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Full Length Research

The effect of climate smart agricultural practices on poverty status of maize rural farming household in Sokoto State, Nigeria

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ABSTRACT: The current level of poverty in Nigeria is disturbing and climate change impends food security and increases poverty indirectly and directly on individuals or households. Farming households are changing agricultural practices as a result of global observation of climatic and environmental changes. This research work recognised a link which exists between climate change, climate smart agricultural practices (CSAP) and poverty status of farming households in North West Nigeria. The objective of this study is to determine the effects of climate smart agricultural practices on poverty status of maize farming household in the study area. This is with a view to establishing the consequences of climate variation and its influence on poverty status among rural farmers in North West Nigeria. The multi-stage, sampling techniques was used to select three hundred and twenty (320) respondents who provided the relevant primary data for this study through a set of pre-tested structured questionnaires. The data were analysed with Principal Component Analysis (PCA) and with instrumental variable of a probit regression model. The regression analysis result shows that CSAP has effect on poverty status of maize rural farming household in Sokoto State were maize enterprises decreases the odds or probability of being poor significantly. Study recommended that Governmental and farmers' organisations can fashion out a favourable training workshop to inspire the low-users of CSA to improve on their performance. Also, the rural farmers should be encouraged to develop interest in CSAP, like the empowerment programmes instituted by the government through Agricultural Development Project (ADP). The policies on informal education should be enhanced and enforced in the curriculum to meet the CSAP challenges. Extension delivery system approach should be upgraded to meet the present information age. The study therefore recommends that massive campaigns be made by government, civil societies and the media to create awareness about CSAP and to proffer indigenous solutions that address the issue of low-users and the constraints being faced.

Key words: Climate change, CSAP, household famers, poverty.

INTRODUCTION

Although, global food (cereal) production has increased significantly as a result of adoption of agricultural innovations and other associated technologies such as climate smart agricultural practices, herbicides and pesticides application (Tilman et al., 2002). Also, with sub-Saharan African region making steady rise in agricultural productivity as a result of agricultural technology adoption (Nin-Pratt and Yu, 2010; Fuglie and Rada, 2013). There are still apprehensions about the ability of the existing traditional agricultural practices to feed the teeming population in the region, especially Nigeria which has the largest population in the region with high rate of poverty, food insecurity and malnutrition (Mnkeni and Mutengwa, 2014).

Besides, there is a growing concern about the possible significances of climate change on poverty status, livelihood projections, economic development, as well as overall human development. According to Smith et al., (2007), the deprived populace in developing countries are likely to face the influences of climate change, with costs on households projected that surpass billions of dollars in many nations. Evidently, the general impacts of climate change on poverty status of rural farmers are colossal. Likewise, Ahmed et al. (2009) submitted that climate change affects the poverty status of rural household farmers in two ways. First, there is a resultant change in the actual cost of living and second, climate change affects income variations at the poverty threshold. Equally, the findings of Assuncao and Chein, (2009) showed that on the average, agricultural productivity per hectare could decline by 18% by 2040 as a result of climate change in Brazil, but that, at the city level, effects could range from a decrease of 40% to an increase of 15%.

Maize *(Zea mays)* is one of the main cereal crops of West Africa, and the most important cereal food crops in Nigeria. Maize is becoming the miracle seed for Nigeria's agricultural and economic development. It has established itself as a very significant component of the farming system and determines the cropping pattern of the predominantly peasant farmers, especially in the Northern States in Nigeria which include Sokoto State (Ahmed, 1996). Maize has been of great importance in providing food for man, feed for livestock and raw materials for some agro-based industries. Maize constitutes a stable food in many regions of the world. It is a basic stable for large population groups particularly in developing countries (FAO and ILO, 1997).

