



## FOOD SCIENCE & TECHNOLOGY | RESEARCH ARTICLE

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# Empowering farmers to learn and innovate through integration of video-mediated and face-to-face extension approaches: The case of rice farmers in Uganda

Gabriel Karubanga<sup>1</sup>, Paul Kibwika<sup>1\*</sup>, Florent Okry<sup>2,3</sup> and Haroon Sseguya<sup>4</sup>

**Abstract:** Agricultural extension is perceived as the primary mechanism through which farmers expand their ability to adopt and adapt new technologies and ideas. The use of Information and Communication Technology like videos in extension is being fronted as an alternative to the conventional Face-to-face extension approach (F2FEA). A comparison of effectiveness of the Video-mediated extension approach (VMEA) and F2FEA among rice farmers in two districts of Uganda challenges the independent use of the two approaches. A cross-sectional survey of two non-equivalent groups subjected to VMEA in Kamwenge and F2FEA in Hoima districts was conducted with 196 farmers. The results indicate greater potential for integration of VMEA and F2FEA as the two are complementary in the various stages of the farmer learning framework developed. VMEA is significantly better in awareness

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### PUBLIC INTEREST STATEMENT

Failures of extension systems is not only a matter of the design and resource investment. It is also about how well the tools and methods fit the context and more especially in as far as they are able to influence life-long learning among farmers. Numerous assessments of extension systems have notably omitted analyzing how well the tools and methods are applied and how these are anchored in sound theory and practices of learning for change. There is seemingly excitement among extension professionals and development actors that the advancement and availability of Information and Communication Technologies (ICTs) will greatly enhance farmer access to agricultural knowledge and technologies and hence accelerate their transformation. This study unravels video as a potential ICT for integration in extension to enhance extension delivery if applied and adapted to the social learning among farmers to foster innovation. The outcomes of this study have relevance for practitioners, educators who train extension agents and policy makers.

creation and sharing of knowledge and experiences while the F2FEA is significantly better at enhancing knowledge acquisition and retention and application. The relative strengths of VMEA and F2FEA can best be harnessed through integration of the approaches. The integration will not solve the problem of large farmer to extension ratio common in developing countries but will rather make the extension workers more effective. The integration however calls for rethinking of institutional arrangement, roles of the extension worker, and pragmatic retooling of the extension worker to embrace social learning principles that empower farmers to be more self-directed learners and innovators.

**Subjects: Food Science & Technology; Communication Studies; Development Studies**

**Keywords: video-mediated extension approach; face-to-face extension approach; farmer learning; innovation; rice production practices and technologies; Uganda**

### 1. Introduction

Face-to-Face Extension Approaches (F2FEA) targeting individual farmers and farmer groups are the most dominant in Uganda (Cai & Abbott, 2013) and in many other African countries. This could be attributed to reasons such as high levels of illiteracy of the farmers and inadequate alternative communication infrastructure development to influence extension service delivery. Among the common extension approaches are Farmer Field Schools (FFS) and Training and Visit (T&V) (Cai & Abbott, 2013; Waddington et al., 2014). These approaches aim at providing first-hand information and advice tailored to the peculiar circumstances and needs of farmers. However, they are expensive in terms of human resource and facilitation needed to reach the many and often widely distributed smallholder farmers. In Uganda, for example, the extension worker to farmer ratio is estimated at 1:3189 (Danielsen, Karubanga, & Mulema, 2015), making the face-to-face contact between extension worker and farmers nearly impossible (Chepkoech, 2015).

Even the recent Uganda National Agricultural Advisory Services (NAADS) program founded under the strategy to modernize agriculture did not explore alternative approaches for advisory services delivery different from F2FEA. With 72% of the working population engaged in agriculture (Uganda Bureau of Statistics, 2015), effectiveness of extension is strategic to achieve the national food security and general economy (Ministry of Agriculture Animal Industry and Fisheries, 2010). Farmer access to quality of extension services however remains a cardinal challenge. The high cost associated with face-to-face extension constrain effective delivery of the service to the farmers leading to limited access to agricultural information on improved technologies and practices (Chowdhury, Van Mele, & Hauser, 2009; Food and Agriculture Organization [FAO], 2014).

