

Adoption of Appropriate Good Agricultural Practices (GAPs) Technologies among Smallholder Farmers in Nigeria

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Low and slow adoption of modern agricultural technologies among smallholder farmers many times discourage researchers and innovation promotion efforts in Sub-Saharan Africa communities. That is particularly true for improved technologies that require working capital and little time to materialize. This study investigates the level of awareness and the adoption of Good Agricultural Practices (GAPs) technologies among smallholder farmers in Kaduna State Nigeria. The study utilized a mixed methods approach to survey 200 smallholder households in Giwa and Sabon-gari Local Government Area of Kaduna State, Nigeria. Findings show that the level of awareness of GAPs technologies was low among smallholder. The study also found that after the GAPs training there was high level of adoption and acceptance of the GAPs technologies by smallholder farmers. Similarly, the chi-square test results show that thirteen (13) GAPs technologies were statistically significant at ($P < 0.05^{**}$). It was found that a greater proportion (84%) of the farmers indicated that the GAPs trainings were effective and provides them with new skills and information. The study also found that extension visits and SMS text reminders interventions encouraged farmers and had positive impact on GAPs adoption. In this study, smallholders unanimously ranked financial constraints, high cost of fertilizers and addiction to traditional method of farming as the major barrier to adoption in the study area. The study also recommends that agricultural policy maker should streamline improved technologies to the meet specific conditions of the rural communities for more rapid adoption and sustainability. Government should invest in improved technologies considered to be cost effective with a clear impact on the adoption decisions of smallholders.

Keywords: Adoption, awareness, good agricultural practices, smallholder farmers, technology.

INTRODUCTION

Smallholder farmers within Sub Saharan Africa (SSA) face a number of challenges both in terms of

production and in marketing their surplus produce. Generally, the focuses of agricultural policies are to

guide farmers to optimize production without damaging the natural resources they depend on. Agricultural production in Nigeria has been largely dependent on the concerted efforts of small-scale farmers who are mainly in the rural areas. Ogungbile and Olukosi (2001) outlined the common characteristics of resource-poor farmers which include; stark poverty, illiteracy, malnourishment, financial inadequacies and low rates of return on their small investments. In order to address some of the challenges faced by stakeholders, a number of policies and extension strategies have been implemented, one of these was the World Bank Assisted Agricultural Development Projects (ADP) that were introduced into Nigeria in 1975 including the component of the Training and Visit (T&V) extension system which was initially enthusiastically adopted in many states (Idachaba, 2007; Sennuga et al., 2020a).

GAPs entail the collection of principles for on-farm production and post-production processes, aimed at delivering in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability (FAO, 2010; Lefebvre et al., 2015; Sennuga, 2019). GAPs cover a range of areas including maintaining soil fertility, water resource and irrigation management, crop land management, degraded land restoration, animal production and welfare, integrated pest management, integrated fertilizer management and conservation agriculture (FAO, 2010; Montagne et al., 2017). GAPs explicitly aim to increase the supply of safe and high-quality food by promoting more sustainable crop production (Sennuga, 2019) while also helping to improve market access and farmers' livelihoods (Poole and Lynch, 2013). Although GAPs have the potential to play a significant role in improving agricultural practices, there is currently limited empirical evidence on the level of awareness and implementation of GAPs.

GAPs were introduced and implemented by the FAO in many agricultural producing countries across the globe in order to guide the production systems towards an ecologically safe and sustainable agriculture, which produces harmless products of higher quality, contributes effectively to food security, generating income through the access to markets and upsurges the working conditions of farming families (FAO, 2010). GLOBALGAP is a privatized version of GAP adoption formulated into audited standards linked to access to more formal markets

including exports. As such, they can underpin the production of safe high-quality food and non-food agricultural products for the producer countries (Oyewole and Sennuga, 2020). Global GAP standards are economically, socially, environmentally responsible and widely accepted by international markets such as the EU and USA (Wannamolee, 2010; Sennuga et al., 2020b). From all views, GAPs can be of significant benefit and high value if judiciously implemented by smallholder farmers as proponents of those good practices. They rely on four major principles:

- i. Economically and efficiently produce sufficient food security, safe food safety and nutritious food (food quality).
- ii. Sustain and enhance natural resources
- iii. Maintain viable farming enterprises and contribute to sustainable livelihoods.
- iv. Meet the cultural and social demands of society.

