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The savannah accelerated development authority: Factors to consider in modernising agriculture in Northern Ghana

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The move by government through the Savannah Accelerated Development Authority (SADA) to modernise agriculture in the savannah areas of Ghana is in the right direction. However, the specific factors to consider in ensuring that farmers in the operational areas of SADA modernise their farming activities are not well known. This paper examines the factors that SADA must consider in its efforts to modernise agriculture because the success of the initiative depends on farmers' readiness to adopt the agricultural modernisation technologies to be rollout by the authority. Data were obtained from 150 farmers across the Bawku West District of Ghana and fitted into a logit model. The results showed that there is about 70% probability that farmers interviewed will adopt the SADA agricultural modernization initiative. Farm size, cost of technology, expected benefits, off-farm activities, education and access to information among others are the factors that will significantly influence farmers' decision to adopt modernisation of their farming activities. It is concluded that success of the SADA initiative depends on socio-economic circumstances of farmers and institutional effectiveness. It is recommended that SADA should take advantage of factors that positively influence farmers' adoption of its initiative by emphasising on them and take steps to mitigate the negative ones.

Key words: Agriculture, Farmers, logit model, Northern Ghana, savannah ecology.

INTRODUCTION

The economy of Ghana is basically agrarian. This is against the backdrop that agriculture accounts for about a third of the Gross Domestic Product (GDP) of the country (ISSER, 2010). Besides, agricultural activities constitute the main use to which Ghana's land resources are put. The agricultural sector is the major source of occupation for about 47% of the economically active age group of Ghanaians (Wayo, 2002). Despite the fact that the country covers an area of approximately 239,000 km² of which agricultural land forms about 57% of the total land area, only 20% of this agricultural land is under cultivation. This means that Ghana is yet to fully utilise its

natural resource base, particularly land for agricultural production.

Agricultural production in Ghana is influenced by agro-ecological conditions which is said to be responsible for the differentials in agricultural productivity across the country. According to Wayo (2002), there are six distinct agro-ecological zones in Ghana. These are the high rain forest, the semi-deciduous rain forest, the forest-savannah transition, the Guinea savannah, the Sudan savannah and the coastal savannah. The conditions of these ecological zones limit the types of crops that can be successfully cultivated in them. In general, tree crops

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do better in the forest zones while food crops do well in the transitional and savannah zones. The transitional and savannah zones are therefore the food baskets of the country.

For food and nutrition security to be guaranteed in Ghana there is the need to formulate pragmatic policy frameworks that will enhance food productivity in the transitional and savannah zones. Though, a number of policies have been implemented over the years by successive governments in Ghana to enhance food production in the country, including subsidies on agricultural inputs, most of these policies have largely failed. There is therefore the need for paradigm shift that focuses on developing a holistic framework for the modernisation of agriculture in the areas of Ghana's food basket. In this regard, the establishment of the Savannah Accelerated Development Authority (SADA) by government with the main objective of bridging the chronic development gap that exists between Southern and Northern Ghana through agricultural modernisation is timely. This is more so following the discovery of oil in commercial quantities in Ghana which has the potential of attracting the attention of policy makers and implementers at the expense of agricultural development. For SADA to achieve its objective of modernising agriculture in its operational areas there is the need for it to know the specific economic, social and institutional factors likely to influence farmers' adoption of the initiative. This will enable SADA develop strategies to take advantage of the positive factors and to deal with the negative ones.

This paper therefore examines the different factors that could promote or otherwise of the adoption of the agricultural modernisation initiative of SADA by farmers in the savannah agro-ecological zone of Ghana using selected farmers in the Bawku West District of the Upper East Region of Ghana as a case.

Choice of factors for logit model estimation

The factors that influence adoption can be broadly put into three main categories. These are economic factors, social factors and institutional factors which are discussed following.

Economic factors

Farm size: Much empirical adoption literature focuses on farm size as the first and probably the most important determinant (Shakya and Flinn, 1985; Harper et al., 1990; Green and Ng'ong'ola, 1993; Adesiina and Baidu-Forson, 1995; Nkonya et al., 1997; Fernandez-Cornejo, 1998; Baidu-Forson, 1999; Boahene et al., 1999; Doss and Morris, 2001; Daku, 2002). This is because farm size can affect and in turn be affected by the other factors

influencing adoption. The effect of farm size on adoption could be positive, negative or neutral. For instance, Feder et al. (1985), McNamara et al. (1991), Abara and Singh (1993), Fernandez-Cornejo (1996) and Kasenge (1998) found farm size to be positively related to adoption. On the other hand, Harper et al. (1990) and Yaron et al. (1992) found negative relationship between adoption and farm size. Interestingly, Mugisa-Mutetikka et al. (2000) found that the relationship between farm size and adoption is a neutral one.

