In modeling the factors that are likely to influence farmer's decision to patronize ISFM video
 375 show, application of the logit model to the dataset is justified considering the level of
 376 statistical significance of the log pseudo likelihood as presented in Table 4.

377 **Table 4: Marginal Effects of the Logit Model**

Variable	Marginal Effect	Standard Error	P > Z
Age	-0.0055**	0.0023	0.017
Sex	0.0896*	0.0518	0.084
Household size	0.0155***	0.0033	0.000
Received formal education	-0.0491	0.0611	0.421
Area under cultivation	0.0029	0.0116	0.797
Member of FBO	0.0092	0.0446	0.836
Have working relationship with research or extension	-0.2034***	0.0395	0.000
Number of observations		322	
Wald chi ² (8)		37.48	
Prob > chi ²		0.000	
Pseudo R ²		0.1551	
Log pseudo likelihood		-153.44221	

378 *, ** and *** denotes P < 0.1, 0.05 and 0.01 respectively

379

380 The parameter estimates of the model are presented in appendix 7. Overall, age, sex,
 381 household size and existing working relationship with research/extension are the factors
 382 estimated to have an influence on decision to patronize ISFM video shows.

383 The likelihood of patronizing the shows decreases marginally as a farmer ages. Since the
384 shows are mostly screened in the evenings, it appears that young farmers (often more
385 adventurous) are more likely to attend, as compared to the elderly ones. Indeed, they (youth)
386 in some instances do not have difficulty travelling to neighbouring communities to watch
387 these shows. In addition, youthful farmers tend to be more innovative and technologically
388 inclined; they may therefore be enthusiastic about such shows as compared to elderly
389 farmers who may prefer to listen to radio and other traditional means of receiving extension
390 information. These shows also provide excellent opportunities for interaction and bonding
391 especially after the programme. Younger farmers may therefore take the opportunity to
392 socialize. In recent times, the youth in most farming communities in the study area pay to
393 watch screened football matches as a source of entertainment. Such farmers are therefore
394 more likely to patronize ISFM videos that can provide them with knowledge in addition to
395 entertainment at no cost. In central Benin, a study revealed that age was not a significant
396 determinant of women's decision to patronize video shows (17). However, (4) reported a
397 significant inverse relationship between age and level of awareness of improved pigeon pea
398 in Kenya.

399 The probability of farmers attending an ISFM video show increases by about 9% if they are
400 males. In terms of inheritance and socio-cultural practices, the people of Northern Region
401 are patrilineal. Hence, men play leading roles and are usually given preference in many
402 situations. For instance, females are more likely to remain in the house if a situation
403 demands one parent to do so. Furthermore, opinion leaders or executives of farmer-based
404 organisations who are often contacted for agricultural programmes are usually men who in
405 most cases work to promote their course and maintain the status quo. The finding of this
406 study contradicts (4) who observed that females in Kenya are more likely to be exposed to
407 improved pigeon peas.

408 There is an increased tendency for farmers to patronize ISFM video shows as their
409 household size increases by one. It appears that the level of social networking increases as
410 household size increase hence the larger the household size, the higher the possibility of a
411 member being informed about impending shows both within and outside of their
412 communities. Moreover, a large household is more likely to have members with diverse
413 interests hence the likelihood of at least a member being interested in an ISFM video show.
414 Further, farmers who have large household sizes are usually wealthy and influential people
415 and may therefore be consulted or even nominated by opinion leaders to host the ISFM
416 video show. A study by (17) however did not find any relationship between number of
417 dependents in a household and women's decision to patronize video shows in central Benin.
418 According to (4), household size did not significantly influence farmer's awareness of
419 improved pigeon peas.

420 The likelihood of a farmer patronizing an ISFM video show decreased by 20% if the farmer
421 has a working relationship with either research or extension service provider. Having access
422 to agricultural extension may suggest that farmers have prior knowledge of the technology or
423 may have even adopted it already, hence their decreased tendency to show in interest in the
424 video shows. In other words, farmers who had access to ISFM technologies through
425 practical training and on-farm demonstrations may not be motivated to watch ISFM videos
426 again.

