Climate Change and Smart Technologies: Information Access and Collboration Among Farmers in Northern Nigeria as Pre- Requsite

Lawal Iro Sani[1]
Department of Library And Information Science
Umaru Musa Yar'adua University, Katsina
NigeriaLawaliros@Yahoo.Com&Lawal.Iro@Umyu.Edu.Ng

Ibrahim Umar Muhammad[2]
Department Of Agricultural Economics
Federal University Dutsinma, Katsina State
Uimuhammad@Fudutsinma.Edu.Ng

Umar Makama Tegina[3]
Department Of Agricultural Education
Federal College Of Education, (T)Gusau
Umarsd.Umt@Gmail.Com

Abstract
This paper is on climate change, and smart technologies and the role of information access and collaboration. The focus is on how best, farmers could have access to agricultural information which includes among others weather and climate information through smart technologies. The objectives are to examine whether farmers have access to information pertaining to weather, climatic change and agricultural information through smart technologies. To evaluate the level of usage of that information so as to enable farmers have sustainable agricultural productivity, became resilient to climate change and to reduce greenhouse emission. A total of 150 household were randomly selected for qualitative survey and 100 were purposively sampled. This is because the respondents were scattered across the state senatorial district. The researcher categorised purposefully the respondent in to Agricultural Development Projects (ADP) zones of Ajiwa, Dutsinma and Funtua zones. Secondary data was collected through document reviews. The findings of the study revealed that members of farmers' association were aware and they have access to information and have been utilizing information through smart technologies. While non-members of the farmers association claimed ignorance about weather, climate and various types of agricultural information, which may be due to illiteracy, poverty and administrative bottlenecks. The paper recommended that a structured and well planned participatory approach toward agriculture is needed by all stake holders, provision of adequate and timely information is paramount and indigenous knowledge should be uploaded in the inter-Net for semi-literate farmers to read, utilise and inform others.

Keywords: Information Access, Climate, Collaboration, Smart Technologies, Weather

Introduction

The United Nation frame work and convention on climate change (2023) define climate change as a change in climate, which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and in addition to natural climate viability, observed over comparable period of time. Changes in temperature and rainfall are likely to result in spatial shift in patterns of agriculture and in crop yields, which may have a considerable socio-economic impacts on the society (Yusuf, 2014).

FAO (2014) estimated that food production must increase by at least 60 percent to respond to the demand of the 9 billion people that are expected to inhabit the planet by 2050. Given that one in eight people are currently food insecure, ensuring global food security over the next decades will be essential. In meeting this challenge, there is an opportunity to create sustainable economic growth in rural areas of developing countries where food security and poverty are most prevalent. Efforts to reduce food insecurity must include building the resilience of rural communities to shocks and strengthening their adaptive capacity to cope with increased variability and slow onset changes. The agricultural sectors (crops, livestock, forestry, fisheries) must therefore transform themselves in order to feed a growing global population and provide the basis for economic growth and poverty reduction. This transformation must be accomplished without hindering the natural resource base, hence, the need to use smart technologies in disseminating information resources to farmers.

FAO has recognized that for agriculture to feed the world in a way that can ensure sustainable rural development, it must become 'climate smart '. Climate-smart agriculture (CSA), as defined and presented by FAO at The Hague Conference on Agriculture, Food Security and Climate Change in 2010 is an approach to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change. It contributes to the achievement of national food security and development goals with three objectives: The magnitude, immediacy and broad scope of the effects of climate change on agricultural systems create a compelling need to ensure their comprehensive integration into national agricultural planning, investments and programs. The CSA approach is designed to identify and operationalize sustainable agricultural development explicitly integrating climate change as a major parameter.

The most general concept of climate change therefore, is a 'change in the statistical properties of the climate system when considered over a long period of time, regardless of the cause'. Accordingly, fluctuations over periods shorter than a few decades do not represent climate change. The term is, sometimes, used to refer specifically to climate change caused by human activity, as opposed to changes in climate that may have resulted as part of the earth's natural processes. In this respect, especially in the context of environmental policy, the term climate change has become synonymous with anthropogenic global warming. However, scientifically, global warming refers to surface temperature increases while climate change includes global warming and everything else that increasing greenhouse gas levels will affect. Weather and climate characteristic of any place on earth determine the type of crop that are grown for food, animal that are reared and

indeed shape the way of life of the people and affect their socio- economic activities. Normal weather and climate conditions are associated with good yield and positive economic impact. Timely and reliable information on weather and climate are very important to all weather sensitive sectors of the economy. Such information is use for strategic planning and for climate-smart decision and practices which could bring about reduction of losses from adverse weather, minimize disasters and maximize output. (Sirika, 2019).

