



A Theoretical Framework on Farmer's Perception and Awareness of Climate Change and Adaptation Strategies for Crop Production in Northeast Nigeria

Rakiya Inusa Mohammed, Iliya Audu, Benjamin Moda Ndomi,
Faculty of Education,
Department of Vocational Education,
Modibbo Adama University, Yola, Adamawa State, Nigeria.

ABSTRACT

Climate change and adaptation strategies for crop production and sustainable agricultural practice is one of the most popular and widely studied areas in agriculture. However, most research in this area has been conducted in advanced countries such as USA, UK, France, and Germany, and reflects different contexts. In Nigeria studies were on the plight of farmers and the adverse effects of climate change on livelihood, small household framers, income inequality, poverty among others and which mostly failed to address farmer's perception and awareness on climate change and adaptation strategies in view of its importance /benefits such as/which include; increased awareness, improved crop yield/productivity, risk sharing, enhanced adaptation strategies, and increased profits. It is a matter of concern that no study was found that specifically addressed or explored farmer's perception and awareness of climate change and adaptation strategies for crop production in the study area (Northeast, Nigeria) with a view to mitigating its adverse effects such as; erosion, floods, damage to crops, low productivity, waste of resources, among others. This paper presents a theoretical framework on farmer's perception and awareness climate change and adaptation strategies for crop production in Northeast, Nigeria with a view to mitigating its adverse effects.

ARTICLE INFO

Article History

Received: October, 2023

Received in revised form: October, 2023

Accepted: November, 2023

Published online: December, 2023

KEYWORDS

Adaptation strategies, climate change, crop production, theoretical framework, Northeast Nigeria.

INTRODUCTION

The agricultural sector/industry is presumed to be one of the oldest economic sectors that can be traced back to the beginning of mankind. The agricultural sector is quite complicated due to a combination of human nature and the nature of the natural environment. Despite the complexities, the agricultural sector has provided many prospects for humans to survive and to thrive expand, as farmers are now able to engage in/venture into crop production and related agricultural enterprise and mitigate the adverse effects of climate change.

According to Udemezue and Osegbue (2018) agricultural development is a sub-set of rural development. However, rural areas cannot attain development without its agriculture being developed because majority

of the rural dwellers are engaged in agricultural practices as their major source of income. This is because the main objectives of agricultural development are the improvement of material and social welfare of the people. Therefore, creating a sustainable agricultural development path means improving the quality of life in rural areas, ensuring enough food for present and future generations and generating sufficient income for farmers (Udemezue & Osegbue, 2018).

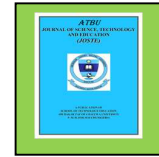
However, Nigeria has been experiencing adverse climatic condition with unfavorable impact on the wellbeing of the citizen. Persistent drought and flooding, off season rains and dry spells have greatly affected growing seasons. This development is worrisome, considering that Nigeria is largely dependent on rain fed agriculture. Rivers and

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



lakes are drying up and reduction in river flow is being experienced in the Northern areas resulting in alteration in water supply for use in agriculture, hydro-power generation and other users (Adelekan & Gbadegesin, 2010). Climate change directly alters precipitation and temperature patterns which are the key natural inputs in agricultural production. One of the effects of climate change is the rise in temperature that leads to water deficit (Chinvamo, 2012; Miti, 2009).

Climate change may cause drought in the middle of wet season which can damage seedlings on fields. Excess rainfall may as well cause floods which in turn result in less aeration of soil, it causes uncertainties in onset of the farming season and agricultural losses due to changes in temperature and rainfall patterns (Umunakwe, Nnandi, Chikaire & Nnandi, 2014). Araya and Adjaye (2001) stated that farmers awareness and perceptions of soil erosion problem as a result of changes in climate, positively and significantly affect their decisions to adopt soil conservation measures.

Climate change refers to changes in long-term trends in the average climate, such as changes in average temperatures (gei.newscorp.com/resources/glossary.html 2010) This implies climate change is any significant change in measures of climate (such as temperature, precipitation or wind) lasting for an extended period (decades or longer). The decreasing rainfall, increasing temperature and evapotranspiration have resulted either in reduction of water levels or total dry up of some rivers and lakes in the Sahelian zone while lake Chad in Nigeria is reported to be shrinking in size at an alarming rate since the 1970s (Ayuba, Maryah & Gwary, 2007). Agricultural production in most of its sectors is reported to be dependent on weather and climate (Ozor, 2009). It is believed that mitigating strategies to combat the effects of climate change and also ensuring improve and sustainable livelihood for the farm family depends on the knowledge, attitudes, practices and belief systems of farmers. Gender analysis of climate change effects and coping strategies is expected to promote an understanding of the ways that men and women are differently impacted by climate related hazards.

