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CURRENT INDIGENOUS TECHNOLOGIES IN USE TO COMBACT THE CHALLENGES OF CLIMATE CHANGE IN BAKURA LOCAL GOVERNMENT

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ABSTRACT

To address the climate change impacts in agro forestry systems in Bakura and beyond there is need for significant improvement in agricultural research and extension system of the local government. This is because agricultural research is the operational tools for deploying science and technology to improve agricultural productivity and ensure effective coping with climate change challenges. The preliminary evidence has indicated, that current indigenous technological responses adapted by farmers in the study area toward climate change impacts were use of weedicides, use of fertilizer, carrying out of tillage operation with mechanized tools, use of pesticides, use of crops with smaller need of water, use of drought resistant crop varieties, use of flood plain farming, use of crop rotation. It was recommended that farmers need to be sensitized on the importance of afforestation programme, more research should be done on the production of improved seeds.

KEYWORDS

Climate change, Adaptation, Indigenous technologies and Farming systems.

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INTRODUCTION

Climate change is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events. Climate change usually refers to changes in the climatic variables. It may be qualified as anthropogenic climate change, more generally known as "global warming" (Anonymous, 2006)[1]. It is mainly the wealthy developed countries that are responsible for these changes, yet they affect every country in the world.

For example the poorest countries, such as Nepal, may suffer most due to the limited resources to cope with and to adapt to the effect of climate change. Likewise marginalized groups are most vulnerable to seasonal drought, intense rainfall, and floods; in particular drought and floods have increased in frequency, intensity and magnitude and have adversely impacted on food and water security, water quality, energy and sustainable livelihoods of rural communities (A A I, 2006)[2]. The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as the "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007)[3]. Many diseases and health problems that may be exacerbated by climate change can be effectively prevented with adequate financial and public health resources, including training, surveillance and emergency response, and prevention and control programs, urban tree planting to moderate temperature increases, weather advisories to alert the public about dangerous heat , grain storage, emergency feeding stations, engaging state and local governments in defining responses to sea level rise, improving early warning systems and flood hazard mapping for storms, altering the timing of planting dates to adapt to changing growing conditions, conserving soil moisture, through mulching and other means.

Human-induced climate change has caused an increase in the frequency and intensity of extreme events as well as gradual changes in the rainfall and temperature patterns. This is expected to continue to varying degrees under different climate scenarios for the future (based on the extent of greenhouse gas emissions). The need to respond to these changes is urgent as the climate change-related impacts are starting to emerge more rapidly than before. improving people's ability to prepare for, and respond to, extreme weather events (such as more frequent flooding) and increasing climate variability; and investing in mechanisms and systems for adapting to gradual climate change (for example, where overall rainfall patterns in a region change.).

Understanding the nature and level of vulnerability of groups and individuals through their perception of risk, choices and patterns of behavior to changes in climatic factors is important in developing locally appropriate and effective adaptation strategies. There is a need to comprehensively assess the existing initiatives in the light of current and expected climate change to ensure that developments being supported and encouraged are sustainable. This will require establishing collaborative arrangements that facilitate closer relationships with National Meteorological Services and academics both nationally, regionally and internationally and/or building research capacity on these issues (Climate change, 2001)[4].

MATERIAL AND METHODS

- **Study Area**
- **Methodology**

STUDY AREA

The study was conductedin Bakura Local Government of Zamfara state which cover (Gamji, Bakura, Kurunkudu, Dambo, Yay-Tsamiya, Kwanarkalgo, Nagarawa, Yarkofiji). The state is located in the North western part of Nigeria between latitude $10^0 40^1$ and $13^0 40^1$N to longitude $4^0 30^1$ and $7^0 06^1$E. (Maduka, 2006)[5], the state covers an area of about 32,038km^2 consisting of 14 Local government areas (Gadzama, 1990)[6].