It has also been noted that climate change leaves many people vulnerable to poverty, and it was projected that about half of the world's populace, as well as most of those who reside in the industrious areas located by the region of coastal delta are susceptible to climate tragedies (IFRC, 2000). However, most of the affected communities are mainly found where there is concentrated number of the underprivileged families, majorly in Sub-Saharan Africa (SSA). As a result, the impacts of climate changes such as desertification, landslides, droughts and flooding, will not only decrease agricultural farm products such as the maize production for many farmers, but will also expose them to poverty in due course. Therefore, it is vital to design policies as well as impose practices that will adapt to the current observed changes in the weather climatic environment. However, community base adaptations and awareness are significant features of climate change main stream, and congruently, community adaptation and focused estimations are important techniques in the community's sustainability which establishes adaptation approaches. Also training and integration on climate change adaptation tactics at the various national levels will bring about a wider ownership of climate response and allow sketches on a wider pool of human resources and financial implementation, with supporting institutional structures and extensive dimensions. Following this, agriculture system must therefore include climate change effects as a benchmark to safeguard sustainable production in agricultural activities such as the maize production. As stated by Kijima et al. (2011), the usage of high quality resilient varieties/hybrids of crops (maize) is another adaptation method that could increase agricultural productivity and farm incomes, thereby reducing poverty.

Apart from being a food crop, maize has equally become a commercial crop on which many agro-based industries depend on for raw materials (Oluwatayo et al., 2008 and Babatunde et al., 2004). Maize contributes about 80 percent of poultry feeds and this has great implication for protein intake in Nigeria (FAO, 2008). Thus, maize can be considered very vital to the economic growth of the nation through its contribution to food security and poverty alleviation.

Consequentially, emphases are now placed on the implementation of CSAP in order to meet the subsequent daily population increase. Meanwhile, CSA is defined as agricultural practices that sustainably increase agricultural productivity which include maize production, income, adapt and build resilience to climate change, eliminate or reduce greenhouse gas emission or adapt to changing climate, which heightens the accomplishment of national food security and developmental goals which include poverty reduction (FAO 2010). However, agriculture is measured to be climate smart when it achieves three key objectives which are: building resilience to climate alteration, reduction of greenhouse gas emission and sustainable increase in agricultural productivity (Fanen and Adekola, 2014). For instance, Mnkeni and Mutengwa (2014) noted that to increase food production CSA stimulates renovation of agricultural systems and agricultural policies in order to improve food security and warrant affordable food with low input-cost; hence there is a reduction in poverty while conserving the biodiversity and guaranteeing resilience to a changing climatic environment.

Doebley (1994) reported that maize can be boiled or roasted on the cob, the grains can be cooked fresh or dry and the dry grain can be made into popcorn (*guguru*) and eaten with roasted groundnuts or coconut. Maize is one of the most abundant food crops in Nigeria. About 80% is consumed by man and animals while 20% is utilized in variety of industries processes for production of starch, oil high fructose, corn sweetener, and ethanol. Despite the economic importance of maize to the teeming populace in Nigeria, it has not been produced to meet food and industrial needs of the country. This could be attributed to low productivity from maize farms or that farmers have not adopted improved technologies for maize production hence the need for climate smart agricultural practices on maize production.

Additionally, existing data revealed that Nigeria suffers from numerous environmental problems which have been directly associated with the ongoing climate change (Adefolalu, 2007). The southern part of Nigeria, mostly known for high rainfall, is currently threatened with abnormality in rainfall patterns, while the Savannah zone is slowly increasing temperatures. In the same vein, the northern part also faces the hazard of desert encroachment at a very high rate annually, brought by a serious decline in the volume of surface water, wildlife resources and vegetation biomass (Obioha, 2008). Nevertheless, climate change adaptation, particularly at the rural areas, is vital because the impacts are best felt and understood at the local level; climate change influences are also experienced at the rural areas where the adaptive capability and susceptibility are very much felt.