The awareness of GAPs is relatively low in rural Nigeria due to dependence on traditional farming which results in low productivity among smallholder farmers (Oladele and Adekoya, 2006). Evidence from studies conducted among smallholder producers indicates limited adoption of improved technologies (Omonona et al., 2016, Oyewole and Sennuga, 2020, Sennuga and Fadiji, 2020). However, land degradation, pests and diseases, lack of appropriate production technologies, lack of labour-saving technologies for field operations and processing, and inadequate supply of yield-enhancing inputs and poor harvest agricultural practices are major factors influencing low agricultural production in Nigeria (Binam et al., 2011; Masette and Candia, 2011). In addition, market-related constraints such as limited access to credit facilities, high cost of farm inputs, poor access to output markets; and weak linkage between farmers and markets (Udoh and Omonona, 2008). Ineffective extension systems and lack of policy incentives also constrain agricultural productivity (Binam et al., 2011, Sennuga and Fadiji, 2020). These challenges adversely affect food security and sustainable agricultural development. For maximum benefit however, it is imperative to couple adoption of GAP innovations with an accompanying market uptake pathway for sustainable agricultural development and food security (Kassie et al., 2010; Sennuga et al., 2020a). As a result, it is evident that the adoption of market-driven GAPs, agricultural production technologies coupled with natural resource

management practices is essential for enhancing agricultural productivity in rural Nigeria. Therefore, the main objective of this study is to find out the level of adoption of appropriate Good Agricultural Practices technologies among smallholder farmers in Kaduna State, Nigeria (Table 2).

The specific objectives of this study are to:

- i. examine the socio-economic characteristics of the farmers in the study area;
- ii. investigate the level of adoption of GAPs technologies by the respondents;
- iii. explore the effectiveness of the GAPs training among smallholder farmers;
- iv. explore the impact of extension visits and SMS text reminders on GAPs adoption;
- v. highlight the barriers to adoption of GAPs technologies in the study area.

METHODOLOGY

Study area

The study was carried out in two rural communities (Shika and Bassawa) in Giwa and Sabon-gari Local Government Areas of Kaduna State, Nigeria. Kaduna State is politically classified as belonging to the North-West zone of the six (6) Geo-political zones of Nigeria, which is located in the Northern Guinea Savannah agro-ecological zone of the country and experiences a tropical continental climate with two recognizable seasonal, dry and rainy seasons. Constitutionally, the state is divided into twenty-three Local Government Areas (Sennuga et al., 2020). Among these are Giwa, Sabon-gari, Kaura, Kaduna North, Birni Gwari. These areas are largely dominated by Hausa and Fulani with other ethnic groups. The study area was purposively selected due to active engagement of the rural dwellers in agricultural production in the district and for its proximity to Ahmadu Bello University, Zaria to facilitate access for the researcher and the assistants. The researcher collected the list of smallholder farmers in the study area from the office of Agricultural Development Programme (ADP) the government extension sector who is working in the area. From the context of fieldwork, the two communities are similar in agro-climatic, ethnic group, religion and cultural settings. The major cash crop in the area is ginger where commercial quantities of 1,728.930 metric tons are produced annually as well as food crops including yam, maize,

millet, groundnut, rice, cassava, beans, guinea corn.

