



## Review Article

# Repositioning Nigeria's Agricultural Extension System Towards Building Climate Change Resilience

Chibuzo Uzoma Izuogu <sup>1\*</sup>, Robert Ugochukwu Onyeneke<sup>1</sup>, Loveday Chukwudi Njoku<sup>1</sup>, Gillian Chidozie Azuamairo<sup>1</sup> and Mary Chikerenma Atasi<sup>2</sup>

<sup>1</sup>Department of Agriculture, Alex Ekwueme Federal University Ndufu Alike, Ikwo, Ebonyi State; <sup>2</sup>Department of Rural Sociology and Extension, Michael Okpara University of Agriculture Umudike.

**Abstract** | This paper focused on redefining agricultural extension practice in Nigeria in response to the challenges of climate change. We reviewed 58 articles from research databases that were in line with our inclusion criteria for adequate understanding of the current state of agricultural extension practice in Nigeria and climate change concerns. The review identified the effects of climate change on agricultural extension practice, ascertained the training needs of agricultural extension workers towards climate change resilience, highlighted the strategies for repositioning the Nigerian agricultural extension system for climate change resilience and ascertained the opportunities and barriers for agricultural extension system towards building climate change resilience. Results show that climate change has adversely affected agricultural extension practice in Nigeria by worsening its operational environment. Changes in rainfall pattern have made it cumbersome for effective implementation of extension advice in real time. Training needs of extension workers for climate change resilience among others include the need to bridge digital divide, implementation of strategies for a better interface with development partners and optimization of the use indigenous mitigation strategies for climate change. The review recommends that essential strategies that must be in-cooperated in the extension service delivery in Nigeria should include adoption of new scenario thinking in communicating resilience building, establishment of emergency management unit by the agency, encouraging the involvement of the private sector in the extension service, transferring of research results on best affordable resilience practices to farmers as well as ensuring that government and other agencies are kept abreast with farmer's feedback on their challenges in building climate change resilience.

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**\*Correspondence** | Chibuzo Uzoma Izuogu, Department of Agriculture, Alex Ekwueme Federal University Ndufu Alike, Ikwo, Ebonyi State;

**Email:** chibuzoizuogu@gmail.com

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## Introduction

The Intergovernmental Panel on Climate Change (IPCC) defined climate change as any statistically identifiable alteration in the climatic condition as a result of alterations in the average of its properties, which continues over a long period

(usually a decade or more) (IPCC, 2014). These changes include alterations in temperature range, rainfall regimes, relative humidity, etc over a given period (Mbah *et al.*, 2016). Anabaraonye *et al.* (2018) identified that climate change emanates from human and natural sources. Variation in solar radiation, differences in the earth's orbit as well as variations in

ocean circulation accounts for the natural causes of climate change. Human activities that cause climate change range from hazardous agricultural production activities like abuse of the application of inorganic fertilizer, emission of air pollutants, deforestation, unplanned industrialization, unhealthy transport systems among others (Oselebe *et al.*, 2016; Oriakhi *et al.*, 2017; Olufemi, 2018). Increase in the emission of Green-House Gases (GHG) with its consequent negative effect of warming the earth's surface, high concentration of carbon (IV) oxide, increase in air pollution through the emission of methane (CH<sub>4</sub>) and dinitrogen monoxide (N<sub>2</sub>O), etc are some of the harmful effects of human activities on the atmosphere.

Resilience is the tendency for a system to envisage, curtail, tolerate and survive the outcome of incidences that are hazardous to its existence in such an efficient and timely manner by utilizing sustainable execution of preservation, advancement, and restoration of its essential structure and functions (IPCC, 2009). Resilience strategies are evaluated in terms of buffer capacity, self-organization, and adaptive capacity (Smit and Wandel, 2006; Jim, 2013).