The problem statement of this research work has to do with the global food crisis increasing with alarming speed and force, necessitating nations and international organizations all over the globe to respond with a strategic and long term approach to address the food insecurity situation. It has been observed that the current crisis is caused by a web of interconnected forces involving agriculture, energy, climate change, trade, and new market demands from emerging markets and therefore has grave implications for economic growth and development, international security, and social progress in developing countries (IPCC, 2007). Nigeria too is currently experiencing food crisis and Sokoto State in particular have the highest rate of poverty in North-West Nigeria (NBS, 3013). This has been attributed to low productivity in the agricultural sector necessitating huge food imports. Maize being a major staple food in Nigeria is of vital concern to agricultural policy decisions. Current production is about eight (8) million tonnes and average yield is less than 1.5 tonnes per hectare. This is far below the potentials of the Nigerian maize sector.

Nigeria faces diverse environmental problems which are directly associated with recent climate change (Ikhile, 2007). Obioha (2008) confirmed that northern Nigeria generally, is under constant attacks and faces hazard of desertification, which has been prompted by decrease in the quantity of rainfall (Ekpoh and Nsah, 2010).

The stronger force of demand for maize relative to supply is evidenced in frequent rise in the price of maize and therefore has great implication for the food security status and economic development of the Nigerian economy. The price of maize increased by about 70% between 2006 and 2008 (Badmus and Ogundele 2009).

Fanen and Adekola (2014) opined that, although, many nations are projected to embrace CSA, its demonstration in an African perspective is not yet so, neither has its sustainability been evaluated. However, subsequent global warming and changes in climate are impending danger to food security such as the staple food like maize and the consequential increase in poverty levels in numerous developing nations, which include Nigeria due to high dependence of agricultural systems on some climatic parameters (Bello et al., 2012). Additionally, rising problem of climate change effects is a worldwide issue, and the developing nations are particularly the most vulnerable, because the African nations' agricultural production system are mainly rainfed and basically relying on the whims of weather (Nwafor, 2007; Onyenechere, 2010). In the northern part of Nigeria, the number of rainy days has dropped by 53% which brings about irregular rainfall arrangement with subsequent increase in temperature in Sokoto States. The impact of this drop has resulted into a rise in desertification, drought and evapotranspiration which patently can result in the reduction of moisture content or the complete dryness of streams, and particularly with continuous annihilation of biodiversity and forest (Adefolalu, 2007). Accordingly, Akor (2012) reported that there are three main climatic zones in Nigeria, namely: Sudan, Sahel and Guinea Savannahs. Temperature, rainfall and humidity differ considerably through these three climatic regions. Nevertheless, in the semi-arid belts comprising the Sahel, Guinea and Sudan savannahs, extreme temperatures could be as high as 40°C. The report of Nigerian Meteorology Agency (NIMET, 2008) revealed that, the northern part of Nigeria has been subjected to poorer than normal rainfall but gradually became drizzlier than normal. Also, the research confirmed that between 1941 and 2000, annually rainfall in the greater parts of Nigeria has declined from eight to two millimeter. Drought and Seasonal rainfall have regularly become perpetual features of northern part of Nigeria. The dry season is commonly severe, and hence it is very essential for farmers to engage in soil moisture preservation agricultural practices in order to ease the destructive effect of climate change at this period. The North West region of Nigeria remains an agricultural hub for the nation with a huge proportion of its population in the agricultural sector (Olapojo, 2012). Nevertheless, it is the poorest zone in Nigeria according to National Bureau of Statistic (NBS, 2013). There is also a prevalence of high-income inequality among the populace (Action Aid Nigeria, 2009). However, the agricultural activities in northern Nigeria are mainly primitive, with about 80% of the households involved in rainfed subsistence farming. Obayelu (2010) averred that agriculture is the major source of income for many families in North-West Nigeria, and weather condition plays an important role in ensuring sustainable agricultural productivity in many parts. In addition, lack of improved agricultural tools compels wide use of traditional farming system. The latest discrepancies in the climate and weather of the area have taken severe toll on crop output with some crop yields now declining (Reddy and Hodges, 2000).