Participants and data collection

The sample size for the study was 200 smallholder farmers (Table 3). It consists of 100 farmers from each community. Village meetings were organized during the first visit to the study area. However, during the second visit (April 2017) to the study area, the researchers, assisted by two extension workers from academia, National Agricultural Extension and Research Liaison Services (NAERLS) who communicate effectively in local dialect (Hausa language) and are also familiar with the targeted study area, undertook a farmer participatory training programme on 16 GAPs technologies. The farmer participatory training was strategically designed by the researchers as a farmer-centered process of purposeful and creative collaboration between the researcher and smallholder farmers. The main purpose of this collaboration was to develop GAPs technologies that would meet the local environmental conditions of the smallholder farmers via exchange of experiences with the farmers and to actively involve the end-user (farmers) in the development process. Rather than developing and releasing “perfected” technology packages which may eventually not meet the farming and living conditions of the farmers (a typical top-down approach). Oladele and Adekoya (2006) observed that the awareness of GAP technologies is relatively low in rural Nigeria. The 16 GAPs technologies collectively selected as appropriate for the training in the communities includes; improved seeds, soil management, spraying of herbicide, pesticide control, improved planting spacing of crops, use of crop residue to feed livestock, cover crops, striga control, water management, crop rotation, improved storage, compost and green manure, zero tillage, spacing and mulching.

Study sample and sampling technique

The sample size for the study was 200 smallholder farmers (Table 3). It consists of 100 farmers from each community. Within each community, farm families were invited to participate in the study through community meetings, in which 137 farmers attended from Bassawa and 142 from Shika, and 8 extension workers were in attendance. From this sampling frame of individuals, 100 farming households were randomly selected from each

Table 1. Demographic representation of the socio-economic Characteristics of the smallholder farmers (n= 200).

Variables	Percentage
Age (years)	
20-30	15.8
31-40	31.7
41-50	27.5
51-60	17.5
61-70	6.7
> 70	.8
Gender (Sex)	
Male	100
Female	0
Marital status	
Single	3.3
Married	96.7
Household size	
≤10	50.8
11-20	36.4
21-30	12.1
>31	.7
Level of education	
No education	30.8
Primary	44.3
Secondary	17.0
Tertiary	7.5
Family education	
No education	3.3
Primary	55.0
Secondary	35.8
Tertiary	2.5
No Children yet	3.3
Household Asset	
Poultry	58.0
Sheep and goats	61.7
Cattle	42.8
Other livestock	6.5
Pig	0

community; primarily on the basis of volunteer families. The other criteria for individual participants were as follows: age between 18 and 65years, farming experience, interested in participating, and permanent resident in the community. The foremost rationale for selecting 100 farmers per community were based largely on the number of farming households that volunteered and showed interest during the community meetings, as well as conformed to the previously mentioned criteria. In the same vein, this study seeks to have a deeper understanding, exploration and in-depth analysis of a real-life situation, which the effectiveness of agricultural technologies training programme and adoption of GAP technologies. Data were collected using focus group discussion, in-depth interview and structured questionnaires.

Data analysis

The data collected were analyzed using the Statistical Package for Social Sciences (SPSS) to produce percentages from frequency distribution, spearman correlation and ranking etc.

RESULTS

Socio-economic characteristics of the rural dwellers in the study area

The socio-economic characteristics of the respondents investigated in the study included: age, sex, marital status, household size, level of education, major crops cultivated, household assets and income level. The age of the farmers in the households ranged from 20 to 70 years. 59.2% of them fell within the middle age of 31-50years in both communities. This suggests that the majority of the respondents were within their economic active age and this enhances their productivity in order to be food secure ([Table 1](#)). The old age group (51-70) had the lowest impact in farm work with 24.2% contributing to active farming among the sampled population. However, it is generally assumed that younger people tended to be more productive than their older counterparts. In the same vein, the results in [Table 1](#) showed that all the respondents were males; this is because the cultural traditions of the study area do not allow females to be actively involved in farming activities (Sennuga and Fadji,