FAO (2014) further indicates that only about 18% of smallholder farmers in Uganda access information through conventional extension. Communication channels such as televisions (TVs), radios, videos and telephones can greatly enhance access to information and stimulate learning among farmers (Bentley, Van Mele, Zoundji, & Guindo, 2014; Cai & Abbott, 2013; FAO 2014) but these are not adequately integrated in the service delivery system. The high farmer to extension worker ratio calls for more innovative ways of delivering extension services effectively to reach large numbers of smallholder farmers. Alternative approaches to extension service delivery not only need to take advantage of the increasingly available Information and Communication Technologies (ICTs) but also emphasize the social interactions among farmers that lead to learning for change, that is, social learning (Cai & Abbott, 2013). The challenge however is how to integrate these ICTs in the conventional extension approaches given the diversity of socio-cultural contexts and infrastructural development challenges prevalent in many Sub-Saharan Africa countries.

In particular, a Video-Mediated Extension Approach (VMEA) is believed to foster learning by enhancing knowledge sharing among smallholder farmers (Van Mele, Wanvoeke, & Zossou, 2010).

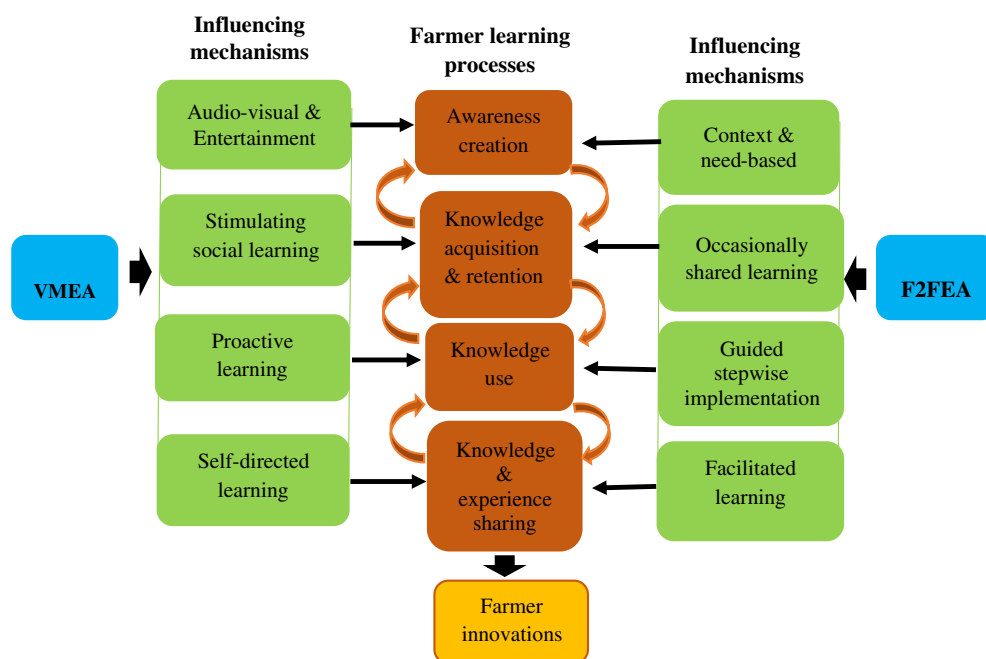
Videos are appealing to audio and visual senses (Bentley, Van Mele, Okry, & Zossou, 2014; MacGregor, 2007) and stimulates joint reflection as farmers discuss what has been observed in the video (Cai & Abbott, 2013). The video therefore has a high potential to complement the F2FEA and increase efficiency in terms of influencing learning and innovation among farmers as well as widening coverage in a cost effective way. VMEA has been experimented by a non-governmental organization in Uganda. Sasakawa Global 2000 (SG 2000) is promoting learning about new innovations among rice farmers in Kamwenge district, while the same practices are promoted by Hoima District Farmers Association (HoDFA) using F2FEA in Hoima district. The contents of VMEA and F2FEA used in all locations were similar, the only difference was in the extension approach used. Different from SG 2000, HoDFA placed conditions for the targeted farmers. The farmer had to have at least one acre of rice, had to be a subscribed member of HoDFA and committed to participation in training. This paper presents the comparative strengths of the VMEA and F2FEA. Cai and Abbott (2013) noted areas of complementarity especially with regard to awareness creation, knowledge acquisition and retention and fostering knowledge and experience sharing. Therefore, this study intended to determine the effectiveness and advantages of integrating video in extension to enhance innovation among rice farmers.

