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**ADAPTATION STRATEGIES ON CLIMATE CHANGE IN MANGU LOCAL
GOVERNMENT AREA OF PLATEAU STATE NIGERIA**

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ABSTRACT

Climate change is an environmental, social and economic challenge on a global scale. This study examines public perception on climate change and adaptation strategies in Mangu LGA. Twenty-seven years secondary data on rainfall and Temperature were used along with 200 questionnaires randomly distributed in Mangu LGA. The research made use of descriptive statistical technique on primary and secondary data depicted in graphs, tables and charts. Results shows that 56% of the respondents were male, majority of the respondents (50.2%) and had tertiary education. In terms of climate change knowledge, findings show that 52.8% of the respondents were of the opinion that the present climate is moderate and that it is increasing gradually due to Climate change. 39.4% of the respondents attributed the climate change to global warming linked to natural factor (54.4%) and human factor (38.9%). Respondents opined that the impact of climate change is felt more on food production and biodiversity. A cross section tabulation of demographic characteristics revealed that perception on local climate change is corroborated more with the age grade 60years and above. It was seen that respondents with tertiary level of education has a better understanding of climate change issues in Mangu LGA than those of lower level of education. The 52.8% of respondents were of the opinion that climate change leads to decrease in crop yields. Some of the adaptation strategies practiced in the study area includes cultivation of crops that are tolerant to low moisture requirement, increased fertilizer usage and cultivation of different crop varieties. The study concludes that climate change knowledge is rather poor among the people in Mangu LGA. It is therefore recommended that there is need to introduce climate change courses in primary schools' curriculum and organize sensitization programmes on climate change in the study area to create awareness and enlighten the general public on climate change.

Keywords: Indigenous people, local inhabitants, climate change, global warming, adaptation strategies.



Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

INTRODUCTION

Climate change is an environmental, social and economic challenge on a global scale (Scholze *et al*, 2006; and Mendelsohn *et al*, 2006). The industrial revolution which began so many years ago has been identified as the turning point of mass human induced climate change action (Houghton , 2001). This position was a support built on the outside of a wall when the IPCC published its first assessment report in 1990 which drew the attention of the global community to the significant increases in atmospheric greenhouse gas concentration since then climate change issued have been viewed from three major perspectives; Climate change and global warming, Stratospheric ozone depletion and ultraviolet radiation, Significant variation in seasonal climates (Adelakan and Gbadegesin; 2005).

According to Dabi, and Jidauna, (2010), climate change is a global crisis, latest estimate by the inter-governmental panel on climate change (IPCC) shows that a business as usual scenarios will lead to an increase in global mean temperature of about 1⁰C above the present value by the year 2025 and 30C before the end of the next century. Global warming on the other hand is the increase in the average surface temperature of the earth due to climate change while climate change has the potential to affect all natural systems thereby becoming a threat to human development and survival socially, politically and economically, global warming can lead to the rise in the sea levels, oceans warn and glaciers melt, thereby threatening agricultural productivity and human settlements. Climate has enormous effects, it affects every citizen, every part of our environment, our natural resources and our urban and sub-urban development pattern Ekpoh (2009). Global concern regarding the devastating impact of climate change has emphasized the need for creating awareness and building capacity for adaptation strategies to mitigate the effect of climate change. The effect of climate change could be negative or positive globally. While carbon dioxide (CO₂) is essential for plant growth, all agriculture depends on steady water supplies and climate change is likely to disrupt those supply through floods and drought. Warmer



Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

winters would mean fewer deaths particularly among vulnerable groups like the aged. Climate change may include greener rainforest and enhanced plant growth in the amazon and possibly increases plankton biomass in some parts of ocean zones. Its responses may include further growth of oxygen, poor ocean zones, exhaustion of fresh water, increased incidence of natural fires etc. Extensive vegetation dies off due to droughts, increase risk of coral extinction, decline in global photo plankton, and changes in seasonal periodicity disruption to food chains and species loss. Others include the economic effect/impact of climate change that is disruption to global trade, transport, energy supplies, and labour markets, banking and finance etc. would wreak havoc on the stability both developed and developing nations. Other effects are the rise in sea level in the south as a result of ice melt and extreme, heat and desert encroachment in the North.

Nigeria as the developing nations is enormously sensitive to these effects of climate change. A better part of the economy of the country depends on national resources which are particularly vulnerable to climate change. When those resources are implicated leading to diseases, loss of live hoods and settlement can force the entire communities into relocation the effects of climate change it, it is not clear how Nigerians perceive climate change whether Nigerians are aware of what climate change is and its effects, perhaps, the biggest obstacle is the inadequate awareness and knowledge of climate change. Several studies conducted to examine perceptions at people/farmers on climate change have shown that people had different perception on climate change adaptation in the world at large. It shows that there is need to be educated and informed about climate change and how it can change their lives drastically.

