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Full Length Research Paper

Farmer field school and banana xanthomonas wilt management: A study of banana farmers in four villages in Siaya County, Kenya

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Banana xanthomonas wilt (BXW) is a primary constraint to smallholder banana production in East and Central Africa. Experiential learning through farmer field schools (FFS) can accelerate the diffusion of integrated pest management (IPM) technologies at community level, consequently rendering production systems more productive, profitable, and sustainable. This paper explores the importance of FFS in successful transfer of the four-pronged ABCC strategy (that is, Avoid disease introduction, Break male buds, Cut down diseased plants, and Clean tools) for effective BXW control in Siaya County in Kenya. About 83% FFS-participants had advanced capacity for BXW diagnosis and control it with the ABCC practices. FFS also contributed to the spillover of ABCC practices to non-participating households in the community. In a paradox, 7.2% FFS-participants disadopted various practices compared to 4.7% non-participants. A few households (21%) deployed the ABCC package in its entirety, whereas majority (79%) dismantled the package, and recreated more user-friendly options. Most widely used reconstituted packages were ABC (Avoid, Break male buds, and Clean tools) (69%), and BC (Break male bud and Clean tools) (74%). An explanation being that adoption decisions are sequential and ultimate choice to adopt being reached after realization of true benefits and costs of the technology. Farmers dismantled the ABCC package after discovering a lack-of-fit within the smallholder's context, defined by several farm level constraints. Dismantling the ABCC package allows farmers to create user-friendly practices, but also diminishes the prior anticipated impacts, which results in resurgence. Fine-tuning of these alternatives is necessary to ensure sustainable BXW management.

Key words: ABCC practices, banana xanthomonas wilt (BXW), farmer field school (FFS), Kenya, Siaya.

INTRODUCTION

Banana xanthomonas wilt (BXW) caused by the bacteria *Xanthomonas campestris* pv. *musacearum* is a primary constraint to smallholder banana production in the Great Lakes region of East and Central Africa (Tripathi et al., 2009). Economic losses of up to 100% mainly arise from plant death, premature ripening and rotting of marketable

banana fruits (Tushemereirwe et al., 2003; Smith et al., 2008). BXW is highly transmissible and spreads very fast through vectors, infected planting materials, and cutting tools (Thwaites et al., 2000; Buregyeya et al., 2008; Shehabu et al., 2010). However, there is no natural source of resistance to the disease among cultivated banana cultivars (Eden-Green, 2004; Ssekiwoko et al., 2006).

A major challenge during the early years of the BXW epidemic was specifying a single control practice as a conclusive remedy. A first line of action was to engage local, national, and regional actors to establish communities of practice for knowledge generation (Karamura et al., 2008). Due to similarities in disease transmission and symptom expression with other banana bacterial wilts, a four-pronged strategy (ABCC) was quickly rolled-out to empower smallholders to avoid disease introduction into new areas (A), break the male buds with forked stick (B), cut down and rouge all diseased plants (C), and routinely clean contaminated tools (C) (Karamura et al., 2006; Tinzaara et al., 2009). Subsequently, through rigorous awareness creation and community-mobilization, the epidemic was finally halted in Uganda, ushering in the recovery of affected banana farms (Kubiriba et al., 2012).

Apparently, sustainable BXW management has largely remained elusive in many countries in the region, despite mass sensitization of smallholders. Numerous local challenges influence farm-level BXW control (Jogo et al., 2011; Tinzaara et al., 2013; Ochola et al., 2014). Many studies have reiterated the importance of tailoring the ABCC practices within the context of smallholders (Blomme et al., 2014; Ochola et al., 2014). Recent evidence reveals that in the absence of this, farmers dismantled the ABCC package and reconstituted its practices into more user-friendly alternatives (Ochola et al., 2014; Jogo et al., 2011). Moreover, dismantling of the ABCC package interferes with complementarities embedded within cultural practices, which subsequently results in disease resurgence on farms, where it had previously been controlled (Ochola et al., 2014). Unfortunately, traditional extension approaches rarely deliver farmer-desired information in an integrated manner that has immediate tangible benefits (Scarborough et al., 1997). There is a heightened need for multidimensional approaches that prioritize farmers' subjective preferences.

Farmer field school (FFS) is among the most popular adult education approaches worldwide (Braun and Duveskog, 2008). Although the methodology emerged in response to the adverse consequences of modern, industrial era rice farming in Asia (Kenmore, 1996), it can address more than immediate social, human health and environmental problems at community level (Pontius et al., 2002). It is synonymous to a school without walls originating from the informal setting through which experiential group learning takes place. Guided by a year-round curriculum, participants learn how to analyze their production systems, identify constraints, and evaluate possible solutions that are tailored to their highly diverse farming conditions. Consequently, the diffusion of useful innovations is accelerated at community level, which renders production systems more productive, profitable, and sustainable (Davis et al., 2010). As a result of its impressive success, several non-Governmental organizations (NGOs), government agencies, and even private industry have mainstreamed FFS into their development agenda, to encourage participatory technology development and dissemination. Over time, FFS was reshaped into a packaged course, with variations reflecting priorities and contexts of competing forces involved in knowledge production (Schut, 2006; Paredes, 2001; Borja, 2004).

FFS approach was introduced in Kenya in 1995 on a pilot basis under Food and Agricultural Organization (FAO) Special Programme on Food Production (SPFP) in collaboration with Ministry of Agriculture (MoA) and Kenya Agricultural Research Institute (KARI). To date, some of the implemented FFS projects in Kenya included: (i) integrated production and pest management (IPPM), (ii) integrated nutrient management to attain sustainable productivity increases in East African farming systems (INMASP), (iii) farmer innovation and new technology options for food production, income generation and combating desertification (PFI-FFS). A key to effective control of BXW is community mobilization. However, there is limited information on the potential of FFS in catalyzing integrated BXW management among smallholder farmers in Kenya. A superlative advantage of FFS in mobilizing community-action for BXW control was reported in Uganda (Kubiriba et al., 2012). Albeit, there is need to understand the diverse smallholder contexts that are likely to diminish the realization of similar impacts on effective BXW control in Kenya. This paper features the initial case in which the FFS approach was deployed to operationalize the transfer and adoption of ABCC practices by famers in four villages of Sidindi, Sigomere, Lunjre, and Ugunja of Siaya County. Herein, the extent to which FFS has improved the adoption of ABCC practices for BXW control was explored, and whether there are any identifiable spillover effects on non-FFS participating households.

MATERIALS AND METHODS

Source of data

Data of 120 households presented in this paper were adapted from

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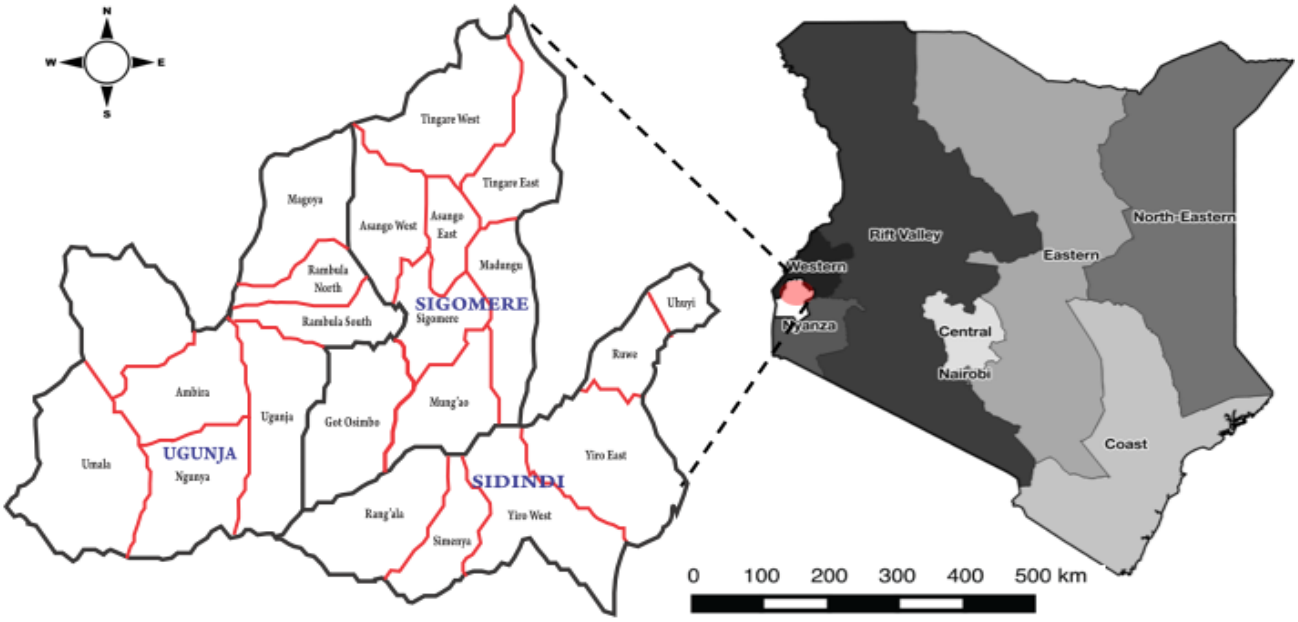

Figure 1. Map showing the surveyed areas: Sidindi, Sigomere, Lunjre and Ugunja.

the survey of small-scale banana farming households in Sidindi, Sigomere, Lunjre, and Ugunja (Ochola et al., 2014) (Figure 1). Bioversity International designed the structured questionnaire used, while the Rural Energy and Food Security Organization (REFSO) and KARI implemented the household survey. The choice of the participants was based on household head membership of FFS that aims at mitigating livelihood risks associated with BXW. In the absence of the household head, any other member of the household familiar with banana production was interviewed. FFS households (n = 38) and non-FFS households (n = 82) were further disaggregated into three categories to elucidate spillovers, that is, (a) FFS households in FFS sites (FFS-FFSS) (n = 38), (b) non-FFS households in FFS sites (NFFS-FFSS) (n = 37), and (c) non-FFS households in non-FFS sites (NFFS-NFFSS) (n = 45).

Empirical model

The empirical model discussed by Gedikoglu and McCann (2009) was adapted in this study. Accordingly, farmers' decision to disadopt an ABCC practice can be represented by the stochastic BXW prevalence framework. Disease prevalence after disadoption of a practice is compared with the prevalence from continuing to use the practice. It is assumed that the farmer disadopts the practice if the disease prevalence from abandoning the practice is greater than that of continuing to use the practice. In contrast, the farmer is most likely to retain a practice if the disease prevalence from abandoning the practice is less or equal to the disease prevalence from continuing to use the practice.

Disease prevalence function π (.) is assumed to be the function of years in farming (YFARM); FFSM, a dummy variable that equals to 1 if the household head belongs to an FFS; AWARE, a dummy variable that equals to 1 if the household head recognizes the threat of BXW to banana production; DIAG, a dummy variable that equals to 1 if the household head can identify BXW symptoms; ABCCP, a dummy variable that equals to 1 if the household head deployed ABCC practices prior to 2012; ABCCN, a dummy variable that equals to 1 if the household head discontinued certain ABCC practices in 2012. It is also assumed that disease prevalence has a random factor ε, which is assumed to have a normal distribution. Disease prevalence function π (.) can be represented as:

π (YFARM, FFSM, AWARE, DIAG, ABCCP, ABCCN, ε)

If πD represents the disease prevalence from disadopting a practice and πND represents the disease prevalence from retaining the practice, then the decision whether to disadopt a practice or not can be represented as:

$yi = 1$ (Farmer disadopts the practice) if $\pi D > \pi ND$

$yi = 0$ (Farmer retains the practice) if $\pi D \leq \pi ND$

For econometric analysis, the hazard function for the current study can be represented by the equation (Wooldridge, 2001):

$$\lambda(t,x) = \lim_{t \to 0} \frac{Pr[t \leq T + \Delta t | T \geq t, x]}{\Delta t}$$

which gives the probability that the length of time a farmer uses a practice T will be between t and t+Δt, given that it is greater or equal to t. The explanatory variables, such as YFARM, FFSM, AWARE, DIAG, ABCCP and ABCCN are included in the vector x. The estimation is done using the maximum likelihood procedure.

Data analysis

Descriptive and comparative statistics (that is, means, percentages and cross-tabulations) were used to show the differences among households. The Pearson's product moment correlation coefficient (chi-square test) was used to test for variations between FFS-FFSS, NFFS-FFSS and NFFS-NFFSS. Stepwise regression is a semi-automated process of building a model by successively adding

Table 1. Comparison of household characteristics across sites.