Crop production is a branch of agriculture that deals with growing crops for use as food and fiber. It depends on the availability of arable land and is affected in particular by yields, macroeconomic uncertainties, as well as consumption patterns; it also has a great incidence on agricultural commodity prices (Organisation for Economic Cooperation and Development [OECD], 2017). Climate is the statistics of weather, usually over a 30-year interval. It is measured by assessing the patterns of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time (Carey, 2009).

Climate change and adaptation strategies for crop production and sustainable agricultural practice are one of the most popular and widely studied areas in agriculture. However, most research in this area has been conducted in advanced countries such as USA, UK, France, and Germany, and reflects different contexts. This can be attributed to the dramatic explosion in human population and the need to feed a growing population that is/exploding population that is growing at an alarming rate, a geometric proportion while food production and supply is growing at an arithmetic proportion, coupled with an increasing interest in them.

In addition, many farmers from different developing countries; e.g Malaysia, Indonesia, Pakistan, Korea, Turkey have started to address the adverse effects of climate change through adaptation strategies. For instance, at the continental level, Zakari, Ibro, Moussa and Abdoulaye (2022), carried out a study on adaptation strategies to climate change and impact on household income and food security in Sahelia region of Niger republic. Zakari et al (2022) categorized the adaptation strategies into six major groups namely; climate-resilient crop varieties, improved agronomic practices, irrigation and water conservation practices, crop diversification, income diversification and agro-forestry. Zakari et al (2022) found out that adaptation strategies have positive and significant impact on both household income and food security. The adapters have 7% to 9% more chances to be food secure than those who did not adopt the strategies. The

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



study recommended access to credit and market, extension services and the use of drought-resilient varieties in order to improve crop production.

Zakari, Ibro, Moussa and Abdoulaye (2022), carried out a study on adaptation strategies to climate change and impact on household income and food security in Sahelia region of Niger republic. Zakari et al (2022) / The authors categorized the adaptation strategies into six major groups namely; climate-resilient crop varieties, improved agronomic practices, irrigation and water conservation practices, crop diversification, income diversification and agro-forestry. Zakari et al (2022) was found out that adaptation strategies have positive and significant impact on both household income and food security. The adapters have 7% to 9% more chances to be food secure than those who did not adopt the strategies. The study recommended access to credit and market, extension services and the use of drought-resilient varieties in order to improve crop production.

Sadiq, Kuwornu, Al-Hassan and Alhassan (2019) conducted a study on assessing maize farmer adaptation strategies to climate change and variability in Ghana. The objective of the study was to examine the adaptation strategies of maize farmers to climate change and variability in the Eastern Region of Ghana. Specifically, it was to assess the percentage of smallholder farmers adopting each of the identified climate change adaptation strategies.

The result of the finding revealed that rainfall perception, access to credit and farming experience significantly influences the adaptation of agricultural practices, whereas the adoption of soil-related strategies is influenced by gender and rainfall perception. They further recommended that there should be formation of water user association for the smallholder farmers regarding the usage and maintenance of the irrigation facilities.

According to Ado, Leshan, Savadogo, Bo and Shah (2018) carried out a study on farmers awareness and perception of climate change impacts on Aguié district in Niger. The findings of the study shows that majority of the respondents (96%) were married and were on average 37.48 years old. Due to their long-term farming experience, the

farmers have high level of local climate knowledge. The farmers are aware of Climate change and that information about climate change was the most significant factor that determine their awareness. It further reveal that effective adaptation to climate change impacts is highly dependent on the extent of community awareness.

It concluded that there should be more efficient irrigation techniques to help save water, for it will lead to a more sustainable use of water and in turn improve the farmers' adaptation through reducing climate change impacts.

Concha (2018) studied farmers' perception and climate change adaptation in the West African Sudan Savannah: Reality Check in Dassar, Benin and Dano, Burkina Faso The results revealed that responses regarding climate change perception and adaptations to climate change impacts are diverse, but site-specific measures do not casually respond to the type of hazard, nor to its impacts but instead tend to address wide ranging demand such as household, food security, income generation and capitalization.

However, it should also be noted that some of the factors/adaptation strategies that are critical, for example in USA may not be critical in Nigeria; consequently, framework/models developed for farmers on climate change and adaptation strategies in China, Malaysia, USA, or The UK, may not be applicable in Nigeria. Thus, the circumstances of applying different framework(s) / models, and the success achieved may vary from country to country depending on the sophistication of the legal, social, economic, financial, local culture, political climate.

In Nigeria studies were mainly on the plight of farmers and the adverse effects of climate change on livelihood, small household framers, income in-equality, poverty among others and which mostly failed to address farmer's perception and awareness on climate change and adaptation strategies in view of its importance / benefits which include; increased awareness, improved crop yield/productivity, risk sharing, enhanced adaptation strategies, and increased profits.

