Vol.11(11), pp. 200-207 November 2019
DOI: 10.5897/JAERD2019.1078
Articles Number: 7DEE51362301
ISSN: 2141-2170
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Journal of Agricultural Extension and Rural Development

Full Length Research Paper

Factors influencing the adoption of improved cowpea varieties in the Sudan Savannas of Northern Nigeria

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Received 26 February, 2018; Accepted 26 March, 2018

The study was undertaken to determine the level and factors influencing adoption of improved cowpea varieties introduced by the Sudan Savanna Taskforce project in Musawa Local Government Area of Katsina State. Data were collected from a random sample of 300 households from ten communities in the study area. The analytical tools used for data analysis include descriptive statistics to examine the level of adoption of improved cowpea varieties and Probit and Tobit regression models to identify factors that influence the adoption and intensity of use of the varieties respectively. Results from the analyzed data indicate that more farmers were aware of improved cowpea varieties by a magnitude of 40% and adoption improved by a magnitude of 35.7% adoption. In addition, households with formal education, extension contact, those who participated in the project activities, members of associations and cowpea growing experience are more likely to adopt improved cowpea varieties. Similarly, factors influencing the intensity of adoption were gender of farmers, extension contact, membership of association, participation in project activities and rearing of livestock. Finally, the study recommends that farm expansion and intensification of extension services would be an incentive to adoption decisions by small-scale farmers in the study area and extended to the less educated farmers. Furthermore, there is a need for special training, seminars, field demonstrations and technical support for the cowpea farmers.

Key words: Adoption, factors, improved cowpea varieties, Sudan Savanna Taskforce.

INTRODUCTION

International agricultural research centers are one of the key institutions mandated for the generation and development of innovations for increasing agricultural productivity across the world. Technology development and transfer play a crucial role in attaining the main goal to increase agricultural output, productivity and the welfare of rural households.

Cowpea, (*Vigna unguiculata* L. Walp.), is an important leguminous crop in Musawa Local Government Area (LGA) and Katsina State at large (Ayanwale et al., 2009). As a legume, it is important for nutrient cycling because of its tolerance to drought and soil acidity as well as its

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ability to fix nitrogen from the air for use in the root. It is very well suited to where decline in soil fertility and drought are serious problems (Ibrahim et al., 2016). Cowpea seeds are a major source of plant proteins and vitamins, feed for animals, and a source of cash income (Ibrahim et al., 2016). It is a major staple food and cash crop in the state. The crop has a tremendous potential to contribute to the alleviation of malnutrition among resource-poor farmers and to enhance food security and the productivity and sustainability of the crop-livestock system (IITA, 2009). According to Ibrahim et al., (2016), the low income earners tend to consume more of cowpea food products to get the desired protein than from animal protein. Dugje et al. (2009) reported that in Nigeria, farmers who cut and store cowpea fodder for sale at the peak of dry seasons have been found to increase their annual income by 25%. Cowpea 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 (Tijjani et al., 2015).

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 a long dry season (Singh et al., 2002). All of these factors, singly or combined, are responsible for the low grain yield, estimated at approximately 350 kg/ha rather than 1000 to 2000 kg/ha that farmers in Northern Nigeria, including Katsina State, obtain from their cowpea fields (Singh et al., 2002). According to Dugje et al. (2009), cowpea performs well in agroecological zones where the rainfall range is between 500 and 1200 mm/year. However, with the development of extra-early and early maturing cowpea varieties, the crop can thrive in the Sahel where the rainfall is less than 500 mm/year. It is tolerant to drought and well adapted to sandy and poor soils. However, best yields are obtained in well-drained sandy loam to clay loam soils with the pH between 6 and 7 (Dugje et al., 2009).