### 1.1. Conceptual framework

The core element of any extension approach is to influence farmer learning in such a way that positive changes are realized in practices and application of technologies. The farmer learning processes involve awareness; knowledge acquisition and retention; knowledge evaluation; knowledge use through experimentation and adaptation; and sharing of experiences including newly generated knowledge (Cai & Abbott, 2013). While farmers’ needs are the organizing principle for content being delivered by extension (Bentley, Chowdhury, & David, 2015), the approach used should aim at triggering these processes. Farmer innovations result from learning processes triggered by mechanisms embedded in the extension approach (Cai & Abbott, 2013; Zossou, Van Mele, Vodouhe, & Wanvoeke, 2010). In this regard, the effectiveness of an extension approach is dependent on the extent to which it influences the different stages of the learning process. Figure 1 presents a framework used for comparing the VMEA and F2FEA extension approaches.

A unique feature of videos is the entertainment element which attracts many people (including non-farmers) to be exposed to the knowledge and information contained in the video. The video is a powerful tool in creating awareness whether the people who attend will need to use the information

**Figure 1. Fostering farmer learning to enhance innovation through VMEA and F2FEA.**





or not. Videos also stimulate discussions among viewers leading to acquisition and co-generation of knowledge thus enhancing memory (Bandura, 1997). This indicates the power of video to trigger proactive learning among farmers. Proactive learning here refers to a situation where farmers take the initiative and explore ways of learning whatever they wish to learn in an interactive manner. This kind of engagement is situated in social learning concept based on exchanges and co-influencing each other to co-create knowledge and experiences. Videos allow for farmer-driven interactions known as self-directed learning, which is important in enhancing farmer learning processes (Chepkoech, 2015; Van Mele, 2011). When learners have control over their learning they tend to exhibit more engagement, a key attribute of video-mediated extension.

The F2FEA, on the other hand, involves a step-wise organization and delivery of information with inherent opportunity for individual farmer monitoring and technical backstopping. This is different from VMEA where the farmers themselves who may occasionally seek for technical support depending on perceived need to drive the learning triggered by the video. The individual monitoring and follow-up is a strong element of the F2FEA (Cai & Abbott, 2013), however, the knowledge sharing guided and facilitated by the extension worker limits the social learning process (Chepkoech, 2015). Though sometimes the knowledge delivered in F2FEA is based on the needs of farmers, it is largely determined by the extension worker.

Conceptually, VMEA and F2FEA if applied in combination can enhance innovation (Cai & Abbott, 2013; Chepkoech, 2015; Shanthy & Thiagarajan, 2011). The two approaches influence farmers to innovate in complementary ways. While VMEA has a comparative advantage of creating awareness through audio-visual power to stimulates social learning, F2FEA is better suited for context-based needs and individual follow-up with technical support. If self-directed learning stimulated by VMEA is complemented by good facilitation by the extension worker, the results will be even greater. Figure 1 above provides the framework for discussing the potential complementarity of VMEA and F2FEA in the context of SG 2000 and HoDFA in Kamwenge and Hoima districts respectively.

## 2. Methodology

A cross-sectional survey of two non-equivalent groups preceded by focus group discussions were conducted in Mahyoro sub-county, Kamwenge district and Buhimba sub-county, Hoima district to assess the effectiveness of VMEA and F2FEA respectively with regards to access to information and learning among rice farmers. The survey was followed by home visits of selected farmers who participated in the two approaches to observe and verify the application of what was learnt in the farm context. Eight villages where VMEA was implemented in Kamwenge district and the same number of villages where F2FEA was applied in Hoima district were purposively selected for the study. The approaches were implemented under the umbrella of farmer organizations; Mahyoro Rice Farmers Association (MARFA) in Kamwenge district and Katweyambe Farmers' Cooperative Society (KAFACOS) in Hoima district.

The study was conducted in three phases. The first phase involved conducting 12 focus group discussions (FGDs); six in each of the study districts with 96 farmers participating in the FGDs. With guidance from the chairpersons of the farmers' associations, farmers with at least 15 years of experience in rice production were selected for the FGDs. The FGDs served to gain insights on the influence of VMEA and F2FEA with regard to learning and use of new practices and technologies in rice production. Specifically, the focus was on awareness creation; acquisition and retention; application and sharing of rice related knowledge. The insights gained from the FGDs were used in the formulation of a survey instrument used to quantify how the farmers were impacted by the two approaches.

