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Assessment of Adoption Rate of Climate Change Adaptation Strategies in Kishi, Oyo State, Nigeria

Adetayo Adewale Olusola

Institute of Agricultural Research and Training, Obafemi Awolowo University, Ibadan, Nigeria

Email address:

wale_agromet@yahoo.com

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Abstract: Adoption of technologies is vital to sustainable livelihood and socioeconomic development of rural households. The level of Adoption of introduced climate change adaptation strategies in Kishi, Oyo State, Nigeria was assessed in this study. The study also investigated the factors influencing the adoption rate of the technologies with a view to identify the constraints vis-a-vis suggesting solutions for improving adoption. In an attempt to carry out the said objective, data were obtained through a structured questionnaire administered to 500 farmers within the study area. Descriptive statistics and multinational logit model were used to present the data and analyse the results. Result shows that gender, age educational level, number of plots access to extension services and credit facilities affect the adaptation rate of farmers to the technologies. Non adequate provision of extension services for follow-up activities may have accounted for the low adoption of the technologies. Therefore, for improved rate of adoption of technologies by farmers, agricultural extension services must be provided. Farmers are also encouraged to join farmers group for improved delivery of services by extension agents. Adequate provision of credit facilities must be provided relevant stakeholders and policy makers, targeting literate farmers, who are the major adopters of disseminated technologies for improved and sustainable food production.

Keywords: Technology Adoption, Climate Change Adaptation, Improved Crop Yield, Farmers Coping Strategies

1. Introduction

Climate denotes the synthesis or summary of weather over a long period of time (30 – 35 years) over a given location or area. Climate acts as both resource and constraint to agricultural production. Many problems facing agricultural production are climate-related. An understanding of the complex interrelationships between climate and agriculture is therefore vital to the solution of these problems. Climate change is defined as a difference over a period of time (with respect to a baseline or a reference period) and corresponds to a statistical significant trend of mean climate or its variability, persistent over a long period of time (e.g. decades or more). Climate change may be due to both natural (i.e. internal or external processes of the climate system) as well as anthropogenic forcing. Climate change and its implications on human existence has remained a great challenge for agricultural production across the globe. There are strong indications that climate change has adversely affected the agricultural system as well as food chain in all phases of human endeavors including food security across the world [4]. Remarkably, the problem is more aggravated in developing countries where local farmers produce the bulk of arable crops that are consumed by a fast growing population in Africa [7]. Climate change is predicted to pose a major potential threat to the sustainability, and viability, of some agricultural activities, while the potential impacts need to be carefully assessed and managed, and their policy implications investigated. Report has shown that the available land area under cultivation has drastically reduced due to impact of climate change [24]. However, adaptation strategies are considered as one of the most appropriate solutions in reducing the impact of the menace.

Major challenges facing humanity today include sustainable utilization of natural resources for increased productivity and conservation of the immediate ecosystem. As the world population increases, stress on resources increases, making it difficult to attain food security and sustainability. The traditional cropping system like fallowing and shifting cultivation which the farmers are practicing to coping strategies against the impact of climate change, lack the capacity to adjust quickly enough to water resources depletion, as the resilience potential of sub-Saharan Africa soils are limited [9, 11]. Research efforts towards achieving sustainable agriculture in the past have failed due to ineffective extension services, poor technology transfer, lack of timely access to credit and inputs at reasonable cost, and complexity in establishing most proven technologies [27]. A number of studies [21-23] have identified the socio-economic impacts of climate change on agriculture. They include shortening of growing season, crop failure, loss of arable land to sea incursion in the coastal areas, and loss of farmlands and grazing land to desert encroachment and sand dunes in the semi-arid regions.

In the last few decades, scientist and policy makers focus on how to proffer solutions to the problems caused by climate change. But their major areas of concern is mainly on human activities induced causes, while the climate change itself could be difficult to control. However, mitigation and adaptation strategies are considered as most appropriate in reducing the impact of the menace. Farmers in Sub-Saharan Africa have their own farming techniques which are considered to be primitive and inadequate [23]. In the West Africa sub-region a number of improved technologies are available for assessment using integrated approach. These approaches include soil and water conservation techniques, micro-dose fertilization, and organic resources utilization, improved farming systems, planting of improved and stress tolerant crop varieties. These technologies have been identified under integrated soil fertility management concept of West and Central African Council for Agricultural Research and Development (WECARD) priority areas which can serve as mitigating and adaptation measures against climate change.