Farm size affects adoption costs, risk perceptions, human capital, credit constraints, labour requirements, and tenure arrangements among others. With small farms, it has been argued that large fixed costs become a constraint to technology adoption (Abara and Singh, 1993) especially if the technology requires a substantial amount of initial set-up cost. In this regard, Feder et al. (1985) noted that only larger farms will adopt these kinds of innovations. With some technologies, the speed of adoption is different for small- and large- scale farmers which is critical for SADA in its pursuit of modernisation of agriculture. In Kenya for example, a study by Gabre-Madhin and Haggblade (2001) found that large commercial farmers adopted new high-yielding maize varieties more rapidly than smallholders.

Furthermore, access to funds including credit is expected to increase the probability of adoption. Yet to be eligible for credit from formal sources, the size of operation of the borrower is important. Farmers operating larger farms tend to have greater financial resources and chances of receiving credit are higher than those of smaller farms. In contrast, it has been argued by Yaron et al. (1992) that a small land area may provide an incentive to adopt a technology, especially in the case of an input-intensive innovation such as a labour-intensive or land-saving technology. In that study, the availability of land for agricultural production was low, consequently most agricultural farms were small. Hence, adoption of land-saving technologies seemed to be the only alternative to increased agricultural production.

Further, in the study by Fernandez-Cornejo (1996), farm size did not positively influence adoption. The majority of the studies mentioned previously consider total farm size and not crop acreage on which the new technology was practised. While total farm size has an effect on overall adoption, considering the crop acreage with the new technology may be a superior measure to predict the rate and extent of adoption of technology (Lowenberg-DeBoer, 2000). Therefore in regards to farm size, technology adoption may best be explained by measuring the proportion of total land area suitable to the new technology. This was measured in hectares for the logit model estimation.

Cost of technology: The decision to adopt is often an investment decision. According to Caswell et al. (2001), the decision to adopt presents a shift in farmers'

investment options. Therefore, adoption can be expected to be dependent on cost of a technology and on whether farmers possess the required resources. Technologies that are capital-intensive are only affordable by wealthier farmers (El-Osta and Morehart, 1999). The adoption of such technologies is therefore limited to larger farmers who have the wealth (Khanna, 2001). Changes that cost little are adopted more quickly than those requiring large expenditures. SADA must therefore be conscious of the fact that both the extent and rate of adoption of its agricultural modernisation initiative is dependent on the cost. This is in line with the law of demand – the lower the price, the higher the demand. Those farmers who said the cost of modernisation does not matter were assigned a dummy value of zero (0). On the other hand, those who said SADA must come out with low-cost agricultural modernisation technologies were assigned a dummy value of one (1) for the logit model estimation.

Level of expected benefits: Development interventions that produce significant gains can motivate people to participate more fully in them. This is because people will not participate unless they believe it is in their best interest to do so. Farmers must see an advantage or expect to obtain greater utility in adopting a technology. In addition, farmers must perceive that there is a problem that warrants an alternative action to be taken. Without a significant difference in outcomes between two options, and in the returns from alternative and conventional practices, it is less likely that farmers, especially small-scale farmers will adopt the new practice (Abara and Singh, 1993). A higher percentage of total household income coming from the farm through increased yield tends to correlate positively with adoption of new technologies (McNamara et al., 1991; Fernandez-Cornejo, 1996). The farmers who did not expect more benefits from modernising their farming activities were assigned a dummy value of zero (0) and those who expected more benefits from the modernisation of their farming activities through the SADA initiative were assigned a dummy value of one (1) for the logit model estimation.

Off-farm activities: The availability of time is an important factor affecting technology adoption. It can influence adoption in either a negative or positive manner. Practices that heavily draw on farmers' leisure time may inhibit adoption (Mugisa-Mutetikka et al., 2000). However, practices that leave time for other sources of income accumulation may promote adoption. In such cases as well as in general terms, income from off-farm labour may provide financial resources required to adopt the new technology. The farmers who said they did not have off-farm income generating activities were assigned a dummy value of zero (0). On the other hand, those who said they had off-farm income generating activities were assigned a dummy value of one (1).