Climate change is global, national, regional and local issue. It is important to study it even at the at the local level, the difference in people's perception of climate change made the researcher to focus on Mangu LGA, how the people in the study area percept climate



Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

change, its effect and also find out the coping strategies this is because inadequate information and knowledge about climate change also means that many Nigerians are reluctant to accept the reality of climate change and may stand the risk of it.

MATERIALS AND METHODS

Mangu L.G.A. lies between latitude $8^{\circ} 55'$ and $9^{\circ} 45'$ North of the equator and $9^{\circ} 01'$ and longitude $9^{\circ} 17'$ East of the Greenwich Meridian (Fig.1 and 2). It shared boundaries with Bauchi State in the North East, Pankshin L.G.A in the East, Qua'anpan L.G.A in the South, Bokkos L.G.A in the West, Barkin Ladi L.G.A in the North – West and Jos – East L.G.A in the North, Mangu L.G.A comprises of eleven districts and has a total land area of about 3619km^2 (Plateau State Ministry of Land & Survey, 2008)

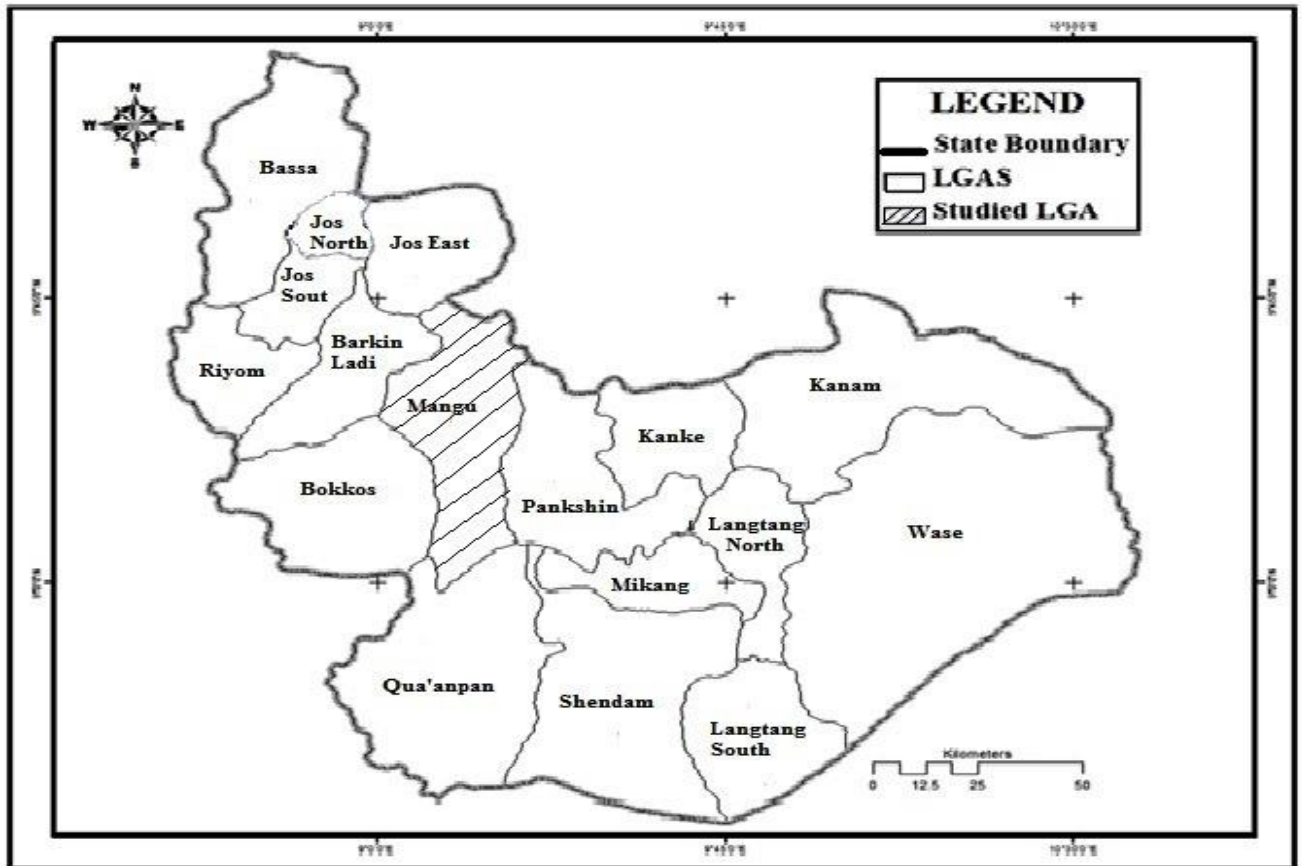


Figure 1: Plateau State showing Mangu LGA

Source: Plateau State Ministry of Land & Survey, 2014

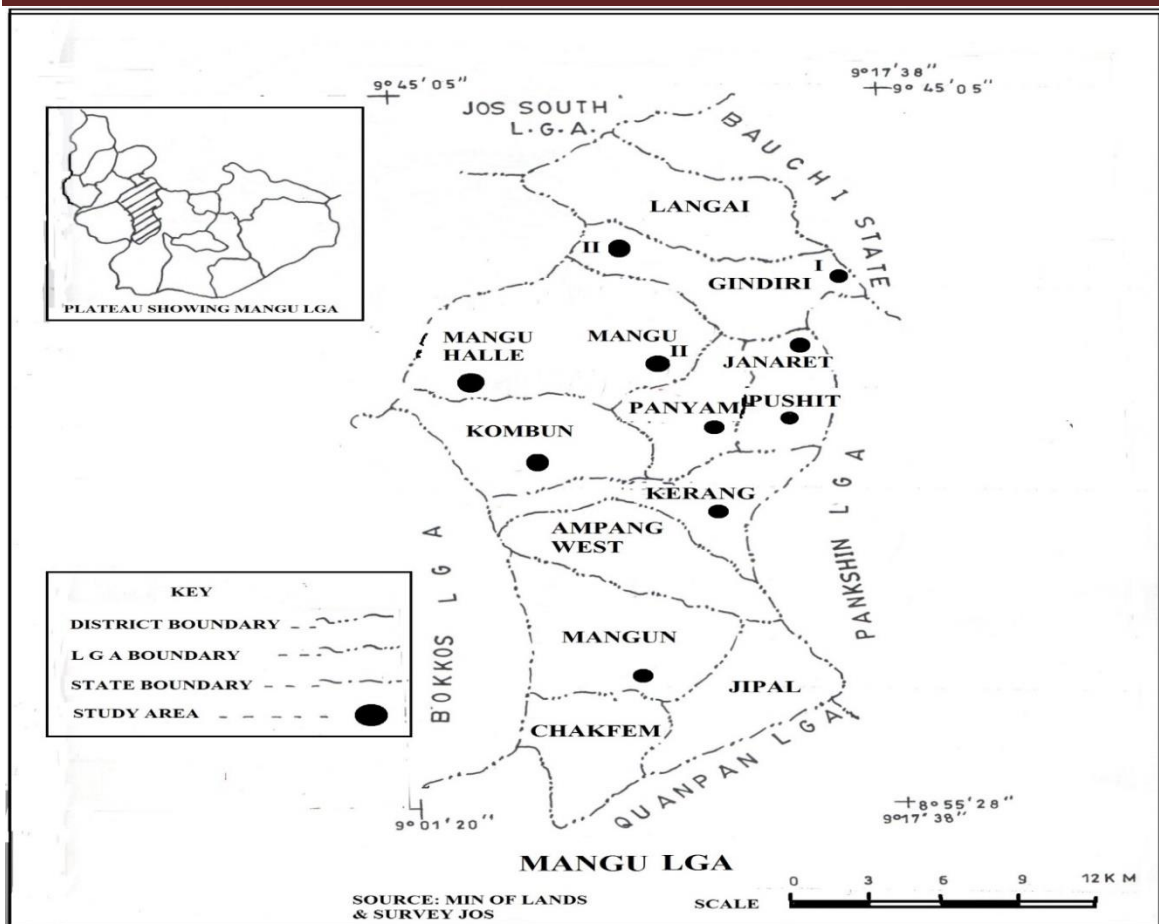


Figure 2. Mangu showing study area

Source: Plateau State Ministry of Land & Survey, 2014

The data needed for achieving the study objectives include both primary and secondary data. The primary data include information generated from the field through questionnaire which was administered to the general public; interview was conducted as well as field observation. Thirty years secondary data on rainfall and temperature from weather observatory station at Department of Geography, College of Education Gindri, Mangu L.G.A was used to assess the rate of fluctuation of the rainfall and temperature in the area,



Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

Plateau Agricultural Department Programme (PADP) North Central Office Mangu, Journals, bulletin, Base Maps from the ministry of Land and Survey Plateau State was acquired in sampling areas in the local government area. The questionnaire was designed to accommodate and answer some topical questions on climate change that affect the people directly and indirectly. Mangu L.G.A has twenty (20) wards; ten out of the twenty wards were selected for the purpose of this study. A total of two hundred copies of questionnaire were administered across the ten (10) selected wards in the study areas. The field observation and questionnaire-based interview methods will have supplemented by the Participatory Learning Approach (PLA) and Focus Group Discussion (FGD) strategies. These methods aid in generating climate, its effect and copy strategies.

The climate of Mangu generally is not different from that of Jos Plateau, is a semi-temperate climate with the temperatures ranging from 18°C (64.4°F) to 25°C (77.0°F). The raining season at Mangu really starts towards ending April or early May, but it is not uncommon for rain to fall in February or even January, the early period of the wet season is characterized by sporadic rainfall, accompanied by strong winds, as the two air masses try to gain control over each other. From the middle of April to early October, over 95% of the annual rainfall will have occurred, concentrated in the months of June to September. The dry seasons sets in from the end of October to early April, when the mean monthly temperature approaches 30°C. The dry season is characterized by weather conditions associated with the familiar hamattan; dry, hazy (dusty), and cool. The cooler temperatures are due to combination of two main factors; (a) the relatively, low angle of the sun during this (winters) season, and (b) the rapid loss of insolation at night owing to clear and cloudless skies.