Institute of Agricultural Research and Training (IAR&T), Ibadan Nigeria has carried out diagnostic surveys and research on some watershed in Nigeria in the past. Such studies include the development of integrated soil nutrient and watershed management under intensive land cultivation, and soil-water-nutrient management under increasing climatic variability sponsored by the Agricultural Research Council of Nigeria (ARCN) and (WECARD) respectively. In these projects, erratic rainfall, poor conservation strategies, low inputs, poor soil-water management and inappropriate land uses were revealed to be responsible for low yields.

Water conservation structures have been deployed as part of adaptation strategies for sustainable crop production under intense climatic variability. This is the major focus of the WECARD projects in Oyo State, Nigeria where resource poor farmers in dry zones are faced with inadequacy in water availability to cope with impacts of climatic variability. These structures (micro check dam, tube well, water pan and roof type water harvesting) have proven beneficial to improving water resilience in the areas.

Micro check dam is a water harvesting structure. The main objective of a reliable micro check dam is to collect, retain and effectively store water for use when it is needed. The concern is to develop a this technology for field water harvesting to make water available for farmers either for supplemental irrigation or for total irrigated agriculture during the dry season. Similarly, harvested water can also be used by livestock during the off season when the challenge of water availability is critical. Micro check dam is a small embankment structure built across a stream or small river to retain and store runoff water within a pond excavated for that purpose. The micro check dam usually contain the dam embankment which is a solid structure built across the cross section of the river/stream to block the flow of water in order to retain it in the reservoir pool. This can be made either from stone boulder or sacks filled with clay. A side embankment is the part of the check dam that is made from excavated materials to increase the capacity of the reservoir areas to retain water. The reservoir or water pond is the retention basin where the water is pooled in front of the dam embankment. Micro check dam is most effective when constructed across streams, small rivers or natural waterways. It can also be constructed in lowland, valley or areas where runoff can easily drain into the pool along the land slopes.

Tube wells are small holes dug into shallow water table to explore groundwater for agricultural or domestic uses. Tube well can be constructed simply using the jetting technique which uses a high velocity stream of water to bore the well. The stream is generated by either motor or hand powered water pump. The excavated material is washed out. The erosive action of water is however ineffective in cases of hard materials. Semi-hard materials may be penetrated by a combination of hydraulic and percussion effects which are obtained by raising and dropping a chisel-edged jetting bit. Moving coarse materials such as gravel vertically out of the hole requires a greater water velocity than do finer materials. All the materials are available locally and cost-effective.

Water pans are water harvesting structure that are either natural or artificial depressions receiving water either by channeling runoff water into them or by receiving rainfall directly into the trough. They can also be made from either plastic, nylon or some borrow pits can be prepared to hold thousands of liters of water and thus be classified as water pans. Water pans enable the collection of runoff which hitherto would have been loss to nearest drainage system. Water Pans are useful for livestock watering and vegetable gardening. The water pan could be constructed around water spring also and this could be a source of water for domestic uses especially in rural environment.

Roof type rainwater harvesting is the collection from roofs and storage of rainwater that would otherwise flow down channels into the drain or septic tank [9]. It is the practice of collecting the water during rainfall events. Rainwater harvesting was recently found popular among the populace in Nigeria.

Rogers defines adoption as a process whereby one fully use an innovation as the only best options available [26]. No or low adoption of promoted technologies is often cited as major reason responsible for productivity gap in cropping [3]. Poor farmers outlook towards a problem and their inability to adopt technologies will aggravate the problem [2, 5, 6, 10]. Adoption of technologies is vital to sustainable livelihood and socioeconomic development of rural households [14]. Almost all countries of the world have developed different kinds of strategies to adapt to the impact of climate change to help rural people to advance their agricultural productivity and improve their living standard [28]. It is equally known fact that knowledge is a factor for change, progress and development. Farmers with better access to extension services are more likely to be better-off compare to those who do not [20]. Therefore, it is important that key drivers of adoption and non-adoption of these recommended technologies be investigated so as to help in making necessary recommendations which could lead to policies that will help at increasing adoption of technologies among poor resource farmers. The aim and objective of this study is to investigate the level of adoption of adaptation and mitigation strategies by poor resource farmers in Kishi (Irepo local government area), Oyo State, Nigeria.