For instance, in Nigeria, Oruonye and Adebayo (2015) analyzed the choice of adaptation measures employed by the local

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



farmers and the constraints to such measures and found that most of the farmers living in rural communities have been affected negatively by recent changes in climate through low rainfall, flooding, drought, high temperature and other factors. The study findings show that most of the farmers opinion, observation and adaptation measures to climate change agrees with expert's report. The study findings show that the common adaptation measures applied by the local farmers include altering of planting season, use of different tillage system, use of tolerant seed varieties, planting early matured varieties and crop diversification. Despite the people's awareness and adaptation to climate change in the rural communities, lack of finance hinders farmers from getting the necessary resources and technology that facilitate adapting to climate change.

Ogunpaimo, Oyetunde-usman, and Sarajudeen (2021) carried out a study on impact of climate change adaptation on household food security in Nigeria. Their findings showed that there is a need for adaptation to climate change by farmers' households which is expected to increase with an increase in farm size, extension contact, marital status, access to credit, ownership of farmland and more. Their study have shown that climate change adaptation can help farmer's households to improve their food security status in the face of prevalent climate conditions. Ogunpaimo et al (2021) have recommended that farmer's household should practice continual implementation of Climate Change Adaptation (CCA) Strategies options to foster improvement in household food security status. Access to credit and extension contacts remain a catalyst for implementing adaptation measures to enable them adapt better to climate change and improve household food security status.

Idoma (2017) studied farmers' adaptation strategies for the effects of climate variation on rice production in Benue State Nigeria. The results showed that there were significant and positive relationship between perceptions and climate change indicators (increasing flood, increasing hot temperature, unpredictable rain and shorter duration of rain) and adaptation strategies. Idoma (2017) had expressed fear by questioning the survival and

growth of farmers in Benue state, Nigeria because of the record of high number of bankruptcies among the farmers, poor quality of yield, mismanagement of farm produce, diversion and stealing of funds meant for farming produce, and general practice of subsistence agriculture.

Madaki et al (2023) carried out study on climate change knowledge and perception among farming household in Nigeria. The authors found out that most of the farmers are aware that deforestation and land clearance by bush burning contribute to climate change. However, the authors emphasized that many of the farmers did not know that methane emission from livestock (enteric fermentation) can contribute to climate change. Their finding also showed that the farmer's perception of climate change is associated with climate change knowledge. Madaki et al (2023) recommended that climate change awareness and education schemes should be made available through cooperative, radio, television and the internet. There should be an increase in organization involvement with farm-relate-association. Madaki et al (2023) concluded that government and the NGOs have important roles to play in developing capacity of the farmers in Nigeria.

Ebenehi, Ahmed and Barnabas (2018) evaluated extension services delivery for climate change adaptation by crop farmers in Niger State. The study finds out that extension services in crop farmers in Niger State are a pertinent means of improving climate change adaptation strategies; however, extension services available are inadequate. The study recommends that extension agents should visit crop farmers more regularly to increase awareness to boost farmers knowledge on adaptation strategies, credit facilities and inputs should be provided to the farmers timely and at the required quality. However, Ebenehi, Ahmed and Barnabas (2018) have failed to assess the adaptation strategies for sustainable crop production. Moreover, very little is said about the factors influencing farmers' perception and awareness of climate change and adaptation strategies.

Ayanlade, Radeny and Morton (2017) conducted a research on comparing small holder farmers' perception of climate

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



change, climate variability and their impacts and adaptation strategies.

The RAI and CDI results shows that 11 out of 30 years in each study site experienced lower-than-normal rainfall. There was a fluctuation in both early growing season and late growing season rainfall. There was a significant relationship, the years of farming experience and level of income of farmers appear to have a significant relationship with farmers choice of adaptation strategies with $r=0.60$ at $p<0.05$ and $r>0.520$ at $p<0.05$ respectively. However, Ayanlade et al (2017) concluded that most farmers in Nigeria failed to invest in strategic and sustainable management practices among others.

Nwabiala (2017) investigate on the effect of agricultural extension delivery methods on arable crop farmers cropping system in Kaduna state. The correlation coefficient analysis showed a significant relationship between agricultural extension delivery methods and cropping system of farmers in the study area. The study recommends framing and retraining of extension workers, provision of mobility and adequate funding of extension agencies for effective agricultural technology delivery in the study area.

In addition, Nwabiala (2017) have expressed concerns about lack of research on climate change and adaptation strategies in the context of the Northeast Nigeria. Nwabiala (2017) revealed that the climate change and adaptation strategies have not been explored intensively, stressing that hunger, disease, poverty, in-equality, poor crop productivity and low crop yield were the most concern of most applications/studies.