RESULTS AND DISCUSSION

Evidence of climate change in the study area

Nigerians experience many significant challenges associated with climate change. Low levels of awareness of climate change amongst policy makers and the public at large, and poor understanding of its risks have hindered effective decision making. Temperature and rainfall records of Gindiri Meteorological Station were used as proxy for the study area. The statistical record of rainfall data from the meteorological station Gindiri (Mangu) between 1987 and 2014 (27 years) showed an increase trend over the years. A large proportion of farmers noticed a decrease in rainfall which corroborate with the outcome of meteorological trend analysis on rainfall and this could be explained by the fact that since 2006 to 2014 there has been a substantial decrease in the amount of rainfall (Fig.3 and 4). Thus, farmers' perceptions of a reduction in rainfall over the years could be explained by the fact that most of the farmers placed more weight on recent information.

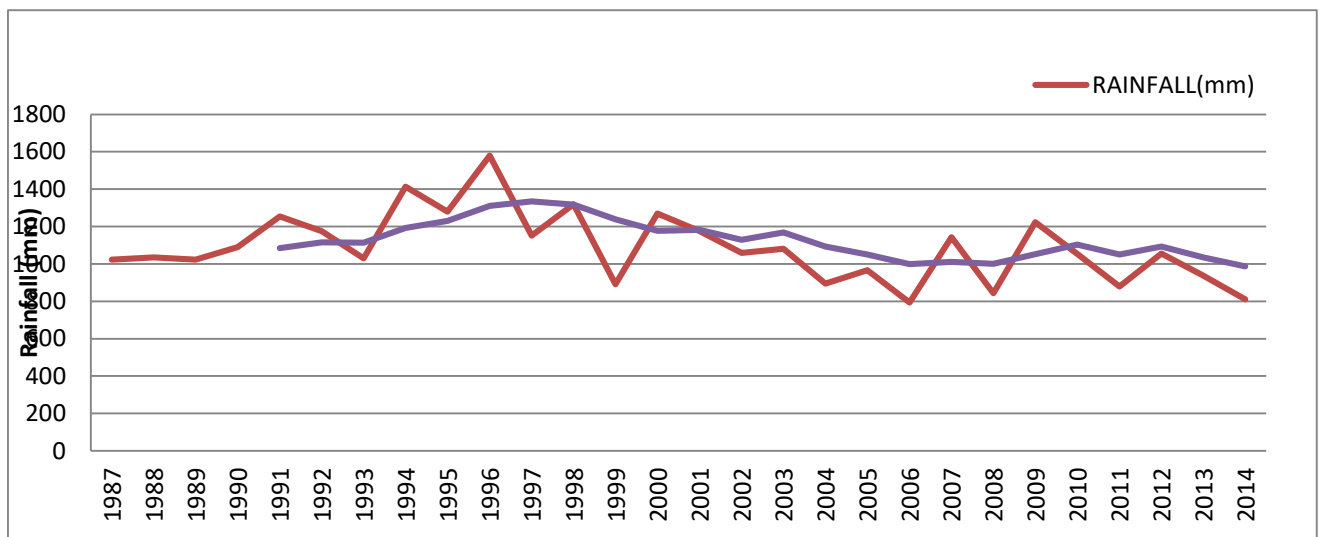


Figure 3 Gindiri Annual Rainfall distribution

Source: Meteorological station, Gindiri, Mangu, 2015

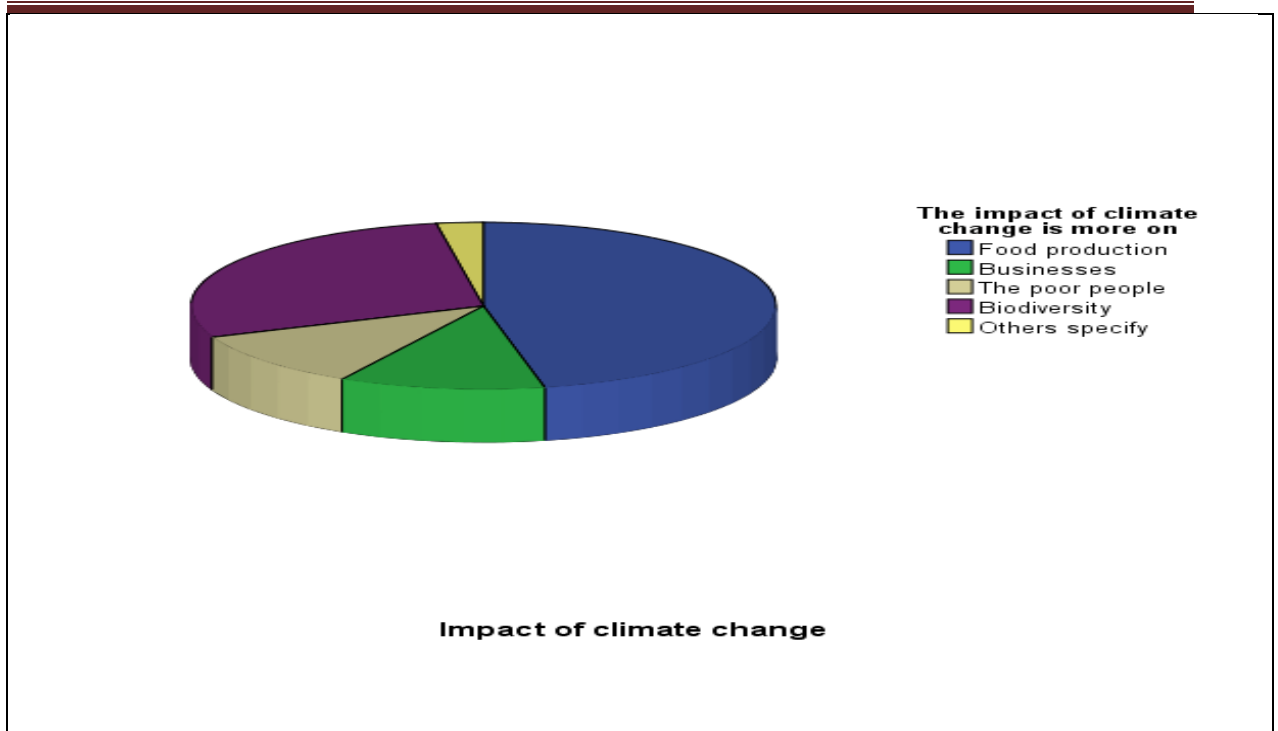


Figure 4. Impact of Climate Change

Source; Author's field work 2015

Climate change is evidently linked to human actions and particular from the burning of fossil fuels and changes in global pattern of land use. The effect of it have already been felt in many parts of the country with the modification of intensity and seasonal nature of the rains, elevation of average annual temperatures and increased frequency of wide spread, high impact weather phenomena including drought and flooding at federal, state and even at the local levels and Mangu in particular. Nigeria faces many significant challenges associated with climate change low level of awareness of amongst policy makers and the public at large, our poor understanding of its risks have hindered effective decisions making. As temperature increases and rainfall pattern becomes more unpredictable, crop yield are expected to drop significantly. Also, extreme weather events such as thunderstorms, heavy winds and floods devastate farmlands and can lead to crop failure,



Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

pest and diseases migration in response to climate change and variations. It is estimated that by 2100, Nigeria and other West Africa countries are likely to have agricultural losses of up to 4% of GDP due to climate change (Mendelson *et al*, 2000; Ekpoh and Ekpoh 2011). Parts of the country that experienced soil erosion and operate rainfall agriculture could have decline in agricultural yield of up to 50%, between 2000 and 2020 due to increasing impact of climate change. IPCC (2009), Molua and Lambi (2006), Rudoff and Herdmann (2009) stated that even if there is sufficient rain, its irregularity can affect yield adversely if rainfall to weather leads to drying up of streams which are sources of irrigation water used by farmers during dry season crop production. Anyanwu (2008), in study identified significant effects of climate change on crops, production as low yield of crop, stunted growth of crop ease spread of pest and disease attack on crops, drying of seeding after germination and ineffectiveness of agricultural chemical due to delay of rainfall. This agrees with the statement of Ozor (2009) that variations in rainfall pattern will affect crop production in varying ways depending on the location.

Mitigating Strategies

Mitigation involves finding ways to slow the emission of GHGs or to store them, or to absorb them in forests or other carbon sinks. At the core of most proposals is the reduction of GHG emission through improved energy efficiency performance of new and existing building infrastructures and influencing behavior of occupant; Reducing the need to travel through affordable and efficient communications system, embark on vehicle emission monitoring programme, ensuring good accessibility to public and other sustainable modes of transport; promoting land use that acts as carbon sinks and encouraging development and use of renewable energy.