In most of the countries in Africa (with emphasis on the non-oil exporting countries) agriculture undoubtedly constitutes an important sector contributing about 30% of the Gross Domestic Product (GDP) and 50% of total export. Also, about 70% of Africans rely on agricultural production for their livelihoods (Prokopy *et al.*, 2017). In Nigeria, the agricultural sector contributes 21.96 % to the GDP and employs 70% of the workforce (NBS, 2020). Although research reports point to an increase in the adverse effects of alterations in the climatic variables on agricultural production in Nigeria, studies also show persistent skepticism among farmers.

Previous studies in developing countries had evaluated the vulnerability of rural livelihood to climate change (Yusuf, 2013), information sources and awareness of climate change (Akin *et al.*, 2001; Maponya and Mpandeli, 2013; Adebisi-Adelani and Oyesola, 2014; Okoro *et al.*, 2016; Nwachukwu *et al.*, 2017; Nwalem *et al.*, 2019) and responsiveness and training needs of extension workers in Nigeria (Adisa and Balogun, 2012; Onyeme and Iwuchukwu 2012).

Also, various studies from developing countries have focused on the agricultural sector for estimation of

resources and institutional barriers. Such studies include domestic water buffaloes: Access to surface water, disease prevalence and associated economic losses (Elahi *et al.*, 2018), The public policy of agricultural land allotment to agrarians and its impact on crop productivity in Punjab province of Pakistan (Elahi *et al.*, 2019), How Much Is the Eco-Efficiency of Agricultural Production in West China? Evidence from the Village Level Data (Xiang *et al.*, 2020), Determinants of the involvement of extension agents in disseminating climate smart agricultural initiatives: Implication for scaling up (Olorunfemi *et al.*, 2019), Climate Change Adaptation in the Delta Nile Region of Egypt: Implications for Agricultural Extension (Kassem *et al.*, 2019). However, although these studies focused on certain concepts that related to the occupational environment of the agricultural extension service, none of them reviewed the emerging challenges to agricultural extension practice in Nigeria as necessitated by climate change and approaches towards resilience building. This study therefore seeks to;

- Identify the effects of climate change on agricultural extension practice in Nigeria
- Highlight the training needs of agricultural extension workers towards climate change resilience
- Suggest strategies for the repositioning of Nigeria's agricultural extension system for climate change resilience
- Highlight the opportunities and barriers for agricultural extension towards building climate change resilience; and
- Make policy recommendations.

## Materials and Methods

This review was based on existing literature through the implementation of a qualitative approach that provided information on climate change resilience and agricultural extension practice in Nigeria. Secondary sources of information for the study included publications from online open access journals such as Elsevier, Scopus, Research gate, Academia.edu etc., and publications by universities, associations and other interested individuals / groups. The statement of inclusion and exclusion criteria was used in determining the eligibility criteria of research articles. Firstly, the type of literature included both empirical and position journal articles. Secondly, considering that climate change studies require at least a period of

ten years of observation a timeline range of ten-years was fixed for article publication from 2010-2020. This implied that articles that were published earlier on were excluded. Thirdly, we included only articles that were published in English language. Finally, in order to ensure exposure to related interest, the review included only publications that focused on climate change resilience and extension practice in Nigeria. A total of 58 articles were used for the review.