In 2008, the Sudan Savanna Task Force (SSTF) project, funded by the Forum for Agricultural Research in Africa (FARA) and led by the International Institute for Tropical Agriculture (IITA) was set up to operate in four LGAs in Kano and Katsina States in Nigeria. The purpose was to disseminate improved agricultural technologies that include cowpea, soybean, maize and rice among others along their agronomic practices to enhance their increase yields. To achieve this, innovation platforms (IPs) comprising coalition of partners and stakeholders were setup by the Sudan Savanna Taskforce to improve agricultural productivity and farmers' incomes. In Musawa LGA/Innovation Platform (IP), the collaborating partners include scientists from the Institute for Agricultural Research (IAR)-Samaru, the International Institute of Tropical Agriculture, 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. Among the technologies promoted by the project in the Musawa LGA of Katsina State are improved cowpea varieties (IT97K-499-35, IT98K-205-8, IT98K-573-1-1 and IT89KD-288 among others). These varieties are of great importance being that they are early maturing, resistance to Striga, insects and diseases, high yielding in both grains, fodders as well as have the potential to contribute to food security. During its implementation stage, the project used the participatory research and extension approach (PREA) (Ellis-Jones et al., 2005) which involved community mobilization to motivate farmers and create awareness about improved technologies, field demonstrations to show-case the performance of improved varieties, mid and end-of season evaluation to obtain feedback from farmers and farmer groups. The project also trained farmers on the use of the improved varieties (Sudan Savanna Taskforce Report, 2011).

Since the inception of the FARA-funded Sudan Savanna Task Force project between 2008 and 2015, it promoted a number of improved cowpea varieties and management practices among farming households, comprising male and female farmers in Katsina State. Until the time of the study however, there was no published information on the factors influencing the adoption of improved cowpea varieties in the study area. Hence, the necessity to evaluate the project with respect to adoption of improved cowpea varieties among farming households in the project area. This study therefore investigates the factors influencing the probability and intensity of adoption of improved cowpea varieties in Musawa LGA. The study was based on the following specific objectives:

(1) To determine the level of awareness and adoption of improved cowpea varieties in the study area.
(2) To estimate the determinants of adoption of improved cowpea varieties in the study area.

METHODOLOGY

Study area

Agriculture is the most important occupation in Katsina State, Nigeria. 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 LGA. It is located within the Sudan Savanna Agro Ecological Zone (AEZ). It is found in the southern part of Katsina State. The LGA 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 with mean annual rainfall ranging between 450 and 650 mm; and duration of not less than 3 months and not more than 5 months (that is, between May and 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 10 communities (study area) based on census conducted by the project was estimated at 21,800 (Sudan Savanna Taskforce, 2009). The vegetation of Musawa LGA is not different from the rest of other part of Katsina State. However, there is sporadic woodlands across the LGA. Major crops grown in Musawa are sorghum and cowpea (Ayanwale et al., 2009).

Sampling procedure and data collection method

Respondents for the study were selected from 10 communities in Musawa LGA where the Sudan Savanna Taskforce project promoted improved cowpea varieties. The communities were Bakam, Dankado, Farin Dutse, Garu, Gingin, Kurkujan, Rugar Fari, Tarbbani, Tuge and Yarkanya. Simple random sampling technique was used for the selection of the sample. Using this technique, thirty 30 farmers were selected from each community to give 300 sampled farmers. Data were collected with a structured questionnaire designed to capture information on households. The questionnaire contained sections on farm and farmer characteristics, market, credit, extension, and awareness/adoption of crop technologies. The questionnaire was pre-tested and administered two months prior to the actual survey by trained enumerators under the direct supervision of the researchers.

Analytical techniques

Data collected were entered using Statistical Package for Social Sciences (SPSS) spreadsheet while descriptive and inferential statistics were used as analytical tools. Descriptive statistics used were frequency counts, percentages and charts, to determine the level of awareness and adoption of improved cowpea varieties as well as the socioeconomic characteristics of the farmers. Inferential statistics used were Probit and Tobit regression models to analyse the factors influencing adoption of improved cowpea varieties.

Probit regression model was used to determine the factors influencing the adoption of improved cowpea varieties in the study area. This model was employed because it accommodates two categories in the dependent variable. According to Bamire et al. (2002), the model has the ability to resolve the problem of heteroscedasticity and it satisfies the assumption of cumulative normal probability distribution. The specification of the Probit model follows:

$$Y_i = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \mu \quad (1)$$

where Y is the dependent variable, the probability of technologies dis-adoption (Dummy: 1, discontinued; 0, otherwise). X_1 = Gender of farmer (Dummy: Male=1, Female=0); X_2 =Age of farmer (years); X_3= Educational level of farmer (Years); X_4 = Cowpea production experience (Years); X_5 = Extension contact (Dummy: Contact=1, No contact=0); X_6 = Membership of association (Dummy: Member=1, Non member=0); X_7 = Participation in project activities (Dummy: Participate =1, Not participate=0); X_8 = Livestock ownership (Dummy: Own livestock=1, Don't own livestock=0); α = constant term; μ = disturbance term or error term; $\beta_1, \ldots\ldots \beta_8$ are the regression coefficients of the independent variables.