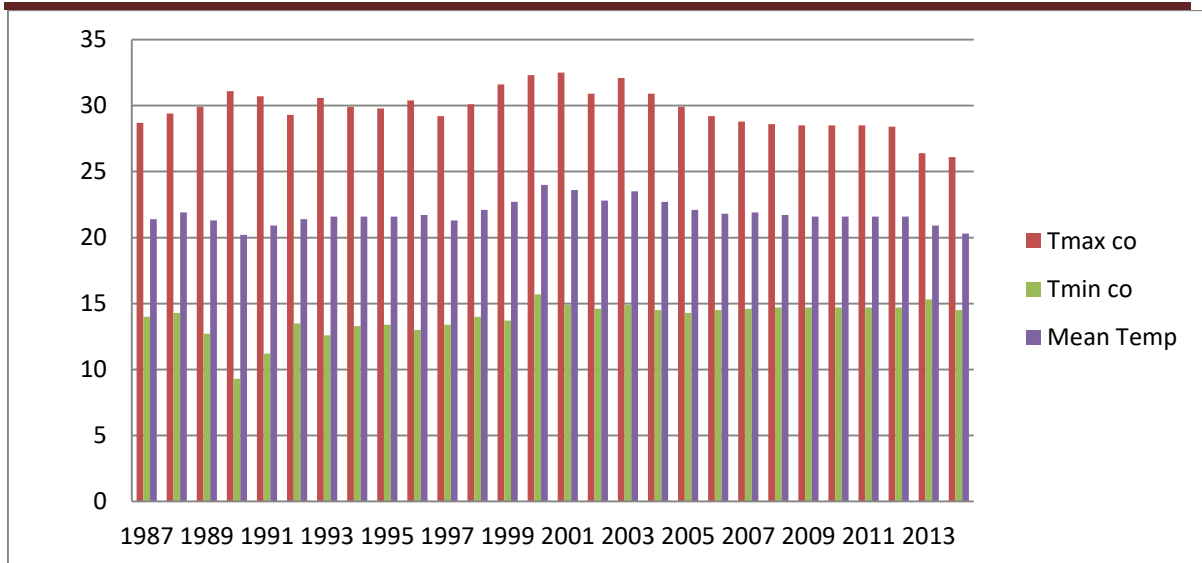


Figure 5 Gindiri Annual Temperatures

Source: Meteorological station, Gindiri, Mangu, 2015

Adaptation strategies involves coping with climate change taking measures to reduce the negative effects or exploited the positive ones, by making appropriate adjustment. The level of preparedness of a person, community or nation refers to pre-defined emergency actions that could be activated when extreme climate events or natural disasters occur in order to minimize damages which are likely to result adaptation. Adaptive capacity of nation or region relates closely to its level of wealth, strength of educational institution and access to technology. This applies that the more developed nations are better equipped to deal with the risks and dangers associated with climate change. Adaptation can be classified on the basis of adaptive responses to it, such as reactive (measures which are made by institutions, individuals, animals and plants as response) or anticipatory (carried our as preparation against potential effects), autonomous (adjustments which are occurring naturally or spontaneously as response) or planed (adaptations need conscious intervention). There are several informal, social, attitudinal and behavioral constraints. According to Anyadike,



Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

2009, the IPCC has recognized that there is significant knowledge and information gaps for adaptation as well as impediments to flows of knowledge and information relevant for adaptation have received attention of the researchers. The food and agricultural organization has highlighted some important options for increasing the adaptive capacity of farming communities who face severe threats due to changing climate. While mitigation involves finding ways to slow emissions or to absorb emission of GHGs, adaptation involves coping with or taking measures to reduce the negative effects or exploit the positive ones, by making appropriate adjustment. Ifeanyi-Obi et al., (2012) refer to mitigation and adaptation strategies to as adjustment in practices, processes or structures in response to projected or actual charges in climate, with the goal of maintaining the capacity to deal with current and future changes. It includes activities that are taken before impacts are observed (anticipatory) and after impacts have been felt (reactive). Eboh (2009) stated that even if efforts to reduce GHGs emissions are successful, it is no longer possible to avoid some degree of global warning and climate change as seen in Figure 6. This implies that in addition to mitigation practices being developed to combat climate change, adaptation to the anticipated climate change is essential.

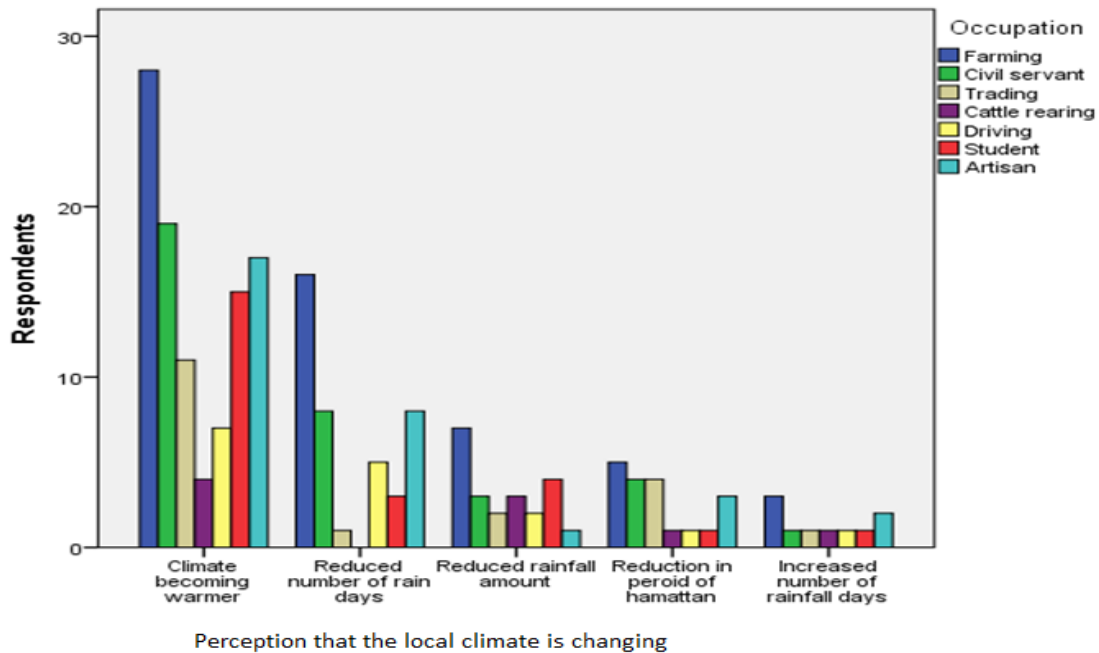


Figure 6: Perception that the local climate is changing with respondents occupation
Source: Author's Fieldwork, 2015