Social factors

Age of adopter: Age is an important factor that influences the probability of adoption of new technologies because it is said to be a primary latent characteristic in adoption decisions. However, there is contention on the direction of the effect of age on adoption. Age was found to positively influence chemical control of rice stink bug in Texas (Harper et al., 1990), adoption of IPM on peanuts in Georgia (McNamara et al., 1991) and sorghum in Burkina Faso (Adesiina and Baidu-Forson, 1995). The effect is thought to stem from accumulated knowledge and experience of farming systems obtained from years of observation and experimenting with various technologies. Since adoption pay-offs may occur over a long period of time, while costs occur in the earlier phases, age (time) of the farmer can have a profound effect on technology adoption.

Age has been found to be either negatively correlated with adoption or not significant in farmers' adoption decisions. In studies on adoption of IPM sweep nets in Texas (Harper et al., 1990), fertilizer in Malawi (Green and Ng'ong'ola, 1993), rice in Guinea (Adesiina and Baidu-Forson, 1995), land conservation practices in Niger (Baidu-Forson, 1999) and Hybrid Cocoa in Ghana (Boahene et al., 1999), age was either not significant or was negatively related to adoption. This implies that older farmers, after investing several years in a particular practice, may not want to jeopardize it by trying out a completely new method. In addition, farmers' perception that technology development and the subsequent benefits require a lot of time to realize, can reduce their interest in the new technology because of farmers' advanced age, and the possibility of not living long enough to enjoy it (Caswell et al., 2001; Khanna, 2001).

Elderly farmers often have different goals other than income maximization, in which case, they will not be expected to adopt an income-enhancing technology. As a matter of fact, it is expected that the old that do adopt a technology do so at a slow pace because of their tendency to adapt less swiftly to a new phenomenon. This was measured in years for the logit model estimation.

Education: A number of studies that sought to establish the effect of education on adoption in most cases relate it to years of formal schooling (Feder and Slade, 1984; Tjornhom, 1995). Generally, education is thought to create a favourable mental attitude for the acceptance of new practices, especially of information-intensive and management-intensive practices (Waller et al., 1998; Caswell et al., 2001). According to Rogers (1983), technology complexity has a negative effect on adoption and this could only be dealt with through education. According to Ehler and Bottrell (2000), one of the hindrances to widespread adoption of new technologies is because of the requirement for greater ecological

understanding of the production system. The ability to read and understand sophisticated information that may be contained in a technological package is an important aspect of adoption. This was measured as number of years of formal schooling for the logit model estimation.

Gender concerns: Gender issues in agricultural production and technology adoption have been investigated for a long time. Most of such studies show mixed evidence regarding the different roles men and women play in technology adoption. Doss and Morris (2001) in their study on factors influencing improved maize technology adoption in Ghana and Overfield and Fleming (2001) studying coffee production in Papua New Guinea show insignificant effects of gender on adoption. Since adoption of a practice is guided by the utility expected from it, the effort put into adopting it is reflective of this anticipated utility. It might then be expected that the relative roles women and men play in both 'effort' and 'adoption' are similar, hence suggesting that males and females adopt practices equally. Women were assigned a dummy value of zero (0) and men assigned a dummy value of one (1).

Institutional factors

Information: Acquisition of information about a new technology demystifies it and makes it more available to farmers. Information reduces the uncertainty about a technology's performance and hence may change individual's assessment from purely subjective to objective over time (Caswell et al., 2001). Exposure to information about new technologies affects farmers' choices about it. Feder and Slade (1984) indicate how, provided a technology is profitable, increased information induces its adoption. However, in the case where experience within the general population about a specific technology is limited, more information induces negative attitudes towards its adoption, probably because more information exposes an even bigger information vacuum thereby increasing the risk associated with it. A good example is said to be the adoption of recombinant bovine Somatotropin Technology (rbST) in dairy production (McGuirk et al., 1992; Klotz et al., 1995). Information is acquired through informal sources like the media, extension personnel visits, meetings, and farm organizations and through formal education. It is important that this information be reliable, consistent and accurate. Thus, the right mix of information properties for a particular technology is needed for effectiveness in its impact on adoption. Respondents who said they were not aware of the SADA agricultural modernisation initiative were assigned a dummy value of zero (0) and those who said they were aware were assigned a dummy value of one (1).