2. Materials and Methods

2.1. Study Area

Kishi is the headquarters of Irepo local government (Kishi) is located at the northern part of Oyo state. It occupies a landed area of 984 km² with a population of about 122, 553 according to [25]. Kish is typically an agrarian community with majority of her inhabitants engaging in farming, providing income and employment for more than 75% of the population. The economic progress of the community is determined by the farm produce. The major farm commodities are Yam, maize, guinea-corn etc. The farm produces are exported to other agro-ecologies within and beyond the State and generally referred to as the food basket of Oyo State. The annual rainfall is 1095 ± 32 mm with the onset and cessation being 30th May and 1st October respectively. The length of the growing season is about 146 days. There are two distinct seasons: wet and dry. May to October is the wet season with the highest mean monthly rainfall in September and dry season during the months of November and April, which is completely devoid of rain. The study area has a tropical climate with temperature rarely falling below 22°C with wet season temperature averages about 28°C with the peak of 40°C in March and 22°C in December. The reference evaporation (ETo) ranged between 60.88 and 80.40 mm/day. Month of March has the highest evaporation which may be due to the high temperature. The mean annual relative humidity is 61%.

2.2. Data Collection

Administration of questionnaires to the inhabitants of the study area serves as the first phase in achieving the sets objectives of this study. Systematic random sampling method was employed to select those to whom the structured questionnaires be administered to. The respondents were interviewed on their farm to establish accuracy and determine the exact origin of the data [12]. The questionnaire survey elicits information on sex, level of education the total coverage of farmland being cultivated, the type of technology being used to carry out their farming activities and other relevant information will be obtained from farmers. Also, information will be collected on farmers perception on climate change, the perceived implication on their crop production, techniques put in place to adapt to climate change impact, their opinion on their productivity level over time and reason behind such opinion, means of averting shortage of food production and other information such as climatic situation at present compared with the past.

2.3. Data Analysis

Descriptive statistics was employed in presenting the socioeconomic characteristics of the respondents. Also, data generated were analyzed using multinomial logit model. The multinomial logit is preferred because of the simplicity of its probability computation. Multinomial logit model of multiple choices is stated according to [13] and is given as Yi to be a random variable which represents the preference of adaptation strategy by farmer i.e.

$$P_{ij} = E(\frac{Y_{i-j}}{X_i}) - F(\alpha + \beta x_i), \quad j - \ 0,1...$$

Where $Pij = E[Yi = j/Xi]$ is the likelihood that farmer i adopt a technology and j = 0,1… is based on category of not using the technology. The βs represent vector of the regression coefficient of explanatory variable vector x where α is the group specific constant. Yi and Xi are time varying observed data. The function F denotes the theoretical distribution function.

3. Results and Discussions

Table 1 shows the descriptive analysis of farmer's socio-economic characteristics. From the result, it was shown that more male farmers (90%) are involved in the adoption of the technologies than female farmers. Majority of the adopters of technologies were aged between 15 and 35 years (51%), followed by ages between 36 and 55 years (41%) and ages of 56 years and above had low adoption. The adoption rate increased with more qualifications. Farmers that possess higher qualification (tertiary education) adopt the introduced technologies more than the farmers with less qualification (primary school and no formal education). Farmers with larger farm size adopt the technologies (76.4%) than farmers with lesser farm size (23.6%). The result further shows that farmers that belong to one farmers association or the other adopt technologies (74.6%) than those farmers that did not belong to any farmers group (25.4%). Accessibility to extension services is grossly inadequate as only 34% of farmers interviewed had the opportunity. Also, there is gross inadequacy of access to credit facilities by farmers in the study area as less than 30% of farmers had access.

Table 1. *Farmers Socioeconomic characteristics.*

Variable	Sub-level	Frequency	Percentage (%)
Gender	Male	450	90.0
	Female	50	10.0
	Total	500	100.0
Age (years)	15 – 35	255	51.0
	36 – 55	205	41.0
	56 – 70	40	8.0
	Total	500	100.0
Educational qualification	No formal education	45	9.0
	Primary school	105	21.0
	Secondary school	145	29.0
	Tertiary education	205	41.0
	Total	500	100.0
Number of plots	One plot	118	23.6
	Less than one plot	382	76.4
	Total	500	100.0
Membership of association	No	127	25.4
	Yes	373	74.6
	Total	500	100.0
Access to extension services	No	330	66.0
	Yes	170	34.0
	Total	500	100.0
Access to credit	No	355	71.0
	Yes	145	29.0
	Total	500	100.0

The response of farmers to the awareness to menace is presented in (Table 2). The awareness to climate change among farmers is encouraging as 75% of farmers are aware that climate change is a phenomenon and the only solutions are mitigation and adaptation strategies to be able to cope with the impacts. Majority (61.2%) of the respondents are of the opinion that the menace is resolvable.