Sampling Procedure

The study was designed to assess current indigenous technologies in use to combat climate change in Zamfara state. Ten villages in Bakura local government being the areas that are prone to effect of climate change. These include (Dambo, Damri, Dan- Kaiwa, Birnin- Tudu, Yar - Kofoji, Nassarawa, Nagarawa, Dan-manau,) Proportionate random sampling was employed to select the villages as the number of villages and households in each villages are not the same, and thirty percent of each villages were proportionately selected. A total of 100 questionnaires were administered.

Data collection

Primary and secondary data were collected from field survey, Structured and open ended questionnaires were used to collect data on the level

of awareness and understanding of farmers and local communities about the manifestation and impacts of climate change; Identify the relationship between climate change and adjustments in farming systems and management technologies; Assess ascertain the patterns and manner of livelihood adjustments that have been implemented by local communities and farmers in response to climate change phenomenon.

Data Analysis

The data collected were subjected to descriptive statistical analysis (frequency and percentages). Descriptive statistic was used to analyze socio economic characteristics of the farmers.

RESULTS AND DISCUSION

Generally, education is considered to broaden the horizon of human activities. Figure No.1 indicates that the majority of the respondents (32%) in the area reported that they had Quranic education as their highest level of educational. It also shows that 27% of the respondents have adult education, ten percentage (10%) have primary education. Only 13% of the respondents reported that their highest level of education is secondary education, whereas 27% of the respondents had post-secondary education as their highest level of education. This scenario indicates that reduced productivity could likely be as a result of lack of adequate understanding of the best practices to farming especially now climate change is affecting farming activities. According to (Obinne, 1991)[7] past studies have revealed that education influenced the adoption of modern farm. This is because a more educated person is more enlightened easily adopts modern practices, better innovations and hence could be a better producer.

Fiqure No.2: 38% of the respondents engaged in commercial production, wlile 62% engaged in subsistence agriculture. this agreed with Ochai *et al.* (1996)[8] defined cropping pattern as the yearly sequential and spatial arrangement of crops in a given area.

Fifty three percentage (53%) of the respondents reported that the major cause(s) of climate change in the area is due to deforestation activities (Figure No.3). Another 23% though the industrial activities are the key causes of climate change in their communities while only 24% of the respondents agreed that agricultural activities are the major causes of climate change in their area. This findings agreed with UNFCC (2007)[9] who stated that with the removal of part of the forest, the region cannot hold much water. The effect of this could be drier climate. This is invariably associated with reduction in the productivity of both the tree and agricultural crops. At extreme dryness a lot of trees and other plants will die leaving the soil open and vulnerable to the desiccating effects of sun and soil erosion which collectively reduce the nutrients content of the soil. The trees serve as carbon sink because they utilize CO_2 in a physiological process of photosynthesis, other carbon compounds like carbohydrates are synthesized through the same process but when the trees died and decayed or are cut and burnt the carbon contents are released either into the soil or atmosphere and the process continues but is broken when the trees are adversely affected by climatic variables.) According to Environmental Affairs Department, (2002)[10]. The growing population has put pressure on the carrying capacity of the natural resources over the past two decades, per-capital land holding sizes has reduced and pattern of land use have changed, in many cases leading to massive soil erosion and silting up of river systems and reduced river flow. Demand for river based products has increased beyond imagination leading to unsustainable use, (Environmental Affairs Department, 2002)[10]. Laurence (1999)[11] reported that when forests are cleared, the carbon is released as CO_2. This leads to an increase in the atmospheric CO_2 concentration. CO_2 is the major contributor to the greenhouse effect. It is estimated that deforestation contributes one-third of all CO_2 releases. According to IPCC (2001)[12], the effects of climate change can reduce agricultural production, worsen food security, increase flooding and drought spreading diseases and increased risk of conflicts over scarce land and water resources.