Characteristic		Non-FFS in non-FFS Site (N=45)	Non-FFS in FFS site (N=37)	FFS located in FFS site (N=38)	All (N=120)	P-values equality of means
Sex	Male	28	22	22	72	0.92
	Female	17	15	16	48	
Age (years)		51.8	55.0	54.7	53.8	0.46
Education (years)		9.7	8.7	9.5	9.3	0.44
Living in area (years)		35.9	40.0	40.9	38.9	0.42
Banana (years)		10.8	5.4	7.3	7.8	0.04**
Household size		5.0	7.1	6.1	6.1	0.02**
Dependence rate		1.1	2.4	1.8	1.8	0.04**
Total land acreage (ha)		1.5	1.5	1.4	1.5	0.84
Arable area (ha)		1.1	1.1	1.1	1.1	0.97
Banana area (ha)		0.13	0.21	0.20	0.18	0.29
Livestock (TLU)		2.53	4.32	3.04	3.3	0.01**

*, **, ***Significance at the 10, 5 and 1% levels, respectively.

or removing variables based solely on the t-statistics of their estimated coefficients. It was used to interactively explore the adoption predictors that provide a good fit. All statistical analyses where conducted in SPSS v22 and STATA v13 for Macintosh. Graphs were developed in Microsoft Excel.

RESULTS

Comparison of household characteristics

Table 1 shows the characteristics of households from FFS and non-FFS sites, including demographic characteristics and basic assets. The mean age of the household heads were 53 years. They have between five and six members in the household. Majority had completed eight years of primary education, had over seven years growing banana on approximately 0.2 hectares and who owned 3.3 Tropical Livestock Units (TLU). Comparison of sites with FFS and without FFS revealed significant ($p<0.01$) equality of means for the years of growing banana, household size, dependence rate, and livestock ownership.

Differences in awareness and diagnostic capacity between sites

Figure 2a and 2b highlights the extent of farmer awareness of the associated risks of BXW on banana production in Ugunja Division. About 95% of the surveyed households acknowledged the disease as a major threat to their banana production. Comparison of BXW awareness between sites revealed significant ($p<0.05$) disparity in between NFFS-NFFSS (89%) and FFSS (100%) (Figure 2a). The capacity of households to diagnose the disease was highly significantly different ($p<0.01$) between sites (Figure 2b). In general, FFS-FFSS had greater (83.3%) competency to recognize multiple disease symptoms as compared to NFFS-FFSS (69.3%) and NFFS-NFFSS (37.4%). A two-fold difference between NFFS-FFSS and NFFS-NFFSS suggests that close proximity to FFS in the community exerts a significant spillover effect on the diagnostic capacity of non-participating households. Notably, about 16% NFFS-NFFSS were not fully conversant in the identification of BXW symptoms in their fields.

BXW information sources

There are many sources of agricultural information to which farmers have access to, and there are varying degrees of smallholder farmer preference how they prefer to access information in the study sites (Figure 3a and b). About 47.2% households acknowledged friends and neighbors as the primary source of information (Figure 3a). Dependence on mutual relationships for BXW information was highest (78%) among NFFS NFFSS (Figure 3b). Results show that households across all sites seldom accessed agricultural information through newspapers (NWP), radio (RAD) and television (TV) (Figure 3a and b). Although the intended beneficiaries of FFS disseminated information are the participants, there is a likelihood of spillovers to non-participants in close proximity of the FFS sites (Figure 2b). Evidence also indicates that FFS presence in the community contributes towards the strengthening of linkages with research (RES) and extension services (EXT).

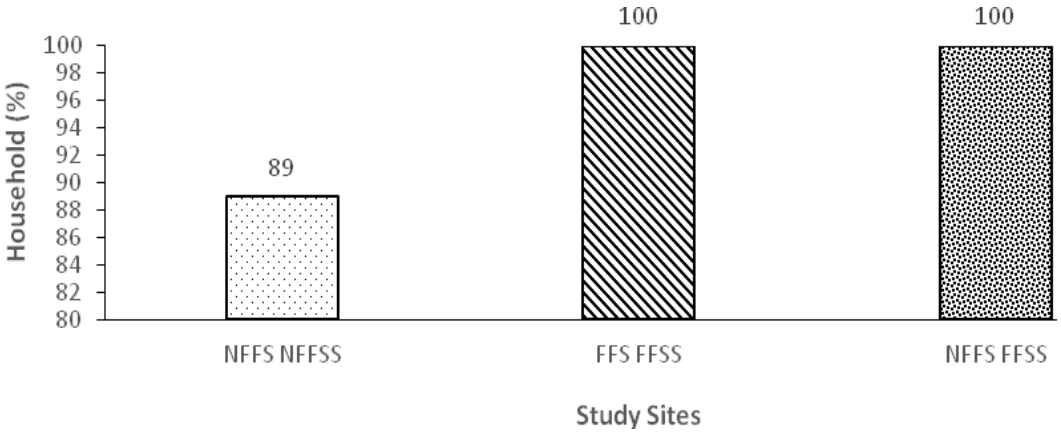

Figure 2a. Percentage of households aware of BXW across sites. NFFS-NFFSS, Non-FFS participant located in non-FFS site; FFS-FFSS, FFS participant located in FFS site; NFFS-FFSS, non-FFS participant located in FFS site.

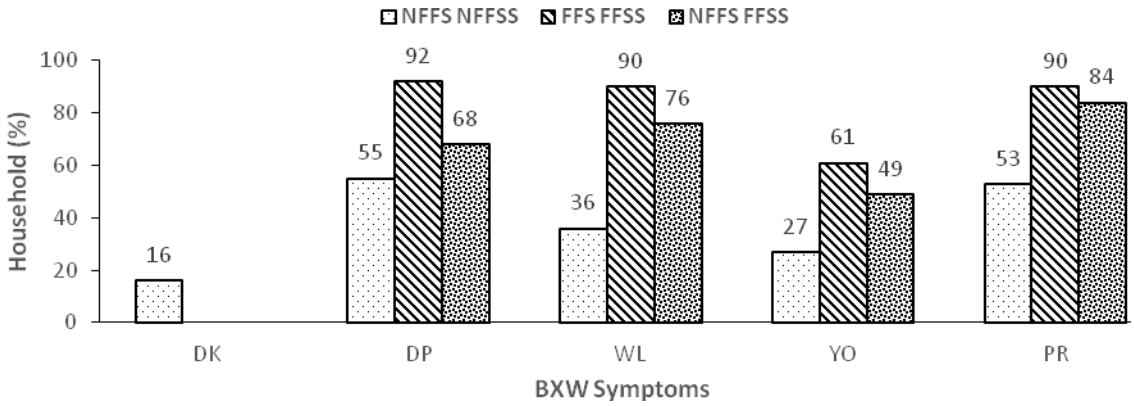

Figure 2b. Comparison of BXW diagnostic capacity across sites. DK, Do not know; DP, discoloration of pulp; WL, wilted leaves; YO, yellow ooze; PR, premature fruit ripening.

Awareness and deployment of ABCC practices

On average, 79% households located in NFFS sites lacked awareness across a wide range of practices embedded inside the ABCC package (Figure 4a). In contrast, 53% households in FFS sites were aware (that is, 62% FFS-FFSS and 42% NFFS-FFSS). FFS-FFSS households were most aware of sterilization of tools with sodium hypochlorite (SJIK) (100%), removal of male buds with forked stick (RMFS) (97%), sterilization of tools with fire (SFIR) (92%) and destroying and uprooting the entire infected mat (DAID) (89%). Likewise, in Figure 4b, the most implemented BXW control practices by FFS-FFSS were RMFS (72%) and SJIK (75%). However, significant difference between the FFS-FFSS and NFFS-FFSS were with respect to deployment of cutting diseased plants and burying (CDBG), use of clean planting materials (UCPM), and sterilization of tools with fire (SFIR) (Figure 4b). Consistent with previous research, this study also reveals that raising awareness does not necessarily result in a high level of deployment of the technology package.

Disadoption and dismantling of ABCC practices

Disadopters are defined as households who used an ABCC practice prior to 2012, but discontinued its use in 2012. About 12% of the households had abandoned at least two control practices that were embedded within the ABCC package (Figure 5a). In a disconcerting paradox, disadoption rates were on average greater (7.2%) in FFS households compared to 4.7% in NFFS households (Figure 5a). DAID and CLGN were the highest (31%) and least (2%) disadopted practices, respectively (Figure 5a). It is apparent that very few (21%) households were using

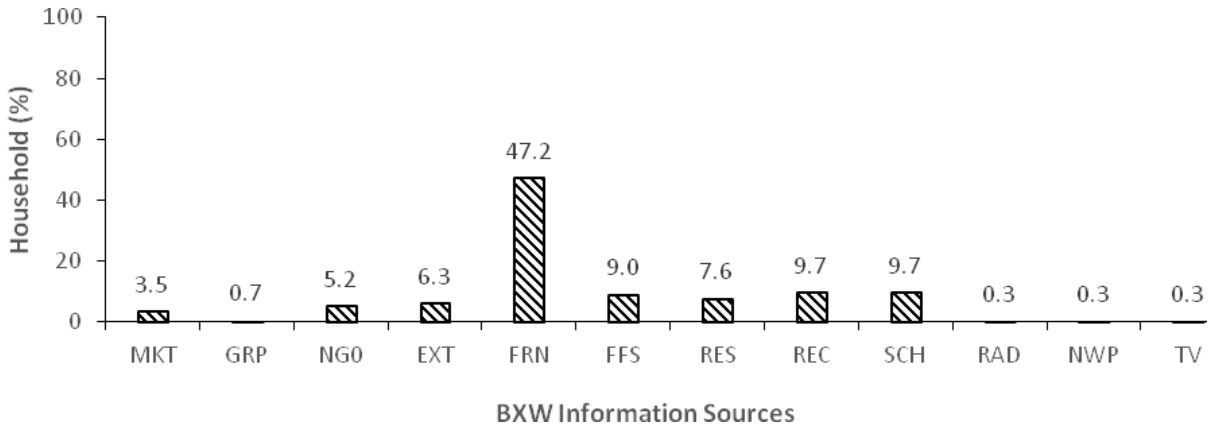

Figure 3a. Average percentage of households who rely on a particular BXW information source. MKT, Market; GRP, farmer group; NGO, non-governmental organizations; EXT, extension; FRN, friends and neighbors; FFS, farmer field school; RES, research institute; REC, religious center; SCH, school; RAD, radio; NWP, newspapers; TV, television.

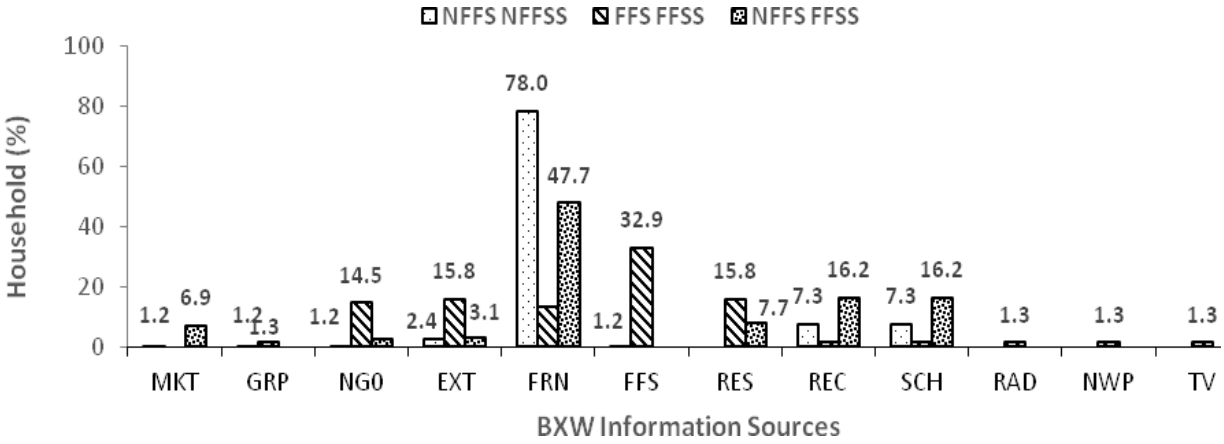

Figure 3b. Percentage household distribution according to BXW information source across study sites. MKT, Market; GRP, farmer group; NGO, non-governmental organizations; EXT, extension; FRN, friends and neighbors; FFS, farmer field school; RES, research institute; REC, religious center; SCH, school; RAD, radio; NWP, newspapers; TV, television.

the ABCC package in its entirety, whereas the majority (79%) had dismantled the ABCC package, which they later stitched together into more user-friendly combinations (Figure 5b). In general, the most widely used reconstituted packages were 69% ABC (Avoid new infection, Break male buds, and Clean tools) and 74% BC (Break male buds and Clean tools). Another important observation from Figure 4b is that majority (35%) of the households in NFFS-NFFS sites retained only the A component from the ABCC package. Data of on-farm disease prevalence confirmed that dismantling the ABCC package failed to create the enabling environment that would otherwise allow practices to complement each other. Interestingly, farmers who discarded debudding and tool sterilization risked resurgence of the disease.