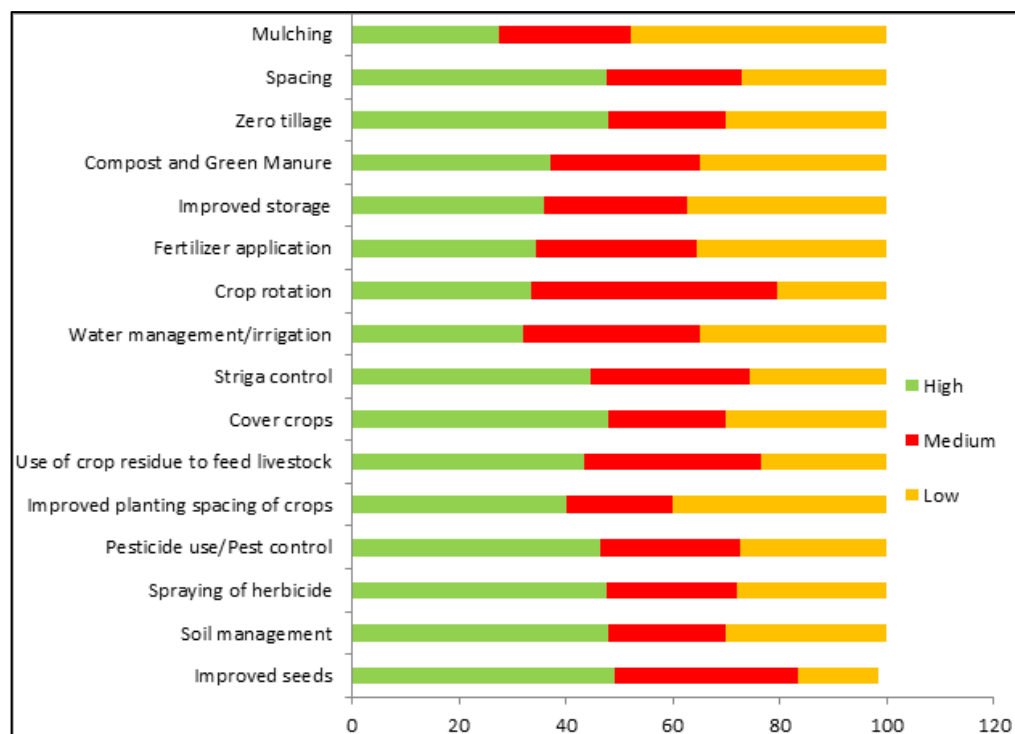


Figure 1. Level of awareness before GAPs training by the survey respondents (N=200) Scale: %

2020). In term of the marital status of the respondents, overwhelming majorities (96.7%) of the respondents were married with half of these households having 10 or more members; the remainder had larger families of 21 plus members reflecting polygamy within the communities. The result is not surprising because large family sizes are the norm in the Northern Nigeria and large families provide accessible workforces. Furthermore, the cultural tradition and religion allows the men to marry at most four wives. The use of household labour for several activities was very common in the study area with activities such as ploughing, harrowing, planting, weeding, chasing away straying domestic animals, irrigation activities and harvesting. In the same vein, large household may also help to access more agricultural information.

Educationally, 44% of the respondents had acquired primary education, while 17% had secondary education. Only 7.5% of the respondents possessed higher education (Table 1). This suggests that the respondents in the study area obtained the basic education required for better understanding and ability to embrace new

technologies especially the adoption of GAPs modern farming technology. In addition, it is generally thought that the level of education enhances the ability to comprehend and also adopt relevant agricultural information. Indeed, according to Kalungu and Filho (2016) and Sennuga (2019) highly educated farmers tend to adopt relevant agricultural technologies better than more illiterate ones. In term of household asset, 58% of the household keep poultry, a greater proportion (61.7%) keep sheep and goats. A sizeable proportion of the respondents (42%) also indicated that they rear cattle and only 6.5% specified that they keep other livestock such as camel, duck, turkey etc. The baseline livelihood survey shows that no single household keeps pigs in the study area. This was attributed to the religion (Muslims) of the respondents. It was revealed during the focus group discussion that the Muslim faithful do not rear pigs.