Causes of Climate Change and how it affect Agriculture

Generally, climate scientists agree that the main cause of the current global warming trend is human expansion of the "greenhouse effect" warming that result when the atmosphere traps heat radiating from Earth toward space. In practical terms, the rate at which energy is received from the sun and the rate at which it is lost to space determine the equilibrium temperature and climate of the Earth. This energy is distributed around the globe by winds, ocean currents, and other mechanisms to affect the climates of different regions. Factors that can shape climate are called climate forcing or "forcing mechanisms". These include processes such as variations in solar radiation, variations in the Earth's orbit, changes in greenhouse gas concentrations etc. According to Ibrahim (2013), there are a variety of climate change feedbacks that can either magnify or shrink the initial forcing. Some parts of the climate system, such as the oceans and ice caps, respond slowly in reaction to climate forcing, while others respond more quickly. Forcing mechanisms can be either "internal" or "external". Internal forcing mechanisms are natural processes within the climate system itself (e.g., the thermohaline circulation). External forcing mechanisms can be either natural (e.g., changes in solar output) or anthropogenic (e.g., increased emissions of greenhouse gases). Whether the initial forcing mechanism is internal or external, the response of the climate system might be fast (e.g., a sudden cooling due to airborne volcanic ash reflecting sunlight), slow (e.g. thermal expansion of warming ocean water), or a combination (e.g., sudden loss of albedo in the arctic ocean as sea ice melts, followed by more gradual thermal expansion of the water). Therefore, the climate system can respond abruptly, but the full response to forcing mechanisms might not be fully developed for centuries or even longer (Gani, 2010).About 80% percent of world agriculture is rain fed providing food and job to millions of people especially in rural Asia and Africa. Climate change has brought about change in rainfall, evaporation, runoff, and soil moisture level. Where drought is prolonged, resultant effects are crop failures of peasant farmers leading to disruption in the economic, political and the social lives of the farmers. Agriculture generally depend on the availability of water. Change in the amount of rainfall or its distribution play a significant role in all aspects of agriculture. The occurrence of moisture during the flowering, pollination, and grain-filling is harmful to most crops and particularly so; to corn, soybean and wheat. Increased evaporation from the soil and accelerated transpiration in the plants themselves will cause moisture stress (National Geography, 2019) On livestock farming system, Spatial and geographical distribution is characterised by resources scarcity. Water is a significant resources for pastoralist while grazing land is equally important resources that attracts

herders, these two resources determine, to the large extent, the livelihoods of pastoralists. Unfortunately, the two are severally affected by the impact of climate change which accordant to Anderson and Hoffman (2011) have a greater impact on rangeland production than overgrazing in dry land area

Information Access and Utilisation as a way of Mitigating Climate Change

Information is an indispensable factor for promoting the development of any society. The so-called developed nations are where they are today, by virtue of information generation and dissemination to their people; it is the raw material for making decisions, for creating knowledge and fuelling the modern organization (Ibrahim & Lawal, 2012).The level of awareness of climate change implication is still low in developing countries (Nzes and Eboh,2010). Farmers ability to effectively respond to climate changr challenges is determined by the level of knowledge and the quality of information available to them and how such information can be assessed (Ozor and Nnaji,2011). Monica et al (2014) reported that only access to weather information showed positive significant effects on farmers' perceptions of climate variability among the variable of farm size, credit, farming experience and age of the farmer. This implies that even if the climate is perceived to be changing, at local level availability of information plays a big role in informing farmers' perceptions, attitudes and practices with regard to the observed changes. This is in agreement with Patt *et al*. (2005), who indicated that of the 75% of farmers who reported receiving seasonal rainfall forecast, 57% reported changing their management practices in response.