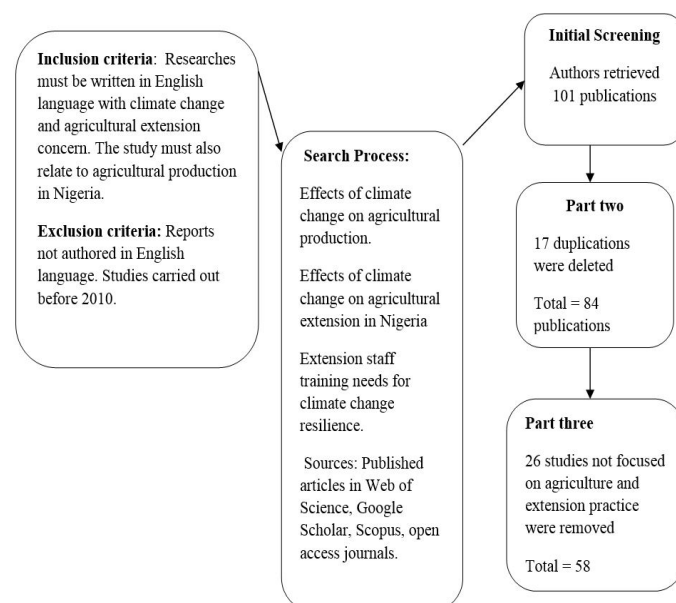
## Results and Discussion

### *Effects of climate change on agriculture and extension practice in Nigeria*

According to [Rani and Maeswari \(2015\)](#), climate change has two major types of effects on agriculture viz. its effects on the geographical limits of the regions that produce different crops and livestock and effects on the potential yields of crops and livestock in those regions. The unintended consequences of climate change will hinder both the natural and human systems in Sub-Saharan Africa in several ways ([Serdeczny et al., 2016](#)). The gloomy effects of climate change in Nigeria's agricultural sector include high mortality rate in livestock and fishery ([Arora-Jonsson, 2011](#); [Cervigni et al., 2013](#); [Chukwunonso, 2015](#)), flooding ([Ikehi, 2014](#); [Abu, 2015](#); [Iheoma, 2015](#)), drying of seedlings after germination and transplanting ([Babatolu and Akinnubi, 2016](#)), leaching ([Ayinde et al., 2017](#); [Odewumi et al., 2013](#); [Nwalem et al., 2019](#)), drought ([Abubakar and Yamusa, 2013](#); [Odewumi et al., 2013](#); [Chukwunonso, 2015](#); [Abdullahi, 2018](#)). One major aspect of crop production that has been affected by climate variability is the Length of Growing Period (LGP). Although global warming may lead to an increase in LGP, an increase in night and day temperatures may encourage the physiological development of crops leading to early maturity of crops, and reduction in crop yield. Global change in climate is expected to give rise to an increase in rainfall variability. A decrease in rainfall with its attendant higher atmospheric requirements due to elevated temperatures will shorten the LGP ([Adebayo and Oruonye, 2012](#); [Adesiji et al., 2013](#); [Ethan, 2015](#); [Okunlola et al., 2018](#); [Operinde and Okogbue, 2018](#)).

For agricultural extension practice in Nigeria, climate change is gradually worsening the ecological and operational environment for agricultural extension services by its negative effects. The increase in crop failure with its attendant low productivity has reduced

the income accruable to farmers and increased food insecurity within the operational environment of agricultural extension. [Mubila and Nabalamba \(2011\)](#), [Inyang et al. \(2018\)](#) and [Olufemi \(2018\)](#) in identifying the extent to which Nigerian agricultural operational environment is vulnerable to the challenges of climate change observed that in 2017, the country had to put up with series of climate change related hazards including increased exposure to diseases, reduction in agricultural output, loss of biodiversity, drought, social conflicts and unrest, deteriorating state of food security, the decline in soil capacity for agricultural production, heat stress, among others ([Anabaraonye et al., 2018](#); [Toungos and Tanko, 2018](#)).



**Figure 1:** Selection criteria and pathway.

The direct effects of climate change on food security and other life threatening challenges are among the key factors challenging food security in Nigeria ([Chikaire et al., 2011](#); [Knox et al., 2012](#); [Ajibola, 2014](#); [Tsojon, 2017](#); [Anabaraonye et al., 2018](#)). [Anyoha et al., \(2013\)](#) and [Oriakhi et al. \(2017\)](#) reported that increased incidences of drought in different parts of Nigeria, especially within the Sudan and Sahel savannah zones, reduces the availability of moisture to crops, leading to a reduction in agricultural yield. These challenges have made it very difficult for farmers to invest in production practices that are exposed to climate risks. The problem of credibility gap in agricultural communication has been worsened by climate change impacts as farmers would always like to see actual situations where new methods have produced satisfactory results at a sustainable level before adopting them.