Level of Adoption of GAPs technologies by the respondents

Data in Figures 1 and 2 reveals the level of

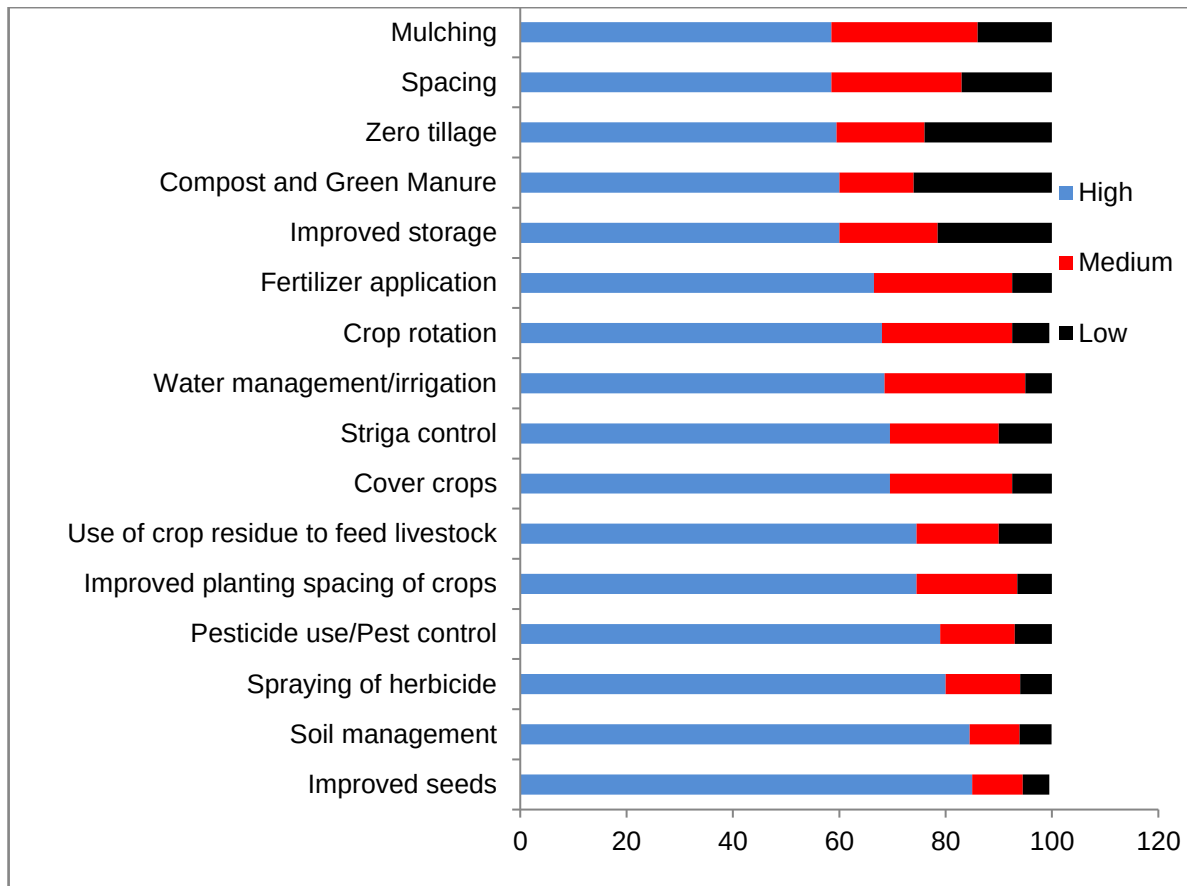


Figure 2. Level of adoption After GAP training by the survey respondents (N= 200) Scale: %

awareness of GAPs technologies by the surveyed before and after (i.e., pre and post) workshop or training on GAPs technologies. Prior to the GAPs training, a total of 200 questionnaires were used to elicit information from the respondents, farmers were requested to indicate their level of awareness and level of adoption of improved technologies by using a three-point Likert rating scale. The scale was as follows: High = 3, Medium = 2 and Low = 1. The level of adoption was determined using Spearman rank correlation. **Figure 1 (a - b)** gives the summary of the estimated results.

Figure 2 shows that all the GAPs technologies displayed various degrees of adoption level after GAPs training among the smallholders. In the same vein, chi-square test results revealed that 13 GAPs technologies were statistically significant at $P < 0.05$ level indicating high level of adoption and acceptance of the GAPs technologies by smallholder farmers. They are: improved seeds, soil management, spraying of herbicide, pesticide control, improved

planting spacing of crops, use of crop residue to feed livestock, cover crops, striga control, water management, crop rotation, improved storage and compost and green manure. Generally, eleven out of the 16 GAPs technologies developed together with the smallholder farmers and trained in a participatory approach have been classified as high adoption while two of the GAP technologies were regarded as medium and the rest (3) of the GAP technologies fell under low adoption (**Figure 2**). The data shows that farmers rated GAPs technologies high after the workshop or GAPs training in terms of technology transfers in the study area.