Precise and timely information on the climate, combined with agro-advisory reduces uncertainty and improves farmer's decision making. For example, climate information on the total rainfall, the onset and end of the rainy season, or daily and weekly forecast across the rainy season, together with advice tailored to meet local needs, allows farmers to adjust farm management practices or purchase index-based insurance to protect assets. Delivery of timely and high quality agricultural weather information has become an important function of many state extension services. Appropriate climate information enhances small holder farmers' ability to mitigate the adverse effects of climate change, it is also argued that to avoid disastrous consequences, fundamental changes in agricultural operations should go hand in hand with changing climate. This is because, timely updated information of weather and climate scenarios help farmers to adjust their farming plans in accordance with expected weather pattern (FMARD/NAERLS, 2017)

Millions of small-scale farmers in low-income countries are trapped in poverty because they are unable to take the risks associated with investments in improved agricultural technologies and practise; a tendency exacerbated by climate change and increased variability. Establishing well-designed information schemes (National Geography, 2019) not only enhances resilience when climatic shocks occur, the presence of an indigenous knowledge can help farmers overcome the risk of investing in climate-smart technologies. To avert more serious hunger crises in this three senatorial districts and indeed in Nigeria, we need to build a stronger food system for smaller holder farmers. They are often the anchors for food security,

system and barriers to entering effectively in the dissemination of commercial information.

Another way of mitigating the climate change is to invest heavily on agricultural research and development. This will help in the provision of the required scientific tool needed to adapt to the changing weather patterns and build resilient food systems that could lead to the production of nutritional food foe the communities as well as provide a more sustainable economic stability.

Providing Climate Information Services and Agro-Advisory Precise and timely information on the climate, combined with agro-advisory reduces uncertainty and improves farmer's decision making. For example, climate information on the total rainfall, the onset and end of the rainy season, or daily and weekly forecast across the rainy season, together with advice tailored to meet local needs, allows farmers to adjust farm management practices or purchase index-based insurance to protect assets.

Collaboration

This is the process whereby two or more (often groups), of professionals (farmers) work together through idea sharing and thinking to accomplish a common goal or target. In this scenario, farmers come together in an association to think of a way out in a certain quagmire so as to achieve their common objective of achieving self-sufficiency, food security and resilient to weather. Adetoro (2021) defined collaboration as a means whereby a group of people come together and contribute their expertise for the benefit of a shared objective, project, or mission. Collaboration is a process of group work where (people) farmers learned skills, valued the activity of learned colleagues, makes teamwork successful and share their responsibilities; this would be done in order to enhance the process of information transfer among a particular group. IFAD 2021 reported that Climate change Adaptation and Agribusiness support programme has promoted farmer to farmer extension service delivery using lead farmers. This is commendable as several indirect beneficiaries were also reached.

Farmers need to collaborate to help themselves learned from each other. They need to collaborate in order help solve a problem; they also collaborate to make their activities more efficient which will eventually leads to higher retention rates or bumper harvest. This will at the end of the day boost their morale across their colleagues, brings them together as an organization, open up a new channels of communication and they are likely to be more successful.

Objectives

The main objectives of the study is to:

1. Identify the type of information farmers preferred
2. Examine whether they have access to climate information and in what format
3. Examine the perception of farmers on climate change
4. Determined any climatic problem encountered by farmers
5. Investigate the best practice needed for adaptive climate change and resilient seedlings.

Method

The methodology employed for this study is the survey research method and a total of 150 household were purposefully randomly selected for data collection. Secondary data was collected through document reviews. The reason for selecting Katsina State was based on the fact that the State was created on 23rd September, 1987 out of the former Kaduna State. It is bordered to the South by Kaduna State, to the North by Niger Republic, to the West by Zamfara State and to the East by Jigawa and Kano States. It lies between Latitude 110 07' 49" to 130 22' 57"N and Longitude between 060 52' 03" and 090 02' 40"E and covers an area of about 23,983 square kilometers with total population of about 5, 8015 million based on the 2006 census figures (Makama, 2007). Katsina, an agrarian state with more than 800,000 farming families and cultivating more than 1.5 million hectares of farmlands is among the largest producers of cotton and maize in the country. Other major crops grown in the state include beans, guinea corn, millet, groundnut, sugarcane and vegetables. Potentials for the development of exportable agricultural products in which the state has comparative advantage include value addition in products like cotton, hides and skin, gum Arabic, sesame seeds and neem seeds. Government supports to agricultural sector include the provision of subsidized farm inputs, fertilizer, improved seeds, pesticides, extension services as well as micro-credits among others. Katsina senatorial district is characterised by drought and intermittent rain fall while Funtua zone is characterised by heavy rain fall but with lots of gully erosion. The instrument for data collection was the interview, though interpreted in Hausa to aid responses (by Non-literate farmers).