Seventeen (17%) of the respondents stated that the manifestation of climate change in the area is decrease in rainfall pattern (Figure No.4). As 14% of the respondents reported that increase in pest

infestation is the manifestation of climate change in their community. Twenty seven percentage (27%) lamented that climate change is manifested in the area through loss of vegetation. Finally majority of the respondents (42%) confirm premature ripening of crops as the major manifestation of climate in the area. According to A I I (2006)[13] "from July to Aug every year, there were heavy rains, the dry season started in October and last until May. Rainy season starts late, sometimes as late as June, December and January were extremely cold months with frequent fogs. Many water coming from rivers had large pools and never used to dry. Now they frequently dry up as early as November. Laurence (1999)[11] reported that when forests are cleared, the carbon is released as CO_2. This leads to an increase in the atmospheric CO_2 concentration. CO_2 is the major contributor to the greenhouse effect. It is estimated that deforestation contributes one-third of all CO_2 releases. According to IPCC (2001)[12], the effects of climate change can reduce agricultural production, worsen food security, increase flooding and drought spreading diseases and increased risk of conflicts over scarce land and water resources.

The survey result shows that 46% of the respondents stated that climate change phenomena was worse now over the past years in their community in the area of changing/irregular rainfall pattern. Another 21% of the respondents agreed that climate change phenomena was worse in their community in terms of increase in temperature over the past ten years in the area. While 18% and 15% of the respondent agreed that climate change phenomena was worse in their communities over the past ten years in terms of harsh weather and pest infestation respectively (Figure No.5). These findings are similar to the experience from other places in Africa and elsewhere as a result of climate change where by variable rainfall pattern According to (Mongi *et al.,* 2010[14], Okoba *et al.,* 2011[15], Tesso *et al.,* 2012[16]), increasing average temperature (Go K, 2009[17], Yanda and Mubaya, 2011[18], IPCC, 2014[19]), and changes in wind speed (Webster *et al*, 2005[20], Young *et al.,* 2011[21]) were also noted. According to IPCC (2001)[12], the effects of climate change can reduce agricultural production, worsen food security, increase flooding and drought spreading diseases and increased risk of conflicts over scarce land and water resources.

The result (Figure No.6) indicated that higher number of participants (43 %) reported that increase frequency/intensity of drought is the recent implication of climate change toward agriculture activities in their community. Also 34% of the respondents confirmed that decrease in rainfall availability is the recent implication of climate change toward agriculture in their area. The increase in the frequency/intensity of drought and pest infestation in recent times is the indication that climate change affected agriculture, and forest product, this might be the reason for the massive failure of crops especially that of rice in the study area. According to A.A.I (2006)[2], difference in weather conditions in a day or over a year influence seasonal rainfall patterns and temperature levels. These changes often some times lead to droughts and incessant rainfall, thereby affecting people's cropping patterns and agronomic calendars.

Figure No.7: The result in Figure No.8 depicts the distribution of respondents according to farming systems adopted in the area. It shows that more than 50% of the respondents reported that they adopted mixed farming system in their communities to response to climate change in the recent time. It also shows that 34% of the respondents adopted mixed cropping as their own farming system in response to climate change in the recent time, only 16% of the respondents agreed that they adopted sole cropping farming system in their communities in the recent time in response to climate change. The implication of the higher percentage of the respondents that accepted that they adopted mixed farming and mixed cropping in the recent time may be to avoid total crop failures in their farm especially as it relates to pest infestation. According to Nhemachema and Hassan (2007)[22], increased diversification through production activities using species that are more drought–tolerant and resistant to tempereture stress, that make efficient use and take full advantage of the prevailing weather condition constitute an important form of insurance against rainfall variability. Growing a number of different crops in the same plot or in different plots, as in agroforesty,

reduces the risk of complete crop failure as different crops are affected differently by climatic factors.