In 2010, conventional CSAP were introduced to farmers in North-West part of Nigeria through a programme called International Institute for Environment and Development (IIED) by the help of Sokoto Agricultural Development Project (ADP). The CSAP that were introduced by the agency are: use of organic manure, agro-forestry, conservation agriculture, the use of improved hybrid varieties, integrated crop/livestock management as well as irrigation for small-holder farmers. Obviously, this was in response to low agricultural productivity with low agricultural output and high incidence of poverty among farmers in North-West Nigeria. In point of fact, presently, desertification and drought have affected several portions of the north, with a resultant yearly extensive decrease in agricultural yields from one locality to another (Oyekale, 2009).

Furthermore, Thornton and Cramer (2009) predicted that by the year 2050, in the sub-tropics, crop yields may decrease by 10 to 20% as a result of global warming but there are some places where the crop yield damages may be more severe. Then, the restraints set by climate change on agricultural activities in this region range from prominent variation in precipitation which may be shorter periods of rainfall or irregular rains (which limits crop production), to repeated droughts. Moreover, the droughts unveil such features as fictional onset of the rains, late onset of the rains, prominent halts through the rainy season, and early termination of the rains, leading to severe modifications in the pattern of seasonal rainfall dissemination (Anyanwale, 2007). The report of Tadross et al. (2009) indicated that influence of climate change on crop yield like maize is not restricted to total rainfall effects alone, the intra-seasonal shocks are also very significant because intra-seasonal arid spells may be more destructive to maize growth than short entire rainfall. Very high extreme temperature through the growing season is also considerably unfavourable to cereal crop yields (Thornton and Cramer, 2012). Such sequential deviation is anticipated to rise in many parts of Africa nations under most climatic change situations (Boke et al., 2007). According to the submission made by United Nation Development Programme, high rate of poverty makes majority of the population susceptible to climate change and compromises their adaptation capacity (UNDP, 2011). Similarly, Etim and Udofia (2013) argued that 70% of Africa's deprived households are mostly found in rural areas and rely solely on agricultural activities. Englama and Bamidele (1997) also avowed that the majority of the rural dwellers are engaged in farming activities. The implication of this is that, a greater percentage of the rural poor are farmers. Given this, most of the poverty deliberations and considerations in Nigeria are always associated with farming households (World Bank, 1996). This is due to the fact that farming is still the backbone of the Nigerian economy and it has continued to employ 72% of the people (Ogbalubi and Wokocha, 2013) despite its decreased role in providing foreign exchange income to the Federal Government. But these farmers, due to their low productivity coupled with inadequate access to capital, transportation, storage and processing facilities are usually exposed to negative impacts of climate change and poverty.

The limited capacity of the Nigerian maize economy to match the domestic demand raises a number of pertinent questions both in the policy circle and amongst researchers. For instance, what factors explain why domestic maize production lags behind the demand for the commodity in Nigeria? To bridge the demand-supply gap, effort has to be channeled towards increasing its productivity through the use of climate smart agricultural practices which can enhance productivity and income.

Nevertheless, despite this alarming consequence of climate change that seems to worsen with time, the poverty statistics of North West Nigeria is equally very worrisome. However, the universal climate models indicated that Sub-Sahara Africa (SSA) will be one of the most affected areas, with anticipated agricultural yield declines of up to 20% for crops and possibly high levels of poverty and food insecurity mainly in the rural communities (Cline, 2008). A rising population promotes demands for, leading to increasing food shortage and poverty levels (Okwi et al., 2007). According to Diale (2011), failure to be equipped for the impacts of climate change can results in starvation, malnourishment and a high rate of poverty among others. As a result, farmers, particularly the younger generation who are anticipated to be future agriculturalists, need to be equipped not only with CSA knowledge, but climate threat management approaches such as timely atmospheric information, crop and livestock insurance, credit facilities and institutions, such as farmers' cooperative societies. Even though Nigeria is a country that is gifted with vast natural resource, physical and human endowments yet a large proportion of its populace live below the relative poverty lines. However, the national evaluation between 2003 and 2004 confirmed that slightly above half of the populace, that is, 51.6% live below US$1 dollar per day and the relative national poverty incidence was found to be 54.4% National Bureau of Statistics (NBS, 2005). Additionally, the recent Human Development Report by the United Nations Development Programme (UNDP, 2007) affirmed that about 83.7% of the populace lives below $1.25 per day.

