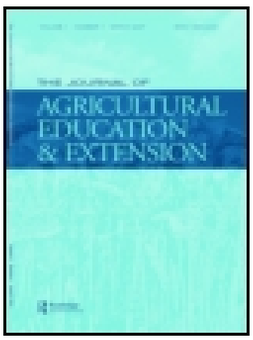

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RESEARCH PAPER

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Achieving scale of farmer reach with improved common bean technologies: the role of village-based advisors

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ABSTRACT

Purpose: We assessed the effectiveness of Village-based Advisors (VBAs) as a novel approach for scaling up improved common bean technologies in southern highlands of Tanzania.

Design/methodology/approach: Data were gathered through focus group discussions (FGDs) and interviews with 11 VBAs and 102 farmers (37% female). The effectiveness of VBAs was assessed based on farmer reach, farmer knowledge, and application of new technologies.

Findings: VBAs played important roles in reaching a wide audience of farmers, with common bean technologies. There was evidence of uptake of promoted common bean practices by farmers, enhanced by judicious incentives such as higher yields, increased land productivity, and labor-saving. VBAs shared information mainly through farm visits and community meetings. Extension materials facilitated VBA engagement of farmers even in informal settings, enhancing information flow beyond village boundaries. The current success of the VBA approach stems from the fact that VBAs are motivated by the rewards they receive – both cash and non-cash.

Practical implications: VBAs are relevant in scaling up improved common bean technologies in rural Tanzania and similar settings, because of farmer understanding and trust. For sustainability, there is need to develop a more systematic incentive structure for VBAs through business development, and knowledge enhancement to keep pace with innovations to address emerging production challenges.

Theoretical implications: Access to extension service providers who are knowledgeable of farmers' context enhances learning and uptake of innovations.

Originality/value: Results fill information gap on the effectiveness of VBAs as knowledge and input disseminators, achieving scale of farmer reach with agricultural innovations.

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Information transfer; input dissemination; social networks; scaling-up; voluntary

Introduction

The United Nations estimates that the world population will be roughly 10 billion by 2050 and more than half of global population growth is expected to occur in Africa. Meeting

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food requirements of this growing population means that world food production will need to rise by 70%, while in the developing world; food production will need to double. One of the suggested ways is sustainable agricultural intensification (SAI), a new paradigm for African agriculture to achieve a doubling in food production while sustaining the environment (The Montpellier Panel 2013). Improved legume technologies represent one of the most cost-effective and affordable approaches to achieve SAI. They have wider proven benefits including food and nutritional security, income for households and enhancing soil fertility. In Tanzania, legume cultivation is widespread, with over half of households growing at least one legume crop (Stahley et al. 2012). Common bean is the most important legume crop, with over 75% of farmers depending on it for daily subsistence (Xavery et al. 2006). However, in the last years, yields of common beans have declined (Linus, Lema, and Ndakidemi 2015), largely attributed to low uptake of improved technologies.

While proven and scalable legume practices already exist, the extent to which smallholder farmers can implement these new practices is limited by many factors, but primarily the lack of access to actionable information (Sones et al. 2015). Extension services in SSA remain weak or dysfunctional characterized by poor staffing, insufficient funds for supporting public extension, limited involvement of rural farmers in extension processes, and lack of appropriate extension methods. Besides, public extension systems have been criticized for taking a top-down approach and failing to adapt to meet the needs of smallholder farmers in an era of rapid marketization (Davidson and Ahmad 2003; WorldBank 2010). Evidence also shows that private extension systems have been just as ineffective as public extension institutions (Benard, Dulle, and Ngalapa 2014). This limits coverage of extension services, particularly across rural regions, and adapting technological packages to community-specific contexts (IFPRI–WorldBank 2010). In Tanzania, for example, the extension-farmer ratio is high reaching 1:2,307 in some districts (ASHC profile of Tanzania, 2012). This high ratio implies that some farmers are not reached at all by extension services. Hella (2013), shows that extension service providers reach only 10% of the farming households in Tanzania. Besides, extension service providers tend to focus on commercial and high-value crops, with less attention to traditional and other farmer-preferred food crops such as common bean.

In response to this challenge, there have been many innovations in extension approaches to reach farmers that aim to strike a balance between the intensity of interaction and reach. Among the common extension approaches are; Farmer Field Schools (FFS), demonstrations, and Training and Visit (T&V), which aim at providing information and advice tailored to peculiar circumstances and needs of farmers (Cai and Abbott 2013). However, these approaches are expensive in terms of human resource and facilitation needed to reach farmers, who are often widely distributed (FAO 2014). The use of village-based intermediaries to help disseminate information to farmers has taken center stage in many extension initiatives in developing countries (Lukuyu et al. 2012; Sones et al. 2015; Kiptot et al. 2016). This approach has the aim of reaching a large number of farmers in communities at low cost (Noordin et al. 2001) and is especially considered more effective when combined with group-based extension approaches that help reduce transaction costs (Kiptot and Franzel 2015). It is also considered more inclusive and offers a wide-reaching alternative in supporting agricultural innovation (Lukuyu et al. 2012; Wellard et al. 2013; Sones et al. 2015). Village-based intermediaries are farmers or other resource persons who live in the village and are trained to provide

assorted advice/services to farmers. Adaptations of the model have been made based on context and objectives e.g. farmer-to-farmer extension (Kiptot and Franzel 2015), community knowledge workers (Grameen 2013), village-based advisors (Priest 2012) or volunteer farmer-trainers (Lukuyu et al. 2012).