Figure No.9: showed that 42% of the respondents stated that the kind of management technologies they use to combat change in their community is the use of fertilizer. Furthermore, 16 % agreed that they use pesticides and other means like crude tools for pre/post harvest activities. It also shows that only 21% of the respondents reported that they carry out tillage operation with mechanized tools as type of management technology to combat climate change, while 21% of the respondents reported that they use weedicides as the kind of management technology to combat climate changes effects. (Kurukulasuriya and Rosenthal, 2003[23]), improving fertilizer use and increasing irrigation on technology will be important, but is equally important is deciding the potential factors of technology adoption at farm level that influence their decisions.

Adaptation strategies

Figure No.10: below indicates that 8% if the respondents' recent adaptation patterns available in adjusting with climate change in their community is through the change in time of planting. It also showed that 14% each of the respondents reported that change in irrigation process and changes in land preparation practices (terracing, contouring, hedges, reservoirs, drainage) are the recent adaptation patterns available in adjusting with climate change in their community. Another 23% of the respondents stated that change in land and livestock management are the recent adaptation pattern available in adjusting with climate change in their community. This agreed with Huber and Pederson (1997)[24], that mulching and land sheltering techniques are extremely important ways of dealing with changes in temperature and soil moisture loss. According to Nhemachema and Hassan (2007)[22], increased diversification through production activities using species that are more drought-tolerant and resistant to tempereture stress, that make efficient use and take full advantage of the prevailing weather condition constitute an important form of insurance against rainfall variability. Growing a number of different crops in the same plot or in different plots, as in agroforesty, reduces the risk of complete crop failure as different crops are affected differently by climatic factors.

Figure No.11: (36%) percent of the respondents reported that the modern technology used for climate change adaptation techniques in their farming community is by use of crop rotation method, and 32% stated that modern technology use for climate change adaptation techniques in their farming community is by seeking advice from government extension agents (Figure No.12). Only 18% of the respondents stated that the modern technology used for climate change adaptation techniques in their farming community is by use of crop with small need for water. According to Nhemachema and Hassan (2007)[22], increased diversification through engaging in production activities that are more drought tolerant or resistant to temperature stresses as well as activities that make efficient use and full advantage of the prevailing water are important forms of insurance against rainfall variability.