Alterations in the pattern of rainfall make it difficult for extension work to be effectively implemented as it makes it cumbersome for extension to conduct timely and relevant training. It is therefore expected that the extension workers must reschedule their work plan to suit the condition. Climate variability also affects the expected result of innovation transfer thereby questioning the expertise, reliability, and validity of extension agents and their advice. Most times, the difference between the climatic conditions at the farmer's plot may not correspond with that at the demonstration/ adoption plot. This alters the result and farmers frequently blame the extension agent for the failure accusing them of issuing wrong advice.

#### *Training needs of agricultural extension workers towards climate change resilience*

The promotion of climate-smart agricultural activities and outcomes requires integrating a broad range of concepts, ideas, and practices from different disciplines and stakeholders. Agricultural extension and advisory services need to reinforce the promotion of adaptation to climate change using approaches that will motivate women, farmers, to utilize appropriate adaptation strategies and technologies. Different approaches to ameliorating the effects of climate change must be adopted by the extension agents to ensure that food production is not only maintained but also increased. Studies show that improving weather forecasting (WMO, 2011; Adisa and Balogun, 2012; Onyeme and Iwuchukwu, 2012; Umair *et al.*, 2014), management of weather equipment (Onyeme and Iwuchukwu, 2012), implementation of indigenous mitigating strategies for climate change (Adisa and Balogun, 2012; Onyeme and Iwuchukwu, 2012), bridging of digital divide (Umair *et al.*, 2014), pest management strategies (Adisa and Balogun, 2012), workshops on climate risks management (Akpan and Aye, 2016), strategies for better interface with development partners (Akpan and Aye, 2016), and statistical evaluation of field data (Adisa and Balogun, 2012; Edenhofer, 2014; Melillo *et al.*, 2014).

The absence of adequate training for the extension workers in Nigeria has hindered the response of the profession to climate change. Several tools are available through the use of ICTs which can assist the extension agent to update their knowledge and make their teaching process more effective. In improving the capacity of the extension workers, the Nigerian agricultural extension system would have

demonstrated that resilience to climate change is a crucial policy priority for the agricultural sector.

#### *Repositioning the national agricultural extension system towards building climate change resilience*

Agricultural extension in Nigeria is currently playing an active role in climate change mitigation and adaptation by initiating changes in attitude, resilience capacity, skills, and knowledge of the clientele. It is therefore important to improve the capacity of the professional extension workers towards building climate change resilience. The job performance and technical competence of extension workers who interface between extension institutions and farmers on agricultural issues such as causes, effects, mitigation, and adaptation strategies against climate change should be broadened and upgraded (Ozor, 2009; Adisa and Balogun, 2012). Klein *et al.*, 2011 and Tanny and Rahman (2016) opined that resilient sensitive agricultural extension system must be tailored towards establishing a closer relationship with the extension clientele and other members of the rural communities to support the advancement of climate-smart agricultural practices among them. The knowledge of farmer's vulnerabilities within their operational environment which should ideally extend to their rural social dynamics, buffer, and adaptive capacities is essential in developing training manuals to be adopted for climate change resilience.

Extension system in Nigeria has remained a public practice leading to its collapse in many states of the federation. With the threat from climate change, it has become imperative that agricultural extension practice should adopt an expanded outlook which will engage the private sector and civil societies. The use of field methods such as Small Plot Adoption Techniques (SPAT) as means of intermediation will not adequately assist in building resilience towards climate change. Agricultural extension system in Nigeria can render strong advocacy through her association (Agricultural Extension Society of Nigeria) for the emergence of national policies that will support a strengthening and enabling operational environment for climate change resilience