Extension services: Good extension services and contacts with producers are a key aspect in technology dissemination and adoption. This assertion is consistent with the observation made by the International Food Policy Research Institute (2001), that "a new technology is only as good as the mechanism of its dissemination" to farmers. Most studies analyzing this variable in the context of agricultural technology show its strong positive influence on adoption. According to Yaron et al. (1992), access to extension services can counter balance the negative effect of lack of years of formal education in the overall decision to adopt some technologies. Farmers who said they did not have access to extension services were assigned a dummy value of zero (0) and those who had access to extension services were assigned a dummy value of one (1) for the logit model estimation.

METHODOLOGY

The survey

The methodology employed for the survey was divided into two parts. The first part was a desktop review of existing literature on the factors influencing adoption of modern agricultural production technologies. The second part was to gather data from selected individuals in the Bawku West District on agricultural development issues through face-to-face interviews using semi-structured questionnaires supplemented by key informant interviews and focus group discussions. The information elicited from respondents bordered on demographic characteristics of respondents, their awareness and understanding of SADA, and the factors that influence farmers' choice of agricultural modernisation strategies. The key informants interviewed included frontline officers of the District Ministry of Food and Agriculture (MoFA); officers of agricultural related Non-Governmental Organisations (NGOs) operating in the District; frontline officers of the District Assembly including secretaries of the Town and Area councils; and officers of the Rural Bank.

In all, one hundred and fifty (150) individuals including hundred (100) farmers, ten (10) input dealers, twenty (20) agricultural commodity traders, five (5) transporters and five (5) food processors were interviewed. These categories of people were sampled from five (5) out of the seven (7) Area and Town Councils in the District. The sampled Town and Area Councils are the Zebilla Town Council, the Sapeliga Area Council, the Gbantongo Area Council, the Tilli-Widnaba Area Council and the Binaba Town Council. In each of the selected Town and Area Councils, 20 farmers; two input dealers; four agricultural commodity traders; one transporter; and one food processor were selected for the individual interviews. In addition, focus group discussions and key informant interviews were held in each of the selected areas to validate the data from individuals. The pieces of information gathered from the interviews were the basic inputs for analyses. STATA (version 11) was the software used for the data analyses.

The analytical framework

Using the logit model, the factors that influence farmers' decision to adopt agricultural modernisation over traditional agriculture were estimated. The use of the logit model for this analysis is consistent with the literature on adoption (Griliches, 1957; Lionberger, 1960; Rogers, 1983; Alston et al., 1995) which describes the process of

adoption as taking on a logistic nature. The study used the threshold decision-making theory proposed by Hill and Kau (1973) and Pindyck and Rubinfeld (1998) to analyse the factors that farmers consider in adopting one agricultural production strategy over others. The theory points out the fact that when farmers are faced with a decision to adopt or not to adopt an innovation, in this case agricultural modernisation, every farmer has a reaction threshold, which is dependent on a certain set of factors. As such, at a certain value of stimulus below the threshold, no adoption is observed while at the critical threshold value, a reaction is stimulated. Such phenomena are generally modelled using the relationship:

$$Y_i = \beta X_i + u_i \quad (1)$$

Where Y_i is equal to one (1) when a choice is made to adopt and zero (0) otherwise; this means: $Y_i = 1$ if X_i is greater than or equal to a critical value, X^* and $Y_i = 0$ if X_i is less than a critical value, X^* . X^* represents the combined effects of the independent variables (βX_i) at the threshold level.

Equation (1) represents a binary choice model involving the estimation of the probability of adoption of a given technology, innovation or intervention (Y) as a function of independent variables (X). Mathematically, this is represented as:

$$Prob(Y_i = 1) = F(\beta' X_i) \quad (2)$$

$$Prob(Y_i = 0) = 1 - F(\beta' X_i) \quad (3)$$

Y_i is the observed response for the i^{th} observation of the response variable, Y . This means that $Y_i = 1$ for an adopter (that is, farmers who decide to adopt agricultural modernization by SADA) and $Y_i = 0$ for a non-adopter (that is, farmers who decided not to adopt agricultural modernization by SADA). X_i is a set of independent variables such as farm size among others, associated with the i^{th} individual, which determine the probability of adoption (that is making the decision to modernize one's farming activities), (P). The function, F may take the form of a normal, logistic or probability function. The logit model uses a logistic cumulative distributive function to estimate, P as follows (Pindyck and Rubinfeld, 1998):

$$P(Y = 1) = \frac{e^{\beta' X}}{1 + e^{\beta' X}} \quad (4)$$

$$P(Y = 0) = 1 - \frac{e^{\beta' X}}{1 + e^{\beta' X}} = \frac{1}{1 + e^{\beta' X}} \quad (5)$$