Using the Tobit regression mode, therefore it was based on the land area under cultivation of improved cowpea varieties out of the total land area for cowpea production as dependent variable against the independent variables in Equation 1. The functional form of the model following Shiyani et al. (2002) is given as:

$$Y_i = X_i\beta \quad \text{if } i^* = X_i\beta + U_i > T \quad (2)$$
$$Y_i = 0 \quad \text{if } i^* = X_i\beta + U_i > T \quad (3)$$

where Y_i = is the probability of adopting and intensity of use of improved cowpea varieties, I* = is a non-observable latent variable, T = is a non-observed threshold level, X_i = is the vector of independent explanatory variables determining the adoption decision of ith farmer, β are the regression coefficients of the independent. U_i is an independently normally distributed error term with zero mean and constant variance $б^2$.

The equation is a simultaneous and stochastic decision model. If the non-observed latent variable *i** is greater than *T,* the observed qualitative variables *Yi* that indexes adoption becomes a continuous function of the explanatory variable and zero otherwise; the Tobit Model uses a maximum likelihood method to estimate the coefficient of the equation. The regression coefficients are asymptomatically efficient, unbiased and normally distributed.

RESULTS AND DISCUSSION

Adoption of recommended technologies implies that technologies are relevant to the farmers' circumstances. If farmers become aware of technologies or modifications in the use of resources that are relevant to their circumstances and can improve their farm production and thus their welfare, they will most likely adopt these changes (Bashir et al., 2018; World Bank, 2011).

The results revealed that 66% of the farmers were aware of improved cowpea varieties and 35.7% of the farmers were growing the improved cowpea varieties with male (30.7%) and female (5.0%) (Figure 1 and Table 1). In addition, 56.3% of the farmers belonged to associations with 50% being farmers association and 41.5% being members of community development associations as shown in Figure 2. Again, results presented in Table 2 revealed that high income (94.7%), high yielding (89.7%) and early maturing (72.3%) were among the major reasons given why farmers grow improved cowpea varieties

Using the probit regression model in Table 3, five variables were found to significantly influence adoption of improved cowpea varieties. The variables include education of the farmers contact of farmers to extension agent, participation in project activities membership of association and experience in growing cowpea. Similarly, the Tobit regression model in Table 4 revealed that three variables, gender, membership of association and participation in project activities, were significant factors found influencing the extent of adoption of improved cowpea varieties. Extension contact aids farmers understanding on modern innovations, which ultimately help farmers to adopt modern technologies.

The result of this study is an update of the baseline study reported by Ayanwale et al. (2009) who found 26% awareness and 0% adoption of improved cowpea varieties prior to the inception of the Sudan Savanna Taskforce project in 2008. This result implies that the project made tremendous progress in creating awareness that led to the increased level in adoption of improved cowpea varieties. This is not surprising as cowpea is an important food and cash crop. It has many attributes that accounts for its adoption. The increase in awareness