Table 2. *Awareness of Respondents to climate change.*

Question	Response	Frequency	Percentage
Have you heard about climate change?	No	125	25.0
	Yes	375	75.0
	Total	500	100.0
Do you think the problem of climate change is resolvable?	No	69	13.8
	Yes	306	61.2
	Total	500	100.0
Do you notice any variability in rainfall pattern?	No	52	10.4
	Yes	448	89.6
	Total	500	100.0
Do you notice any increase in temperature	No	52	10.4
	Yes	448	89.6
	Total	500	100.0

Table 3 shows the results of characteristics of adopters and non-adopters of adaptation strategies (Test of Equalities of Means). The difference in the adopter and non-adopters of the technologies by gender is not significant in the study area. This is in agreement with the findings of [1, 15] that adoption of technologies is not based on the sex of farmers. Significant differences between the mean ages of non-adopters and adopters among farmers were noticed. Farmers between the ages of 15 and 35 years significantly adopt the technologies than any other age groups considered in the study. The findings are in accordance with the results of investigations made by [18] and [29] who found out that old age could negatively affect adoption rate of technologies. The table further shows that the educational levels of adopters were significantly higher than non-adopters thus indicating that level of education significantly influence the adoption rate of technologies positively. Similar findings were recorded by [27, 15], farmers with higher educational qualification embrace advanced technologies the farmers with lower qualification. This is because farmers with higher education can easily act rationally due to their level of understanding of the importance of the introduced technologies. Significant differences in the non-adopters and adopters in terms of expertise were also noticed. Experience in a particular hobby influences the level of adoption of technologies as shown in the work of [8]. The farm size owned by a particular farmer was found to be significantly higher for adopters than non-adopters of technologies. Famers with higher plot size adopt technologies more than farmers with lesser size of plots. The study however agrees with [16] that there is higher correlation between farm size and adoption rate of technologies. The increased in the accessibility of farmers to extension services caused an increase in adoption rate of agricultural technologies. Number of visits by extension workers influenced the rate of adoption of technologies. There is high correlation between the availability of extension workers and adoption of technologies. Famers are likely to be ignorant of new technologies if there is non-adequate provision of extension services. The table also shows the financial institutions inability to grant farmers with credit facilities greatly affect its adaptation rate. Therefore, more the accessibility to credit facilities, the more the adoption rate of adaptation technologies. Few farmers have access to credit facilities in the study area which affects the adoption of technologies negatively. [17] found out that only 17% of sampled financial institution offers credit facilities to farmers, which poses threat to agricultural production in developing countries. Knowledge about climate change impact encourages technology adoptions aimed towards adaptation. Climate change awareness and its impact in agricultural production and sustainability prompted farmers within the study area to turn toward adaptation strategies for improved farming systems.

Table 3. *Adopters and Non-Adopters of Technologies Characteristics (Test of Equality of Means).*

Variable	Check dam			Tube well			Water pan			Roof rain harvest		
	Adopter	Non-adopter	t-value	Adopter	Non-adopter	t-value	Adopter	Non-adopter	t-value	Adopter	Non-adopter	t-value
Age	45.7	52.6	3.56*	12.5	41.5	0.46*	52.8	43.4	0.55*	64.4	44.8	1.24*
Gender	64.2	42.5	1.49	11.4	11.3	0.21	48.5	54.5	2.84	58.6	42.5	2.26
Education	10.7	24.5	2.78*	0.8	9.2	0.24	58.5	38.5	1.49	64.2	41.8	1.55
Expertise	28.4	24.8	2.42*	11.1	10.4	0.15*	64.8	72.3	1.21*	47.8	44.5	1.67*
Farm size	38.5	33.8	1.84*	10.2	8.4	0.78*	41.2	30.8	1.36*	40.6	39.6	1.96*
Extension services	19.5	31.6	1.21*	0.78	1.2	1.41*	11.2	10.4	0.12*	9.6	9.8	0.10*
Credit facilities	4.4	6.2	0.56*	2.2	2.4	0.24*	9.6	8.4	0.11*	7.4	8.2	0.08*
Knowledge of climate change	66.8	54.2	2.46*	24.8	19.6	1.46*	54.2	48.4	1.96*	52.6	44.5	1.98*

Note * is significant at 5%.

4. Conclusion

This study investigates the rate of adoption of introduced climate change adaptation strategies in Kishi, Oyo State, Nigeria. The study indicated that the rate of adaptation of technologies is dependent on ages, sex, educational qualification, plot size, farmers group, extension services and accessibility to credit facilities. Male farmers that are in ages between the ages of 15 and 35 years adopt technologies most. The higher the education level, the higher the likelihood of adopting technologies. Membership of association by farmers and adequate access to extension services promotes adoption of agricultural technologies by farmers. Relevant stakeholder involved in the adequate access to provision of credit facilities for farmers are advised to step up their activities with the aim of encouraging farmers at adopting agricultural technologies viv-a-vis optimizing crop production.

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