While benefits of village-based intermediaries or farmer-to-farmer extension approaches have been quantified in some studies, there is limited evidence of their effectiveness in achieving scale of farmer reach with new technologies, particularly for traditional food crops where cash incentives are low. Scaling up or reaching scale is defined by the International Institute of Rural Reconstruction (IIRR 2000) as bringing more quality benefits to more people over a wider geographical area, more equitably and more lastingly. Drawing lessons from the Africa Soil Health Consortium (ASHC) program, this study determines the effectiveness of village-based advisors (VBA) in scaling-up improved common bean technologies in the context of the southern highlands of Tanzania. More specifically, the study examines the following questions;

- To what extent did VBAs achieve scale of farmer reach with information on common beans and what approaches were used for information dissemination?
- How relevant was the VBA approach in reaching farmers with common bean technologies and inputs, and what were farmers' perceptions of the role of VBAs?
- Did information sharing by VBAs affect farmers' knowledge and uptake of new common bean technologies?

The VBA approach

The VBA approach used in this study is a model for village-based intermediaries, piloted by Farm Inputs Promotions Africa (FIPS) (http://fipsafrica.org). This approach is predicated on finding locally trusted farmers and turning them into self-employed micro-businesses supplying agro-inputs and information services to neighboring farming families. It's anticipated that as VBAs provide information to farmers, they also promote agricultural inputs providing them means of economic diversification. The VBA approach, therefore, focuses on building sustainable extension services and brokering linkages between input supply and demand.

Selection of VBAs is usually based on a set of criteria including; residence in the community, ability to communicate well, ability to work voluntarily, facilitate access to inputs, demonstrate practices, and participate in scheduled trainings. Community members participate in selecting the VBAs and mainly focus on those members who command respect and trust within the community beside the set selection criteria. VBAs promote improved varieties with good agronomic practices through farmer training, laying demonstration plots and holding field days. Every farmer in the VBA catchment gets to learn and try out promoted technologies through 'mother-baby' demonstrations. VBAs are not paid for their services, but as farmers buy small commercial packs from them, they take the retailers margin. Priest (2012) estimates an average return of USD60-125 per season depending on the technology being promoted. Selected VBAs receive prior training in good agricultural practices associated with the new varieties/technologies being promoted.

Methodology

Study design

We employed qualitative methods to assess the outcomes of the common bean campaign and the role of VBAs. Qualitative methods seek to provide an in-depth and interpreted understanding of people's social and material circumstances, experiences and perspectives (Ritchie and Lewis 2003). This approach is appropriate for this study to understand farmer learning and uptake of new technologies, given a multiplicity of socio-economic factors at the household and farm level. In this way, we can identify critical constraints and opportunities in the learning and technology adoption process. Qualitative data can confirm whether farmers' rationale for uptake and subsequent adoption is the same as scientists' rationale for proposing the technology, and, if not, why not. The qualitative data can also identify social and cultural constraints not readily identifiable, as Researchers may come from a different social class or even cultural background than rural householders. This provides useful feedback for researchers to modify technologies to make them more useful to farmers.

Description of intervention and study area

The ASHC common bean campaign was implemented in Mbeya region in the southern highlands of Tanzania. The southern highlands are characterized by undulating plains, dissected hills, and mountains lying between 1200–1500 meters above sea level. The soils are moderately fertile and volcanic in nature. Rainfall is bimodal delivering 1000–2000 mm per year during October–December and February–May. The southern highlands form the main growing areas for common beans in Tanzania, besides the north and the Great Lakes region.

The ASHC common bean campaign aimed to scale-up information, on proven improved technologies. The campaign was implemented during the second growing season (July–December 2015). Technical briefs were first developed in liaison with the Legume Alliance (stakeholders in legume research in Tanzania including government, NGOs, the private sector and academia), and key messages to farmers agreed. Messages focused on; the regeneration role of legumes in intercrops and rotations, production planning, seed selection, new varieties, agronomic practices (land preparation, sowing, weeding, fertilizer application, pest management), harvesting and post-harvest handling, and marketing. The messages were translated into Kiswahili, the language commonly spoken in Tanzania.