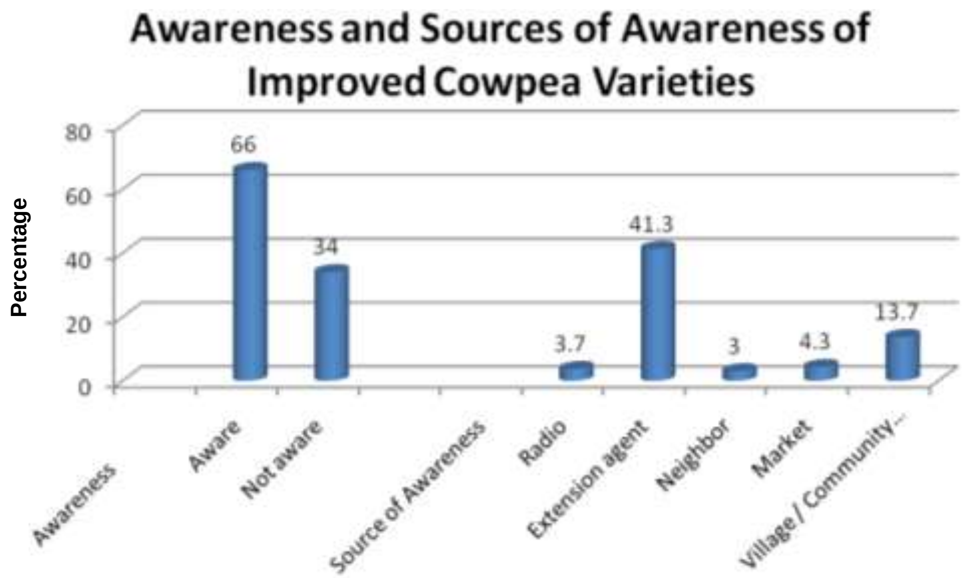

Figure 1. Percentage distribution of respondents according to awareness of improved cowpea varieties and sources of awareness.
Source: Field Survey (2011).

Table 1. Percentage distribution of respondents according to level of adoption of improved cowpea varieties.

Gender	Grow cowpea	Grow improved cowpea
Male	90.3 (271)	30.7 (92)
Female	9.0 (27)	5.0 (15)
Total	99.3 (298)	35.7 (107)

( )=Frequency.
Source: Field Survey (2011).

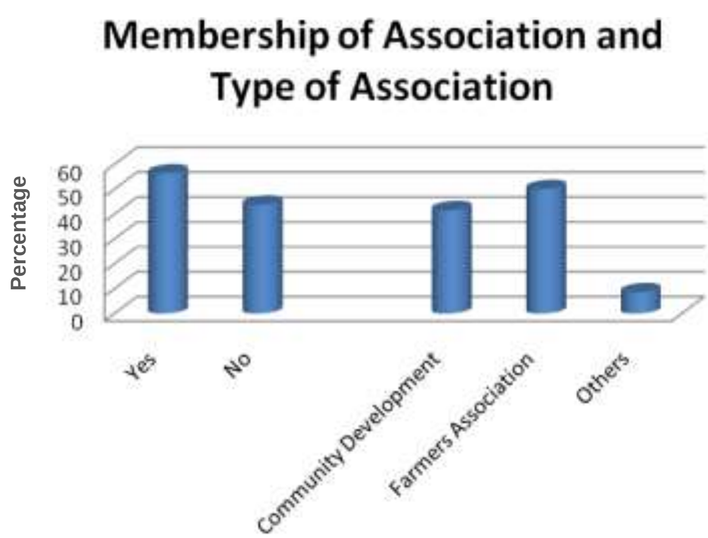

Figure 2. Percentage distribution of respondents according to membership of association and type of association.
Source: Field Survey (2011).

Table 2. Percentage distribution of respondents according to technology-related characteristics as reasons of adoption of improved cowpea varieties.

Variable	Frequency	Percentage of n=107
Is it high yield	96	89.7
High income/profit from market sales	101	94.7
Resistance to drought	60	56.3
Early maturity	77	72.3
Household food security	66	61.7
Diversified food products from cowpea	70	65.3

Source: Field Survey (2011).

Table 3. Probit model estimate of determinants of adoption of improved cowpea varieties in the study area.

Variable	B	S.E.	Wald	Sig.
Constant	-3.925	1.114	12.407	0.000
Gender of farmer	0.207	0.639	0.105	0.746
Education of farmer	0.743	0.419	3.141	0.076*
Extension contact	1.158	0.443	6.832	0.009**
Participation in project activities	2.974	0.416	51.154	0.000***
Membership of association	0.662	0.379	3.053	0.081*
Farming experience	0.012	0.016	0.624	0.430
Age of farmer	0.001	0.016	0.002	0.961
Experience in growing cowpea	2.995	0.421	50.683	0.000***
Household size	0.044	0.028	2.424	0.120
Keeping of livestock (Dummy)	-.116	0.075	2.410	0.121
-2 Log likelihood		216.5892802		
Cox & Snell R Square (%)		43		
Nagelkerke R Square (%)		59		

*Significant at 10% probability level; ***Significant at 1% probability level.