Nigerian agricultural extension system as an education system should serve as a key capacity building strategy with necessary information on the climate variability in farm production and also advocate for measures to enhance resilience towards the associated negative

impacts on the farmer's livelihood. This can be executed by training and equipping farmers and assisting them to find appropriate solutions to cushion the negative indices of climate change on the production activities. One of the approaches to climate change resilience is self-organization which focuses on the principle of social resilience that is anchored on the ability of farmers to absorb and handle challenges emanating from climate change and to adequately reorganize themselves without causing catastrophic alterations to individuals or communities. The national agricultural extension system should be geared towards helping farmers in developing farmer's groups and co-operative organizations that will effectively provide social support to the individual members against the challenges of climate change. Social capital is an essential tool for countering natural crisis.

National agricultural extension program needs to ensure adequate broadcast and transmission of research results about climate change to ensure that farmers become aware and adequately equipped to ameliorate the negative effects of climate change. This could assist farmers in identifying and capitalizing on strategies to cope with the variability of climate (Maka, *et al.*, 2019). Also, extension system in Nigeria should be repositioned to aid the coping strategies of its clientele after incidences of climate change disaster by linking the farmers to sources of relief and assist in attracting agencies that will promote the rebuilding of farmer's sources of livelihood (Izuogu *et al.*, 2015). The current practice where agricultural extension targets more on technology transfer if in-cooperated to focus on institutional change will give rise to a more coherent arrangement of responses that will form a socio-institutional innovation towards climate change resilience.

In Nigeria, the weather forecast should be improved to the extent that farmers may use it in their farm operations. Timely and accurate weather forecasting is crucial to improving farming activities (Ozor, 2009; Adesina and Odekunle, 2011). Access to seasonal climate forecasts can benefit farmers in making decisions about their agronomic and other farm practices. Agricultural extension systems in Nigeria must develop the capacity to share meteorological forecasting with farmers at the level of farmers' understanding and aid them in determining the need to adopt an innovation given future climate projection. To achieve this, extension services must change from

its current concentration on the rural space to serve as a national intermediary. Emerging challenges in climate change resilience require an adjustment of roles and responsibilities between participants at all levels with the farmers. Agricultural extension communication should aim at enhancing the formation of the networks and the establishment of relationships to support services targeted at building resilience.

The implementation of Information and Communication Technologies (ICTs) based advisory service mechanism is growing as an innovative extension delivery mechanism with convergence base (Muralikrishnan, 2012). There is an increase in the use of social media as an avenue for sharing ideas and generating awareness. Platforms such as Facebook, Whats App, Twitter, Zoom, You Tube, and blogs can be utilized to engage various audiences (Akin *et al.*, 2001). Agricultural extension communication in Nigeria must not lag behind in adopting the trend.

#### *Opportunities, barriers and future directions for agricultural extension on building climate change resilience*

The central role of agricultural extension towards agricultural development is educational. Although agricultural extension may be involved in the provision of institutional support and facilitating farmer's needs; the major role of agricultural extension officers is to provide and transfer information to their clienteles (usually the farmers). The agricultural extension system in Nigeria while serving as a link between the farmers and researchers has developed a broad base for wider consultations and interactions among the actors in the agricultural value chain. This role will be very essential in promoting climate-smart agriculture in Nigeria. For instance, agricultural extension system in Nigeria has among other things played active roles in advocating the cultivation of improved crop varieties, capacity to build linkages among stakeholders, biodiversity, ecosystems, soil and water conservation, promotion of rearing of improved livestock breeds, ability to translate climate information into practical guidance.