For information dissemination, ASHC project engaged 40 VBAs (one VBA per village) with a target of reaching 80–100 farmers each during the season. A typical village in rural Tanzania comprises on average 500 households, sometimes reaching as high as 1500 in some locations. Selected VBAs were trained on the common bean technologies to be disseminated and equipped with demonstration materials, which included 5–10 kg of seed of improved common bean varieties and a planting string (to demonstrate spacing at planting). The seed was packaged in 25 g small-packs to set up farmer learning plots and distribute to farmers for trialing. The promoted varieties were; 2004 *Maini*, *Uyole Wanja*, and *Kilimo Uyole*, all developed and officially registered in Tanzania. Besides the demonstration materials, VBAs were equipped with printed extension materials (ASHC

extension materials). The aim was to understand the value addition of these materials to the normal VBA operations and farmer learning. Four different sets of information materials ('treatments') were randomly provided to VBAs, with 10 VBAs receiving the same set of materials (or treatment). The materials contained similar information but differed in the level of detail. The four treatments were defined as follows;

- Seeds only (control group)
- Seeds, comics
- Seeds, agro-dealer posters, comics, manual, poster on varieties
- Seeds, agro-dealer posters, comics, manual, poster of varieties, summary cards, leaflets on pests and diseases

Comics included a 6-page story containing common bean production message targeted at youth audiences under the '*Maharage Bingwa*' storyline with the 'Hustla' (someone finding a way to make money, usually outside of formal employment) tagline. Agro-dealer posters were A2 size display posters covering common bean practices along the production cycle (Figure 1). Extension manual contained the same information as the agro-dealer poster, but detailed targeted at trainers. The materials were taken to the field, in time for the start of land preparation for planting. This assessment was undertaken in April 2016, just after the start of the first growing season (March–June). It was anticipated that farmers would translate any learning in the previous season into the current season, including trialing some of the promoted common bean practices/technologies.

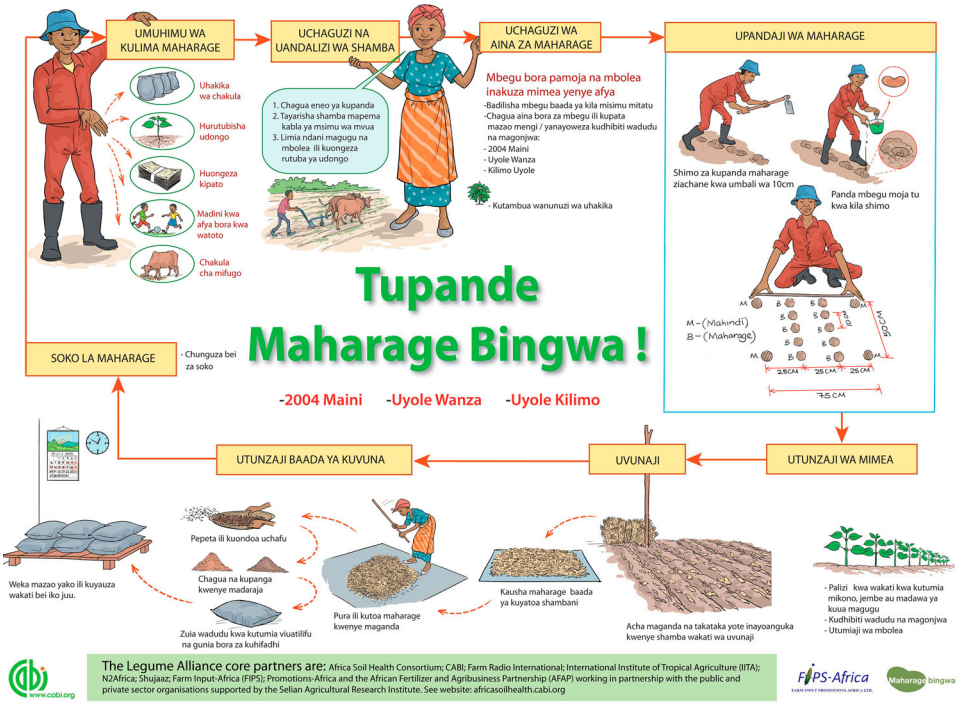

Figure 1. Copy of Agro-dealer poster (in Kiswahili).

Intervention logic and evaluation framework

The contribution of the campaign, in the long run, is increasing food and income security of households engaged in bean production. The campaign intervention logic is premised on the assumption that, access to information contributes to farmer learning process, and influences positive change in farming practices or application of technologies, positively impacting on yield (Figure 2). Cai and Abbott (2013) describe farmer learning process as involving awareness, knowledge acquisition and retention, knowledge evaluation, knowledge use and adaptation, and knowledge sharing. The effectiveness of any information dissemination or extension approach, therefore, is dependent on the extent to which it influences the different stages of the learning process as well as outcomes. Karubanga et al. (2016) assessed the effectiveness of video-mediated and face-to-face extension approaches amongst rice farmers in Uganda focusing on stages in the learning process. authors have used various methods to evaluate effectiveness of extension approaches in different countries. Hellin and Dixon (2008) looked at livelihood impacts to measure the effectiveness of the farmer-to-farmer extension model in the Andes. Amudavi et al. (2009) looked at farmers' knowledge of, and skills about the push-and-pull technology, diffusion, and uptake. Lukuyu et al. (2012) assessed the effectiveness of volunteer farmers in disseminating technologies in Kenya, by considering their technical (practical agricultural expertise and knowledge) and individual characteristics (honesty, interest, and willingness to work without expecting any reward). Kaufman and Keller (1994) framework for assessing effectiveness focuses on four dimensions; (i) learner satisfaction and relevance of training; (ii) participant knowledge, skills, and attitude; (iii) participant application of learning; and (iv) increase in productivity and efficiency.