Effectiveness of the GAPs Technologies Training among Smallholder Farmers

Training is assumed to have a strong influence on the adoption decisions of smallholders since it creates awareness about new improved technologies. During the focus group discussions with farmers,

Table 2. Benefits of GAPs training among smallholder farmers.

Benefits GAPs training among farmers	Percentage
Providing farmers with new skills and information	84.6
Easy to understand because we are familiar with/trust the lead farmers	76.3
Providing intensive support	69.4
Ability to work together as a community	64.2
Increased quantity of crops this farming season	58.1
Improved family welfare	55.3
Adoption of more GAPs technologies	52.7
Increased household income and standard of living	49.1
Acquisition of additional farmland	46.0
Enhanced education and level of farmers' socialisation with others	42.2

**Multiple Responses; Source: Field survey, 2017

Table 3. Interventions employed in the study area.

Shika Village (100)	Bassawa Village (with-SMS group)
GAPs technologies training	GAPs technologies training
	Four (4) Extension visits
	SMS text reminders fortnightly

several issues relating to the effectiveness of participatory extension delivery in the area and GAPs training were discussed. Smallholders revealed that GAPs Technologies Training was very effective and beneficial to them. Specifically, participants were asked to mention benefits of agricultural extension services, particularly those derived from the farmer participatory training on GAPs technologies either directly from the researcher or from lead farmers to the trainees. A number of key factors emerged. The benefits of GAPs training listed by smallholder farmers include:

Impact of Extension Visit and SMS Text Reminders on Agricultural Technology

During the second visit to the study area, farmers (Bassawa village) received five extension visits and Short Message Service (SMS) fortnightly from the researchers. In order to establish whether the extension visits and SMS text messages sent to farmers in Bassawa village had strong benefits, in addition to the GAPs technologies training. Therefore, analysis was undertaken between farmers who had received the training only (Shika village) and

those who had received the GAPs training but also had received an extension visit and SMS text reminders (Bassawa village). The positively significant rank of extension visits made to the farms of the with-SMS group (Bassawa village) by the researchers as reported in the methodology had a positive and significant impact ($P < 0.001^{**}$). This suggested that extension visits conducted after the GAPs training to the farmland of the farmers (Bassawa village) had positive and significant impact. The findings imply that regular visit of extension workers may enhance the rate of adoption of improved technologies by smallholder farmers. According to the findings in [Table 4](#) all aspect of the intervention had positive and significant impact on GAPs technologies adoption, for example, the results of this revealed that (GAPs participatory training, SMS reminders and extension visit) triggered the adoption among the smallholder farmers in the study area. The findings imply that no single intervention could successfully influence GAPs adoption in the study area. This intervention also serves as motivation for the decision to adopt agricultural technologies.

The results of the study showed that the

Table 4. Spearman rank test of the Impact of Extension Visit and SMS Text Reminders on GAPs Technologies Adoption (Bassawa n= 100).

Variables	Spearman Rank	P-value
Education level	0.453**	0.011
Age	0.302**	0.005
Farm size	0.389	0.063 ^{NS}
GAP participatory training	0.053**	0.000
SMS Text Reminders	0.379**	0.000
Four (4) Extension visits	0.36	0.001**

Source: Survey 2017; P < 0.05 is significant

interventions employed by the researchers encouraged the adoption of the GAPs technologies via extension services by providing quality, complementary, adequate and appropriate extension services immediately after GAPs training which enabled farmers to adopt and implement the recommended technologies more easily. These results revealed that agricultural technology embodies a number of important characteristics that may influence adoption decisions. It is unfortunate however that the majority of the smallholders in rural areas of Nigeria had not been able to obtain technological information previously perhaps due to poor extension service delivery, lack of social amenities, lack of technical know-how and access to communication medias. The findings imply that regular visit of extension workers may enhance the rate of adoption of agricultural technologies by smallholder farmers.