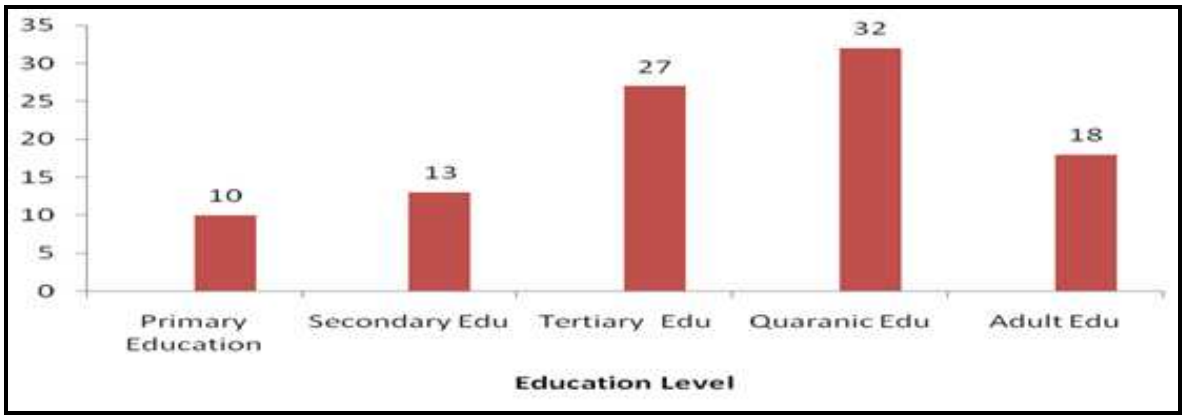

Figure No.1: Education Level

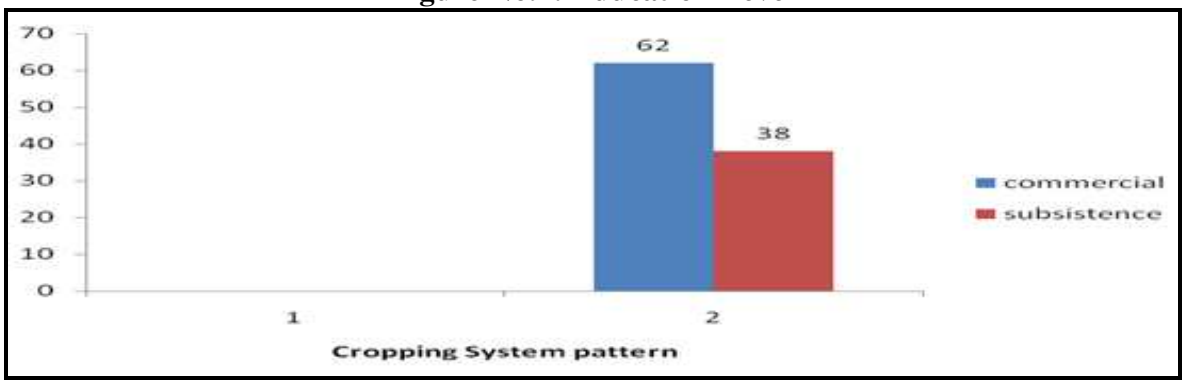

Figure No.2: Cropping System Pattern

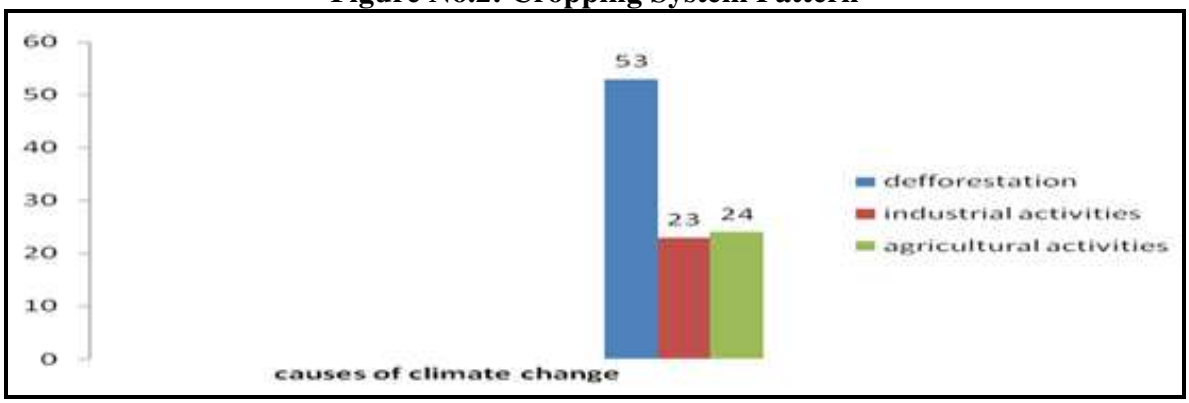

Figure No.3: Cause of Climate change