Furthermore, this poverty status is worse in the rural communities where over 70% of the population dwelled and earn their living via agricultural activities other than in the urban cities. Moreover, greater than 86.5% of the rural populace is involved in farming activities (NBS, 2005). Consequently, this consistently defines agriculture as an important sector capable of affecting majority of Nigerians in various ways. Importantly, the persistence of poverty and hunger in Nigeria, to a large degree must then be attributed to the failure of the agricultural sector to fully impact positively on the largest and most populated nation in Africa. However, the gap this study wants to fill is to see how to use climate smart agricultural practices to alleviate the poverty status of rural maize farmers in the study area.

Moreso, the objective of this study is to: Determine the effects of climate smart agricultural practices on poverty status of maize farming household in the study area. Therefore, this study seeks to establish the effects of CSAP on poverty status of maize farming household in North West Nigeria.

Hypothesis statement

H_0: Climate smart agricultural practices do not significantly affect poverty status of maize farming household in Sokoto State.

H_1: Climate smart agricultural practices significantly affect poverty status of maize farming household in the study area.

METHODOLOGY

Study area

Sokoto State is located within the Sudan Savanna zone in the North western part of Nigeria, and lies within longitudes 30 and 60°E and latitudes 80 and 130°N (Obiora, 2014). Sokoto has a semi-arid climatic condition, characterized with low rainfall varying widely in amount from year to year (500m-1300nmm) and a long dry season. Diurnal and seasonal temperature fluctuations are very wide. Maximum temperature of 41°C is attained in April while minimum temperature of 13.2°C occurs in January. Humidity is very low during most parts of the year and solar radiation is relatively high due to dry atmosphere and clear skies (Obiora, 2014). The State is also divided into 23 Local Government Areas (LGAs). The State has a total land area of 25,973 square kilometers (10,028 square miles). Sokoto State has a total population of 4,244,399 people with a density of 170 per square kilometers, which is about 440 per square miles. Sokoto State is equally divided into four agricultural zones, namely: Gwadabawa, Sokoto, Isa and Tambuwa zones. North western region experiences a relatively hot climate, with seasonal rainfall and a marked dry season (Draper and Maureen, 2009). The top soil in the northern region of Nigeria is notably reddish brown, a feature of the semi-arid areas, typically known as tropical ferruginous soils (Harris, 1999). The main crops produced in the State are maize, millet, cowpea, guinea corn, rice, wheat, cassava, potatoes, groundnut, cotton, and sugarcane. Fruits and vegetables grown in the State include oranges, mangoes, lettuce, onions, spinach, okra, cabbage and guava (Obiora, 2014).

Sample size

The multi-stage sampling procedure was employed for the collection of data and information from the rural farming households. The first stage involved a purposive selection of Sokoto States due to high prevalence rate of poverty (NBS, 2013). The second stages involved a random selection of two (2) Local Government Areas from each of the four agricultural zones in Sokoto State, which bringing the total eight LGAs. The third stages also involved random selection of ten (10) communities from each Local Government Areas to bring the total to eighty (80) Communities. Lastly, four (4) farming households were randomly selected from each of the communities, making a total of three hundred and twenty (320) respondents, who were utilized for this analysis although not all of the respondents returns their instruments.