Obinna, Thomas, Phillips and Komali (2017) studied climate change impacts awareness and perception of Africa Rural Farming Communities in Enugu State. The study also revealed that majority of Nigerian Farmers were fully aware of climate change and its impacts, with most complaining that due to higher costs there was little or nothing they could do to address the issues. Furthermore 64% of Nigerian farmers trusted information received from mass media while the majority attributed climate change to anthropogenic factors Results showed that (41%) of the farmers were more concerned

about increasing rainfall and drought than other environmental issues. In addition, Obinna et al (2017) have recommended that future research should be carried out to further knowledge on framework/models (adaptation strategies) for climate change and adaptation strategies and possibly analyse how they influence success in crop production and adaptation strategies.

In spite of the array of studies, it is a matter of concern that no study was found to have explored the perception and awareness on climate change and adaptation strategies in Northeast Nigeria with a view to understanding factors that are associated with such adaptations, or reported of any experience of farmers perception and awareness on climate change and adaptation strategies in the study area. In addition, scholarly works shows that the activities of farmers in Northeast Nigeria are not featured in the leading Journals on Agriculture in Nigeria, in spite of the devastating effects of the Boko haram insurgences that have ravaged the area (Northeast, Nigeria).

This paper (a part of a larger PhD study) presents a theoretical framework for climate change and adaptation strategies in Northeast Nigeria with a view to improving sustainable crop production in the study area that will yield positive results for survival and sustainable growth of farmers in the challenging agricultural food chain/environment. Thus, presents a theoretical framework for /on climate change and adaptation strategies in the Northeast Nigeria becomes very apt.

The findings of this study will be of immense benefit to farmers, students, Ministry of Agriculture, Agricultural extension agents/agencies and researchers, policy makers at both state and federal level and Non-Governmental Organizations (NGOs). The study hopes to contribute significantly to climate change discourse and adaptation strategies that would provide insights on the farmer's perception and awareness on climate change and adaptation strategies with the potential to shape agricultural sector policies in Nigeria, with regards to climate change and adaptation strategies. The findings of this study is of utmost importance to researchers in the fields of agriculture and extension

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



management, and environment especially as it relates to agriculture and crop production hence, further promoting the practice of mitigating the adverse effects of climate change.

METHODOLOGY

The study area is the Northeast Nigeria which comprised of six states namely; Yobe, Borno Adamawa, Taraba, Bauchi and Gombe states, Nigeria. The area is sometimes referred to as one of the six geopolitical zones of the country (Nigeria) and covers close to one-third (i.e 280,419 km²) of Nigeria's land area (i.e 909,890km²). According to the projections for 2011 by the National Bureau of Statistic (NBS), the states that comprised the Northeast have 13.5% (i.e. 23,558,674 million) of Nigeria's population which is put at 173,905,439 million. Majority of the crops grown in the area are millet, maize, guinea corn, rice, cotton, cowpea and groundnut. However, yam, sweet potatoes, benni seed are among other minor crops grown.

The choice of Northeast Nigeria was in appreciation of the large concentration of farmers and the high volume of farm produce that had hitherto being realized from the area prior to the advent of Boko Haram insurgency that has ravaged the area for over a decade now. In addition, most of the farmers around the lake Chad basin, and the neighbouring countries of Niger republic, Chad, and Cameroun republics and most part of Borno state used to have parts of their farmlands or branch offices in the former Northeastern state with capital in Maiduguri because of its strategic locations, being the administrative headquarters of the Northeastern state. Thus, the Northeast can be described as one of the heart of crop production and agricultural activities in Nigeria, as well as the epicenter of the devastating effects of climate change in Nigeria.

Previous studies have used the Northeast Nigeria as one of the locations to base their analysis of climate change and adaptation strategies in Nigeria for similar reasons. Although only farmers that are based in study areas were considered for selection in both (quantitative & qualitative) phases of the study, it was assumed that reasonable generalisation can be made from the study.

This is because most farmers are characterised by high mobility and usually operate on any conducive land/area they can access in any part of the country, hence, share similar attributes irrespective of their locations.

This study focuses on developing a theoretical framework for climate change and adaptation strategies for crop production in Northeast Nigeria. It is limited to farmers communities involved with the Agricultural development programmes in the study area. The deliberate limitation of the study to these categories of farmers and the study location/area was informed by government interest in the growth and development of the Northeast as a result of the devastating effects of the Boko haram insurgency that ravaged the area for over a decade, coupled with the adverse effects of climate change. These are in addition to the characteristics, nature/types, and the volume of agricultural produce derived annually from the area when compared with other geo-political zones of the country. Furthermore, the need to develop the area as evident by the creation of the Northeast Development Agency necessary for the return of peace and settlement of people dislocated (IDPs) guided the limits.