Results

Demographic information of the respondents

S/N	Sex	Responses	Percentages
1	Male	101	81%
2	Females	49	19%
	Total	150	100%

Questions to the respondents

S/N	Questions	Responses	%
1	Do you have access to information?	Yes we have but not in written format. In most cases we got our information from colleagues and Radio	93%
2	What type of information are you provided with?	We got information on fertilizer only and it is only the literate among us that can read Newspapers and other forms of information from other sources. And also they belong to farmers association.	93%

3	Do you have access to timely weather information?	No, we seldom got this information unless you are engaged in irrigation and belong to any of the farmers Associations.But for those who belong to farmers association , only 8% received that information.	94%
4	What is your perception about climate change and do you use any of the ICT facilities in accessing information on climate change?	All the interviewed respondents agreed that farmers perceive Climate change to be affecting them. We only contact our colleagues to access weather information. Whenever we have meetings of our association, we used to share information.	92%
6	Do you engaged in any collaborative efforts with colleagues?	Yes we do and that is where we used to share some vital information with them, particularly those that belonged to association.	100%
7	What are the causes of climate change?	From experiences climate change occur as a result of changes in rainfall patterns, floods, dry spells, and prolonged droughts coupled with increased temperatures, felling of trees, bush burning,industrial revolution and global warming among others.	92%
8	What are the effects of climate change?	High change in weather (air), soil erosion, intermittent rain fall and arrival of so many pest (hydrological, meteorological or climatologically). Overall decline in production and it affect our economy.	93%
9	Do you encounter any problem with regards to climatic change in your farm?	Yes, lack of enough rain fall, low yields, soil erosion and degradation and reduction in economic output.	93%
10	Are you provided with any palliatives as a result of draught, erosion and other climatic challenges?	Never by government and where you lodged complains it take time before you are considered and by then you have heard the effect.	93%
11	How best could government support you?	To provide us with timely information about weather, control of pest, market information(commercial information), all these through Radio programmes, Town criers and provide us with cheap and domesticated Android phones.	94%

12	How do you think government can provide solutions to these challenges.	Aggressive attitudinal re-orientation, Remediation of areas affected by erosion, effective economic empowerment, Policy on ranging and livestock rearing etc.	93%

From the data Table obtained on demographic information about the respondents, the majority were males (81%), this male dominance further reflects the religious and cultural backgrounds of the community while the females constitute only 19%. Females accounts for this percentages because of the nature of the area of coverage, as majority of them are on Purdah and only few of them do engaged in farming and the rest lost their husbands and no body to take care of them, except to fully engage in farming. this finding confirmed the notion that farming was predominantly for male whereas the female were known for selling the agricultural produce and processing it. The result is in line with FAO's (2011) submission on rural employment and farm labour project; it was reported that with regard to farming, men proved more productive than their female counterparts.

Discussion

Farmer's perception on climate change

Past experience influences farmers selectivity of perception, all the interviewed respondents (93%) agreed that they perceive climate change to be affecting their production in Katsina State, this can be explain further by looking at our perception to be relative rather than absolute.. The result was based on practical experiences and the realities farmers faced in their daily interaction with the environment as they carry out farming activities. Their views were corroborated with Yusuf (2018) where he stated that as a result of climate change farmers faced low output in their farming activities. However the major effects of climate change perceived to be high by the farmers in the area were irregular rainfall and unpredictable weather harshness. Farmers'decisions to adopt adaptation technologies generally depend on farmers' perception of the variability in the climatic condition

Access to information

All the 83% respondents indicated that they do not have access to information but through friends (colleagues) and the rest who belong to farmers associations and are literate got their information on weather/climate through print and electronic means. This indicated majority of the farmers were illiterate, they cannot read or access the information needed and therefore could not access written information and the literacy level of the farmer portent great prospect for increase production, especially with regard to taking inform farm decision, innovativeness and adoption of technologies in the sector. This finding is also in line with Asadu et al, (2018) who indicate that information on climate change were sourced mostly from neighbours or friend and personal experience and according to his finding conventional extension agent are expected to be one of the major sources of information for the farmers but due to inadequate number of extension agents its affect creating awareness and building capability of farmers for climate change adaptation. Accordant to Adebayo et al, 2012 in a study conducted in Adamawa State, Nigeria;