Experienced farmers and more elderly inhabitants were more inclined that temperature has increased while rainfall is decreasing as shown in Figure 7. Civil servants on the other hand observed that temperature has risen in the past years, rainfall had the highest perception on rise in temperature and decreased rainfall. Figure 6 shows how the respondents and their occupation perceived climate change. Looking at how respondents according to their age groups responded to this question, from thirty-one years old and above stressed that the impact of climate change is more on food production as revealed in Figure 6. Biodiversity has been under threat since it is more vulnerable to climate change, there has been loss in biodiversity as inclined by more elderly inhabitants 11.4% of the respondent inclined that business are more jeopardized by climate change. Others stressed that the impact is more



Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

towards instigating disaster, some were of the opinion that the impact has been on health and crop diseases. This is one agreement with the findings of Ifeanyi, (2012) that climate change is already affecting agricultural activities with the most devastating adverse effects in Nigeria as: extreme weather condition, frequent drought ,increased environmental damage, increased infestation of crops by pests and diseases, depletion of household assets, increased biodiversity loss, depletion of wildlife and other natural resource base, changes in the vegetation type, decline in forest resources, decline in soil conditions, increased health risks and the spread of infectious diseases changing livelihood systems. Eboh (2009) on the order site stated that the effects of climate change are projected to manifest through changes in land and water regimes, specifically, changes in the frequency and intensity of droughts, flooding, water shortages, worsening of droughts, worsening soil conditions, desertification, disease and pest outbreaks on crops and livestock.