Stepwise regression analysis

Unlike ordinary multiple regression, stepwise regression was useful for sifting through potential independent variables influencing household adoption of the ABCC package, and fine-tuning a model by poking variables in or out. Model 1 variables that were statistically significant are YFARM, HHSIZE, and FFSM (Table 2). In Model 2, HHSIZE and YFARM ceased to be statistically significant upon the inclusion of AWARE, DIAG, ABCCP, and ABCCN (Table 2). A positive coefficient for ABCCP suggests that much of the success in controlling BXW on smallholder farms in Western Kenya originated from multi-actor efforts prior to 2012. Moreover, the negative coefficient for FFSM suggests that household heads that

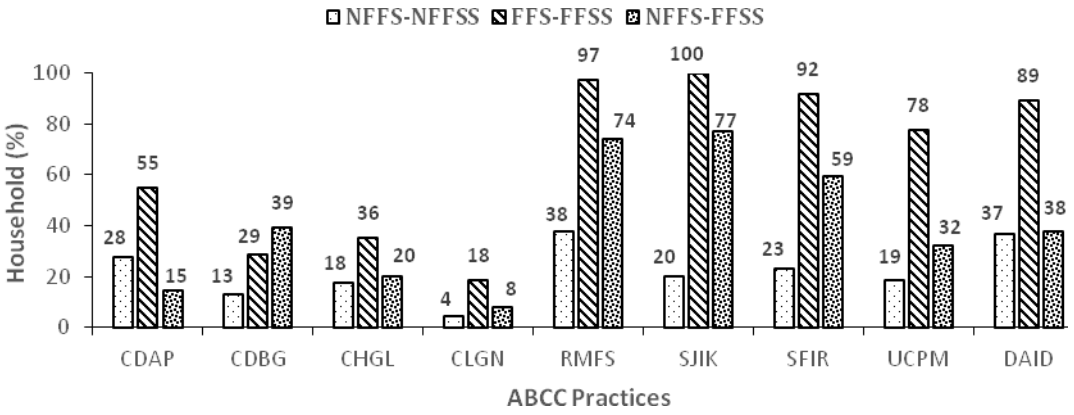

Figure 4a. Percentage household awareness of ABCC practices across sites. CDAP, Cut-down all infected plants; CDBG, cut-down all infected plants and bury in the ground; CHGL, cut-down and chop infected plants into pieces and heap on ground; CLGN, cut-down all infected plants leave on ground not heaped; RMFS, removal of male buds with forked stick; SJIK, sterilization of tools with sodium hypochlorite; SFIR, sterilization of tools with fire; UCPM, use of clean planting materials; DAID, destruction and uprooting entire mat.

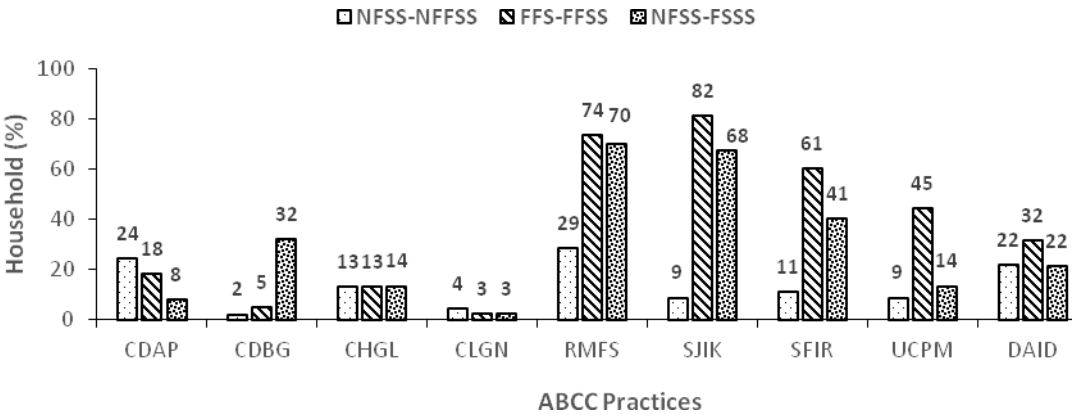

Figure 4b. Percentage household deployment of ABCC practices across sites. CDAP, Cut-down all infected plants; CDBG, cut-down all infected plants and bury in the ground; CHGL, cut-down and chop infected plants into pieces and heap on ground; CLGN, cut-down all infected plants leave on ground not heaped; RMFS, removal of male buds with forked stick; SJIK, sterilization of tools with sodium hypochlorite; SFIR, sterilization of tools with fire; UCPM, use of clean planting materials; DAID, destruction and uprooting entire mat.

are not FFS members are more likely to experience BXW on their farms.

DISCUSSION

Based on past successes in Uganda, the ABCC strategy is considered the most effective for BXW management in East and Central Africa. Besides, the FFS approach has been adopted to facilitate collective action between farmers, researchers and other stakeholders, and for scaling out the ABCC strategy to farmers as part of an effort to control BXW.

Results indicate that family size has a positive impact on adoption and application of ABCC practices. As a proxy of labor availability, household size influences the adoption of technology by reducing household labor constraints (Teklewold et al., 2006). However, differences in absolute and relative factor endowments often encourage farm households to engage in labor exchange with other farmers in their locality (Amsalu et al., 2013). Notably, families with many members are more likely to divert a significant portion of the labor force towards off-farm activities to earn cash income to ease the

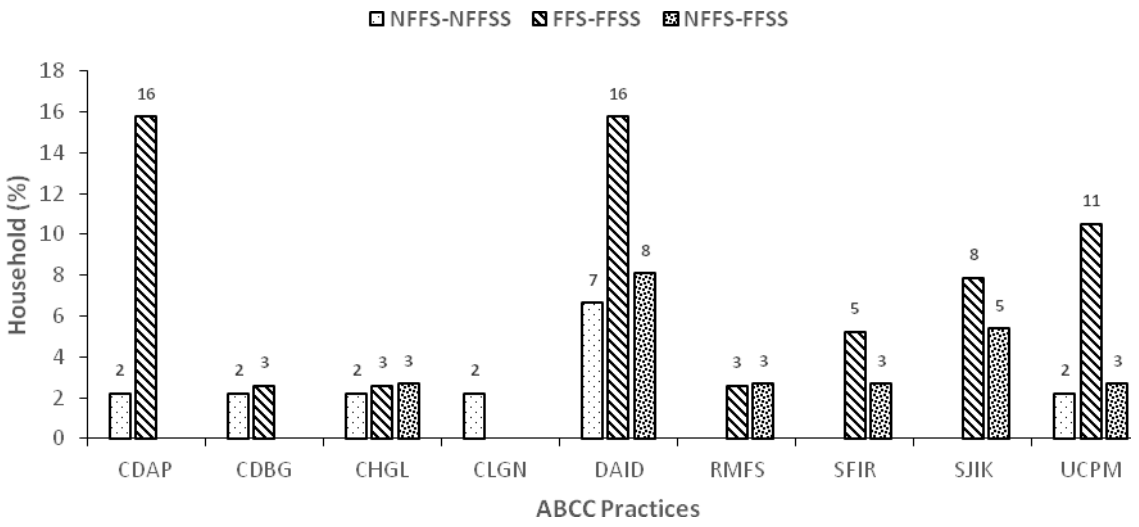

Figure 5a. Percentage household disadoption of ABCC practices. CDAP, Cut-down all infected plants; CDBG, cut-down all infected plants and bury in the ground; CHGL, cut-down and chop infected plants into pieces and heap on ground; CLGN, cut-down all infected plants leave on ground not heaped; RMFS, removal of male buds with forked stick; SJIK, sterilization of tools with sodium hypochlorite; SFIR, sterilization of tools with fire; UCPM, use of clean planting materials; DAID, destruction and uprooting entire mat.

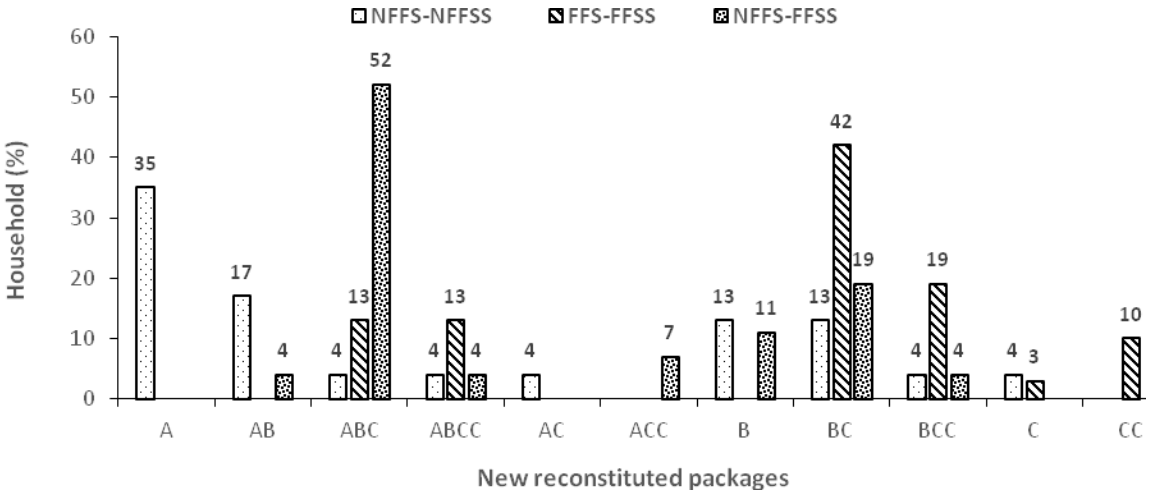

Figure 5b. Percentage of households that dismantled ABCC practices. A, Avoid new infection; AB, avoid new infection and break male buds; ABC, avoid new infection, break male buds and clean tools; ABCC, avoid new infection, break male buds, clean tools and clean planting materials; AC, avoid new infection and clean tools; ACC, avoid new infection, clean tools and clean planting materials; B, break male-buds; BC, break male buds and clean tools; BCC, break male buds, clean tools and clean planting materials; C, clean tools; CC, clean tools and clean planting materials.

consumption pressure associated with large family size (Tizale, 2007).

Farming experience is another key household characteristic that emerged to play an important role in influencing farmers' decisions to adopt components of the disseminated ABCC package. It is generally agreed that farmers' experience is very influential on adoption decision (Banerjee and Martin, 2009; Marra et al., 2001; Qaim and de Janvry, 2003; Alexander et al., 2003). Specifically, experienced farmers are believed to have generally better knowledge and information on several crop management practices (Nhemachena and Hassan, 2007). Moreover, farming experience is largely useful in the early stages of technology adoption when farmers are

Table 2. Stepwise regression to identify predictors of household adoption of the ABCC package.

Variable	Model 1	Model 2
Gender	-0.3489 (0.3022)	-0.3862 (0.3384)
Age	0.0008 (0.0129)	-0.0027 (0.0139)
Educ	0.0111 (0.0376)	-0.0074 (0.0412)
YAREA	0.0059 (0.0095)	0.0060 (0.0102)
YFARM	0.0301* (0.0155)	0.0288 (0.0175)
OCCUP	-0.0630 (0.2946)	-0.2054 (0.3355)
HHSIZE	0.1071** (0.0478)	0.0498 (0.0501)
FFSM	-1.047*** (0.2766)	-1.4837*** (0.3556)
AWARE	-	1.157 (0.7327)
DIAG	-	0.2896 (0.5245)
ABCCP	-	2.1757*** (0.7696)
ABCCN	-	-1.2294 (0.9385)
Constant	-0.4213 (0.8068)	-1.3772 (1.0783)
Log likelihood	-68.3621	-58.0459

*'**'***Significance at the 10, 5, and 1% levels, respectively.

still testing its potential benefits (Ainembabazi and Mugisha, 2014).

This study also reveals that FFS participants possess advanced capacity to accurately diagnose BXW symptoms and deploy the mutually reinforcing control practices. Notably, learning through the entire crop cycle enabled the farmers to develop confidence and expertise to make evidence-based crop management decisions. In general, by emphasizing a participant-led, multi-faceted, and iterative learning action methodology, FFS exposes farmers to diverse knowledge, experience, and skills, which enhances their decision-making capacity to solve field problems (Nederlof and Odonkor, 2006; Waddington et al., 2014). This is consistent with qualitative evidence generated by studies in Asia (Winarto, 1995; Mancini et al., 2007), Africa (Machacha, 2008; Van Der Wiele, 2004; Friis-Hansen et al., 2012), and Latin America and the Caribbean (Van Rijn, 2008; Dolly, 2009).