According to Greene (2008), the probability model is a regression of the conditional expectation of Y on X giving:

$$E(Y/X) = 1[F(\beta' X)] + 0[1 - F(\beta' X)] = F(\beta' X) \quad (6)$$

Since the model is non-linear, the parameters are not necessarily the marginal effects of the various independent variables. The relative effect of each of the independent variables on the probability of adoption (that is making the decision to modernize farming activities) is obtained by differentiating Equation (6) with respect to X_{ij} resulting in equation (7) (Greene, 2008):

$$\frac{\partial F_i}{\partial X_{ij}} = \left[\frac{\lambda \beta' X}{(1 + e^{\beta' X})^2} \right] \beta = F(\beta' X)[1 - F(\beta' X)]\beta \quad (7)$$

The maximum likelihood method was used to estimate the parameters. The implication for applying the logit model in this paper is that, the farmer would decide to adopt agricultural

modernisation in his or her farming activities at a given point in time when the combined effects of certain factors exceed the inherent resistance in him/her to change. The preference for the probability model (logit) to the conventional linear regression models, in analysing the factors farmers will consider in adopting agricultural modernisation over the traditional agriculture is based on the fact that, the parameter estimates from the former are asymptotically consistent and efficient. The estimation procedure employed also resolves the problem of heteroscedasticity and constrains the conditional probability of making the decision to adopt agricultural modernisation to lie between zero (0) and one (1). The main reason for choosing the logit model over the probit model for this paper is because of its mathematical convenience and simplicity (Greene, 2008) and the fact that it has been applied in similar studies (Feder et al., 1985; Shakya and Flinn, 1985; Green and Ng'ong'ola, 1993; Rogers, 1995; Nkonya et al., 1997; Boahene et al., 1999).

The empirical model for the logit model estimation is specified as follows:

$$\log \frac{P_i}{1 - P_i} = \alpha + \beta X_i + \varepsilon_i \quad (8)$$

Where X_i is the combined effects of X explanatory variables that promote or prevent farmers' decision to adopt SADA's agricultural modernization initiative. $\log \frac{P_i}{1 - P_i}$ = The log-odds in favour of farmers' decision to adopt agricultural modernization; $X_1 \dots X_i$ are factors that promote or prevent farmers from adopting agricultural modernisation and are defined as follows: X_1 = Farm size in hectares; X_2 = Cost of technology/modernization; dummy (1 = Cost matter; 0 = Otherwise); X_3 = Level of expected benefits; dummy (1 = High expected benefits; 0 = Otherwise); X_4 = Has off-farm income generating activities, dummy (1 = Yes; 0 = Otherwise); X_5 = Age of farmer in years; X_6 = Age of farmer in years squared; X_7 = Level of education measured as years of formal schooling; X_8 = Gender; dummy (1 = Man; 0 = Otherwise); X_9 = Access to extension services; dummy (1 = Has access; 0 = Otherwise), and X_{10} = Access to information on SADA initiative; dummy (1 = Has access; 0 = Otherwise).

RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents

The study was conducted in the Bawku West District of the Upper East Region of Ghana. In all, one hundred and fifty (150) individuals were interviewed. Out of the people interviewed, 2% of respondents were below the age of 18 years (Table 1). These people are below the economically active age group and are expected to be in school. About 91% of the respondents belonged to the economically active age group of between 18 and 60 years with the remaining 7% of respondents being above the economically active age group. The implication of the age distribution of respondents across the different age groups is that, the findings indicated in this paper are representative of the different generations.

Further, 54% of the respondents were men with the remaining 46% of them being women. This implies that, the outcome of the study represents the collective views, concerns and opinions of both men and women with regards to the adoption of agricultural modernisation being spearheaded by SADA. Majority of the respondents

Table 1. Socio-demographic characteristics of respondents.