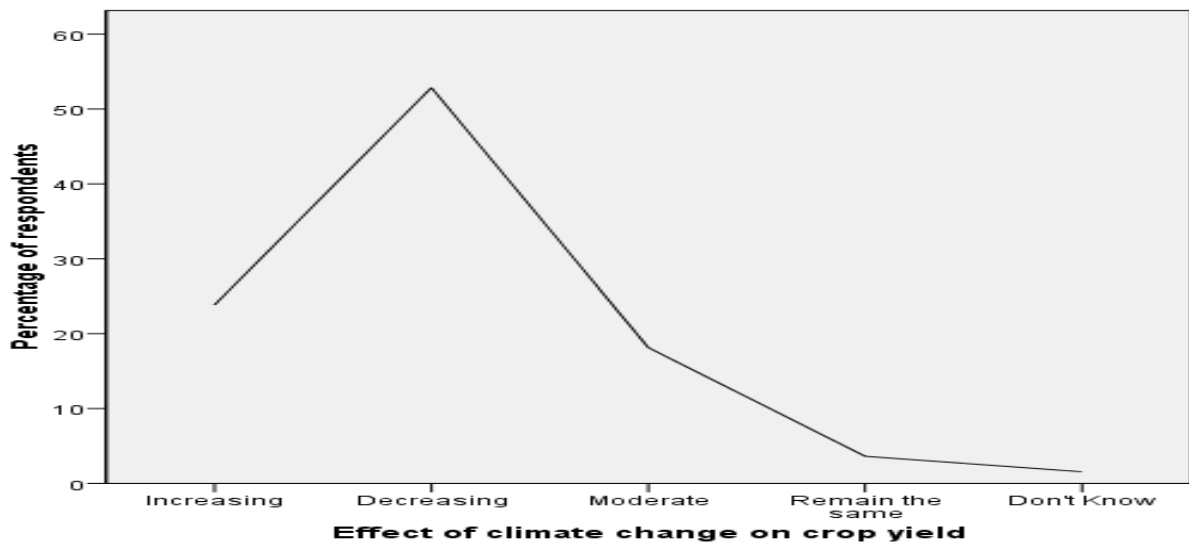


Figure 7; Effect of climate Change on crop yield

Source: Field work 2015



Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

Adaptation to the adverse effects of climate change is a key issue for all countries, especially developing countries, which are often the most vulnerable and at least equipped to adapt. The level of preparedness of a person, community or nation refers to pre-defined emergency actions that could be activated when extreme climate events or natural disasters occur in order to minimize damages which are likely to result as revealed in Figure 8. Adaptive capacity of a nation or region relates closely to its: level of wealth, strength of educational institutions, and access to technology. This implies that the more developed nations are better equipped to deal with the risks and dangers associated with climate change. Adaptation refers to adjustments in practices, processes or structures in response to projected or actual changes in climate (Dixon et al., 2001 and Ayanwuyi, 2010), with the goal of maintaining the capacity to deal with current and future changes. Adaptation to climate change also refers to activities that reduce the negative impacts of climate change and/or takes advantage of new opportunities that may be presented. It includes activities that are taken before impacts are observed (anticipatory) and after impacts have been felt (reactive) (Ajadi et al., 2011). Ekpoh (2009) stated that even if efforts to reduce greenhouse gas (GHG) emissions are successful, it is no longer possible to avoid some degree of global warming and climate change. This is supported by Francesco (2008) who stated that as a result of greenhouse gases already in the atmosphere from past and current emissions, our planet is already committed to at least as much warming over the 21st century as it has experienced over the 20th century (0.75°C). This implies that in addition to mitigation practices being developed to combat climate change, adaptation to the anticipated climate change is essential. This fact is also made more explicit in Ozor & Cynthia (2010) which stated that while mitigation is necessary to reduce the rate and magnitude of climate change, adaptation is essential to reduce the damages from climate change that cannot be avoided.

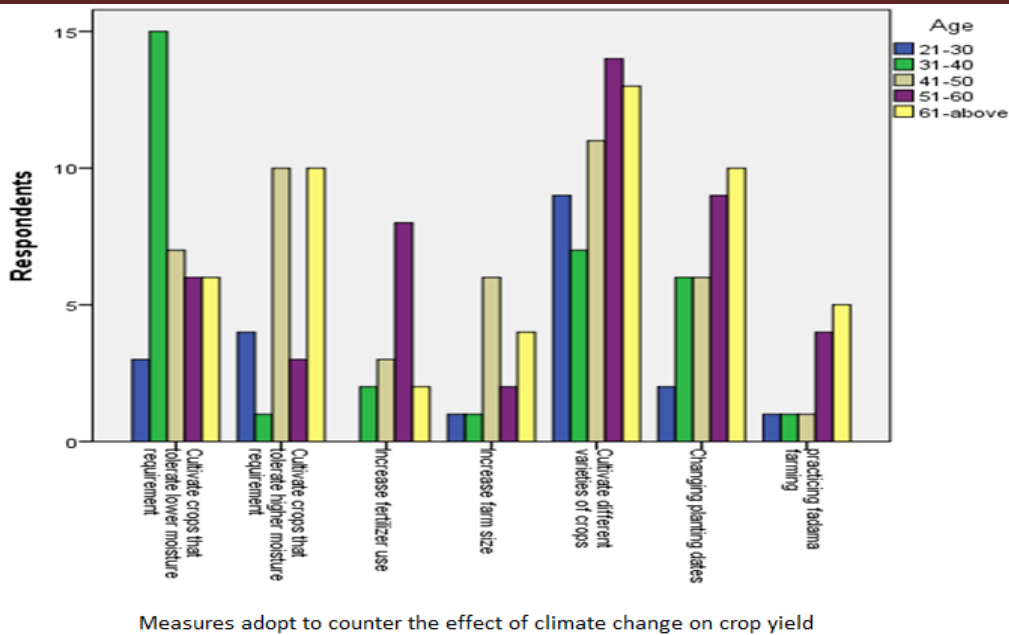


Figure 8: Mitigation strategies

Source: Author's Fieldwork, 2015

Figure 8 is only possible by first and famous educating the indigenous people on the implication of climate change, educate the indigenous people on the significance of conservation of the natural environment, support the most environmentally friendly people and groups towards achieving set goals and objectives in the study areas. Until recently, policy makers concentrated on mitigation, partly because of worries that highlighting adaptation options might reduce the urgency for mitigation. According to Aondoakaa (2012), Mitigation is essential and adaptation is inevitable. It must be stated however, that mitigation and adaptation are not alternatives; both need to be pursued actively and in parallel. Public Awareness programme on climate change and environmental issues, environmental education programmes in schools and zero tolerance to unsustainable lifestyle.



CONCLUSION AND RECOMMENDATION

Conclusively mitigation is essential and adaptation is inevitable. It must be stated however, that mitigation and adaptation are not alternatives; both need to be pursued actively and in parallel. Public awareness programme on climate change and environmental issues, environmental education programme in schools and zero tolerance to unsustainable lifestyle.

A massive campaign is indisputable at this time; the earlier the, public are told of global climate change that is breaking every continental boundary, the better they start knowing the actions to take and how to reduce it to enhance the ability of further cope with the challenges of climate change, it is envisaged that the following recommendations be fortified through environmental education, people of Mangu LGA need to understand the implications of their actions and inactions equipped with the knowledge of climate change, “let them know that man contribute at least half or more than half percent to climate change through his activities” to salvage the future environment through environmental friendly actions of the present. Their willingness to rise to the challenges of fluctuation in climate because effectual if they are harnessed to enhanced security and rewards for doing so.

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Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

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Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

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Lapai Journal of Science and Technology, Vol. 8, No. 1 (2022)

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