The second phase of the study was a survey involving 196 farmers from the two districts. All farmers who participated in the VMEA in Kamwenge district and F2FEA in Hoima district were identified and involved in the study. One hundred farmers (71 males and 29 females) were involved for VMEA

and 96 (61 males and 39 females) were for F2FEA. Effectiveness of the two approaches at various stages in the learning process were measured as follows:

- Awareness creation was measured by the new practices and technologies that farmers were exposed to through VMEA and F2FEA. Farmers indicated how many new practices and technologies they were aware of as a result of exposure to video shows and face-to-face trainings. However, the authors are aware that VMEA and F2FEA could have enabled more awareness of even the practices and technologies the farmers knew before.
- Knowledge acquisition and retention was measured by the details on relevance and application of the specific practices and technologies communicated through VMEA and F2FEA. The difference between the two approaches was an indicator of the knowledge acquired and retained.
- Knowledge use was measured by the number of new practices and technologies farmers applied after watching the video or attending the face-to-face trainings. What farmers were able to apply indicates the proportion of knowledge put into use in relation to what they learnt from the video or face-to-face trainings.
- Knowledge sharing was measured by farmers' confessions on sharing what was learnt in video or face-to-face trainings with other farmers before and after application.

The third phase involved conducting eleven home/field visits (six in Kamwenge district and five in Hoima district) to observe the practices and technologies implemented by farmers and the context in which they were applied. The farmers visited were identified by the researchers during the FGDs. Farmers who expressed outstanding knowledge and practices were preferred for the home visits.

Qualitative data generated through FGDs and field observations were analyzed using content analysis to extract related information on the major themes of the study. The survey data were analyzed using the Statistical Package for Social Scientists (SPSS) version 18.0. Descriptive statistics and inferential statistics such as independent samples t-tests (for awareness creation, knowledge acquisition and retention and knowledge use) and Chi-square (for knowledge and experience sharing) were used to compare the two groups studied.

### 3. Results and discussion

#### 3.1. Socio-demographic characteristics

Table 1 summarizes the profile of farmers who participated in VMEA and F2FEA.

The samples for both VMEA and F2FEA comprised of more males than females indicating that extension service is still skewed towards the men but also taking into account that rice is largely a commercial crop dominated by men. Most of the farmers who participated in the VMEA and F2FEA were in the middle age category of 31–50 years. It is however important to note that more youth (below 31 years) attended the VMEA compared to the F2FEA. This is possibly due to the entertainment element in the VMEA, which attracts the youth. The majority of farmers who attended VMEA travelled one kilometer or more to the venue of the video shows, while for the F2FEA, 72% travelled only less than one kilometre to the training venue. This illustrates the power of video in attracting farmers including those from far. The distance however coupled with the timing of the video can be a constraint to the female farmers because of their multiple gender responsibilities. Because the video was non-discriminative, the diversity of farmers in VMEA was greater in terms of membership to groups, distance from the point of action (video show or training venue) and age mix. This diversity is also very important in social learning as knowledge and experiences are generated and shared from a wider scope and across generations. Surprisingly, nearly all farmers (98%) who attended the VMEA had no other off-farm activities as compared to 74% in the F2FEA that were not engaged in off-farm activities. This is more of a characteristic of the two study districts rather than the extension approach used. Mahyoro where VMEA was experimented in Kamwenge district is surrounded by a national park and so had less off-farm opportunities compared to their counterparts in Hoima

**Table 1. Socio-demographic characteristics of farmers**

Variable	Type of approach	
	VMEA (n = 100)	F2FEA (n = 96)
	%	%
<i>Gender</i>		
Male	71	62
Female	29	38
<i>Age</i>		
Below 30 years	25	20
Between 31 and 50 years	54	52
Above 50 years	21	28
<i>Level of education</i>		
No formal education	89	45
Formal education (not beyond primary)	11	55
<i>Distance to place of training or video show</i>		
<1 km	27	72
1–2 km	53	19
3–4 km	17	9
>4 km	3	0
<i>Major occupation of respondents</i>		
Farmer	98	74
Personal business	2	26
<i>Group membership</i>		
Yes	30	75
No	70	25
Land allocated to rice production (Acres)	1.5	1.9

district. Those who participated in the F2FEA, 26% did not consider farming to be their major occupation, the off-farm activities were more important to them. On average land area allocated to rice production for farmers who participated in VMEA and F2FEA were 1.5 and 1.9 acres respectively.