LITERATURE REVIEW

The literature review research method (based on secondary data as research source) was adopted for data collection from peer reviewed journals, conference proceedings, reports, and agricultural/government policies. It consists of a desk research; online/library based approach to be subjected to content analysis and serves as basis for the preliminary research and the empirical study (Snyder, 2019; Okoli; Schabram, 2017) on farmer's perception and awareness on climate change and adaptation strategies in the study area.

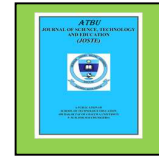
The selected methodology is a well-established and credible way of synthesising research findings capable of revealing evidence at a meta level and to unravel research areas that require further studies which is a critical component of creating theoretical frameworks and building conceptual framework (Marut, Anigbogu, & Daniel, 2020; Vigelius, 2017). Davis, Mengersen, Bennett, and Mazerolle (2014), and Okoli and

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



Schabram (2017) have reported that quantitative and qualitative studies can also be synthesized using systematic literature review. Content analysis is a type of study that looks for patterns, in recorded conversations. Data are collected from set of texts, which can be written, oral, or visual to undertake content analysis. It involves counting and comparisons of key words or content, followed by the interpretation of the underlying context (Hsieh & Shannon, 2014).

Theoretical framework

There are many theory of climate change but this study will benefit from the following theories: Anthropogenic Global Warming theory (AGW), Human forcings beside Greenhouse Gases, Diffusion of Innovation theory (DOI), Utility theory, (UT) and Information Pick-up theory. This is because farmers perception and awareness on climate change and adaptation strategies for crop production has become a common concept in agricultural and agric extension literature, yet its definition remain elusive and its use inconsistent. Due to its ambiguity, it becomes apparently difficult for researchers to adopt a single theory or approach in the analysis of farmers on climate change and adaptation strategies for crop production. Consequently, this study explored relevant theories with the view to examine the complexities of relationships in the constructs/variables of concern to this study. The study reviewed multiple theories in order to develop a theoretical framework for the study with a view to improving on sustainable crop production in the study area.

Researchers have argued that a theoretical perspective is necessary in order to provide a comprehensive explanation on climate change and adaptation strategies, or in explaining the antecedents of farmers' perception and awareness on climate change and adaptation strategies. Thus, combining the various theories serves to capitalize on their strengths and reduce their drawbacks, giving rise to a more robust theoretical underpinning.

Thus, in line with existing literature, the study adopted four (4) independent but interrelated theories to serve as a framework of analysis. These include: Anthropogenic Global Warming theory (AGW), Human forcings

beside Greenhouse Gases, Diffusion of Innovation theory (DOI), Utility theory and Information Pick-up theory. The four (4) theories are used to underpin the main work and explain the relationships between the variables of the study. The choice of these theories is based on the consideration of multiple causes and the explanation of inter-relationships by the theories.

1. The Anthropogenic Global Warming (AGW) theory of climate change:

This theory attribute the catastrophic rise in global temperatures to human emissions of greenhouse gases, principally carbon dioxide (CO₂), methane, and nitrous oxide (Pieike, 2009). The theory contends that the ~0.7°C warming of the past century-and-a-half and ~0.5°C of the past 30 years is mostly or entirely attributable to man-made greenhouse gases.

The theory suggest that during the past century, human activities such as burning wood, fossil fuels and cutting down or burning forests are responsible for increased concentration of carbon dioxide (CO₂) in the atmosphere by approximately 50 percent. The earth's climate also responds to several other types of external influences, such as variation in solar radiation and in the planet's orbit, and therefore cannot account solely for the rise in earth's temperature over the past three decades. In addition, the forcing caused directly by man-made greenhouse gases is also small.

The main assumption of the theory is that man-made carbon dioxide (CO₂) is responsible for disasters such as floods, droughts, severe weather, crop failures, species extinctions, spread of diseases, ocean coral bleaching, famines, and literally hundreds of other catastrophes, which could become more frequent and severe as temperatures continue to rise. Thus, the implications of the theory to the study suggest that nothing less than large and rapid reductions in human emissions will save the planet from these catastrophic events which also includes sustainable crop production.

2. Human Forcings beside Greenhouse Gases Theory:

The Human forcings beside greenhouse gases theory was originated by

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



Roger Pielke, Sr., a climatologist at the University of Colorado – Boulder, and spear headed by IPCC (2007). The basic assumption of the theory is that mankind's greatest influence on climate is not its greenhouse gas emissions, but the transformation of earth's surface by clearing forests, irrigating deserts, and building cities. The theory acknowledged that natural causes of climate variations and changes are undoubtedly important, but argued that human influences are significant and involve a diverse range of first-order climate forcings, including, but not limited to, the human input of carbon dioxide (CO₂).