Age	Frequency	Percentage (%)
<18	3	2
18-45	96	64
46-60	41	27
>60	10	7
Total	150	100
Gender		
Men	81	54
Women	69	46
Total	150	100
Education		
No formal	78	52
Basic	45	30
Post basic	27	18
Total	150	100

Source: Field Survey Data, 2011.

(52%) did not have any form of formal education. Besides, 30% of the respondents had basic education and 18% of them had post-basic education (Table 1). This means that the findings are representative of both literate and illiterate residents of the Bawku West District of the Upper East Region of Ghana.

Factors to consider in the promotion of agricultural modernisation

The estimated factors influencing adoption of technology (that is, agricultural modernization by SADA) using the logit model included the economic factors such as farm size, cost of adoption, expected benefits from the adoption and the off-farm income generation activities. The social factors included the age of farmers, the level of education and gender. The institutional factors included access to information regarding the specific strategies to be adopted by SADA in its efforts to modernize agriculture and access to extension services. The logit model estimation gave a Pseudo R^2 of 0.7153 which implies that the variables included in the model are able to explain about 72% of the probability of adoption of the agricultural modernization initiative by SADA (Table 2). The Log-likelihood Ratio (LR) was also found to be significant at the 1% level. This means that all the explanatory variables included in the model jointly influence farmers' probability of adoption of the initiative. The model results also gave a predicted probability of adoption of 0.7023. This means that there is about 70% probability that the people interviewed will adopt the SADA agricultural modernization initiative but this is contingent on a certain set of factors as mentioned

earlier. Given the foregoing goodness of fit measures, it is concluded that the logit model employed had integrity and hence appropriate.

Farm size was found to have a positive relationship with the probability of adoption of agricultural modernization. It was found to be significant at the 1% level. This finding is consistent with the literature that large scale farmers are more inclined to adopt new technologies than small scale farmers (Feder et al., 1985; McNamara et al., 1991; Abara and Singh, 1993; Fernandez-Cornejo, 1996; Kasenge, 1998). It is however, important for SADA to come out with strategies for encouraging small scale farmers to agree to modernize their farming activities given that they form the majority in SADA's operational areas, particularly the Bawku West District and elsewhere in the Upper East Region of Ghana.

The cost of modernization was found to be negatively related to the probability of adoption. It was found to be significant at 1%. The finding is consistent with Caswell et al. (2001) who noted in their study that the decision to adopt a new technology presents a shift in farmers' investment options. This means that if the technology is costly to the farmer, there is low probability that he or she will adopt it. Besides, the fear of losing livelihoods is a social cost that farmers consider in their adoption decisions. For instance, a farmer whose main source of livelihood is maize farming will hesitate to replace this crop with improved groundnut cultivation for the fear that if the crop fails his or her livelihood will be greatly affected. In effect, as noted by El-Osta and Morehart (1999) and Khanna (2001), technologies that are capital-intensive are only affordable by wealthier farmers and hence the adoption of such technologies is limited to larger farmers who have the wealth. For SADA to achieve its objective of modernizing agriculture, it must consider coming out with technologies that are affordable, especially to poor rural dwellers about 90% of who depend on agriculture for their livelihoods.

The expected benefits from modernization of agriculture were found to be positively related to the probability of adoption. This was found to be significant at the 1% level. This implies that if farmers expect benefits from modernizing their farming activities to be higher than their current methods of farming, they are most likely to modernize. This is consistent with Abara and Singh (1993) who observed that without a significant difference in outcomes between two options, and in the returns from alternative and conventional practices, it is less likely that farmers, especially small-scale farmers will adopt the new practice. Farmers currently expect that the SADA agricultural modernization initiative will bring them higher returns which is a good sign for SADA to succeed in getting farmers adopt whichever technologies that the authority will come out with.

Off-farm activities were found to have negative relationship with the probability of adoption. This was

Table 2. Logit regression results of agriculture modernisation adoption (N = 150).