For this study, we adapted the framework by Kaufman and Keller to assess the effectiveness of VBA approach. Given the duration of the intervention, we focused on the first three indicators, defining the learning process as opposed to the outcomes. We, therefore, based our assessment on; farmer reach and satisfaction with information; farmer

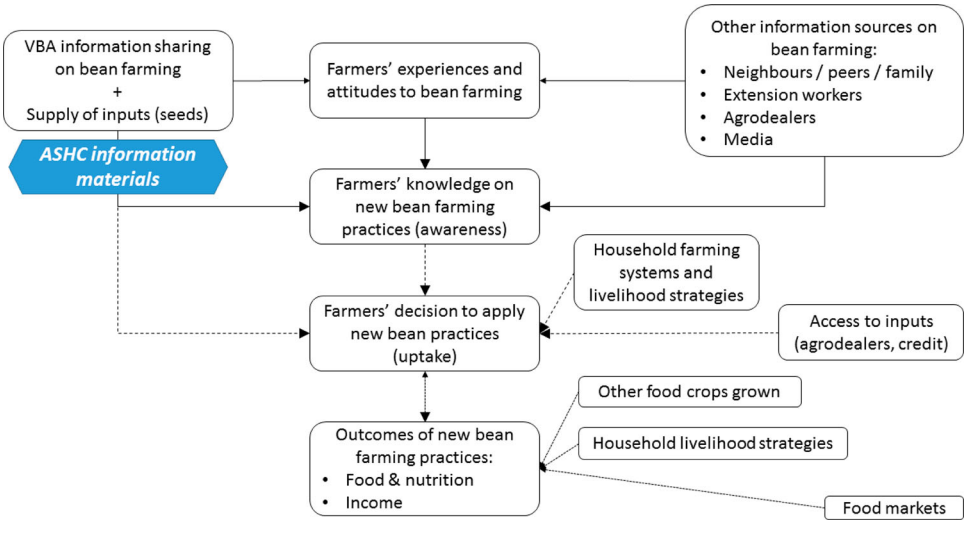

Figure 2. Impact pathway of information sharing by VBAs.

knowledge, and application of new common bean technologies/practices. We also assessed farmer perception with regard to the role of VBA and their potential to continue providing extension services to farmers. Considering that VBAs were equipped with different extension support materials, we also assessed the value addition of these materials in enhancing information delivery and farmer learning process.

Data collection and analysis

The basic tool employed for this study was the focus group discussion (FGD) with participating farmers, but allowing open discussions among participants. We used an interview guide, which covered issues about farmer knowledge and experience of common bean production practices; farmer perceptions of common bean technologies promoted; relevance and completeness of information provided by VBAs; farmers' perspective of the training provided by VBAs and frequency of interaction; and uptake on new common bean practices and their perceived attributes. During FGDs, we attempted to capture individual responses as well as group responses to reduce any bias that may be introduced as a result of a few vocal farmers talking on behalf of others. In total 11 FGDs were conducted comprising of an average of 8–12 representatives of farmers' groups (Table 1). Group size was based on empirical data regarding group size for FGDs (Krueger 2000). In addition to FGDs, we conducted individual interviews with 11 VBAs to further understand the information sharing process and feedback received (if any) from information users. We used a questionnaire with both closed- and open-ended questions. The questionnaire covered issues on; how farmers were reached, time spent and frequency; information passed on to farmers; usefulness of extension support materials; knowledge gaps and intervention required; and their perceptions of farmer learning and uptake of new practices. The sampled VBA locations were evenly distributed according to the four treatments, to allow as well capturing of any differences that may be attributed to access to extension materials.

We analyzed data from FGD using mixed method content analysis. First, we used Morgan's three-element coding framework (Onwuegbuzie et al. 2009) to create smaller

Table 1. FGDs conducted in Mbeya and number of participants.

				FGD participants	
No.	Village name	Ward	Treatment group[a]	Male	Female
1	Idugumbi	Ut'usongwe	4	6	10
2	Isangala	Isangala	3	2	4
3	Itambalila	Maendeleo	1	6	2
4	Izuo	Lyimapinduzi	2	6	4
5	Jojo	Santilya	2	6	1
6	Makwenje	Makwenje	3	5	3
7	Malowe	B/Songwe	1	5	4
8	Mapogoro	Mapogoro	3	11	1
9	Mjele	Njele	2	5	5
10	Mwaselela	Iwindi	4	3	3
11	Simboyo	Ikokoa	4	9	1
	Total			64	38

[a]Treatment group based on extension materials received by VBA: 1 = Seeds only (control group); 2 = Seed, comics; 3 = Seed, agro dealer posters, comics, manual, poster on varieties; 4 = Seed, agro dealer posters, comics, manual, poster of varieties, summary cards, leaflets on pests and diseases.

units of data/variables per question and placing a code based on whether; (i) each participant in the FGD used a given code, (ii) each group used a given code, or (iii) all instances of a given code. We counted the codes per variable, providing frequencies (quantitative information), and subsequently presented as graphs. We then provided a detailed description of each variable (qualitative information) based on group consensus, creating a mixed method content analysis. Consensus data from FGDs was useful in understanding the context of the community and wider understanding of the value of VBA, while individual data was useful in understanding the extent of farmer learning and practices attributed to VBA interventions. In presenting results, we also compared the various attributes across the treatment groups where applicable; to understand if there was value-added benefits from information materials.