The theory defines the relationship between man and the environment in which he interact with for survival, and stressed that the major responsibility of man in his interaction with the environment is to ensure a stable and sustainable relationship in exploiting the environment for survival and growth to ensure sustainable food/crop production among others.

Some of these "human forcings" other than greenhouse gases include:

1. Urban Heat Islands which suggests that cities tend to be warmer than suburbs, and suburbs warmer than rural areas,
2. Aerosols and ozone which suggests that clearing forests, irrigating deserts, and building cities have shorter lifetimes than greenhouse gases, as they are likely to give rise to the warming effects, not carbon dioxide (CO₂).
3. Deforestation which is the process of removing trees by burning, which releases carbon dioxide (CO₂) into the atmosphere and tends to be warmer.
4. Coastal development which refers to anthropogenic activities in coastal areas such as logging, agriculture, construction, mining, drilling, dredging, and tourism that can increase surface temperatures of nearby bodies of water.

3. Diffusion of Innovation Theory: Diffusion of Innovation (DOI) Theory was developed by (Rogers, 1962) as one of the oldest social science theories. It originated in communication to explain how, over time, an idea or product gains momentum and diffuses (or spreads) through a specific population or social system. Diffusion is the adoption of a new idea, behavior, or product. In other words,

adoption means that a person does something differently than what they had previously (i.e., purchase or use a new product, acquire and perform a new behavior, etc.). The implication of the theory to this study suggest/imply/underscore the need for diffusion of adaptation strategies to farmers in order to combat the adverse effects of climate change on crop production to achieve sustainable crop production in the study area.

However, the major the failure of technical assistance and community development programs, based on the diffusion model remain the major limitations as the model as it failed to generate either rapid modernization of traditional farms or rapid growth in agricultural output (Udemezue, & Osegbue, 2018).

4 Utility theory: Utility theory was postulated by Fish burn in 1968. The theory is concerned with peoples preferences, choice, decision based on preference and value with assumption about a person preference that enable them to be represented in numerically useful ways that reflect the satisfaction level associated with individual preferences. The theory came up with the following assumptions; completeness, more-is-better, mix- is- better and rationality.

The basic assumption of Utility theory is that it is based on assumption of rationality and describes all decision-outcomes (financial and otherwise) in terms of the utility (or value) that an individual placed on them. The main idea of the utility theory is an agent preferences over possible outcomes can be captured by a function that maps these outcome to a real number, the higher the number the more agent likes that outcome, the function is called a utility function. (i.e utility theory governs individual decision making).

The theory was adopted because it is all about people preference, value and decision making process, hence it is relevant to this study because it is focus on value system, which could have far reaching implications on perception and awareness of climate change and adaptation strategies relevant to this study.

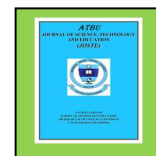
5. Information Pick-up Theory: The theory was postulated by (Gibson 1966). It suggest

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



that perception depends entirely upon information in the “stimulus array” rather than sensations that is influenced by cognition. The basic assumption of the theory is that the environment consists of affordance (such as terrain, water, vegetation etc) which provide clue necessary for perception. Perception is a direct consequence of the properties of the environment and does not involve any form sensory processing. Information pick-up theory stresses that perception requires an active organism. The act of perception depends upon an interaction between the organism and the environment. All perception is made in reference to body position and functions (proprioception). This means that awareness of the environment derives from how it reacts to our movements (Gibson 1966).

The information pick-up theory is relevant to this study as it is concerned with the act of perception which depends upon an interaction between the organism (farmers in

this context) and the environment and how awareness of the environment is derived. Information is vital and has to be made available before strategies can be used as an option for sustainable crop productions, hence the relevance of the theory and its adoption for this study.

Therefore, the theoretical framework, could aid farmers in the fight against climate change and adaptation strategies for improved crop production in the study area. This implies that the environment may be beneficial to farmers if they are able to develop an adaptive ability that allows them to move beyond environmental constraints. This also means / suggests that farmers can benefit from interactions with the environment if they can develop ability to adapt to the environment and reduce the damages to the environment. Table 1: depicts the theories reviewed for the study, basic assumptions of the theories, and their application to the study.