Variable	Coefficient	Std. Error	Z	P> z
Farm size	0.4241	0.1384	3.0643	0.0001
Modernisation cost	-0.5535	0.1221	-4.5332	0.0000
Modernisation benefits	0.5361	0.1318	4.0675	0.0012
Off-farm activities	-0.4859	0.1248	-3.8020	0.0027
Age of farmer	-0.4812	0.2278	-2.1124	0.0351
Age of farmer squared	0.0454	0.1002	0.4531	0.2832
Educational level of farmer	0.3224	0.1611	2.0012	0.0387
Gender	0.4158	0.1253	3.3184	0.0009
Access to information	0.4814	0.1301	3.7002	0.0034
Extension services	0.2392	0.1657	1.4436	0.1931
Constant	0.3806	0.7379	0.5158	0.2861
Goodness of fit measures				
LR Chi Square (10)			131.29	
Prob>Chi ²			0.0000	
Log likelihood			-51.8321	
Predicted probability of adoption			0.7023	
Pseudo R ²			0.7153	

Source: Field Survey Data, 2011.

found to be statistically significant at 1%. This implies that the higher the off-farm activities, the lower their probability of adopting agricultural modernisation technology. This is in line with the observation made by Mugisa-Mutetikka et al. (2000) that practices that heavily draw on farmers' leisure time may inhibit their adoption of on-farm technologies.

The age of farmer assumed a quadratic function which implies that farmers' rate of adoption is low at both the younger and older ages. It was found to be significant at the 5% level. At the younger age, farmers may not be able to adopt, especially for capital intensive technologies because of the fact that they might not have adequate resources to do so. At an older age, farmers' volume of economic activities reduced hence they may be unable to pay for technologies. Besides, older farmers have accumulated years of experience in farming through experimentation and observations and may find it difficult to leave such experiences for the new technologies.

The level of education of farmers was found to have a positive relationship with the probability of adoption and significant at 5% level. The implication of this is that farmers who are educated are more likely to adopt agricultural modernization technologies than those who are not educated. This is consistent with the literature that education creates a favourable mental attitude for the acceptance of new practices, especially of information-intensive and management-intensive practices (Waller et al., 1998; Caswell et al., 2001).

The gender of farmer was found to be positively related to the adoption of agricultural modernization by farmers. This was found to be significant at 1% level. This means

that male farmers are more likely to adopt modernization of their farming activities than their female counterparts. The reason for this is that men are the people who make production decisions in the study area. This finding is inconsistent with that of Doss and Morris (2001) who in their study on factors influencing improved maize technology adoption in Ghana as well as Overfield and Fleming (2001) studying coffee production in Papua New Guinea show insignificant effects of gender on adoption.

Access to information on SADA and its activities were found to have a positive relationship with the probability of adoption of agricultural modernization. This was found to be significant at the 1% level. This means that SADA must make information on its agricultural modernization initiative available to farmers to be able to make their decisions as to whether to adopt the initiative or not. This is because access to information is said to reduce the uncertainty about a technology's performance hence may change individuals' assessment from purely subjective to objective over time (Caswell et al., 2001). Access to extension services was also found to be positively related to the adoption of agricultural modernisation but insignificant.

CONCLUSION AND RECOMMENDATIONS

The factors that influence the adoption of new technologies such as the agricultural modernization initiative of SADA are broadly categorised into economic factors, social factors and institutional factors. The economic factors include farm size, cost of technology or

modernization, expected benefits from adoption of the technology, and off-farm activities. All the economic factors will have significant influences on farmers' decision to adopt the agricultural modernization initiative of SADA. The social factors that influence probability of adoption of new technologies by farmers include age of farmers, level of education and gender. All these social factors were found to significantly influence the decisions of farmers to adopt agricultural modernization by farmers. Access to information was the only institutional factor which will have significant influence on farmers' probability of adopting SADA's agricultural modernisation technologies. Based on the findings, the following recommendations are made:

1. Farm size positively influences the probability of adoption of agricultural modernisation by farmers. It is therefore recommended that SADA should be mindful of the fact that farmers are heterogeneous in terms of farm sizes and hence should come out with specific technologies that meet the needs of small, medium and large size farms.
2. Cost of modernisation or technology has the potential to inhibit adoption of the SADA agricultural modernisation initiative. As such, SADA should aim at delivering low cost technologies to the target farmers.
3. Farmers expect that the agricultural modernisation initiative by SADA will bring them higher benefits than their current farming practices. It is recommended that SADA should take advantage of this good will from farmers by ensuring that the expectations of farmers are met.
4. Age of farmers has quadratic relationship with the adoption of agricultural modernisation technologies. It is recommended that SADA should target the economically active age group in its attempts to modernise agriculture in its operational areas.
5. Access to information and extension services play critical influences on farmers' decision to adopt new technologies. It is recommended that SADA should make information on its operations readily available to its clientele group. It should also ensure that extension services on new technologies are integral part of the SADA agricultural modernisation initiative.

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