Results

Farmer reach and approaches used by VBAs

Responses from VBAs showed that most of them covered a distance of about 10 km and engaged on average 282 farmers, reaching an estimated 11,000 farmers with common bean technologies during the season. During FGDs, all farmers acknowledged interacting with VBAs, though not all of them were reached the same way. Farmers mentioned up to 8 different ways in which information was passed on to them by VBAs. Verbal explanations were the most commonly used approach for information sharing by VBAs either through one-to-one with the farmers or through gatherings (91% of farmers), followed by printed materials – manuals (55%) and variety posters (45%) (Figure 3). Other approaches mentioned by farmers include; agro-dealer posters, comics, summary cards, leaflets and demonstration plots.

All VBAs (100%) indicated that they made contact with farmers mainly through farm visits (Figure 4) where they guided farmers on the implementation of some practical aspects of bean production such as seed input estimation, spacing, line planting and fertilizer application. Community meetings, farmers' inquiry from VBAs, interactions at marketplaces and social gatherings (e.g. drinking clubs, village development meetings, and co-operative loan group meetings) were also commonly used by VBAs to reach farmers. At least 27% of VBAs set up demonstration plots for communal learning,

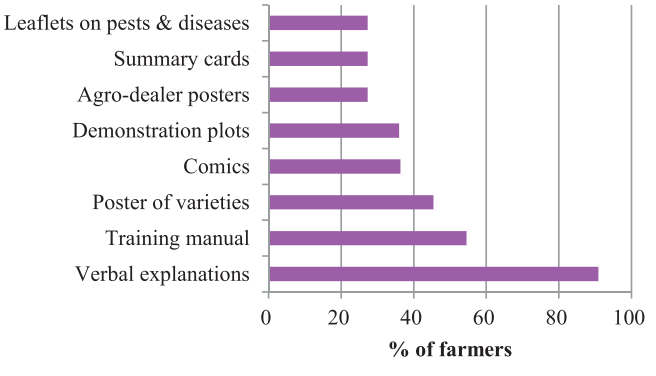

Figure 3. Different ways in which VBAs passed on information to farmers.

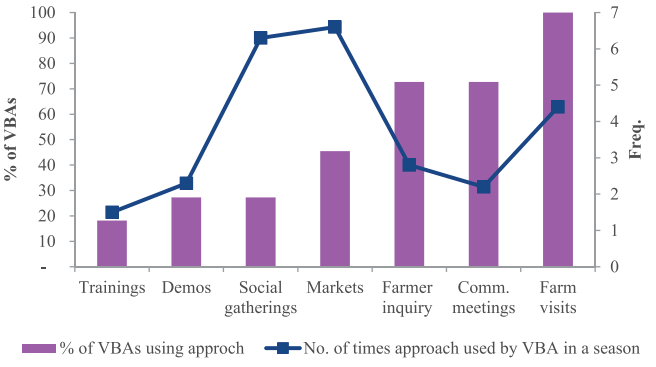

Figure 4. Avenues used by VBAs to contact farmers and pass on information.

while only 18% conducted formal training, primarily at their own farms. Formal training and farm practical sessions lasted up to an hour, while information sharing at informal sessions such as meetings and social gatherings took a maximum of 20 min. On average VBAs made 4.5 farm visits per farm household during the season (3 months). Informal engagements were the most frequently used by VBAs, up to 6 times during the growing season (see Figure 4).

We, however, noted differences in delivery approaches used by VBAs in different treatment groups. VBAs who had printed materials covered comparatively longer distances and reached more people, but used less interactive approaches such as meetings at the marketplace and social gatherings. VBAs that did not have printed materials used more of demonstrations and farmer visits, within their communities. While the VBA methodology encourages more farm-based engagements, the observed inclination to informal sessions by VBAs could be assumed that they tried out social-based information dissemination as an innovative approach to speed up information flow and reach more farmers within the short period of the campaign. It could also be due to the fact that they had been facilitated with printed information materials whose distribution necessitated going beyond the usual VBA coverage.

Information shared by VBAs

VBAs indicated that they provided training to farmers on common bean technologies, along the value chain. The most commonly mentioned topics by VBAs were; recommended bean spacing (45%), seed selection/seed varieties (45%), timely planting (27%), and pest and disease management (18%) (Figure 5). Further, VBAs included topics such as input estimation and importance of bean growing to further motivate farmers' entrepreneurial spirit and farm budgeting. Input planning was also intended to help farmers project their seasonal input needs to facilitate timely procurement and distribution by the VBAs. Farmers, on the other hand, indicated to have received from VBAs specific information on; sowing and spacing, fertilizer application, new bean varieties, and pest and disease management (see Figure 5). Other information farmers obtained from VBAs were on storage, land preparation, intercropping and field sanitation. The difference between what VBAs trained and what farmers were aware of may reflect the