Data analysis

Model Specification for the objective

The Instrumental Variable (IV) - probit regression model was used to ascertain the objective which is to examine the effect of CSAP on poverty status of the maize farming household. The principal component analysis was used to develop composite indices for the practice of CSA which includes: the use of organic manure, agro-forestry, conservation agriculture, integrated crops and livestock management, the use of improved varieties/hybrid of crops/animals and the use of irrigation for smallholder farmers. The Probit function follows a normal distribution. Following the assumptions of the normal distribution where Z_i is the standard normal variable, β_1 is the intercept and β_2 the coefficient of x, while 'x' represents explanatory variables and Z~N $(0, \delta^2)$ and 'F' is the standard cumulative distribution frontier, which could be written as;

$$F(I_i) = \frac{1}{\sqrt{2\Pi}} \int_{-\infty}^{I_i} e^{\frac{-x^2}{2}} dz = \frac{1}{\sqrt{2\Pi}} \int_{-\infty}^{\beta_1+\beta_2 X_i} e^{\frac{-x^2}{2}} dz \text{ .... (i)}$$

Where $I^i = F^{-1}(I_i) = \beta_1 + \beta_2 X_i$

Then to be able to examine the effects of CSA on the probability that a household is poor, we estimate

$$\frac{dP_i}{dX_i} = f\left(\beta_1 + \beta_2 X_i\right)\beta_2 \text{ .... (ii)}$$

Where dP_i = Differential for the dependent variable, dX_i = Differential for the explanatory variable, f = Standard cumulative distribution frontier, β_1 = Intercept, β_2 = Coefficient and Xi = Explanatory variable

RESULTS AND DISCUSSION

To ascertain the objective which is to determine the effect of CSAP on poverty status of maize farming household, the researcher used an instrumental variable (IV) probit regression model. The post-estimation tools for IV-Probit analysis identified these selected instrumental variables (lack of access to CSAP, sources and use of water from borehole for drinking and quantity of maize per yield) to be strong and not weak for the analysis which were meant to cater for the potential problem of endogeneity in the analysis. It is worth noting that, CSA for maize (the key independent variable) is a quantitative variable that have been achieved with the aid of the Principal Component Analysis (PCA). In addition, the test for multi-collinearity among the variables was carried out with Variance Inflation Factor (VIF), the mean VIF was found to be 1.55

Table 1. Multi-Collinearity Test of variables.

Description	VIF	Tolerance	Eigen Value
Age	2.54	0.3931	11.3794
Gender	1.95	0.5115	1.2463
Education	1.08	0.9241	0.9948
Marital status	1.76	0.5695	0.8250
Households size	1.53	0.6552	0.6612
Farm size	1.31	0.7618	0.4625
Experience	2.36	0.4230	0.4009
Ownership farmland	1.81	0.5526	0.3420
Land Acquisition	1.49	0.6701	0.2466
Labour	1.06	0.9436	0.1287
Membership	1.58	0.6333	0.0946
Transportation	1.14	0.8781	0.0751
Housing materials	1.25	0.8008	0.0619
Communication kits	1.21	0.8245	0.0365
Access to credit	1.41	0.7086	0.0252
State	1.32	0.7571	0.0125
Mean VIF	1.55		0.0068

Source: Author's computation from the computer printout of Multi-collinearity Test.

in the analysis and the high level of tolerance computed for the variables indicates that there was absence of serious multi-collinearity in the model which means the overall model is fit for this analysis (Table 1). Variables with negative parameters imply a negative relationship with dependent variable while those with positive ones indicate a positive and direct relationship with dependent variable. Meanwhile, the dependent variables represent poverty status wherein one represents farmers whose monthly income is less than $1.9 US Dollar and zero otherwise. To that end, this result shows to what extent CSA practices for maize enterprises affect poverty status of farmers in the study area.