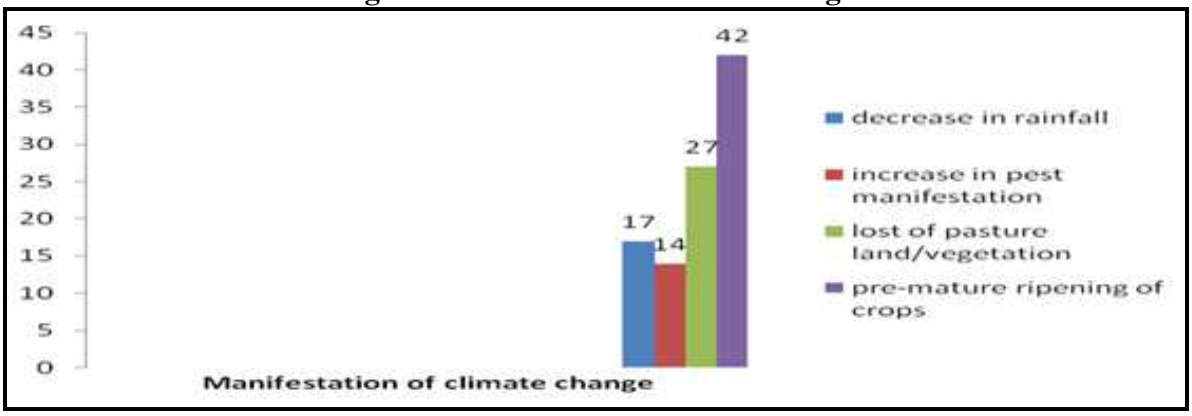

Figure No.4: Manifestation of climate change

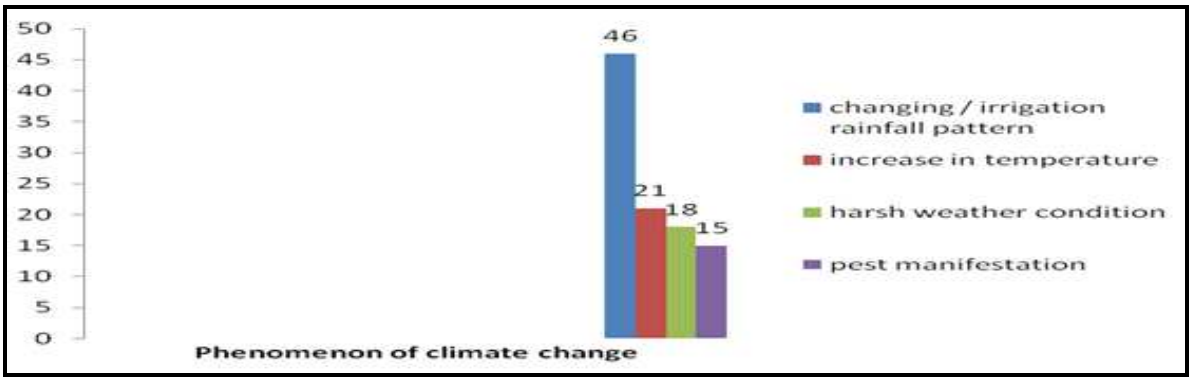

Figure No.5: Phenomenon of climate change

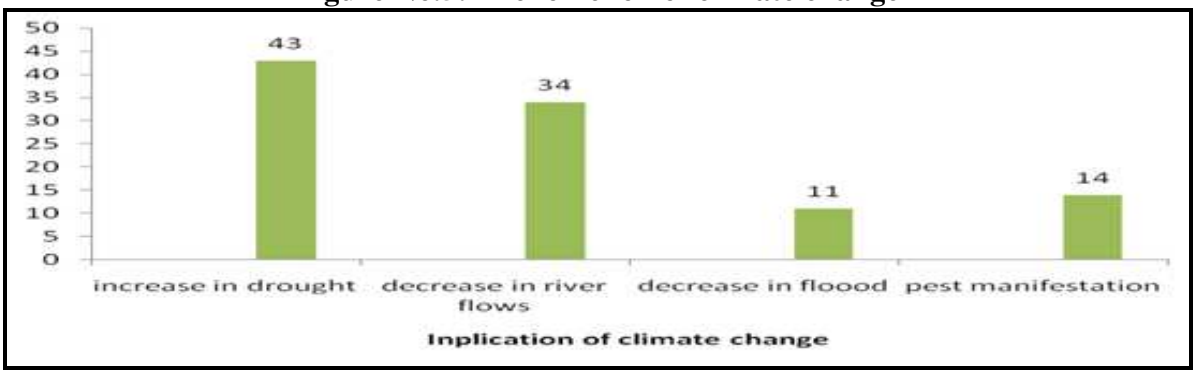

Figure No.6: Inplication of climate change