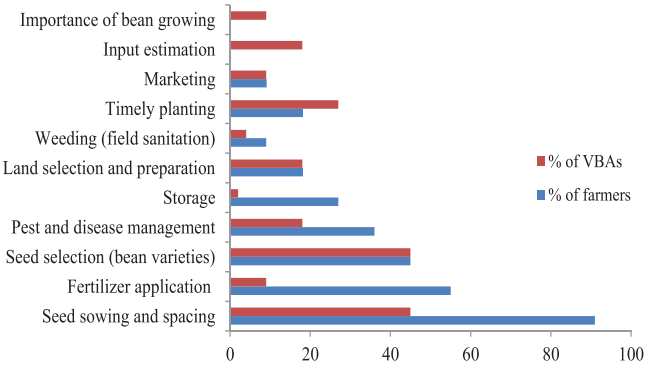

Figure 5. Information shared by VBAs vs what farmers reported as received from VBAs.

level of learning or what farmers considered important and/or novel to their farming process. For example, farmers indicated that the training received on line planting and bean spacing by VBAs were different from their common practice of sowing on mounds in a generic pattern. Similarly, the demonstrated use of spot fertilizer application using bottle tops and other locally available materials meant that farmers could optimize fertilizer application.

Across the treatment groups, farmers had similar knowledge and were aware of the same technologies. This implies that VBAs passed on similar information to trainees, irrespective of whether they had extra extension materials or not. This could be attributed to the quality of training VBAs received, which may be considered adequate with respect to common bean messages. Alternatively, it could be as a result of the noted obvious diffusion of information materials within the VBA network, especially variety posters. Also, considering that there was significant information sharing through social gatherings, it's possible that information could have reached farmers outside the designated village boundaries, or passed from farmer to farmer. This implies that information cannot be confined and social experiments are difficult to control; as long as farmers value information, they will share it even across long distances.

We further asked farmers their perception of the usefulness of information shared by VBAs, in terms of its value, applicability, completeness, and ease of understanding. There were divergent views about the usefulness of information shared by the VBAs (Table 2). Eighty percent (80%) of the farmers indicated that the information shared by VBAs was of high value. Farmers indicated that they received information from VBAs at the right time, before the commencement of the season which helped them apply some of the promoted practices to their seasonal planting. The seed trial packs added value as farmers were able to test the various varieties in combination with promoted practices for learning and decision making. In terms of delivery, farmers indicated that VBAs were knowledgeable, taught in an easy to understand way and used local language which they understand well. The extension materials added value as visual aids, and illustrations were clear for farmer learning. The extension manual, in particular, provided complete and well-illustrated information, covering the entire bean cropping cycle, providing a good reference on bean technologies and how to apply them. The variety poster was also well appreciated because the farmers could easily see the various varieties by shape and color. The planting

Table 2. Farmers perception of usefulness of information from VBAs and reasons.

Information usefulness	Yes (% of responses)	Reasons (yes)	Reasons (no)
Is information valuable (addresses farmers' problems, given at the right time)?	82	• Information received at the right time, before planting seasons commenced • Addressed timely planting, spacing and field crop management which are important aspects of common bean production • Different options for pests and diseases management provided	• Farmers need own copies of comic and manual for reference
Is information applicable (proposed practices accessible and easy to apply)?	91	• Easy estimation of spacing using planting string • Spot application of fertiliser using bottle tops doable, and helps rationalize application • Seed trial packs (50 gm) provided farmers opportunity to test new varieties on their farms • Proposed practices done on small plots with seed trial packs	• Seed varieties promoted not available in agro-dealer shops • Purchased inputs are too expensive for most farmers to afford
Is information complete (wide-ranging, addressing pertinent problems)?	73	• Information provided covered practices along the entire bean cropping cycle • Information included harvesting and marketing aspects	• Information did not address effective/safe pesticide use
Is information understandable (easy to comprehend even by the less literate farmers)?	82	• Information shared in local language and information materials translated • Use of visual aids and illustrations • VBAs used demonstration and undertook follow ups to ensure farmers understood the messages • Demonstration materials such as planting strings were simple and locally available	

string despite its simplicity, provided a practical guide on spacing, as opposed to farmers trying to memorize the spacing dimensions.

In terms of applicability, however, farmers noted that some of the promoted technologies were not easily accessible either due to the high cost associated with purchasing inputs such as fertilizer or due to erratic supply especially new seed varieties. Information gaps were also noted particularly on pest and disease management, where farmers would prefer more detail especially on application of pesticides.

Application of new common bean farming practices

Over 60% of farmers took up one of more promoted common bean practices (Figure 6). At least 64% of farmers applied recommended common bean spacing, while 18% used new seed varieties and pest management practices. Intercropping practices (beans and maize), fertilizer application and field management were minimally taken up (less than 10% of farmers).