However, this study examined the effect of CSAP for maize farming household enterprise on poverty status of the farmers in the study area and the results have a probability chi-square of 0.000, showing that the overall model is significant. The findings validated the fact that CSAP for maize enterprise, age, education, housing materials and State were significant determinants of poverty status, given that their z-values are greater than 1.96 and their probability values are less than 0.05. Table 2 presents the outcomes of analyses for the effect of CSAP on poverty status of the respondents using Two-Stage Least Square (2SLS) probit model. The instrumented results were meant to correct for the likely problem of endogeneity. Additionally, Wald test of exogeneity was statistically significant ($p<0.01$) in the fitted model. The result indicates that the inclusion of maize climate smart agricultural enterprise as an endogenous variable was reasonable and the selected instruments satisfied the necessary conditions (Gujarati, 2004). The Wald chi-square statistics was also statistically significant ($p<0.01$), showing that the model produced was a good fit and estimated parameters were jointly unequal to zero. The results showed that CSAP was significant and had a negative relationship with the odds of being poor for farmers involved in maize enterprise. In fact, the result suggests that a unit increase in climate smart agricultural practice reduces the probability of farmers involved in maize production to be poor by 0.7582123. This is expected a priori, as CSAP should generally improve production and consequently reduce poverty. This was expected because CSAP had impacted greatly on the farmers' means of livelihood and also changed their poverty status. This finding was confirmed in the research carried out by FAO (2013) that agricultural policies such as CSA are the basis for achieving food security and improving livelihoods and that an effective combination of sustainable agriculture and climate change policies can boost green growth, protect the environment and contribute to the eradication of hunger and reduce high poverty rate in the rural areas. Equally, education was significant and inversely related to the probability of being poor. Possession of informal education, decreases the probability of being poor by 0.2624578. This is in agreement with Prasad et al. (2006) study. The researchers discovered that cereal farmers who practiced CSA in Tanzania had higher yield compared to their counterpart because education accelerated the rate of comprehension of the technicality associated with the used of climate smart agricultural techniques. On the other hand, age was significant and had positive relationships with the probability of being poor. The result shows that a unit increase in age, increases the probability of farmers being poor by 0.0328457. Then, it follows that the older

Table 2. IV-Probit Regression results determining the effect of CSA practices on poverty status of farmer's maize enterprise.

Description	Coefficient	Standard Error	Z-value	P>/z/-value	Marginal Effect {dy/dx}
Maizecsaindex	-0.7582123	0.105982	-7.15	0.000*	-0.7582123
Age	0.0328457	0.0120891	2.72	0.007*	0.0328457
Gender	0.2774317	0.3951599	0.70	0.483	0.2774317
Education	-0.2624578	0.1299249	-2.02	0.043**	-0.2624578
Marital status	0.0686225	0.4565479	0.15	0.881	0.0686225
Households size	0.0739883	0.0545875	1.36	0.175	0.0739883
Farm size	-0.0077441	0.0277985	-0.28	0.781	-0.0077441
Experience	-0.0170221	0.0119261	-1.43	0.153	-0.0170221
Ownership farmland	-0.3644852	0.3898637	-0.93	0.350	-0.3644852
Land Acquisition	-0.0119436	0.3542807	-0.03	0.973	-0.0119436
Labour	0.0905952	0.2345065	0.39	0.699	0.0905952
Membership	-0.1971802	0.1846458	-1.07	0.286	-0.1971802
Transportation	0.2167461	0.243268	0.89	0.373	0.2167461
Housing materials	-0.7496268	0.2162328	-3.47	0.001*	-0.7496268
Communication kits	-0.1668879	0.1530503	-1.09	0.276	-0.1668879
Access to credit	-0.0918715	0.1603149	-0.57	0.567	-0.0918715
State	0.9221478	0.1641148	5.62	0.000*	0.9221478
Constant	-2.274299	0.6531988	-3.48	0.000	
Number of Observation	294				
Rho	0.8822057				
Sigma	1.092749				
Wald $chi^2(17)$	224.00				
Prob > chi^2	0.0000				
Log likelihood	-587.57785				

Note: *, ** and *** means 1%, 5% and 10% level of significance respectively.
Source: Author's Computation from Computer Printout of IV-Probit Regression Analysis.

the farmers become, the higher the possibility for them to be poor. This corroborated the findings of Sokoya et al. (2006) that farmers tend to be less productive as they advance in age because their natural strength diminishes, likewise their mental capability.