Existing studies reveal that long-term community empowerment through FFS may be achieved when graduates expand knowledge by helping others learn what they have already learnt (Simpson, 2002; David et al., 2006). Results particularly highlight a significant improvement in general orchard management among neighboring, non-participating farmers in the community, which actually suggests that non-participating farmers strategically benefit from knowledge spillovers. Although this finding contradicts observations by Tripp et al. (2005); it is consistent with previous studies in Kenya that showed that non-participating farmers recognized the relative advantage of FFS practices over existing practices (Najjar, 2009; Machacha, 2008; Hiller et al., 2009).

A major setback in many of the surveyed households is the disadoption of practices embedded within the BXW control package. Paradoxically, the highest disadoption rates existed among field school participants vis-à-vis non participants. A possible explanation being that adoption decisions by farmers are often sequential, made after the realization of true benefits and costs of the technology (Gedikoglu and McCann, 2009). The ultimate decision to disadopt being finally reached upon recognition that a technology does not fit within the smallholder's context, is defined by several farm level constraints (Asiabaka, 1994). For example, about 50% of the households abandoned labor intensive BXW control practices that required the destruction, uprooting and burying entire banana mats. This corroborates with reports that farmers were more likely to abandon control practices for which the amount of effort required outweighs the anticipated benefits (Jogo et al., 2013; Ochola et al., 2014; Blomme et al., 2014). In general, adoption of labor saving technologies results in more available time for household members to increase income by seeking off-farm employment. Subsequently, the diversion of household labor to off-farm employment does not interfere with BXW management, because available extra income enables the acquisition of alternative labor options.

Farmer-led experimentation and discovery learning facilitates the integration of new knowledge into prior experiences, which results in the creation of relevant, durable and retrievable knowledge (Ndoye, 2003). As our analysis shows, farmers seldom adopted the ABCC package in its entirety. Instead they dismantled the package and reconstituted its practices into distinct user-friendly combinations that fitted within their local realities. This is consistent with Horne and Stür (2003) who observed that farmers adapt rather than adopt technology packages. In fact, discovery of the single diseased stem

removal (SDSR), an effective alternative to uprooting the entire mat, was the result of experimentation with the ABCC package (Ocimati et al., 2013; Blomme et al., 2014). Apparently, the choice of cultural practice combinations that lack complementarity could result in diminished impact, and increased risk of disease upsurge and resurgence in areas where disease had been previously controlled (Ocimati et al., 2013; Ochola et al., 2014). For example, SDSR without consistent debudding with a forked stick and sterilization of cutting tools immediately after use raises the risks for inflorescence and tool-based infections (Ocimati et al., 2013; Buregyeya et al., 2008).

Conclusion

Key household characteristics identified to have a positive impact on adoption and application of ABCC practices were family size, years of farming experience and FFS participation. Particularly, FFS participation advanced the diffusion of knowledge for effective BXW management in the community. It is increasingly clear that the ABCC technology package has several limitations to operate within the local realities of the smallholder. Moreover, a wide range of user-friendly alternatives have emerged as the result of farmer innovation with the ABCC package. Although, dismantling the package permits farmers to create novel productive and sustainable practices, it unfortunately also diminishes the prior anticipated impacts, which is likely to result in disease resurgence. Therefore, fine-tuning of these alternatives is necessary to ensure sustainable disease eradication.

Conflict of Interests

The authors have not declared any conflict of interest.

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Pattern of adoption and constraints to adoption of improved cowpea varieties in the Sudan Savanna zone of Northern Nigeria

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A survey was carried out in 10 communities in Musawa Local Government Area of Katsina State to identify the pattern and constraints to adoption of improved cowpea varieties introduced by the Sudan Savanna Taskforce project. The survey was undertaken after three years of project intervention. Results revealed that 35.7% of farmers adopted the improved cowpea varieties, significantly higher than the number of farmers adopting prior to project interventions. Majority of the farmers who adopted improved cowpea varieties were male farmers (86.0%), participants in cowpea related activities (78.5%), farmers who had extension contacts (89.7%) and were young within the age bracket of 25-54 years (85.0%). Non-availability of seeds and fertilizer when needed, high cost of fertilizer, pests and diseases were revealed as the major constraints facing farmers in the study area. It was therefore recommended that Government together with other development agencies should encourage women participation in crop production and subsidize farming inputs so as to remove any barrier that will hinder their participation in farming. The Government should subsidize farm inputs like improved seeds and fertilizers so as to enable farmers afford and finally farmers should be sensitized on where to access the improved seeds and fertilizers.

Key words: Adoption, pattern, constraints.

INTRODUCTION

Cowpea (*Vigna unguiculata*), is one of the major crops grown in Katsina State. As a legume, it is important for nutrient cycling because of its tolerance to drought and soil acidity as well as its ability to fix nitrogen from the air. It is very well suited to where decline in soil fertility and drought are serious problems. It is a major staple food and cash crop in the State. The seeds are a major source of plant proteins and vitamins for man, feed for animals, and also a source of cash income. According to Bressani (1985), cowpea grain contains about 25% protein and 64% carbohydrate and according to Inaizumi et al. (1999) the crop has a tremendous potential to contribute to the

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alleviation of malnutrition among resource-poor farmers and to enhance food security and the productivity and sustainability of the crop-livestock system. In Nigeria, farmers who cut and store cowpea fodder for sale at the peak of the dry season have been found to increase their annual income by 25% and also plays an important role in providing soil nitrogen to cereal crops such as maize, millet, and sorghum, when grown in rotation, especially in areas where poor soil fertility is a problem (Dugje et al., 2009).

Cowpea is a low cost nutritious food that does not require refrigeration. It fits the condition of the urban poor. It is a versatile African crop: it feeds people, their livestock and the next crop, and is referred to as the "hungry-season crop" given that it is the first crop to be harvested before the cereal crops are ready. It is a crop that offers farmers great flexibility (Coulibaly et al., 2010). The dry grain and fodder yield are two most important components of cowpea (Mahalakshmi, 2004). According to Moalafi et al. (2010), cowpea is a staple food in many regions of Africa. Its desirability reflects the fact that the leaves, immature pods, fresh seeds (southern pea or “green pods”), and the dry grain are popularly eaten or marketed. According to Singh et al. (2003), some varieties have a short cycle and mature early and thus are able to provide food during the hungry period, usually at the end of the wet season when food availability can become extremely scarce in semi arid regions of Sub-Saharan Africa.

However, despite the potential for further yield increases, cowpea production faces numerous problems including insect pest attack, *Striga gesneroides* parasitism, disease, drought, low and erratic rainfall, and long dry season (Singh and Tarawali, 1997; Inaizumi et al., 1999; Singh et al., 2002). According to International Institute of Tropical Agriculture (IITA, 2006), every stage in the life cycle of cowpea has at least one major insect pest. Also, since cowpea is grown mainly in the dry savanna areas with no irrigation facilities, irregular rainfall especially early in the season have adverse effects on the growth of the crop. All of these factors, singly or combined, are responsible for the low grain yield, estimated at approximately 350 kg/ha that farmers in Northern Nigeria including Katsina State obtain from their cowpea fields.

Strong agricultural research for development is crucial for improving agricultural productivity and efficiency, which in turn will lead to agricultural development, food security, and poverty reduction. In an attempt to address these issues, several efforts have been made over the decades to strengthen National Agricultural Research Systems (NARS) in numerous developing countries. Many development projects have sought to remove some of these constraints by introducing facilities to provide credit, information, the orderly supply of necessary and complementary inputs, infrastructure investment, marketing networks, etc. The (IITA) has made effort to develop several improved varieties of cereal and legume crops that are high yielding, early maturing, resistance to drought and striga among others in order to enhance farmers’ productivity and income. Despite the development of a large number of improved cowpea varieties, farmers in northern Nigeria including Katsina State have continued to grow predominantly local varieties.

According to Kamara et al. (2009), the limited use of improved varieties in a predominantly cowpea growing region may be due to several factors; lack of information on improved cowpea varieties, unavailability of seed, or the unacceptability of new varieties due to low market values or unsuitability for the farming system.

In 2008, the Sudan Savanna Taskforce project was set up to disseminate improved agricultural technologies in northern Nigeria including Katsina State. Among the technologies promoted by the project in the State are improved cowpea varieties. In achieving its objectives, the Sudan Savanna Taskforce used Innovation Platforms (IPs) comprising a coalition of partners and stakeholders have been setup, one in Musawa Local Government Area and another in Safana Local Government Area all in Katsina State. The project is particularly concerned with agricultural intensification and integrated natural resource management to improve the rural livelihoods in the Sudan Savanna. The collaborating partners include scientists from the Institute for Agricultural Research (IAR), Samaru, IITA, NGOs, private sector actors, policymakers (especially at the local level) and the Katsina State Agricultural and Rural Development Authority (KTARDA) which provides extension services. This group constitutes the nucleus of the innovation platform.

There have been reports by farmers that they have adopted the improved varieties of cowpea introduced by the Sudan Savanna Taskforce project but there is no adequate information provided regarding the category of farmers that have adopted the improved cowpea varieties. There is also no information on the varieties that have been adopted, and the reasons for adoption. Information is also lacking on constraints farmers are facing in the process of adopting the crop. This study focused on; examining the pattern of adoption of improved cowpea varieties, reasons for the adoption of improved cowpea varieties and identifying problems faced by cowpea farmers.

METHODOLOGY

Musawa LGA is one of the two Innovation Platforms in Katsina State established by the Sudan Savanna Taskforce project; the other being Safana LGA. Musawa IP is also known as the maize-legume-livestock innovation platform by the project and covers the entire Musawa Local Government Area. It is located within the Sudan Savanna Agro Ecological Zone (AEZ) and is geographically located across Longitude 7°40´11´´ East of the Greenwich Meridian and Latitude 12°7´48´´ North of the Equator. It is found in the

Table 1. Percentage distribution of adopters of general cowpea and improved cowpea variety by gender

Gender	Grow cowpea	Grow improved cowpea
Male	90.3(271)	30.7(92)
Female	9.7(29)	5.0(15)
Total	100.0(300)	35.7(107)

Source: Field survey (2011), ( ) = Frequency.

Table 2. Percentage distribution of Adopters of improved cowpea varieties by participation and extension contact.

Participation (N = 107)	Frequency	Percentage of respondents
Participants	84	78.5
Non-participant	23	21.5
Extension contact (N = 107)		
Yes	96	89.7
No	11	10.3

southern part of Katsina State. The Local Government Area enjoys tropical wet and dry climate with relatively wind and rapid change in temperature and humidity. The highest amount of rainfall in the area normally falls between June and September. The mean annual rainfall ranges between 450 and 650 mm per annum; with duration of not less than three (3) months and not more than five (5) months, (that is, between May to September). The mean temperature of the area ranges from 14°C as the lowest to 33°C as the highest.

The farming household population for the ten (10) communities (study area) based on census conducted by the project was estimated at 21,800 (Sudan Savanna Taskforce, 2009). Two-stages of sampling techniques were carried out to select the sampled communities and respondents. In the first stage, a purposive sampling technique was used to select villages from the where the project promoted improved cowpea technologies. The second stage was a simple random selection of respondents that included participants and non-participant.

Participants were those farmers who participated in the Sudan Savanna Taskforce project's activities (those given improved seed directly or indirectly, who attended trainings, field days and demonstrations). The pattern of adoption explains which of the cowpea varieties was mostly adopted by farmers, which category of farmers adopted the improved cowpea varieties that includes: Participating and non participating farmers, male and female farmers, farmers who had extension contacts and those who did not and which of the project communities adopted the most.

Among the respondents selected were: one hundred and fifty (150) participant or direct beneficiaries and one hundred and fifty (150) non-participants or indirect beneficiaries, making a total of three hundred (300) farmers as sample. Data were collected with a Focus Group Discussion guide and a structured questionnaire designed to capture information on households in the Sudan Savanna Taskforce project communities in Musawa LGA of Katsina State.

The questionnaire contained information on farm and farmer characteristics, market, credit, extension, and awareness/adoption of crop technologies. The pre-tested questionnaire was administered two months prior to the actual survey by trained enumerators. Data collected were entered using SPSS spreadsheet and analyzed using descriptive statistics by SPSS package. The results of the study were presented based on the percentage of farmers who adopted the improved cowpea varieties.