Uptake of practices by farmers was premised on their perceived usefulness of practices, primarily, ease of field operations (including labor saving), increased land productivity and increased yield. Farmers mostly valued proper bean spacing, new seed varieties,

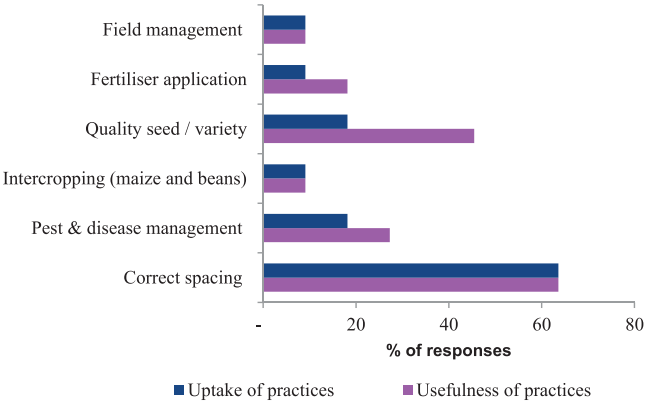

Figure 6. Farmers' uptake of trained practices compared to their perceive usefulness.

fertilizer application, and pests & disease management, which they related to better yields. As noted by one of the participants in an FGD in Itambalila village, Mbeya rural;

> '*With our traditional practice of broadcasting, I usually harvest 10 tins of beans per ½ acre. With the new practice of line planting and right spacing, I have been able to obtain 20 tins from the same sized piece of land*' said Piusi Saje, farmer, and resident of Itambalila.

In addition, appropriate spacing made farm operations much easier e.g. weeding, fertilizer application and spraying. Line planting also allowed farmers to intercrop with maize, which helped increase land productivity. Farmers also acknowledged that with line planting they used considerably less seed compared to their traditional practice of broadcasting. The observed direct relationship between the perceived (or actual) usefulness of the practices and the associated uptake by farmers, lends support to the fact that farmers are rational decision makers. Practices that have been proven to be more useful are likely to be taken up more by the farmers, contingent upon their own proof of effects and farmer access and/or ability. Across treatment groups, farmers tended to take up the same set of practices. This is not surprising since farmers received similar information and faced similar socio-economic realities. In a few instances, however, farmers were not able to take up some technologies owing to their high cost and unavailability as explained earlier, despite their perceived usefulness.

Farmers' perception of the role of VBAs

Farmers mentioned VBAs as the most common source of agricultural information. In fact, they mentioned VBAs as their primary source of information on common bean. On their own, farmers indicated that common beans are not considered very important crops and as such, government extension programs tend to focus on other crops such as maize, potatoes and cash crops (coffee and sunflower). As a consequence, farmers have always grown beans using their traditional approaches or relying on farmer-to-farmer information exchange. VBAs thus form a valuable source of information on common beans, introducing new varieties and practices that can help farmers to improve their yields.

Besides training, VBAs played other roles in their communities. They compiled input demand, especially seed, fertilizer, and pesticide and facilitated buying and distribution.

This helped them obtain some cash incentives through input sale. The only challenge VBAs faced was farmers' low purchasing power, and as such, this duty was not well executed, with just 27% of farmers accessing inputs through VBAs during the season. Farmers mainly purchased pesticides, fertilizers and other seed (mainly maize) from VBAs. Beside, seed availability was a challenge, not necessarily attributed to VBA/farmer failures but rather national supply systems as earlier indicated. Farmers indicated that seed availability is a long-term challenge for them. They explained that seed of desired varieties was not always available at the time of planting, exposing them to fake seed. The promoted varieties, in particular, were not available with local agro-dealers, meaning that farmers could not access them, thus farmers' reliance on own-saved seed. One of the FGD participants in Itambalila village, Mbeya rural had this feedback;

> '*I received 50 gm of Uyole Wanja bean seed (one of the bean varieties promoted through VBA). When I planted this seed, I harvested 4tins (each weighs about 1 kg). If it was our usual varieties, I would get less than a tin. I have kept the seed for next season planting since I am not sure to get this variety from the agro-dealers. I hope to get more seed and expand my garden with this variety because it is high yielding*' Hakimu Katilungwe, a resident of Itambalila village.

While VBAs primarily worked as volunteers, they also had strong non-cash incentives such as respect in the community, knowledge acquisition through training received, and networking with other VBAs or technical persons. VBAs were also usually the first beneficiaries of new technologies and inputs which helped them improve their farm production as well.

Discussion

This study has demonstrated that VBA approach can help achieve scale of information dissemination of common bean technologies, and consequently new production technologies to rural farming communities. VBAs were mentioned as the primary source of information for farmers in the study areas and a quick contact for farmers to access information. Some other studies also report similar results where farmers ranked fellow farmers as their most important, least expensive and reliable source of information (Kiptot and Franzel 2015; Drafor 2016). Village-based advisors' abilities to spread information and innovations may be due to their knowledge and location in the farming communities that make them potentially better to communicate with fellow farmers.