Table 1: Theory, basic assumptions of the theory and application of the theory to the study

Theory	Anthropogenic Global Warming theory (AGW)	Human forcings beside Greenhouse Gases theory	Diffusion of Innovation theory (DOI)	Utility theory	Information Pick-up theory
Basic Assumptions of the theory	Human emissions of greenhouse gases: carbon dioxide (CO ₂), methane, and nitrous oxide, causes catastrophic rise in global temperatures, vide greenhouse effects (Pieike, 2009),	Mankind's greatest influence on climate is not its greenhouse gas emissions, but its transformation of earth's surface by clearing forests, irrigating deserts, and building cities (IPCC 2007).	It explains how, over time, an idea or product gains momentum and diffuses (or spreads) through a specific population or social system. Resulting into diffusion where people, (as part of a social system), adopt a new idea, behavior, or product (Rogers, 1962).	The theory is based on the assumption of rationality and describes all decision outcomes (financial and otherwise) in terms of the utility (or value) placed on them by the individual. The theory assumes that an agent preferences over possible outcomes can be captured by a function that maps these out-	The theory suggest that perception depends entirely upon information in the 'stimulus array' rather than sensations that is influenced by cognition. Thus, the environment consist of affordance (such as terrain, water,

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved

				come to a real number, the higher the number the more agent likes that outcome (Fish burn, 1968).	vegetation etc) which provided the clue necessary for perception (Gibson, 1966).
Application of theory to the study	The main assumption of the theory is that man-made carbon dioxide (CO ₂) is responsible for disasters such as floods, droughts, severe weather, crop failures, species extinctions, spread of diseases, ocean coral bleaching, famines, and literally hundreds of other catastrophes, which could become more frequent and severe as temperatures continue to rise.	The theory defines the relationship between man and the environment in which he interact with for survival, and stressed that the major responsibility of man in his interaction with the environment is to ensure a stable and sustainable relationship in exploiting the environment for survival to ensure sustainable food/crop production among others.	The implication of the theory to this study suggest/implies/underscore the need for diffusion of adaptation strategies to farmers in order to combat the adverse effects of climate change on crop production to achieve sustainable crop production in the study area.	The theory was adopted because it is all about people preference, value and decision making process, hence it is relevant to this study because it is focus on value system, which could have far reaching implications on perception and awareness of climate change and adaptation strategies relevant to this study.	The information pick-up theory is relevant to this study as it is concerned with the act of perception which depends upon an interaction between the organism (farmers in this context) and the environment and how awareness of the environment is derived.

CONCLUSION

The theoretical framework for climate change and adaptation strategies in Northeast Nigeria is very apt considering that farmers are most affected by the vagaries of climate change. This is in addition to the scarcity/paucity of research on farmers' perception and awareness on climate change and adaptation strategies in the study area. The study explored and reviewed five (5) inter-related theories: the Anthropogenic global warming, Human forcing beside greenhouse gases, Diffusion of innovation, Utility and Pick-

up theories in explaining the main concepts/elements/factors of concern to the study. However, the study would benefit from these theories in explaining the complex relationship between the constructs, elements and variables of concern to the study.

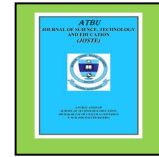
The study has several distinctive strengths and limitations resulting from trade-off decisions required in all rigorous/empirical research. First, this study is limited to a certain extent as it is based on literature review and content analysis, which leads to issues related to secondary data inference. Second, a

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



possible concern with the major study (in terms of scope) is the focus mainly on farmers in the Northeast Nigeria. These farmers have different preconditions than farmers in other parts of Nigeria, mainly due to more restricted resources, arising from crises and insurgency that have affected the area, among others. Therefore, the humanitarian crises (the fact that the place is prone to crises), posed to the farmers is a potential limitation that may affect this study. Future research may take this issue into account when conducting similar research in Nigeria context in general.