Similarly, in order to measure the impact of extension visits on GAPs technologies amongst with-SMS farmers (Bassawa village), the evaluation survey employed some parameter estimates to measure the impact. These include; education, the age of the household head, farm size, road network and participation in the GAPs training. **Table 4** reports the analysis of the findings on the impact of access to extension visits on with-SMS farmers (Bassawa village) on levels of GAPs adoption. The results of the spearman rank test revealed that the estimated parameters were statistically significant in terms of having an impact on GAPs adoption levels. This finding suggests that receiving four (4) extension visits could influence farmers positively and improve technologies adoption and crop productivity. The results revealed that Bassawa farmers, who received

extension visits during the cropping season and SMS text reminders followed technical training and extension advice, adopted more than 78.5% of the recommended GAP technologies. This result is consistent with what was found regarding the impact of GAP training on adoption (**Table 4**).

Nevertheless, a number of barriers to technology adoption were identified by the without-SMS farmers. Barriers identified by this study include; poor information, lack of capital, the high cost of herbicides and preference for conventional farming methods. The findings also identified that the majority of farmers use their mobile phones to call extension workers from ADP and NAERLS for advice, as well as people like traders and other farmers who are in possession of agricultural related information.

The article has also presented the findings from the semi-structured interviews conducted in the third phase of the study which were used in conjunction with the survey to aid better interpretation of the results. The interviews identified some impacts of the GAP training and action plan amongst the sample farmers as well as some impacts associated with the SMS text reminders. The research further identified drivers or reasons behind with-SMS farmers' decision to adopt GAP technologies and highlighted some constraints facing smallholder farmers' access to markets in the study area.

There was a rapid increase (85%) in the level of adopted of improved technologies after the farmer participatory training among the respondents compared to pre-training (49.5%). There was a strong positive correlation ($r = 0.001^{**}$, $p < 0.05$) between participatory training sessions and adoption of GAP. The use of participatory GAPs training, extension visits to farmland and SMS text