### 3.2. Effectiveness of VMEA and F2FEA

Table 2 shows the comparison between VMEA and F2FEA in fostering learning with regard to the 12 rice production practices and technologies promoted by both approaches. Because of the nature of data, a t-test is used to compare awareness creation, knowledge acquisition and retention and knowledge use for the two approaches. The other parameter (knowledge and experience sharing) is compared using the  $\chi^2$ .

**Table 2. Comparison by awareness creation, knowledge acquisition and retention, and knowledge use**

Attribute	Mean of practices		Comparison between VMEA and F2FEA		
	VMEA	F2FEA	t-test	Sig.	df
Awareness creation	6.63	5.44	2.802	0.006*	194
Knowledge acquisition & retention	8.51	7.61	1.819	0.071	194
Knowledge use	4.20	5.69	-3.586	0.000*	194

\*Significance level at  $p < 0.01$ .

### 3.2.1. Awareness creation

The difference in awareness creation about the practices and technologies was significant for the two approaches at 1% level of significance ( $t = 2.802$ ;  $p < 0.01$ ). The VMEA exhibited more awareness about the practices and technologies than the F2FEA, similar to what Cai and Abbott (2013) and Chepkoech (2015) reported. Ninety-five percent of the farmers who participated in VMEA attributed their awareness to some attributes of the videos such as clarity and attractiveness of images, and interest stimulated in an entertaining way. One of the farmers in Katanga village of Kamwenge district explained his experience as follows:

We were very attentive while watching the video because the images were clear and attractive. The demonstrations and explanations in the videos kept us interested and entertained as well. The farmers demonstrating in the videos made the messages clear, relevant and learning from a fellow farmer makes it interesting. (FGD, 23 August 2015)

In some situations, the F2FEA relies on facilitative skills of the extension worker (trainer) who may not be clear and humorous to enhance memory. Further, the content to be delivered is determined by the extension worker, though sometimes it may be based on the farmer needs still as established by the extension worker. Farmers served by F2FEA revealed that the trainings were more theoretical while farmers preferred to learn by engaging in real-life activities such as demonstrations. Sustaining interest throughout the learning process was difficult as some farmers felt bored even with some energizers to keep them alert.

A video even if not in the local language can easily be understood by people with no formal education because of the visual element. Farmers can see the practices and relate with what they do in their own situations. This explains why over 89% of the farmers most of whom had no formal education were aware of the new practices and technologies demonstrated in the videos as compared to 45% in the face-to-face trainings (Table 1 above). Mass publicity through posters and announcements in churches and other social events is adequate for VMEA, while for F2FEA, may in addition to those require individual contacts either through face-to-face or through telephones, which increases the cost of mobilization. From the theory of communication and extension methods, it is already known that mass media and emerging methods such as video play a better role in creating awareness whereas individual and/or group methods play a seemingly better role in subsequent stages (Bentley, Chowdhury, et al., 2015; Mozammel & Schechter, 2005). Our study findings further confirm this known fact. For example, in terms of creating awareness, the VMEA is more effective and yet cheaper in terms of mobilization compared to the F2FEA. In this respect, VMEA created more awareness even though videos in Kamwenge district were shown fewer times than the trainings in Hoima. Specifically, 19% of the farmers who participated in VMEA were aware of all the practices and technologies promoted after attending the video only once, and this increased to 49% when farmers attended the videos twice. To the contrary only 13% of the farmers were aware of all the practices and technologies promoted after attending the training once, and this increased to 25% after attending training the second time.

### 3.2.2. Knowledge acquisition and retention

As shown in Table 2, there was no significant difference in knowledge acquisition and retention between farmers who participated in VMEA and F2FEA approaches. Knowledge acquisition and retention are reinforced by interactions and technical backstopping after exposure. More than half of the farmers who participated in VMEA reported sharing of what they learnt with fellow farmers as compared to only 12% in the F2FEA. However, farmers who participated in the F2FEA were followed up or had more consultations with the extension worker (22%) than their counterparts in VMEA (12%). The mental models created through watching videos aids memory and retention but these models can be made even more concrete through technical backstopping by the extension worker. Thus, the reason why VMEA and F2FEA should be integrated to complement each other in order to cause technical change among farmers as affirmed by Zossou et al. (2010), Cai and Abbott (2013), and Chepkoech (2015).