REFERENCES

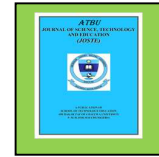
- Adelekan A. O., & Gbadegesin T. A. (2010). Regional evidence of climate change in Nigeria. *Journal of Geography and Regional Planning*, 3(6): 142 – 150.
- Ado, A. M, Leshan, J, Savadogo P, BO, L., & Shah, A. A. (2018). Farmer's awareness and perception of climate change impacts. Case study of Aguié district in Niger. *Journal of environmental development sustainability*.
- Ayanlade, A., Radeny, M. & Morton, J. F (2017). Comparing smallholder farmers perception of climate change with meteorological data. A case study from South Western Nigeria. Published by Elsevier.
- Ayuba, H. K. Maryah, U. M. & Gwary. D. M. (2007). Climate change impact on plant species composition in six semi-arid range lands of Northern Nigeria. *Nigerian Geography Journal*, 5(1), 35-42.
- Bartels, W. & Furman, C. (2016). The tri-state climate learning community: A long-term engagement process for building agricultural adaptive capacity in the SE USA. Southeast Climate Consortium Annual Report.
- Chareze L. I., & Corpus K (2008) Impact of Climate Change on agriculture in Sub-African Countries.
- Chikaire, J., Nnadi, F.N., Orusha, J.O. and Onogu, B. (2012) Integrating Climate Change Issues into Agricultural Education, Teaching and Learning in Nigeria. *Advances in Agriculture Sciences and Engineering Research*, 2, 115-127.
- Ebenehi, O, T., Ahmed, T. A., & Barnabas, M. (2018). Evaluation of extension services delivery for climate change adaptation by crop farmers in Niger state. *Asian Journal of Agricultural extension economic and sociology*. 27(1):1-2,
- Hsieh, H., & Shannon, S. E. (2014). Three approaches to qualitative content analysis. *Research Gate*: Retrieved from <https://www.researchgate.net7>
- IPCC (2007). Climate Change: Impacts, Vulnerability and adaptation. Contribution of working group III to the third assessment report on the intergovernmental panel on Climate Change. Cambridge University Press, Cambridge.
- IPCC (2009) *Climate Change Mitigation, contribution of working group I to Third Assessment Report*. Cambridge University Press.
- IPCC 2014. Climate Change 2014—Impacts, Adaptation and Vulnerability: Regional Aspects, Cambridge University Press
- IPCC 2014a, 'Climate Change 2014: Synthesis Report' Contribution of Working Groups I, II and III to the Fifth Assessment Report of the IPCC [Core Writing Team, Pachauri RK, and Meyer LA, (eds.)], IPCC, Geneva, Switzerland, pp. 151.
- IPCC 2014b, 'Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects' Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, CB, Barros, VR, Dokken, DJ, Mach, KJ, Mastrandrea, MD, Bilir, TE, Chatterjee, M, Ebi, KL, Estrada, YO, Genova, RC, Girma, B, IPCC, (2007). Summary of Policy makers In: Climate Change (2007). Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry, M. L., Canziani, O. F., Palutik of, J. P., Vander, Linden, P.

Corresponding author: Rakiya Inusa Mohammed

✉ rakiyainusa37@gmail.com

Department of Vocational Education, Faculty of Education, Modibbo Adama University Yola, Adamawa State, Nigeria.

© 2023. Faculty of Technology Education. ATBU Bauchi. All rights reserved



- J., and Hanson, C. E., Eds.,
Cambridge University Press,
Cambridge, UK, 7–22.
- IPCC. Climate Change (2007). ? The Physical
Science Basis: Working Group I
Contribution to the Fourth
Assessment Report of the IPCC. Vol.
4. United Kingdom: Cambridge
University Press; 2007
- Obinna, I. K., Thomas, T., Jenkins, R. E.,
Phillips, M. R., & Komali, K. (2017).
Climate change impacts awareness
and perception of Africa Rural
communities in Enugu State. *Journal
of Advance in crop science and
technology. Open Access*
- Ogunpaimo, O. R., Oyetunde-usman, Z &
Surajudeen, J. (2021). Impact of
climate change adaptation on
household food security in Nigerian-
A difference –in-difference approach.
Sustainability 2021, 13, 1444.
<https://doi.org/10.3390/su1331444>.
- Okoli, C. & Schabram, K. (2017). A Guide to
conducting a systematic literature
review of information systems
research. Retrieved from
<http://chitu.okoli.org>
- Oruonye E. D. & Adebayo A. A. (2015)
Assessment of flood risk perception
and response in Jalingo Metropolis,
Taraba State, Nigeria. Proceedings
of the Annual Conference of the
Nigerian Association of Hydrological
Sciences held at Federal University
of Agriculture Abeokuta (FUNAAB),
pp 4 – 12.
- Ozor, N. (2009). Understanding climate
change: Implication for Nigeria
agriculture, policy and extension. A
paper presented at the National
conference on climate change and
the Nigeria environment held at the
Uni. Of Nigeria, Nsukka.
- Sadiq, A. M., Kuwomu, J. K. M., Al-Hassan, R.
M., & Al-Hassan, S. I. (2019).
Assessing maize farmers Adaptation
strategies to climate change and
variability in Ghana. *Agriculture*, 9
(5).
- Umunakwe, P. C. Nnadi, F. N. Chikaire, J.
& Nnadi C. D. (2014). Information
Needs for Climate Change
Adaptation among Rural Farmers in
Owerri West Local Area of Imo State,
Nigeria. *Agrotechnol* 3, 118. Doi:
[10.4172/2168-9881.1000118](https://doi.org/10.4172/2168-9881.1000118)
- Zakari, S, Ibro, G, Moussa, B & Abdoulaye, T.
(2022). Adaptation strategies to
climate change and impacts on
Householder income and food
security: Evidence from Sahelian
Region of Niger. *Sustainability* 2022,
14, 2847.
<https://doi.org/10.3390/su14052847>.