RESULTS AND DISCUSSION

Table 1 shows that almost all the farmers (99.3%) were growing cowpea. This is represented by 90.3% male and 9.7% female farmers. The results further revealed that from the total population of farmers growing cowpea, 35.7% were growing improved cowpea varieties. When segregated by participation in the Sudan Savanna Taskforce project activities as revealed in Table 2, the result showed that 78.5% of those who adopted were those who participated in the project's activities and 21.5% were those who did not participate. Similarly, 89.7% of those who adopted were those who had extension contacts and 10.3% did not have any extension contact.

Results in Table 3 also revealed that those who adopted improved cowpea varieties were young farmers within the ages of 25 to 54 years (86.0%). Improved cowpea varieties are largely new technologies in the study area. The study revealed that cowpea is one of the major crops grown in the study area as almost all the farmers were growing the crop. Farmers attach greater risk to new varieties than their traditional or local varieties.

Based on the results, women are not actively involved in cowpea production in the study area. They are supposed to be key players especially in cowpea production as most processing is being done by them. Coulibaly et al. (2010) stated that women play key roles in agricultural production, but agriculture is increasingly characterized by growing gender imbalances in access to

Table 3. Percentage distribution of respondents according to adoption by age range.

Age (years)	Frequency	Percentage of respondents
15-24	4	3.7
25-34	26	24.3
35-44	38	35.5
45-54	23	21.5
55-64	11	10.3
65 and above	5	4.7

N = 107.
Source: Field survey (2011)

key productive assets such as land, animal power, and education. The failure of many agricultural research and extension programs in Africa has been argued to be due largely to gender biases in project design and implementation. With the interventions largely inappropriate to them, it is argued that women have been effectively excluded from the development process. The role of women in agriculture is no way insignificant. They should be encouraged to participate actively in farming activities especially cowpea production because of the nutritional value attached to the crop.

Farmers participation in agricultural activities organized by institutions promoting agricultural activities is very crucial especially for the adoption of new technologies, which can be enhanced through farmers who have first-hand experience with the new technologies. To increase the rate of adoption therefore, farmers should be encouraged to participate in activities relating to new farm practices like; on-farm trials, demonstrations and training related to such technologies as in the case of improved cowpea introduced in the study area.

In a recent study, Adedipe (2012) reported that farmers who participated in cowpea related activities benefitted from the activities by using the income they generated from the sales of cowpea to meet certain needs that are associated with improved standard of living such as food, clothing, shelter, education, healthcare and recreation. Unlike the non participants she reported that they were more of subsistent farmers. Farmer's participation has been an important factor in extension programmes.

The implication of the findings is that farmers should be actively involved in the analysis of their situation which forms the basis for identifying their immediate needs and constraints for appropriate interventions. Through participation, farmers are exposed to new farming techniques to improve on their production yields to enhance better standard of living.

This study revealed that farmers who had extension contacts adopted more than those who did not. According to Owens et al. (2001) and Doss et al. (2002), extension contact is clearly the variable that is most highly correlated with the use of improved technologies and that regular contact with extension raises improved cowpea production by an average of 18.5 and 15% but the contact has no significant effect on cowpea production under traditional technology.

The goals of extension according to Chikaire et al. (2011) includes; transferring knowledge from researchers to farmers; advising farmers on their decision making; educating farmers to be able to make similar decision in future and enabling farmers to clarify their own goals and possibilities to enhance desirable agricultural development. This result corroborates findings of Onu (2006) who reported that farmers who had access to extension adopted improved farming technologies. They had 72% more productivity growth rate than those who had no access to extension services.

The utilization of new technologies is often influenced by farmers' contact with extension services, as they provide technical advice for increase in agricultural production. Adoption level increases with the intensity of extension services offered to farmers. This is in line with Odoemenem and Obinne (2010), who pointed out that constant meeting / frequency of extension contact between the extension personnel and farmers would enlighten them and create better awareness for the potential gains of improved agricultural innovations.

Farmers who adopted were between active farming age ranges of 25 to 54 years. The role of a farmer's age in explaining technology adoption has been controversial. Older people are sometimes thought to be less amenable to change and hence reluctant to change their old ways of doing things. In this case, age is expected to have a negative impact on adoption.

On the other hand, Muyanga (2009) reported that older people may have higher accumulated capital, more contacts with extension and preferred by credit institutions predisposing them more to technology adoption than younger ones. Bonabana-Wabbi (2002) classified age as the primary latent characteristic in adoption decision.

Caswell et al. (2001) and Khanna (2001) reported that farmers perceive that technology development and the subsequent benefits require long duration to realize, can reduce their interest in the new technology because of their advanced age and the possibility of not living long enough to enjoy it. According to Bamire et al. (2010), younger

Table 4. Percentage distribution of adoption of improved cowpea varieties, year and source of seeds.

Year of adoption	Varieties			
	IT97K-499-35	**IT98K-205-8**	**IT98K-573-1-1**	**IT89-288**
	% (N)= 47	**% (N)= 25**	**% (N) = 12**	**% (N) = 29**
2009	55.3 (26)	48.0(12)	33.3(6)	51.5(17)
2010	36.2(17)	32.0(8)	27 .8(5)	24.2(8)
2011	6.4(3)	20.0(5)	11.1(2)	12.1(4)
Seed origin	**% (N) = 46**	**% (N) = 24**	**% (N) = 17**	**% (N) = 33**
SSTF/IITA	85.1(40)	95.8(23)	52.9(9)	60.6(20)
KTARDA/ADP	0(0)	0(0)	0(0)	6.1(2)
Market retailer	2.1(1)	0(0)	0(0)	0(0)
EAs	2.1(1)	4.2(1)	17.6(3)	18.2(6)
Friends/relatives	6.4(3)	0(0)	23.5(4)	15.2(5)
Other farmers	2.1(1)	0(0)	5.9(1)	0(0)

Source: Field survey (2011); ( ) = Frequency.

Table 5. Percentage distribution of adopters of improved cowpea variety by location.

Village / community	Frequency	% of respondents
Bakam	15	14.0
Gingin	9	8.4
Tarbbani	6	5.6
Yarkanya	18	16.8
Dan kado	10	9.3
Rugar	9	8.4
Farin Dutse	9	8.4
Garu	13	12.1
Kurkujan	6	5.6
Tuje	12	11.2
Total	**107**	100.0

Source: Field survey (2011).

younger farmers are willing to take risk and adopt new technologies.

Table 4 shows adoption pattern of four different improved cowpea varieties from 2009 to 2011. IT97K-499-35 and IT89-288 were mostly adopted in 2009. In 2010, IT97K-499-35 and IT98K-205-8 were also the most adopted. In 2011, IT98K-205-8 was mainly adopted. From the result, it could be concluded that IT97K-499-35 and IT98K-205-8 were farmers' choices as they have the average adoption level of 32.6 and 33.3% over three years respectively.

The Sudan Savanna Taskforce project should therefore promote more of these varieties in order to enhance farmers' well-being as majority of the improved seeds were from the Sudan Savanna Taskforce project. Also, Table 5 revealed the adoption pattern of improved cowpea varieties by location. Results showed that four out of the ten sampled communities adopted more than the other communities. They include: Yarkanya (17%), Bakam (14%), Garu (12%) and Tuje (11%).

Table 6 shows the desired characteristics of improved cowpea varieties given farmers in the study area. The farmers gave high income (94.7%), high yield (89.7%), resistance to drought (56.3%), early maturing (72.3), household food security (61.7) and diversified food products from cowpea (65.3%) as reasons why they grow improved cowpea. The major constraints to the adoption of improved cowpea varieties were: non-availability of seeds when needed (68.0%), non-availability of fertilizer (54.3%), high cost of fertilizer (59.3%), diseases (70.3%) and pests (79.3%) as presented in Table 7.

Non-availability of improved seed was the third major constraint which singly can lead to low adoption rate in the study area. It is not surprising to see farmers citing

Table 6. Percentage distribution of respondent according to technology related characteristics as reasons why farmers grow improved varieties.

Variable	Frequency	Percentage of (%) n=300
Is it high yield	269	89.7
High income/profit from market sales	284	94.7
Resistance to drought	169	56.3
Early maturity	217	72.3
Household food security	185	61.7
Diversified food products from cowpea	196	65.3

Source: Field survey (2011).

Table 7. Major problems / constraints to cowpea production.

Problems / Constraint	Frequency	Percentage
Non-availability of seeds when needed	204	68.0
Non-availability of fertilizer	163	54.3
High cost of fertilizer	178	59.3
Diseases	211	70.3
Pests	238	79.3

Source: Field survey (2011).

high income and food security as a reason for growing cowpeas. Cowpea is a cash crop in the dry savannas of West Africa. It is consumed in the entire West African region with high demand all year round. Farmers in the dry savannas prefer early maturing and drought-tolerant crops because of high crop failure associated with terminal drought in the region.

According to Coulibaly et al. (2010), the low adoption of improved varieties is argued to be one of the reasons for low yields. Even when a farmer is said to have adopted an improved variety, it is usually the case that the seeds have been recycled for many generations to the extent that their yields advantage have been lost and hence give no more yields than the local varieties. Also, that most improved varieties lack the characteristics valued by farmers. This has in turn been due to the failure of crop improvement programs to involve farmers in the process of designing and developing improved varieties with a view to meeting their priorities and preferences.

It is therefore important that Breeders look for these traits (high yielding, earliness, marketability and drought resistant) while breeding seeds for farmers. According to Kamara et al. (2009), although new varieties have potential roles where they offer advantages over local varieties, they are unlikely to replace local varieties which combine many farmer-preferred characteristics. It is therefore essential that researchers (Breeders) in developing new varieties are aware of the wide range of criteria or local preferences in the production and utilization of cowpea and, if possible, build these traits into new germplasm which fits local farming systems. It was also revealed by the study that improved cowpea varieties can lead to food security by providing food at the peak of hunger period when food is mostly needed and the crop has the quality to be produced twice in the year making it to be known as a dual-season crop.

Across the surveyed communities, it is clear that non-availability of seeds, disease and insect pests attack were among the major constraints facing farmers in cowpea production. These reasons are mostly responsible for abandoning or why farmer are not growing improved cowpea varieties. The study is in agreement with the findings of Singh and Tarawali (1997), Inaizumi et al. (1999), Singh et al. (2002) and IITA (2006). They all reported that despite the potential for further yield increases, cowpea production faces numerous problems including insect pest attack, *Striga gesneroides* parasitism, disease, drought, low and erratic rainfall, and long dry season.

As reported by Oladele (2005), that since prices of seed and fertilizer are the major cost components of production, a rise in input, coupled with other constraints, may render farm activities unprofitable which is in line with disenchantment theory of dis-adoption. According to Coulibaly et al. (2010), the profitability of the cowpea cropping systems depends mainly on the types of varieties used (local or improved), the cropping practices and management (use of chemicals including fertilizers and pesticides), and the access to input and outputmarkets.

Conclusion

Considering the results of this study, it can be concluded that the study has obviously brought to light some facts about the adoption pattern and constraints facing farmers in cowpea production in the study area. Results of this study revealed that the adoption level of improved cowpea varieties increased from zero percent (Ayanwale et al., 2009) to 35.7%. From those who adopted the improved cowpea varieties, 86.0% were male farmers, 78.5% were those who participated in cowpea related activities organized by the Sudan Savanna Taskforce project, 89.7% were those who had extension contacts and 85.0% were farmers within the age bracket of 25 to 54 years. IT98K-205-8 was more adopted in 2011 among the four varieties of improved cowpea varieties that were introduced in the project area by the Sudan Savanna Taskforce project. Yarkanya, Bakam, Garu and Tuje were the communities that recorded the highest adoption rate among the ten communities where the project was implemented. High yielding, early maturing, drought tolerance, high income leading to payment of school fees, payment of medical bills and buying of clothing, household food security and diversified food products were reasons given for the adoption of improved cowpea varieties. Non-availability of seeds and fertilizer when needed, high cost of fertilizer, pests and diseases were revealed as the major constraints facing farmers in the study area.

Based on the findings of this study the following recommendations are suggested in order to improve the adoption level of improved cowpea varieties in the study area. Farmers need to take full advantage of the benefits of cultivating improved cowpea varieties which usually translates into increased income. This will only be possible with an effective network of extension agents who deliver their services to these farmers more frequently.

Farmers' participation in development project activities should be emphasized by States Agricultural Development Projects (ADPs) and development agencies so as to enjoy the full packages of such projects. In addition, policy makers and development agencies should ensure that adequate inputs are being made available to farmers at subsidized rates in order to improve on their crop yields.

Conflict of Interest

The authors have not declared any conflict of interest.