427 **4. CONCLUSION**

428
429 Although access to production technologies is a critical step in the adoption process, the role
430 of awareness creation cannot be underestimated. Farmers who are aware of a particular
431 production technology are more likely to adopt it as compared to those who are not aware of

it. Awareness can be created using interpersonal, group and mass communication methods with each method having some advantages and disadvantages. Video shows can be classified as a mass communication method. The CSIR-SARI in partnership with Countrywise Communication Ghana under the auspices of the AVCMP purchased a motor tricycle and modified it to house an audiovisual equipment and generator that is being used to screen ISFM shows in remote/rural communities without electricity. In 2013 for instance, 20,306 farmers in sixty communities in ten districts in the Northern Region benefitted from this innovation. On-farm demonstration is the most preferred method in the study area. On-stage drama and radio broadcasts are the least preferred methods of receiving information on ISFM technologies in 'Dagbon' and 'Gonja' Land respectively. Video show was ranked as the third most preferred method of receiving information on ISFM technologies. Use of video and on-farm demonstrations was found to be the least and most expensive methods of disseminating ISFM technologies to farmers. Whereas it costs GH¢1.0 to screen an ISFM video to a farmer, it costs thirty times more to achieve similar results using on-farm demonstration. Overall, sex, household size, access to extension and age are the factors that influence farmer's decision to patronize ISFM video shows.

The study recommends that agricultural technology interventions should either employ on-farm demonstrations or video shows when constrained to adopt only a single approach. Projects that are cash constrained should opt for video shows and possibly adopt the motor tricycle video vans to reduce cost. For maximum impact, female farmers, members of small households and elderly farmers should be targeted. Future studies should focus on the effectiveness of different awareness creation techniques including their interactive effects.

COMPETING INTERESTS

The authors do not have any competing interest.

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574 ABBREVIATIONS

575	AGRA	Alliance for a Green Revolution in Africa
576	AVCMP	Agricultural Value Chain Mentorship Project
577	CSIR	Council for Scientific and Industrial Research
578	DANIDA	Danish International Development Agency
579	FBO	Farmer Based Organisation
580	FM	Frequency Modulation
581	GAABIC	Ghana Agricultural Associations Business Information Centre
582	IFDC	International Fertilizer Development Centre
583	ISFM	Integrated Soil Fertility Management
584	LCD	Liquid-Crystal Display
585	SARI	Savanna Agricultural Research Institute

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587 APPENDIX

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590 **Appendix 1: A Motor Tricycle being used for Human Transport**

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593 **Appendix 2: A Motor Tricycle modified for ISFM Video Show**

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602 **Appendix 3: ISFM Video Screening in a Community**

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605 **Appendix 6: Description of the Explanatory Variables used in the Logit Model**
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Variable	Description	Unit of Measurement
Age	Age of farmer	Years
Sex	Sex of farmer	Dummy: 1 = Male, 0 = Otherwise
HHSIZE	Household size	Number
Educ	Received formal education	Dummy: 1 = Yes, 0 = Otherwise
Area	Area under cultivation	Hectares
FBO	Member of FBO	Dummy: 1 = Yes, 0 = Otherwise
Ext	Have working relationship with research or extension	Dummy: 1 = Yes, 0 = Otherwise

607 **Appendix 7: Parameter Estimates of the Logit Model**
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Variable	Coefficient	Robust Standard Error	P > Z
Age	-0.0354**	0.0152	0.020
Sex	0.5803*	0.3389	0.087
Household size	0.1002***	0.0244	0.000
Received formal education	-0.3183	0.3934	0.418
Area under cultivation	0.0193	0.0749	0.797
Member of FBO	0.0597	0.2887	0.836
Have working relationship with research or extension	-1.3179***	0.2969	0.000
Constant	-0.5738	0.6909	0.406
Number of observations		322	
Wald chi ² (8)		37.48	

Prob > chi ²	0.000
Pseudo R ²	0.1551
Log pseudo likelihood	-153.44221

*, ** and *** denotes P < 0.1, 0.05 and 0.01 respectively