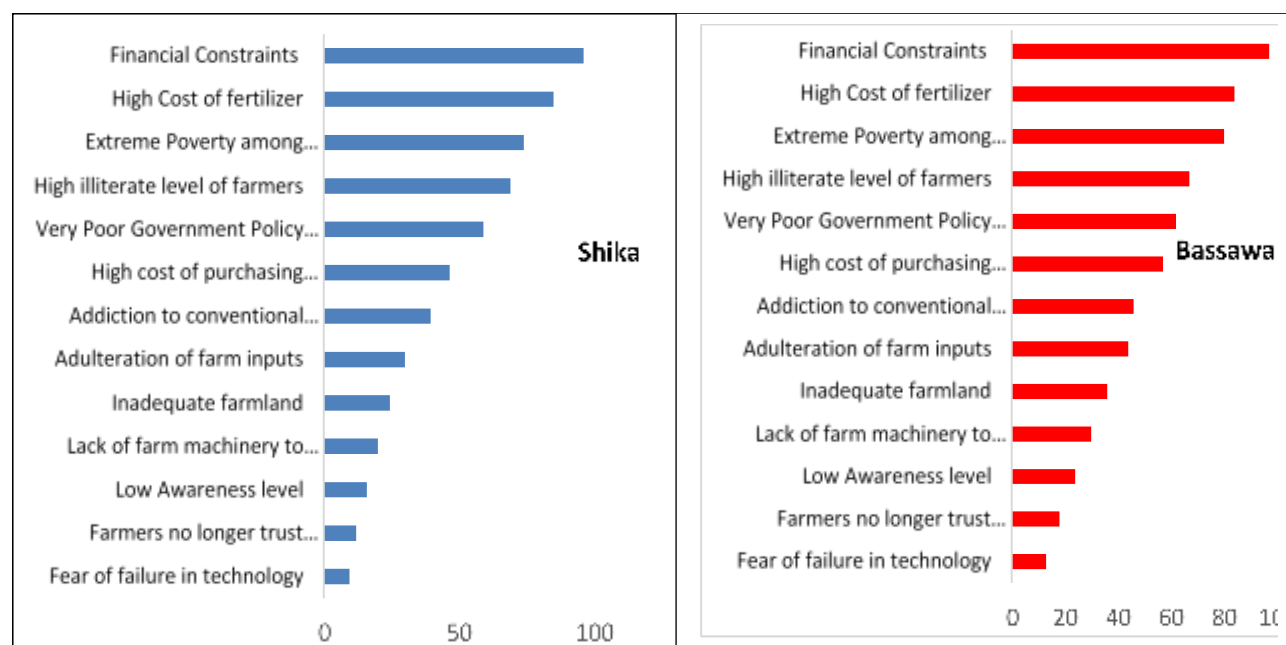


Figure 3 (a-b). Barriers to adoption of GAP technologies by farmers in the study Area
Source: Survey; Shika n=100, Bassawa n=100; Scale: 100%

Table 5. Chi-squared analysis between the communities in relation to extension and government policy on agriculture.

	Shika		Bassawa		Chi-squared	Df	P-value
	Yes	No	Yes	No			
Very Poor Government Policy on Agriculture	89	11	78	22	46.39	5	0.001**

Source: Survey; Shika n = 100, Bassawa n = 100; P < 0.001 is significant

Reminders have shown to influence farmers' decisions to take up recommended GAP technologies.

Barriers to Adoption of GAP Technologies in the Study Area

Smallholder farmers from Shika and Bassawa were requested to state the reasons why they do not adopt GAP technologies. Farmers highlighted the barriers to adoption and also ranked them in the order of importance (Figure 3, a - b). They unanimously ranked financial constraints as the major barrier to implementation, followed by high costs of fertilizers and extreme poverty level in the study area. High illiteracy levels of members, very poor government

policy in agriculture and the high cost of labour, herbicides and improved seeds, and addiction to the traditional method of farming were ranked 4th, 5th, 6th, 7th and 8th respectively (Figure 3, a - b). Other barriers cited by smallholders included adulteration of farm input in the markets, inadequate farmlands, lack of farm machinery to assist members, low awareness level, farmers no longer trusting extension agents and fear of failure of improved technology were also noted. Moreover, as shown in Table 5, the Chi-squares analysis revealed that there is a statistically significant difference between the communities in relation to extension experience and government policy on agriculture. The two factors were statistically significant at <0.001 level (Table 5). However, other factors were not statistically

significant. This shows that Bassawa community is more open to extension services and more influenced by the project.

CONCLUSION

This article investigated the level of awareness and adoption of appropriate GAPs among smallholders before and after the GAPs training in the study area. The study main finding is that the level of awareness of improved agricultural technologies was low among smallholder before the GAPs training. However, immediately after the training was conducted in the area, the study revealed that level of adoption was very high. The chi-square test results revealed that 13 GAPs technologies were statistically significant at $P < 0.05$ level indicating high level of adoption and acceptance of the GAPs technologies by smallholder farmers. The study also found that extension visits and SMS text reminders interventions encouraged farmers and had positive impact on GAPs adoption. In this study, smallholders unanimously ranked financial constraints, high cost of fertilizers and addiction to traditional method of farming as the major barrier to adoption in the study area.

RECOMMENDATIONS

The study recommends that Federal Ministry of Agriculture and Rural Development, should understand what knowledge and attitude smallholders have in relation to these Good Agricultural Practices technologies and how the technologies are introduced to the farmers. Subsequently, agricultural policy can streamline these technologies to the meet specific conditions of the rural communities for more rapid adoption and sustainability. In the same vein, the effectiveness of GAPs training/workshop helped towards influencing farmers' decisions to adopt the given technologies. Thus, there is a clear indication of need for empowerment of Nigerian Agricultural extension system in diverse ways first, by training smallholders both in conventional (i.e. fields demonstration and training program) and non-conventional (modern ICTs) techniques and carefully choosing the right training methods and period convenient for the farmers. Second, Government should endeavor to strengthen the Agricultural Development Project (ADP) extension agents and material resources of

local and national extension system. Finally, Federal Government should invest in improved technologies considered to be cost effective with a clear impact on the adoption decisions of smallholders.

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