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Prioritizing needs assessment techniques for agricultural programs implementation: The case of Northern Region, Ghana

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The Northern region is among the poorest in Ghana. The Southern regions possess a lot of natural resources, and at the same time viable for the production of cash crops. The Northern regions however, have agriculture as their most dependable source of livelihood. The proportion of people working as farmers in the region is 73%, making it the highest in the country. In the light of this, most developmental programs in the region are agriculture based. However, the impact of these programs is not being felt as farmers continue to experience lower harvest and productivity. We however blamed the situation on the absence or inappropriate Needs Assessment. We tried to establish from the farmers the programs they found successful. It was established that, an insignificant number of programs were adjudged successful. Reasons why they considered projects successful or otherwise were also investigated. Combining the results from the data and the practical application of the techniques in the study area, we prioritized these techniques. It was realized that individual group techniques were complements to group techniques in the context of the study area. A case is made for the prioritized techniques as well as further discussion on the highly prioritized ones.

Key words: Agricultural programs, needs assessment, need assessment techniques.

INTRODUCTION

Ghana's economy is economically dependent on agriculture, not in terms of how much it contributes to gross domestic product (GDP) and economic growth but rather in terms how many people it employs. It is the least in terms of contribution to GDP, but the highest in terms of population employed. Agriculture, industry and services contribute 21.9, 28.6 and 49.5% respectively to GDP (Ghana Statistical Service, 2014a:5) and (World Bank Ghana Development Indicators, 2014). Agriculture however, employs 44.7% of the labor force as at October 2013 (Ghana Statistical Service, 2014b:51). The intricate nature of agriculture in rural setting makes implementation of agriculturally oriented programs very difficult. Unlike industrial farming which operates as an economic unit with higher efficiency and productivity, small scale farmers who comprise most of the world farmers simultaneously operate as an economic, social and cultural unit. This means, the implementation of any

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program needs to strike a balance among these aspects of the rural community life. The regions in the Northern Ghana are typically less developed than those in the south where there are a lot natural resources and cash crop production. Apart from the fact that the countries mineral resources like gold, diamonds, bauxites, manganese and oil are found in the south, the production of Ghana's most important and precious cash crops; cocoa and coffee are viable only in the south. The Northern regions have only small scale agriculture as the only livelihood of most people. It is also the region with the highest proportion of its population as farmers; 73.11% (Ghana Statistical Service, 2012:76).

However, most of the agricultural outputs in the northern region especially food crops are below 50% of their potential productivity. These include important ones like maize, rice, cassava yam, tomato, and cocoa (Ministry of Food and Agriculture, 2011:12). Furthermore, the productivity levels of some of the crops are not only below the national average, but are continuously declining over the years. For example, while the national productivity of cassava, yam, maize, rice and soybean improved from 2010 to 2013, that of Northern region for the same crops, with the exception of the tubers decreased from 2010 to 2014. For 2010, the national yield for cassava, yam, maize, rice and soybean were 15.4, 15.5, 1.9, 2.7 and 1.5 respectively, whiles that of 2013 were 18.3, 16.8, 1.7, 2.7 and 1.9. However, at the Northern regional level, the yields were 13.28, 12.53, 1.83, 2.95 and 1.97 for 2010, and 16.5, 17.2, 1.43, 2.16 and 1.96 for 2014 respectively. The unit of measurement is metric ton per hector (Mt/Ha) (MoFA, 2010 and 2013) and (FAOSTAT, 2015).

Even though Ghana as whole is improving in terms of poverty reduction, the source of this positive development is not from the agricultural sector but rather the service sector. This explains why poverty among the farmers in the northern region is rising. Between 1992 and 2006 for instance, the number of poor people in the southern regions deceased by 2.5 million while the northern regions experienced an additional 900,000 more poor people within the same time period (IFAD, 2012:5). The combined effect of poverty, falling agricultural productivity and some other factors force the youth in the north to migrate to the south to work as head potters, store keepers, maids, farm work etc.

In an effort to bridge this gap between the South and the North, agriculture has been the target of most development programs and policies in the Northern Region. Whiles some programs target yield improvement, others consider marketing. Others may attempt to solve problems along the entire agricultural value chain. The government of Ghana through the Ministry of Food and Agriculture (MoFA), private and non-governmental organizations implement programs aimed at fulfilling any or a combination of the above objectives. In this regard the Agricultural program implementers and extensionists play a major role. It has to be noted that almost all the government programs are supported by international organizations or a country that is a development partner. In some cases a Non-Governmental Organizations (NGOs) undertake a project with funding mostly from outside Ghana. This type of organizations has a little coordination with the MoFA and most time none with other partners working in the same districts with the same farmers. Sometimes too, development partners execute a project directly through some other official organizations within the country. The development partners who are directly or indirectly involved in executing agricultural projects in Ghana are African Development Bank (ADB), Alliance for Green Revolution for Africa (AGRA), Canadian International Development Agency, Food and Agriculture Organization (FAO), German Development Cooperation in Agriculture, International Fund for Agricultural Development – IFAD, United States Agency for International Development (USAID), Millennium Challenge Corporation, World Bank, World Food Program, Japan International Cooperation Agency and more (MoFA's website).

Most programs go into these communities with very good objectives and solution to a particular agricultural problem, but the problem has always been obstacles at the implementation stage. These obstacles include lack of community support, lack of corporation from participants, timing, funding, incompetent staff etc. These obstacles subsequently lead to agricultural programs that do not promote voluntary participation, adoption, and sustainable implementation of outcomes. Most of these obstacles could have been prevented if proper planning and consultations were done before the implementation. We therefore think that, the missing link in these project implementations is proper Needs Assessment (NA) and the appropriate NA techniques.

NA is basically the life line of every successful socially oriented project or program. This takes an objective overview of the current situation in the society and what it should have been. It is a multi-disciplinary concept so wide that its definition depends on the discipline, organization and focus of the researcher or the decision maker. This situation between the current state and the desired or targeted state is call the gap and the contributing factors to help close this gap is called needs (Watkins et al., 2012:19). However, a need is the same as a gap if the word 'need' is defined as a noun (Witkin and Altschud, 1995:9). The Gap forms the bases for any NA and any decision taken should be focus on addressing the gap. It tells where you are and where you intend to go.

Why needs assessment

For any gap in agriculture to be addressed the project implementer or the extensionists play a significant role.

The farmer is always at the center of all these and makes most of the decisions, hence whatever decision is to be taken about the program and its implementation, the farmer needs to be part of it and be well informed.

NA is critical in the execution of any program. Agricultural programs and extension in general is required by statue to consider stakeholder input as part of the designs and delivery of programs (McCawley, 2009:4).

According to McCawley (2009:3), NA for agricultural programs and extension purposes is done by first learning what the audiences (in this case farmers) already know and thinks, so that an educational product and services can be designed to address their need. For example, if farmers want to increase productivity of wheat per acre in a particular community. So many needs might have accounted for low productivity but the researcher or the program formulator cannot just guess the ones really responsible. He or she must use any of the NA techniques. Sometimes it can be one particular need or a combination of more than one. These needs may include inadequate machinery, inadequate pesticide and weedicides, inadequate labor, the inappropriate use of equipment, and so on. Further scrutiny has to be made regarding this information gathered. For example, all the above may be adequate or enough in that particular community, but however the inappropriate use of pesticide, weedicides and machinery may be the problem. If the researcher finds out that there is a combined effect of three of the above listed problem, they must be prioritized, that is, which is more pressing or needed then the other to address the said goal (increasing productivity per acre).

Some authors stress the need to make distinction between a Need, Want and an Interest, as these terms are often confused and used interchangeably by program implementers, extensionists and farmers. ‘‘Needs refer to something considered necessary or required to accomplish a purpose. Wants, on the other hand, are considered desirable or useful, but not essential. Interests indicate an individual's concern or curiosity about something’’ (Swanson et al., 1997). In the scenario above, the difference between want and need is exemplified by the fact that the farmers want to increase productivity, but they actually need education on the usage of farm equipment. When that equipment usage gap is reduced or closed, we can be sure that productivity will increase. This explains how suicidal it to execute agricultural programs in farming communities without NA.

In some cases, the buck does not stop at perfectly identifying the need. Some cultural and social lifestyle of the community may impede on the program implementation. Rural life in most part of Africa has a form of collective socialist behavior ingrained in them. They are ready to abandon anything that they think is not in the collective interest of their community especially their beliefs, customs and tradition. Some of their lifestyles however, are anemic to their development. In fact some of them prevent innovation, networking, technology, education and gender equality. It is rather the duty of the project implementers and the extensionists to be aware and well informed about them so as not to be obstructed by them in the implementation process. Since the primary aim of the agricultural program is not to change those lifestyles, it is prudent to avoid or managed them. A classic example is distributing a medicine whose structure or packaging looks like a cross to a Muslim dominated community, considering how Muslims abhor the cross. To some extent, NA can reveal the attitude the community will have towards the program when it is being implemented. This will give an expectation as to the pace of implementation. Lastly, knowledge about existing government policies as well as meeting other program implementers in the same communities is essential. Sometimes the objectives of the current policies or programs may be counter reactive or overlap with the one to be implemented.

It is in the light of these that we decided to evaluate the successes or otherwise of these agricultural programs from the farmers’ own perspective. It has to be noted that the farmers’ definition of success is more paramount to the programs definition of success in their reports. Using the results from the data gathered in addition to the practical applicability of each technique in our study area, we prioritized the techniques in order of importance.

METHODOLOGY

Numbers will not reveal the unquantifiable explanations behind the topic of discussion, whiles qualitative methods is not capable of giving a vivid picture of events. We therefore resorted to a mixed methodology, which is considered appropriate in a socially oriented research like this (Bryman, 2008). Qualitative research answers research questions from the perspective of the respondents. Therefore its application is paramount to this study because we seek to assess those programs directly from the farmers. This will enable us to calculate some quantitative results as well as give answers to the what, how and why questions. Considering the fact that the two methodologies have interviews as a common data collection instrument, we tend to have a face to face interview with each respondent. The difference being that, interviews for quantitative analysis will be less in-depth as compare to the qualitative (Trochim, 2000). The first part of the questionnaires would be structured, whiles the last part of it will be in-depth interviews.

What we requested as the main yardstick for success of a program was whether the program satisfied all or some of their needs as farmer. Reasons for the success or otherwise of programs were also investigated, ranked and discussed. Their knowledge about the project before implementation was also sort. We also enquired from them what their needs are. Their responses were ranked in order of frequency. From the responses we evaluated and established the NA techniques that were used for each successful project. The target respondents are Farmer Based Organizations’ (FBOs) leaders and members.

Descriptive statistics such as the mean mode and frequency tables will be used. Some of the analysis will also be done using the graphical representations such as the bars, lines and the dots.

Table 1. Selected FBOs.

Districts	Number of FBOs	Total membership
Chereponi	7	183
East Gonja	7	99
Gushegu	7	229
Savelugu Nanton	7	262
Saboba	7	108

Table 2. Number of successful projects.

Districts	Total number of projects	Successful
Chereponi	28	8
East Gonja	17	3
Gushegu	21	8
Savelugu Nanton	31	5
Saboba	30	7
Total	127	31

Based on the open ended questions asked, qualitative analysis would be made using direct responses from the farmers.

Data

The information is gathered on wide range of issues to assess the NA techniques used in the formulation of the agricultural programs. For any FBO, a member of the executive and a group member are interviewed. It is expected that the executives will have much information about the projects as well as their assessment of it. Information is gathered on the number of projects they participated, their knowledge about the projects before implementation, their assessments etc. A random sampling of 5 districts was chosen from among the total of 20 in the region. Out of which 7 FBOs were randomly selected from each of the 5 districts given a total of 35 FBOs. Since two members from each FBO are to be interviewed (an executive and a member), the total sample is 70 farmers (Table 1).

RESULTS

On the number of projects each group participated the number varied between the two respondents for the same FBO. We considered the report of the executive as right one because they have the records. The member may be new to the group and may not be aware of other projects that the group participated. The other thing worth mentioning was the fact that many of the members and some few executives could not identify projects by their specific names but by the country or the international organization that supported or a famous personality directly or indirectly involved the implementation of the project (Table 2).

As seen in Figure 1, the FBOs in Savelugu and Saboba implemented the most projects. However it has to be acknowledged that more than one FBO could be refereeing to the same project. This means that the results are aggregated at the district level. For example MiDA was a common name that came up in almost all the FBOs in the district in which it was implemented. The proportion of successful programs is indicated by the percentage figure above each bar.