The results showed that housing materials was significant and had a negative relationship with probability of being poor for farmers in maize enterprise. The analysis indicated that a unit increase in the number of farmers that used bricks or concrete (cement)/zinc materials for building reduces the probability of the respondents being poor by 0.7496268. This is equally articulated in the findings of United Nation (2007) which stated that households are considered to be "above standard" if their dwelling place do meet the predetermined standards such as suitability, adequacy, and affordability norms, that means a house built with concrete block and modern roof for a comfortable living. Additionally, the result illustrated that State was significant and had a positive relationship with the probability of being poor for farmers engaged in maize enterprise. This result also established the fact that the poverty rate in Katsina State is higher than Sokoto State, cinching a match with the report of National Bureau of Statistics (NBS, 2013. They discovered that poverty increased at the rate of 4.1 in Sokoto between 2013 and 2015.

Evaluation of hypotheses

Evaluation of hypotheses for this study was that, the probability value of 0.000 for maize climate smart agricultural indices which is less than 0.05 and absolute t – value greater than 1.96 shows that CSAP are significant at the standard of 1%. Therefore, the researcher rejected the null hypothesis and accepted the alternative hypothesis which stated that CSAP are significant and determinant of poverty status of maize farming household in Sokoto State, Nigeria.

Conclusions and recommendations

The research work was motivated by the increasing popularity of climate alteration consequences being witnessed all over the world. Projections show that developing countries who are least prepared for the changes in climate will be the most affected. However, the present poverty in Nigeria is frightening and climate change brings about food insecurity and poverty to a large extent. It was on this note that the study assessed CSAP and its implication on poverty status of maize farming households in Sokoto State, Nigeria. Additionally, the study showed that age, education, farm size and type of housing materials were the significant determinants on the use of CSA for most of the enterprises under consideration. And CSAP in the maize enterprises decrease the odds or probability of being poor significantly. The study therefore recommends that massive campaigns be made by government, civil societies and the media to create awareness about CSAP and to proffer indigenous solutions that address the significant constraints being faced. The findings of the study suggest several policy implications as follows:

1. The study recommends that massive campaigns be carried out in educating the youths regarding the importance of agriculture production activities and how sustainable it can be when using CSAP. The importance could equally be emphasised in the school curriculum so as to diffuse the misleading urge for white collar jobs and focus on where the talents lead you. Formal education and Arabic or Qur'anic educational curriculum should be enriched with climate smart agricultural information and should be agriculturally focused. This will serve as bait for household farmers in the study area because education was one of the major significant variables.
2. There is need to invent new ways of encouraging education in the study area. The government has done a considerable work in this aspect, the most significant being the universal basic education. Nonetheless, it is still necessary to make such considerations for post primary educational levels so as to get those who eventually become farmers more knowledgeable about the business which is becoming more lucrative and scientific with CSAP and not just planting and then wait for harvest time activities. In the educational sector, there is very urgent need to re-orientate the thinking and value system of both parents and their children through mass educational campaign regarding the importance of education and the need for parents to insist on their children going to school at least up to first degree before seeking employment or going into business because majority were found to be informally educated.
3. Government and farmers' organisations should create an environment to motivate the low-users of CSA to increase and improve on the level of their usage of CSAP because CSA was one of the significant variables that needed to be improved for more productivity and profitability.
4. The practice of CSA can be greatly encouraged to the rural farmers since they are getting involved in the practices gradually. Moreover, the consequences of climate change effect, on all and sundry, has been alleged to increase poverty levels among farmers. It is therefore only logical to practise CSA so as to be sustainably increasing in agricultural productivity, income, adapt and build resilience to climate change, reduce or eliminate green-house gas emission which enhances achievement of national food security and reduce poverty in the long run.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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