### 3.2.3. Knowledge use

Irrespective of the type of approach that is used to train farmers, not all that is acquired and retained is applied. Application is the transferability of knowledge into real practice, which depends on confidence on knowledge acquired but also on several other contextual factors such as relevance, cost effectiveness and social compatibility. Table 2 also shows that farmers who participated in VMEA applied less of the acquired knowledge than those who participated in F2FEA ( $t = -3.586, p < 0.01$ ). This was possibly due to follow up of farmers (individually or in groups) in the F2FEA by extension worker to provide technical assistance for putting acquired knowledge into practice. In the VMEA, farmers relied more on exchange between themselves and less technical support from experts as a follow up mechanism. However, it is also possible that the F2FEA focused more on priority needs of the farmers as compared to the VMEA where farmers had no opportunity to determine the content of the videos. For example, 82% of farmers who participated in F2FEA were able to properly select and sort their seed prior to planting compared to only 50% who participated in VMEA. Therefore, the stronger social learning element in VMEA still requires guided technical backstopping to enable translating knowledge into practice. This challenges the thinking that use of ICTs could be an alternative to a number of extension workers. Rather the ICTs can greatly improve the effectiveness and efficiency of the extension workers through complementarity of tools and methods. The VMEA, however, triggered more innovativeness among farmers for example in the way they sorted seed. The way it was considered in the videos was perceived more tedious and instead farmers selected the best heads (panicles) which matured uniformly in the field before harvesting and reserved these for seed. The principle applied here was careful genetic selection based on phenotypes which preserves and improves the quality of seed used in the subsequent seasons.

The field days used as a follow-up method in VMEA enabled farmers to contextualize, adapt and repackage the knowledge including what was generated through their own experiences and shared with others through songs and drama in the local language. The field-days were attended by many other farmers including those who never watched the videos. The songs, drama and practices in the field-days represents modified knowledge adjusted to farmer realities. Recording these events on videos and other electronic formats allows wider dissemination through mass media such as community radios, which have become more accessible by farmers (also see Okry, Van Mele, & Houinsou, 2014).

### 3.2.4. Knowledge and experience sharing

There was association between the extension approach used and level of sharing knowledge among farmers ( $\chi^2 (1) = 9.265, p < 0.05$ ). A large proportion (86%) of farmers who participated in VMEA reported to have shared the knowledge they acquired and or generated through their own practice compared to 67% of those who participated in F2FEA. The audio-visual nature of video coupled with the entertainment element, triggers viewers to reflect, share, and inspire experimentation and innovation (MacGregor, 2007). This empowers the farmers to be self-directed learners who do not only apply knowledge acquired but also co-create knowledge and innovate. Expanding such learning alliances through networks of practitioners would be a major responsibility of the extension worker to facilitate scaling out (also see Chepkoech, 2015).

## 3.3. Comparative strengths of VMEA and F2FEA

VMEA and F2FEA are complementary approaches, which could be integrated for better efficiency of extension services delivery. Table 3 presents a summary comparison of the relative strengths of VMEA and F2FEA at the different stages of the farmer learning process as established in this study.

An analysis of comparison of relative strengths between VMEA and F2FEA in raising awareness, enhancing knowledge acquisition and retention, knowledge application and sharing of knowledge and experiences between farmers indicate that, the two approaches can work best in combination. Through video, farmers employ both seeing and hearing senses in order to learn better, which is often lacking in face-to-face training (Chepkoech, 2015; Zossou, Van Mele, Vodouhe, & Wanvoeke, 2009; Zossou et al., 2010). Because of the clear and attractive images coupled with demonstration