It was also observed from further questioning that there were common names among the projects deemed successful. MiDA for example was considered successful for all FBOs that participated in it. It was implemented in five district of which Savelugu Nanton and Gushegu was part. In the Gushegu district, all the seven FBOs participated in it and considered it the only successful project they have participated. Only one considered an additional project a success. This additional program was a nucleus farmer. These are farmers who extend services to other farmers mostly on credit. They pay back the loan mostly in the form of harvested crop after the farming season. This makes a total of 8 (Table 2). In the case of Savelugu Nanton, only 5 FBOs participated in the MiDA program and it was considered the only successful program among all the programs they have participated. The other two think all the projects they have ever participated have not been successful or useful to them. Saboba and Cheriponi districts have the same explanation. In this case all the seven districts in both districts considered EPDRA program as the only successful project they have participated. The eighth successful project in the case of Chereponi was a project that provided the community with boreholes. They however could not identify the program by name. In East Gonja, one FBO referred to SEND Ghana project as the only successful project whiles another FBO mentioned

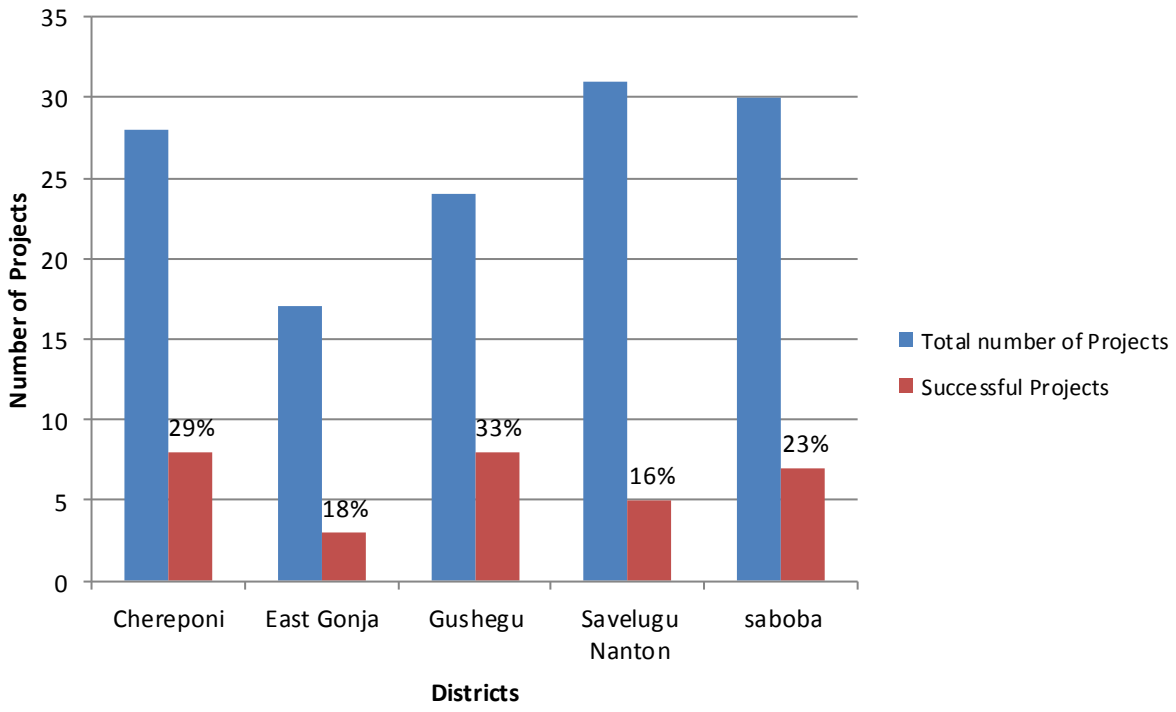

Figure 1. Proportion of total projects which are successful.

SEND Ghana in addition to a project whose name they could not remember.

In all, out of about an average of four projects each FBO participated, an average of one was considered successful that is, 25% of total projects implemented. Considering the yardstick for a successful project and the results in Figure 1 we conclude that most of the programs did not meet the needs of the farmers.

Pre knowledge about projects

The FBOs in Savelugu Nanton and Gushegu Districts singled out MiDA project as the only projects they had information about before its implementation. According to them, there were stake holder and consultative meetings at the district level to sensitize them about it. Their inputs and suggestions were taken but were not sure whether they were incorporated into the program. In the case of Saboba and Cherponi districts were EPDRA program was considered a success among all projects, it was revealed that EPDRA programs are continual. They work with them throughout the farming season and have meetings with them to plan for the coming season. Because of this, they have a permanent secretariat in those districts they are operating. This means that farmers are abreast with their activities before any farming season. The other issue has to do with the Nucleus farmers. According to them these business people inform them earlier and organize meetings to explain the modalities in what he or she is going to offer them. Because it is always in the form of credit and other services, those meetings are necessary for legal issues. Some of them are made to sign contracts to that effect. Other nucleus farmers make their transactions based on trust. These farmers are members in the community and they already know the package he or she is offering. They claim for all other projects, they are only informed about programs at the implementation stage. We therefore conclude no NA was conducted for most of the projects, and even if it was done, it was not properly done.

Why projects were successful

It was only logical to probe further to understand why they think some of the projects were considered successful. There were varied reasons given. We decided to arrange them in order of frequency.

1. The objectives were holistic
2. It addressed some of their needs
3. Continuity
4. Still benefiting from it.

The challenges in agriculture is spread across the various stages of the value chain; production, harvesting, processing, storage and marketing. Farmers would often like a project that seems to solve the various challenges

along the chain. For example a project or program that seeks to increase productivity by acquiring good seed variety and fertilizer, tractor and plough availability for timely production, processing equipment, storage facilities, good prices for their produce and most importantly credit of any form. MiDA for instance, strengthened the organizational structures of the FBOs, gave them technical training on good farming practices, linked them up with agro dealers, gave them loans, build storage facilities for them, provided tractor and implements, assigned buyers(aggregators) to the participating FBOs. The EPDRA program doesn't do as much as MiDA did but virtually assist farmers in most part of the production process. The package of some Nucleus farmers is also holistic; from production to marketing. They mostly act as aggregators of the produce of their clients. The holistic nature of these projects earned them the success tag from all the FBOs that participated in them.

According to them, some programs wasted their precious time. They were not just what they needed. Among the examples mentioned was a project that wanted to promote farm insurance, another one was teaching them precision agriculture, market linkage project etc. The holistic nature of the EPDRA and MiDA projects meant that some or all of their farming needs would have been addressed by those projects. Programs that are rolled out yearly are considered successful as compared with those that have a limited lifespan. Those types of programs are scanty. EPDRA programs in Saboba and Chereponi, and SEND Ghana program in East Gonja are good examples. Even though their activities vary, the fact that they are always around for the farmers to rely on every season make them important in the eyes of the FBOs. Lastly, they also attach importance to projects that have left an important impression on them even after it has folded up. Farmers in Gushegu district considered a project a success even though they could not identify its name. They pointed to a silo provided by the project for storage of their cereals. They could only identify the project as a German funded project and that there are other silos in other communities. The MiDA FBOs also added the presence of an Agribusiness Center (ABC). These centers were provided by the project to form as a meeting and learning place for the FBOs. It also harbors a tractor and its implements as well as rice mills for rice processing. They also mentioned of some roads that were constructed to link some communities to the main road, as well as the existence of the FBO itself. Most of the FBOs were formed purposely because of the MiDA program and they still exist four years after the end of the Project.

Why projects were unsuccessful

A lot of reasons were also given under this question. Again the responses are ordered in terms of frequency.

1 The implementers were not serious
2. It was very complex
3. We lacked information
4. It was expensive to implement
5. Do not know
6. We did not need it
7. Our chiefs did not support it
8. FBO organizational problems
9. Ethnic unrest
10. No credit component
11. Apathy towards the implementation

Most of the farmers blamed the unsuccessful nature of some project to the nonseriousness the implementers attached to the project. They claim it often leads to the truncation of the project without any official communication from the implementers. Sometimes, the complexity of the project couple with lack of information makes it difficult for the farmers to identify with it. The farmers in the rural Northern region are mostly illiterates who find it difficult to identify with anything that is little complex. A farm insurance project was launched in the Savelugu Nanton district, which the farmers thought was too complex for them to understand not to talk of adopting it. Farmers did not turn up for the second meeting and that marked its demise. Farmers also alluded to the fact that some projects are not just feasible in terms of their financial situation. The implementation of those projects is expensive both in terms of time and money.

The case is worsened when those programs do not have a credit component. Examples were given of projects that came to promote a high yielding hybrid maize seed which require four times the fertilizer they normally use. The other common answer to our question was 'I do not know'. This was mostly coming from FBO members. When a program is discontinued, the reasons are not normally communicated to the FBOs, hence this response. As mentioned earlier, the farmers thought some projects are just not important to them, that is, they do not need it. This normally leads to the abandoning of the project or it ends without making any impact.

In some cases, the traditional authorities impede on the implementation of certain projects. Even though Ghana has a constitution, the traditional authorities (Chiefs and kings) wield much power and authority especially in the rural setting. They have full control over all lands under their jurisdiction. In instances where they are not okay with the implementation of a certain project they have all what it takes to stop the project or impede it implementation. One sure way is by refusing to give out lands. Few farmers blame the truncation of some projects on the organizational structure of their FBOs. Sometimes organizational conflicts can crop up in the middle of a

project implementation. This normally arises out of distrust among members and executives of the FBO. There are sometimes ethnic conflicts in the region. Some farmers attributed the failure or the truncation of some projects to the emergence or start of a conflict between families or tribe within the district.

There was only one farmer who raised a very vital point that is worth mentioning. He explained there is general apathy towards projects if they do not have the credit component. Their main concern is what they will use to implement the recommendations of the programs on their farms. The last concern was a reason a farmer felt contributed to the general apathy towards agricultural programs. He said they are confused on what to do concerning good farming practices and other agricultural educational programs. For example, whiles some projects came to discourage them on the use of chemical fertilizer, others encouraged them to even apply more of it. The same contradiction is seen in the use of pesticides.

What are their needs?

About 95% of the reasons assigned to the failure of the projects would have been avoided if time was invested in conducting NA. Each respondent was asked to rank in order of importance, what they think their Needs are, as farmers. We also arranged their responses in order of frequency as seen below;

1. Tractors and plough
2. Credit of various forms
3. Irrigation
4. Wells and boreholes
5. Electricity
6. Roads

The availability of tractors is a major need according to the responses. If the land is not ploughed, nothing can be done in the farming season especially for cereals. Normally the Northern region has a single maxima rainfall pattern which lasts for about five months. However, the unpredictability of the rains forces farmers to wait till it starts before they can plough. When the rains finally set in, there is a mad rush for tractors to plough the land. The tractor operators takes an advantage to exploit them by either charging them exorbitant prices or ploughing less than the required land size. A farmer in the East Gonja district explained that some members of their FBO could not cultivate their crops because it is always late by the time the tractors get to their turn. Those who are not able to plough on time will normally end up abandoning their farms or harvest very little. Even though they admitted an ownership of a tractor by the FBO would have been better, they just need it to be available when they need it. Credit was the second most important need according to the responses. They are of the view that, the availability of credit will help expand their scale. With the exception of a few, most of them use up their harvest before the next farming season. This is because, the size of the farm they are using commensurate the little capital they have for the farming season. The credit they said could be of any form; cash or rendering services on credit. According them the most common one is the rendering of agricultural services on credit. For example, the tractor operator can plough additional acres on credit, payable after harvest. Agro dealers can also extend more fertilizers and pesticides on credit. The mode of payment is mostly the harvest. For example, the supply of a bag of fertilizer on credit will attract one and half bags of maize. Irrigation facilities to them will not only help them cultivate in the dry season but will help augment the rains when it delays in starting. Even though the rains come in a short period, it is normally very heavy that most parts of the region get flooded. All what is needed is a technology to harvest this water during the raining season. Most parts of the region lack portable drinking water. They rely on the streams and dams which dry up in the dry season. Some part of the region is blessed with underground water, however extracting it has always been a problem. Though the need for wells and boreholes are not for agricultural purposes they still saw it as a necessity. This underground water also has the potential for irrigation in the dry season. The availability of electricity will help directly in the agro processing and other related agricultural activities. Roads will ease transportation and other related agricultural activities.

Needs assessment techniques

Watkins et al. (2012:83) outlined 7 techniques, Royse et al. (2009:44), Witkin and Altschud (1995:101) and Swanson et al. (1997) also outlined some techniques. Swanson et al. (1997) however went a little further to classify them into four major categories; individual, group, secondary source, and rapid rural appraisal techniques. With this categorization, we group all the techniques outlined by the above references in Table 3.