VBAs disseminated a range of information and practices on common bean production. Information disseminated by VBAs varied, with the majority focusing on spacing, varieties and timely planting. Some elements of training such as pest and disease management were not fully explored by the VBAs. The variation was irrespective of the treatment groups. This may be attributed to VBA knowledge, interest, or possibly because VBAs understood their farmers well enough to recommend only those practices they thought were practical and accessible. Hoffmann (2005) suggests varying interests and keenness of farmer trainers as the reason for the variation in technologies disseminated to farmers. Lukuyu et al. (2012) suggest that farmer trainers would normally disseminate simple technologies such as crop varieties compared to complex ones with higher risks such as crop protection, which alludes to the knowledge they have and their confidence to disseminate such information. Lamontagne-Godwin et al. (2017); Ragasa et al. (2013) on the other hand suggest

differences in cropping patterns, and anticipated farmers' ability to access the various technologies or recommended options as the reason for providing different recommendations by trainers. This implies that even with enhanced knowledge and information dissemination approaches, the type of advice given by trainers is largely conditioned by predicted availability, access, and affordability of recommended practices by farmers.

Interaction of farmers with VBAs showed positive effects on technology uptake. A large proportion of farmers (>60%) who interacted with VBAs took up one or more technologies. Technology uptake was motivated by expected yield increases, increased land productivity, and labor saving. However, the proportion of farmers taking up practices such as new seed varieties, fertilizer application, and disease management options was comparatively lower than the proportion that perceived these technologies to be useful. The expressed reasons by farmers and VBAs were; the high cost of inputs and unavailability especially at the time of planting. The noted lack of seed reflects not only a local challenge but general seed system failures especially with regard to traditional and non-cash crops, where formal seed sector has limited interest. This challenge may not have been anticipated at the time of the campaign. To alleviate this challenge, VBAs or farmers or farmer groups can be promoted as seed entrepreneurs, producing and marketing quality seed of farmer-preferred varieties, especially those not well integrated into the formal sector e.g. common bean. Currently, the Agricultural Seed Agency (ASA) in Tanzania undertakes this role, but gaps still exist in satisfying local demand, further justifying the need to support local seed production. This concept is consistent with current seed sector policies in Tanzania, and other policies on the development of small rural businesses that encourage long-term sustainability. Performance of various informal local seed supply initiatives has been documented showing positive results in achieving local seed supply (Bishaw and van Gastel 2008). Other initiatives around Africa have focused on developing integrated seed systems linking formal and informal sectors (Subedi et al. 2013).

This study also reveals that VBAs worked as volunteers. The approach anticipates that VBAs, besides training farmers, facilitate input dissemination where they get a financial reward. For this study, it's clear that VBAs did not gain much economically due to farmers' low input demand/low purchasing power. Interestingly, VBAs had other non-cash motivations such as respect from community members, gaining knowledge from training received and networking with other VBAs. However, for sustainability, several scholars have suggested the need for a more organized incentive structure for village-based trainers or volunteer farmers. Facilitating VBAs to start income-generating activities related to the technologies they are promoting may help enhance the economic benefits they receive for being farmer trainers (Lukuyu et al. 2012; Kiptot and Franzel 2015). One such suggested income generating activity is farmer seed entrepreneurship. This would achieve duo results – enhancing access to quality seed by farmers and developing cash incentives for VBAs to further engage as trainers. Other interventions such as business training for VBAs, formal linkages with input providers such as seed companies or agro-dealers and support for access to business credit can also help boost their income-generating activities at the same time addressing input accessibility issues.

Considerably, more VBAs who had printed extension materials distributed them at various social gatherings. It is possible that extension materials reached farmers outside

the designated village boundaries, or were passed from farmer to farmer or shared within the VBA networks, a plausible explanation why messages were not significantly different across treatment groups. This implies that information cannot be confined and social experiments are difficult to control; as long as farmers value information, they will share it even across long distances. This study cannot, therefore, conclude with confidence on the effect of information materials on learning, but confirms their value addition as reference materials, which ideally should contribute to the proper application of learned techniques.

Conclusion

This study has shown that VBA approach can help reach many farmers with new technologies within a short period of time. VBAs provided adequate information to farmers and greatly influenced farmers' to take up new technologies, albeit farmers decisions were also affected by other factors such as expected benefits or cost associated with the technology. VBAs gave similar information to farmers irrespective of extension support materials they had, an indication of the learning they had achieved. This also demonstrates that VBAs can deliver accurate information and hence facilitate effective uptake of technologies without distortions, a feat that is critical for technology and/or information transfer especially in an environment with a paucity of agricultural information providers as is the case in the study area. The added value of information materials, in this case, was the provision of visual guides for training and providing a quick reference for VBAs to address farmer questions and boosting message retention by farmers. This approach should be promoted by extension service providers such as government and NGOs to help achieve scale of information flow even to rural areas. However, the success of VBAs in contributing to improved agricultural information dissemination is dependent upon their sustainability. This requires developing an incentive structure based on business development principles and maintaining a knowledge base through re-training, and linkages to government extension agents and other good agriculture practice information generation hubs for technical backstopping. Further, equipping VBAs with demonstrative and easy to carry extension support materials such as was the planting string and printed materials, would also be helpful to ensure appropriate information dissemination to farmers. Developing viable VBA businesses especially in technologies they promote would also go a long way in ensuring sustainable access to technologies by farmers, as well as sustainability of the VBA approach.

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No potential conflict of interest was reported by the authors.

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