after three years maybe due to the efforts of the project to create awareness through field days, radio programs, field demonstrations and training of farmers. These findings are consistent with report from Simtowe et al. (2012). They found that improved pigeon pea adoption rates in Kenya could have risen up if the entire population was aware or exposed to the improved pigeon pea varieties. This study revealed that education significantly influenced the probability of adoption of improved cowpea varieties, indicating possible association between education and adoption of improved cowpea varieties. According to Okuthe et al. (2013), education enables one to access information needed to make a decision to use an innovation and practice a new technology. Education increases managerial competence and therefore enhances ability to diagnose, assess, comprehend, and respond to financial and production problems. High level of education enhances the understanding of instructions given and improves the farmers' level of participation in agricultural activities. This suggests that educated people will tend to adopt and increase area of cowpea under cultivation. In addition, favourable level of formal education of the farmers would make it easier for extension agents to introduce improved cowpea technologies to them. According to Alene and Manyong (2007), farmer education has significant and positive effects on improved cowpea, as opposed to traditional cowpea production. According to them, four years of education raises cowpea production under improved technology by 25.6%, but it has no significant effect on traditional cowpea production. They further concluded that farmer education has a higher payoff for farmers cultivating improved varieties and applying a package of new inputs than for farmers using largely traditional technology. According to Sahin (2006), to create new knowledge, technology education and practice should provide not only a how-to experience but also a know-why experience. In fact, an individual may have all the necessary knowledge, but this does not mean that the individual will adopt the innovation because the individual's attitudes also shape the adoption or rejection of the innovation. Again, the results revealed cowpea

Table 4. Tobit model estimate of extent of adoption of improved cowpea varieties in the study area.

Variable	B	S.E	t-value	P>|t|
Constant	-146.6628	36.11163	-4.06	0.000
Gender of farmer	45.47679	17.74433	2.56	0.014**
Age of farmer	-0.3558906	0.564711	-0.63	0.532
Household size	0.3890319	0.8425112	0.46	0.645
Education of farmer	11.78681	12.1899	0.97	0.332
Experience in growing cowpea	-0.1023775	0.6354491	-0.16	0.871
Extension contact	24.04992	14.62997	1.64	0.102
Membership of association	30.31062	12.33824	2.46	0.024**
Participation in project activities	91.97951	14.20083	6.48	0.000***
Keeping of livestock (Dummy)	0.3954458	0.2480392	1.59	0.107
Number of observations		300		
LR chi^2 (10)		145.76		
Prob > chi^2		0.0000		
Pseudo R^2		0.1008		
Log likelihood		-649.91329		

***1% probability level of significance; **10% probability level of significance.

growing experience as a significant factor influencing adoption of improved cowpea varieties. Here, farmers who have been growing cowpea overtime can easily find it easier to adopt any new variety introduced. Their experience coupled with the new production practices, could boost their uptake of the new varieties introduced.

Tobit regression result showed that gender had significant influence on the intensity of adoption of improved cowpea varieties at 10% level of significance. This means that the male farmers were more likely to adopt modern agricultural production technologies than their female counterparts. The reason for this is that men are the people who make production decisions in the study area and also control productive resources such as land, labour and capital which are critical for the adoption of new technologies. This report therefore agreed with Yanguba (2005), who reported that women are prohibited in Northern Nigeria to be directly involved in farming activities in some communities in Northern Nigeria because of religious and cultural limitations. Bashir et al. (2018) reported similar result.

The findings of the current study also agreed with study by Kamara (2010) in Borno State. She reported that male adoption was higher than that of female in the state. Similarly, this result agrees with previous studies which noted that, in general, women tend to adopt improved technologies at a lower rate compared to men (Doss, 2001). This outcome may be due to the time and resource constraints that women often face as in the case of women farmers in Northern Nigeria (Yanguba, 2005). Coulibaly et al. (2010) also stated that women play key roles in agricultural production, but agriculture is increasingly characterized by growing gender imbalances in access to 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.

Extension contacts had a significant influence on the probability of adoption of improved cowpea varieties. The major players in creating awareness about the existence of the improved crops are the extension agents who act as major driving force behind improved cowpea adoption. They play crucial roles in adoption process as they are very close to the farmers by giving them first hand information on improved varieties and others improved agricultural practices. There is therefore need to strengthen extension institutions by national and international research institutions. Many studies have supported that extension contact is very important. Chikaire et al. (2011), reported that the goals of extension 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 finding is in agreement with findings of Onu (2006) who reported that farmers who had access to extension adopted improved farming technologies had 72% 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. The result again agreed with findings of Alene and Manyong (2007) who reported 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. This confirms the greater role of extension services in raising the yields of improved varieties through the provision of adequate and timely advice on improved technological packages. Unlike this study, Bashir et al. (2018) on adoption of cowpea production technologies among farmers in Taraba State, Nigeria, they found zero extension contact among the respondents. This might have been responsible for the low adoption rate of improved cowpea in Taraba State.