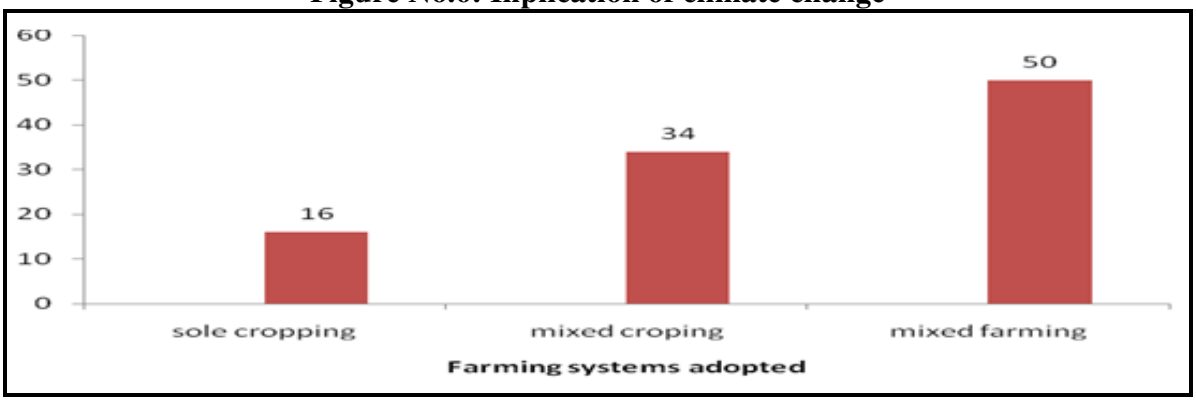

Figure No.7 and 8: Farming systems adopted

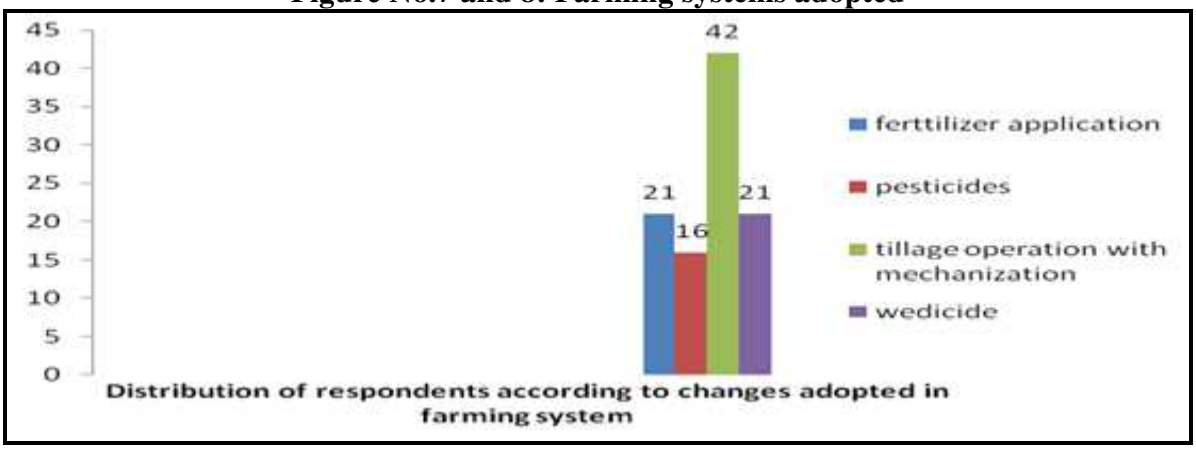

Figure No.9: Distribution of respondents according to changes adopted in farming system