As observed earlier, there were some kind of NA conducted for the projects deem successful; MiDA, EPDRA, SEND Ghana and the Nucleus farmers. We narrowed the discussion to these projects so as to identify the sort of NA technique or techniques that were used. The responses from those questions are matched with the NA techniques in Table 3 to determine what specific technique or category of techniques was used. We assume every project will one way or the other refers to some secondary source about the region. More so, the use of this technique cannot be verified from the farmers. We are therefore left with two groups since the fourth category is already a combination of the other three categories (Table 3).

Table 3. Needs assessment techniques.

Individual	Group	Secondary source	Rapid rural appraisal
1). Face-to-Face Interviews. 2). Key Informant Interviews. 3). Questionnaires. 4). Informal personal observations. 5). Formal personal observations. 6). Dual-Response Surveys. 7). Critical Incident technique.	1). Community forum 2). Focus group 3). Delphi 4). Nominal group 5). World Café 6). Informal group 7). Dacum process	Document and Data Review can be done by using information from; 1). Census Reports. 2). Previous Studies 3). Administrative Records and Reports 4). Guided Expert Reviews	This method is a synthesis of the other 3 categories in a superficial way especially when the information is needed urgently. (Freudenberger, 1994)

Matching responses about programs to the above NA techniques, we found out that MiDA used focus and nominal group techniques. The farmers claim to have had series of meetings with the FBOs as whole and separate meetings with only their executives. EPDRA also uses face-to-face interviews as well as some form of nominal and focus group techniques. Like the EPDRA projects, some Nucleus farmers also use face-to-face interviews, nominal and focus group techniques. In addition some of them employ informal group techniques and informal personal observation since they are part of the community. Even if their package is not holistic they know the specific need they should target by their program, since they are part of the community. From the responses in the East Gonja districts it was discovered that SEND Ghana programs used focus group technique to solicit the marketing needs of their FBOs.

Prioritizing NA techniques

With the multidisciplinary nature of NA, it is almost always impossible to define the most suitable method to be used in conducting it. Every need, targeted audience, organization and community is unique and hence depending on the practical feasibility and the researcher's discretion, a suitable method or a combination of methods will be used. However in the area of agriculture that deals with the holistic rural community, the type of data being sort should be facts and not opinions. The data should be voluntarily given by the farmers and are well informed of its intent. Witkin and Altschud (1995:46) has it that there are two kinds of data collected for NA purposes; they are facts and opinions. Researchers should go for the facts and even when respondents mixed it up with opinions, they should be able to separate them. With this consideration, a lot of NA techniques fall short of the criterion to establish an agricultural program which seeks to promote voluntary participation, adoption, and sustainable implementation of outcomes. This does not close the doors on the use of the other techniques but just to emphasis that priority should be given in our opinion to some techniques more than others in the area of agricultural programs implementation. Secondly some of the techniques are structurally difficult if not impossible to be used in remote rural setting. Thirdly, some techniques do not promote the participatory extension being promoted by the FAO. Combining these three criterions with the empirical responses from the survey, we prioritized the techniques in order of importance in the context of northern region.

First of all, as can be seen from the results all the successful programs used the group or a combination of group and individual techniques. This goes to emphasize the fact theoretically and practically, individual NA techniques are compliments to group techniques when it comes to agricultural program which seeks to promote voluntary participation, adoption, and sustainable implementation of outcomes. Because of this we are inclined to those that have to do with grouping of farmers and stakeholders in agriculture. From our point of view, unlike other organizations where there is an organizational structure and levels of authority defined, agriculture is not like that. That is why farmers must be involved in every stage of activities leading to the decision making and outcomes. In a private company or government institutions, not everybody must accept a decision before it is implemented. Most people have to just obey and execute instructions. In the case of the farmers, their acceptance is key to the success of any project. Consider observation as a NA technique. When there is any need gap to be closed or solved in a company, observations can be used and recommendations made to the employees by the employers and it takes effect. Even though valuable NA data can be gathered especially through Informal Personal Observations (Swanson et al., 1997), recommendations thereof can be used for anything other than asking farmers and the community to implement them. This will sometimes see an outright rejection or it implementation will be a nine-day wonder.

It is in the light of these that we give less priority to Individual and Secondary techniques. In addition, structurally, telephone interviews will not be effective as few have access to telephones or mobile phones in the rural communities in the Northern region. Questionnaires

for NA purposes in agriculture are mainly used in developed countries (Swanson et al, 1997). Postal survey and Dual-Response Surveys will face the problem of high illiteracy and lack of postal addresses. Very poor record keeping will make Document or Data Review and Guided Expert Reviews techniques less effective. Secondary sources techniques generate data for future use with often unknown application. By it very nature, we do not prioritize it for NA technique for agricultural programs. Agriculture and rural development have ever changing challenges which requires current information and data to tackle them. It is no surprise that it is rarely used by Extension agents as a NA technique. This Sofranko and Khan (1988) attributed to its lack of straightforward application couple with the fact that extension staffs have little understanding about the role of secondary data.

The order

With the group techniques, there is still a need to prioritize them in terms of which technique ultimately promote the whole essence of agricultural programs; that is voluntary participation, adoption, and sustainable implementation. We consider the first four as highly prioritized and the rest less prioritized. In order of priority, they are; 1. Community forums, 2. Focus groups, 3. The World Café, 4. Nominal Group, 5. Delphi Technique, 6. Informal group, 7. Dacum process.

Starting from the bottom of the hierarchy, Dacum process as a group technique is very effective in identifying effective procedures built on a set of behavioral nature of the people involved, for a particular occupation (Witkin and Altschud, 1995:189). As the name suggests (DACUM stands for Developing a Curriculum), its final objective is to develop a curriculum which outlines the job descriptions and captures the best practices in that particular job or occupation. The question now is, is farming not a job? Yes it is and would have been better with such a curriculum. However the dynamic nature of farming does not make it attractive to the use of such curriculum. Farming as a job varies a lot within a particular community not to talk of regional and national levels. The unstructured nature of farming as a job makes its activities very diverse in terms of procedures even within one community. Again, per the procedures in conducting the Dacum Process, people who are successful and out-standing in that job constitute the group (Witkin and Altschud, 1995:189). In the case of farming that will require only successful farmers to form that group for the process. This form of discrimination will ultimately not enforce voluntary participation. Finally, the process itself is very complex and will require not only successful farmers, but highly technical ones who can do a lot of brainstorming on technical issues. In rural communities, this technique is disabled.

Informal groups as a technique in our opinion are not so much different from observation as a technique. According to Swanson et al. (1997), this form of information gathering is done at events which involve the grouping of people. It is believed that, prevailing discussions in those meeting reveal the unadulterated problems confronting the community which the extensionist or the researcher can easily capture. In rural setting, Social gatherings such as recreational, cultural, and religious occasions provide a platform for this, whiles in organizations, tea and coffee breaks provide the environment for this technique. Even though programs formulated from this technique are likely to reflect the authentic views of the people, they will not have confidence in its source. Like observation technique this will be good for structured organizations and public institutions.

The criticisms of Delphi survey technique come in three ways. First the faceless interaction of the participants does not augur well for a rural setting. Farmers do not have confidence in this form of interaction and will not identify their opinions in the final report even if it is captured. Secondly, it is biased towards literates. All contributions and discussions are expressed in writing, making it a privilege for those who can read and write. In rural setting, as researches have shown, the level of education of a farmer does not contribute positively to agricultural productivity (Alemdar and Oren, 2006). The educated farmer considers farming as a second job and does not pay much attention to their farms leading to lower productivity. The literate farmers in many cases may not be the right people to gather information from for NA purposes. Finally the medium with which it is conducted may as well not be appropriate for a rural setting. Most rural communities are so remote that mailed surveys will take a lot of time to reach there, couple with the fact that most of the rural farmers do not have mail addresses with which they can be reached.

The highly prioritized ones (Community forum, Focus Group Interview, World Café and Nominal Group Technique) appear to be more effective both in terms of empirical evidence above and practical application in the study setting. Even though they also have some disadvantages similar to the less prioritized ones, their advantages offset some of these disadvantages. For example, the Nominal group technique shares the second criticism of the Delphi technique; writing skills of participants. However, it is face to face and allows some degree of discussion and sharing ideas verbally. Community forum technique for instance has the advantage of announcing the presence of the program to a larger part of the community. All the four highly prioritized techniques tend to promote trust between the community and the researcher, which is very relevant in project implementation. With the exception of Nominal Group Technique, the rest do not limit participation of people in terms of literacy level. However, it is still worth mentioning that a combination of these group techniques

can yield more effective results.

Case for selected techniques

In the words of Akridge (1992), it is very important to pick a niche in the development of an agricultural program. When the exact problem is not identified the program will end up not fitting anyone in the community. Different farmers will have different views about the same issues and problems. What is happening in someone farm may not be exactly what is happening in the others farm. A Group NA method like community forums, nominal Group, focus group will not only help identify the exact problem, but will open up further discussions about the problem completely unknown to the researcher or the extensionist. Furthermore, these methods provide the implementer a quick, intensive picture of the real problem.

In any successful agricultural program, the trust and confidence of the community is very paramount (Oakley and Garforth, 1985; Petrović et al., 2010; Buck and Alwang, 2011). In outlining the problems in Agricultural programs and Extension Petrović (2010) and the colleagues identified farmers' lack of trust in government, its institutions and as well as its agricultural policies. According to Buck and Alwang (2011), farmers' lack of trust and interest in extension programs emanates from two sources; lack of trust and confidence in the extension agent or implementer and the source of the information. This situation can only be improved if there is a two way communication channel between the stakeholders involved. The group techniques can effectively build trust with the local citizens in planning, publicizing, moderating and evaluating of the program. These group techniques especially the highly prioritized ones has the potential to offset the two concerns raised by Buck and Alwang (2011). What these techniques do is to increase the interest of the farmers in three fronts; 1. When these methods are used in the NA stage, they get a better understanding into the program increasing their trust and confidence in it. Even when there are some grey areas, the researcher through meetings and discussions, takes care of that before the program starts. 2. The fact that the farmers are involved with the researcher and other experts through these techniques boosts the confidence and trust they impose on the extension agent or the implementer. 3. Some farmers especially the less educated who mostly constitute the large proportion of the target group finds confidence and trust neither in the agent or the source, but from their fellow farmers who they consider trust worthy and role models in the area of farming amongst them. These techniques create a situation where these role models form part of the interactions leading to the formulation of the program. Their trust in the program has a ripple effect in this situation. To sum up, the more farmers develop trust and confidence in the agent and source of information, the more they are willing to voluntary participate, adopt, and sustain implementation of outcomes of the agricultural program.

According to Ponniah et al. (2008:62), outlined four major factors for a successful agricultural extension program. First among the four factors is participation and empowerment of farmers and communities. The participation aspect of this has been dealt with in the preceding paragraph. Even though the concepts of participation and empowerment are the catch phrase of the current extension paradigm, their realization depend on the NA technique used. The group techniques ensure their empowerment at the NA stage where they understand and appreciate the whole program. It opens up a continual two-way communication between farmers and all stakeholders involved, which to Ponniah et al. (2008) is invaluable when it comes to fostering participation and empowerment of farmers through agricultural and extension programs. Linkage between farmer groups and institutions, innovative learning and communication and policy, and political influence are considered second, third and fourth factors respectively. With the exception of the fourth factor, the success of all of them is deeply rooted in the group techniques at the NA stage. The employment of any other NA techniques will not guarantee the positive outlook of these factors.

Conclusion

The ultimate aim of every agricultural and extension program is that farmers should voluntarily participate, adopt and implement the outcome in their farms. The greatest success is when this adoption is sustained over a long period of time. Agricultural and extension programs that promote participation and interactions between implementers or extensionists and farming communities should be encouraged. The NA that is conducted before these programs are rolled out goes a long way to ensure the above mentioned measure of success of any agricultural program. It could be seen that, all the unsuccessful programs did not conduct a NA or they used other techniques other than the group and the individual techniques. This accounted for the fact that the farmers had no knowledge of those programs until the implementation stage. All the reasons assigned to why those programs failed would have been avoided if a proper NA techniques was used. The availability of tractors, credit of any form and irrigation facilities are the most pressing needs of the farmers. If a program cannot be holistic like the case of MiDA, it can target any of these for effective impact on the farmers' lives. Going through the prioritized techniques, the common trend that runs through them is the sense of ownership the farmers feel. This translates into whatever extension or agricultural program that comes out of it. As seen from responses of the FBOs and the discussion of the chosen techniques, the group techniques are complemented by

the individual techniques in the context of a rural agriculture. It could be seen that a combination of some group techniques complimented by individual techniques could even provide better results. In our opinion, apart from these group techniques, any other technique can be used with even higher rate of adoption, objective and relevant information gathered but sustainability and sense of ownership cannot be guaranteed which is very crucial to rural agricultural development.

Conflict of Interests

The authors have not declared any conflict of interest.

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