Extension workers and other decision makers in the agricultural sector across Nigeria are currently aware that climate change may lead to a severe risk to rural community livelihoods and welfare. Despite this knowledge, the extension system in Nigeria faces

barriers towards developing a resilience approach for farmers in rural areas. A major challenge is the development and sustenance of a vibrant combination of formal and informal institutions that is aligned to the rural farmers. These institutions must endeavor to adequately relate with other agencies involved in agriculture and rural development towards supporting the well-being of farmers. [McLeman et al. \(2011\)](#) opines that the productivity of integration within these interacting levels of government can either make or mar the adaptive and buffer capacity of a community

Another challenge to building the capacity of rural farmers towards climate change resilience is the unavailability of suitable information on climate change resilience as it affects rural communities. The current spatial distribution of climate change information is not detailed enough for rural community policymakers' needs, especially considering that the effect scenarios that are generated by researchers are not very meaningful to rural areas.

Although scholars have identified the need to build resilience towards climate change, there is a new discussion over the limits of resilience and these limits may also pose a challenge to the extension system if it is not properly analyzed. [Adger et al. \(2008\)](#) identified ethnic, knowledge, risk, and cultural limitations to climate change resilience. While ethnic preposition suggests that limits to resilience may depend on the goals of building resilience, which is subject to divergent values, knowledge preposition opines that climate resilience may be limited by the uncertainties related to potential climate change. Within the context of risk proposition, [Adger et al. \(2008\)](#) reported that certain personal and social indices may limit resilience actions. Reports show that such factors as risk perception, social status, and age function at personal decision levels may constrain collective action. Cultural limitations are evident when we consider that the systematic under-reporting of involuntary loss of places and rural culture disguises the real experienced limits to adaptation.

Future directions for repositioning the Nigerian agricultural extension system for climate change resilience must involve the expansion of the degree of interactions between climate change researchers and agricultural extension practitioners to ensure that climate change researchers provide the extension

practitioners with data that agrees with the standards that are used in the rural areas. This will produce an enormous result as the livelihood activities in the rural communities enables them to understand their ecological environment and the challenges connected with these alterations than the urban residents.

The extension system must adopt new scenario thinking in relating resilience building to farmers in rural areas. Scenario thinking is frequently used in building business structure and military strategies, solving the complex global problem, and the development of the non-profit sector ([Nautilus Institute, 2007](#)). [Okunlola et al., 2018](#) has recognized the important need for scenario approaches towards evaluating climate change resilience options. In doing this, the system must ascertain the level of awareness of rural farmers about the climate change resilience challenges, dialogue with the clientele (farmers) on complications involved, and aggregate their resilience ideas. The report of the scenario thinking would enable agricultural policymakers in identifying any discrepancies in climate change resilience within the rural communities. This will pave the way for the production of information and capacity development programs geared towards addressing the identified gaps.

## Conclusions and Recommendations

The Nigerian Agriculture extension system plays a crucial role in creating awareness, promoting farmers' skill and knowledge for an increase in agricultural production, and advocating behavioral change among farmers towards building climate change resilience. This notwithstanding, there is the need to reposition the extension system to ensure that it is adequately strengthened for the enhancement of farmer's knowledge of potential resilience options. As farmers strive to build resilience towards climate change, extension services must be repositioned to adequately respond to farmers needs. The essential strategies that must be in-cooperated in the extension service delivery in Nigeria include staff training on climate change adaptation and mitigation, the establishment of emergency management unit by the agency, encouraging the participation of the private sector in the extension service, transfer of research results on best affordable resilience practices to farmers as well as ensuring that government and other agencies are kept abreast with the feedback from the farmers on



their challenges in building resilience.

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## Novelty Statement

This study is a review of on the Nigeria's agricultural extension system which seeks to identify some of the challenges and means of repositioning the system to make it more relevant to the current challenges of climate change. The study will be an addition to literature in line with ensuring that research works relating to upgrading extension systems in Africa to respond adequately to build resilience meets the felt needs of the extension workers and farmers.

## Author's Contribution

ORU conceived the need for this systematic review and suggested it to ICU who initiated the process and did a good part of the review work. NCL and AGC and ACM assisted in the write up and preparation of the framework for the study. All authors read and approved the final manuscript.

## Conflict of interest

The authors have declared no conflict of interest.

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