Membership of association had a significant influence on both probability and extent of adoption of improved cowpea. This implies that farmers were able to exchange ideas among themselves. As further revealed by the study, those who were members of associations adopted the technology more than those who were non members. This is in support of study reported by Odoemenem (2007) stating that membership of association enhances access to information on improved technologies, material inputs of the technologies (fertilizers and chemicals) and credit for the purchase of inputs and pay for farm labour. Since a large number (56.3%) of farmers belonged to one organization or the other, the possibility of sharing knowledge among them concerning improved or new farm practices and new agricultural products is inevitable. Baseline study in the project area reported by Ayanwale et al. (2009) revealed membership of the farmer organization was 20% all put together. Tura et al. (2010), reported that membership to cooperative were found to be important in Ethiopia. Studies by Bamire et al. (2010) reported that membership of association positively and significantly influenced adoption of improved technologies.

Another significant factor that had influence on both the probability and extent of adoption of improved cowpea varieties was farmers' participation in the Sudan Savanna Taskforce project's activities. These activities include among others: on-farm trials, field demonstrations and training relating to cowpea production. Improved cowpea varieties are largely new technologies in the study area. Farmers attach greater risk to new varieties than their traditional or local varieties. Therefore, adoption of new technologies can be enhanced through farmers who have first-hand experience with the new technologies. To increase the rate of adoption among farmers, they have to 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 similar recent study by Adedipe (2012), she 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 project activities. Farmers' involvement in the project activities in the study area was a bit low. There is need to increase their involvement.

The result of the study also revealed a positive relationship between livestock keeping and cowpea production and has significant influence on the extent of adoption of improved cowpea. Livestock rearing and cowpea production complements each other. Cowpea fodder is used to feed animals (IITA, 2009). This result therefore agreed with IITA (2009) and Bashir et al. (2018) who reported that the production of cowpea fodder is a significant source of income as well as feed for livestock.

CONCLUSION AND RECOMMENDATIONS

Awareness and adoption level of improved cowpea varieties was the basis for assessing the effectiveness of Sudan Savanna Taskforce project. Compared to the baseline report by Ayanwale et al. (2009), who reported that only 26% of the farmers were aware of improved cowpea varieties with zero percent adoption in Musawa LGA; this study revealed that awareness from that time has increased to 66.0% over a period of three years. Adoption level has grown from 0 to 35.7%. This implies a tremendous achievement in three years. The major source of information came from extension agents. This shows the importance of strengthening extension institutions in the state since they are very vital to training of farmers in the use of improved cowpea production technologies. However, the disparity between awareness level and adoption rate might have been due to some factors that include non-availability of seeds when needed, non-availability and high cost of fertilizer, pests and diseases. This implies that adoption of any technology is not automatic rather a process that needs time and space.

This study recommends that enterprise diversification and intensification of extension visit would be an incentive to adoption decisions by small-scale farmers in the study area and should be intended to the less educated farmers. Furthermore, there is a need for special training, seminars, field demonstrations and technical support for the cowpea farmers.

In conclusion, policy makers should support informal ways of extending new technologies to cowpea farmers.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Adedipe OI (2012). Effect of improved cowpea varieties on farmers income in Sudan Savanna Taskforce's maize – legume platform of