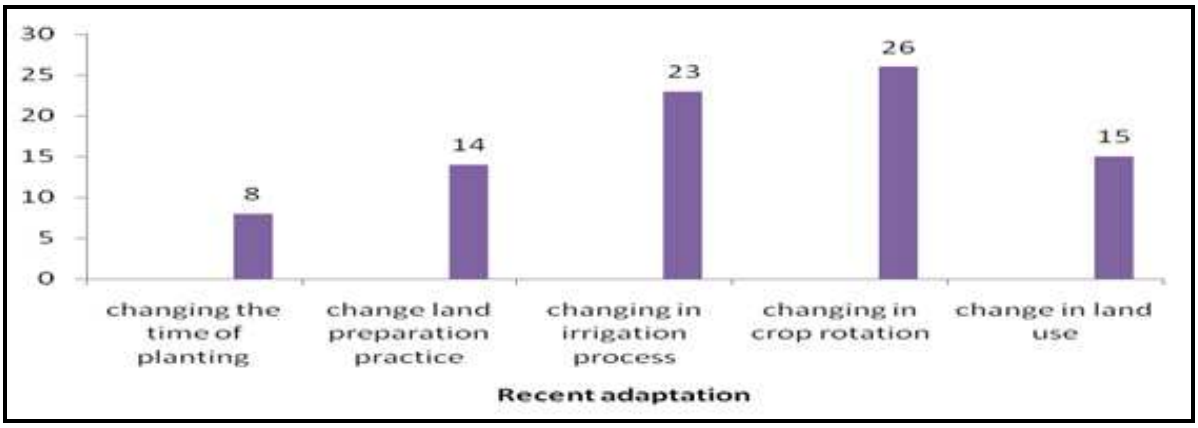

Figure No.10: Recent adaptation

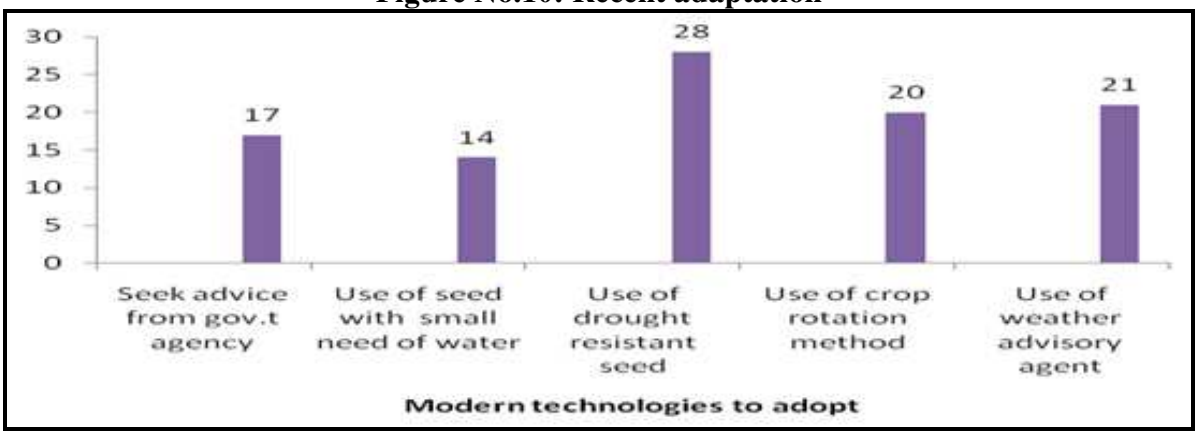

Figure No.11 and 12: Modern technologies to adopt

CONCLUSION

Agriculture is clearly vulnerable to climate change. Therefore there is need for adaptation in agricultural farming systems at all levels of government within the sub-regional level, country level like Nigeria, state and local governments' levels and finally community level.

RECOMMENDATION

- Exstablishment of afforestation programme to moderate tempereture increase
- Government intervention interm of weather advisories to alert the public about dangerous heat, improving early warning systems and flood hazard maping for storms
- Altering the timing of planting dates to adapt to changing growing conditon
- Research should be intensified toward production of improved varieties of seed. .
- Proactive measures by government at all levels on development of adaptation measures to help vulnerable members of the local communities so that they can adapt to change in climatic conditions in their localities.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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