it was found that very few farmers were aware of the impact of climate change and they, therefore, used tolerant varieties, early maturing seeds, alteration of planting schedule and crop diversification to mitigate the effect on crop production.It is important to note that access to weather information showed positive significant effects on farmers' perceptions of climate variability. IFAD, 2021 reported that all the seventeen participating LGAs on Climate change adaptation and agribusiness support programme were reached on climate information services. This service is the flagship formed a strong partnership with NIMET to drive this activity from 2016 to 2021. It was preceded by a very successful awareness campaign on climate change. Evidence during field visits throughout the project area shows that awareness on climate change (called ***chanjin Yanayi*** in the local Hausa language) is very high among the rural small holder farmers and the population at large. The rate of uptake of climate information is high across all the participating states and CDAs, and farmers look forward to the yearly downscaled seasonal rainfall prediction information and outreach to plan their planting seasons and prepare for climate risks especially dry spells during the growing season. Testimonies from CASP farmers brought tremendous benefits to NIMET and earned the organization international recognition and grants for supporting small-holder farmers. As a result of the success of the partnership with CASP, this partnership is being extended to other IFAD projects - VCDP and LIFE-ND. 99. Feedbacks from the smallholders' farmers suggest that the annual seasonal rainfall prediction which is downscaled, and shared and discussed with farmers in native language contributes significantly to improving their adaptive capacity and resilience. Most importantly, this annual service has enabled them to be more acquainted with the rainfall onset and cessation dates as well as possibility of dry spell to develop crop calendar and thus mainstream climate information-driven smallholder cropping. There are testimonies of farmers who staved off dry spell by preparing ahead of time based on prior information received.

Type of information received

On the type of information farmers received either from Government or through ICT and print materials, majority of them 83% revealed that since they are not literate and do not belong to any association they only have access to fertilizer information from their wards or from their colleagues. Apparently, they do not have access to information pertaining weather, climate and other scientific information. This is a big challenge to them. This is because before they got the information particularly on climate change the damage has been done. They do not have and do not know how to use Android phones since they are not manufactured to take care illiterates. More so, there are no adequate extension workers to translate the research findings to the farmers. Extension is a system that should facilitate access to information, the organization and all other actors involved in the dissemination of knowledge, information and technologies to farmers. This will facilitate their interaction with other partners in order to assist farmers to develop themselves. I

Whether they encounter any of the climate change and its effect on them

Respondents were asked on whether they encounter any of the climatic changes in which they answer in the affirmative. 92% of all the respondents affirmed that face one form of climate change or the other. And the consequences of the climate changes are enormous among which are; High change in weather (air), soil erosion, intermittent rain fall and arrival of so many pest (hydrological, meteorological or climatologically). Overall decline in production and it affect our economy. Lack of enough rain fall, low yields, soil erosion and degradation and reduction in economic output are some of consequences and this is in conformity with Ibrahim Y (2018) who reported that katsina state is exposed to the danger of climate change. It is highly susceptible to the impending threats because of its proximity to the fringes of Sahara desert and the implication of climate change to the state include treat to crop and livestock farming considering the strong nexus between climate change and development the state is highly at the risk in the area of food security, poverty and income generation.. When asked about government intervention or palliatives given to them, majority were of the opinion that nothing was given to them.

Remedy to the problems

Respondents were also asked to provide solutions to the problem encountered as a result of climatic changes and whether they can become resilient to it. They advice that Aggressive attitudinal re-orientation, Remediation of areas affected by erosion, effective economic empowerment, Policy on ranging and livestock rearing, establishment of RUGA, provision of high growth yields and resilient crops are better solutions to climate changes. However Adaptation to climate change necessitates that farmer should first perceive its diverse instrumentations and manifestations, and information access will help in decision making after which they can then recognize suitable adaptations and practice them (Maddison, 2006).

Conclusion and Recommendations

Precise and timely information on the climate, combined with agro-advisory reduces uncertainty and improves farmer's decision making. For example, climate information on the total rainfall, the onset and end of the rainy season, or daily and weekly forecast across the rainy season, together with advice tailored to meet local needs, allows farmers to adjust farm management practices. Radio programmes and jingles, to develop and disseminate downscaled climate information services (CIS), and to raise capacity of partners to do longer-term analysis and convey more actionable information for farmers is necessary to curve the effects. Finally elsewhere (like in India) agro-advisories were disseminated to farmers in over 60 villages through voice messages on mobile phones with inputs taken from metrological departments, scientists, input dealers and farmers. Much of this work focuses on Farmers associations and women's groups, to empower women to participate in farming decision-making. So in Nigeria and Katsina State in particular, it's recommended by the study to do the same so as to empower and disseminate information to the peasant farmers.

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