**Table 3. Summary comparison of relative strengths of VMEA and F2FEA**

Learning stage	VMEA	F2FEA
Awareness creation	<ul style="list-style-type: none"> <li>• The entertainment element attracts wider range of audience from a wider coverage</li> <li>• Arouses and sustains interest and curiosity throughout the process</li> <li>• Cheaper in terms of mobilization and outreach since one extension worker can reach many farmers at a time</li> </ul>	<ul style="list-style-type: none"> <li>• The content delivered is pre-determined and based on context and sometimes the farmer needs</li> <li>• If well-organized it is a good approach for targeting information to specific individuals or groups</li> </ul>
Knowledge acquisition and retention	<ul style="list-style-type: none"> <li>• Farmers learn from fellow farmers demonstrating in the video</li> <li>• Video enhances the memory of farmers because of the audio-visual images</li> </ul>	<ul style="list-style-type: none"> <li>• Localization of content to suit local context</li> <li>• Localization of language to enhance comprehension</li> <li>• Provides clear and specific information easy to acquire and retain</li> </ul>
Knowledge use	<ul style="list-style-type: none"> <li>• Stimulate and encourages proactive learning among farmers</li> <li>• Video fosters creativity through experimentation and adaption</li> <li>• Through creative means, video fosters repackaging of messages for common understanding before full application</li> <li>• Fosters demand driven technical backstopping</li> </ul>	<ul style="list-style-type: none"> <li>• Training is complemented with follow-ups for more technical support</li> <li>• Application of acquired knowledge is effective at individual farmer level</li> </ul>
Knowledge and experience sharing	<ul style="list-style-type: none"> <li>• Audio-visual nature of video elicits and triggers self-directed learning</li> <li>• It allows for experiential learning as farmers can see and relate what is being demonstrated in their own context</li> <li>• Through creative knowledge sharing mechanisms, video allows a wider sharing of information even beyond the scope</li> </ul>	<ul style="list-style-type: none"> <li>• Topic of discussion is pre-determined by extension worker for effective facilitated learning</li> <li>• It allows for immediate knowledge sharing as it is planned and well-guided by the extension workers</li> </ul>

of practices and technologies in the video, farmers' attention and curiosity are enhanced (Bentley, Van Mele, Harun-Ar-Rashid, & Krupnik, 2015) and if integrated with F2FEA would be more interesting and less boring (Bede Lauréano, 2016; Chepkoech, 2015). Even with the use of video, farmers are able to get better motivated to learn about new experiences from other farmers including those from foreign countries compared to F2FEA.

Overall, our findings suggest that video can effectively complement the F2FEA in Uganda especially in targeting marginalized resource poor farmers mobilized in groups particularly women, youth and those with relatively low prior knowledge about new practices and technologies. In general, use of video in extension enhances more awareness, stimulate demand for technical support, foster farmer-to-farmer learning and enhance innovativeness, and creativity among the farmers. Appropriate integration of the two approaches implies that ICT developers and policy makers need to acknowledge that the two approaches cannot produce a desired farmer learning to enhance innovation in isolation but complement each other to ensure more effective and self-directed learning

#### 4. Conclusion

A comparison of effectiveness of both the VMEA and F2FEA in fostering learning and innovation among rice farmers indicate that, on one hand, VMEA is more effective in arousing awareness and enhancing self-directed learning through fostering knowledge and experience sharing. The F2FEA, on the other hand, better supports knowledge application through a guided technical backstopping. This illustrates perfect complementarity in the farmer learning framework to foster innovations and adaptability to the myriad of challenges in farming practices exacerbated by climate change phenomenon. A social learning concept is central to the learning framework, empowering farmers to play a central role in their own learning and innovation but also drawing on external knowledge and practices to adapt to their own peculiar conditions and needs. Whereas VMEA and F2FEA are currently fronted and practiced as alternative approaches, they have greater potential for effectiveness and efficiency when integrated. On the contrary, the notion that ICTs can replace the human face (in this case, the extension worker) is rather misplaced as this study reinforces the critical importance of enough and competent extension workers than ever before. The diversity of enterprises of the smallholder farmers and increasing complexity of environmental, economic and social factors demand for more and competent extension workers. However, the roles of the extension workers may shift more towards facilitation of social learning processes and brokerage of knowledge, practices and technologies. Videos can make extension workers more effective but the extension workers will need to be more versatile in the use of videos including producing informative video clips and appropriately utilizing them in various aspects of their work. Appropriate institutional arrangements and technical capabilities will be essential for meaningful integration of VMEA and F2FEA towards a holistic and integrated extension service delivery system.

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#### Competing Interests

The authors declare no competing interests.

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#### Cover image

A child sits on a rake to provide weight for making furrows for planting rice in lines.

Source: Gabriel Karubanga.

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