Kano-Katsina-Maradi Project site. An (Unpublished) Masters thesis Bayero University Kano.
Alene AD, Manyong VM (2007). The effects of education on agricultural productivity under traditional and improved technology in northern Nigeria: An endogenous switching regression analysis. Empirical Economics 32:141-159.
Ayanwale A, Abdoulaye T, Ayedun B, Akinola A (2009). Baseline Report Of The Sudan Savannah Zone Of The Kano-Katsina-Maradi Pilot Learning Sites of The Sub Saharan Africa-Challenge Program (SSA CP) Baseline Report.
Bamire SA, Abdoulaye T, Amaza P, Tegbaru A, Alene AD, Kamara AY (2010). Impact of promoting sustainable agriculture in Borno (PROSAB) program on adoption of improved crop varieties in Borno State of Nigeria. Journal of Food, Agriculture and Environment 8(3&4):3 91- 98.
Bamire SA, Fabiyi YL, Manyong VM (2002). Adoption pattern of fertilizer technology among farmers in the ecological zones of South Western Nigeria: a Tobit analysis. Australian Journal of Agricultural Research 53:901-910.
Bashir MB, Ndaghu AA, Nakwe SHG, Abdulazeez AW, Samuel RT (2018). Adoption Of Cowpea Production Technologies Among Farmers In Taraba State, Nigeria. Journal of Agriculture and Veterinary Science 11(3) 37-46.
Chikaire J, Ejiogu-Okereke FN, Anyoha NO (2011). Agricultural extension: key to implementing the millennium development goals in developing countries. Continental Journal of Agricultural Science 5(2).
Coulibaly O, Alene AD, Abdoulaye T, Chianu C, Manyong V, Aitchedji C, Fatokun D, Kamara A, Ousmane B, Tefera H, Boahen S (2010). Baseline assessment of cowpea breeding and seed delivery efforts to enhance poverty impacts in sub-Saharan Africa (Report).
Doss CR (2001). Designing agricultural technology for African women farmers: Lessons from 25 years of experience. World Development 29(12):2075-2092.
Dugje IY, Omoigui LO, Ekeleme F, Kamara AY, Ajeigbe H (2009). Farmer’s Guide to Cowpea production in West Africa. IITA Ibadan, Nigeria.
Ellis-Jones J, Schulz S, Chikoye D, de Haan N, Kormawa P, Adezwa D (2005). Participatory research and extension approaches: a guide for researchers and extension workers for involving farmers in research and development. IITA, Ibadan, Nigeria, and Silsoe Research Institute, UK. 52 p.
Ibrahim AA, Waba SY, Mohammed N, Mustapha SB (2016). Factors Influencing the Level of Adoption of Cowpea Production Technologies in Askira/Uba Local Government Area of Borno State, Nigeria. International Academic Journal of Innovative Research 3(9):15-23.
Kamara SM (2010). Factors influencing the adoption of Soybean Production among male and female farmers in Borno State: Implications for Community Development. Unpublished M.Ed. Thesis, Kano, Bayero University, Kano, Nigeria.
Odoemenem UI (2007). Capital resource mobilization and allocation efficiency by small-scale cereal crop farmers of Benue State, Nigeria. Ph.D Dissertation, Department of Agricultural Economics Management & Extension, Ebonyi State Univ., Abakaliki, Nigeria.
Okuthe IK, Kioli F, Abuom P (2013). Socio Cultural Determinants of the Adoption of Intergrated Natural Resource Management Technologies by Small Scale Famers in Ndhiwa Division, Kenya. Current Research Journal of Social Sciences 5(6):203-218.
Onu DO (2006). Socio-economic factors influencing farmers’ adoption of alley farming technology under intensified agriculture in Imo state, Nigeria. The Philippine Agricultural Scientist 89(2):45-52.
Shiyani RL, Joshi PK, Asokan M, Bantilan MCS (2002). Adoptation of improved cowpea varieties: KRIBHCO experience in tribal regions of Gujarant, India. Journal of Agricultural Economics 27:33-39.
Simtowe F, Muange E, Munyua B, Diagne A (2012). Technology Awareness and Adoption: The Case of Improved Pigeonpea Varieties in Kenya. Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August.
Singh BB, Ehlers JD, Sharma B, Freire-Filho FR (2002). Recent progress in cowpea breeding. In: Fatokun C.A., Tarawali S.A., Singh B.B., P.M., Tamo M., editors. Challenges and opportunities for enhancing sustainable cowpea production. Ibadan, Nigeria: IITA. pp. 22-40.
Tijjani AR, Nabinta RT, Muntaka M (2015). Adoption of innovative cowpea production practices in a rural area of Katsina State, Nigeria. Journal of Agricultural and Crop Research 3(4):53-58.
Tura M, Aredo D, Tsegaye W, La Rovere R, Tesfahun G, Mwangi W, Mwabu G (2010). Adoption and continued use of improved maize seeds: Case study of Central Ethiopia. African Journal of Agricultural Research 5(17):2350-2358.
Yanguba A (2005). Agricultural technology adoption by small-scale farmers: The case of extra-early maize varieties in the Sudan savannas of Katsina State, Northern Nigeria. (Unpublished M.Sc. Thesis): University of Ibadan, Nigeria.