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Evaluating the Perceived Effects of Climate Change on the Availability of Water Irrigation in Dutse Local Government Area of Jigawa State, Nigeria

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Abstract
This research evaluates the perceived effects of climate change on the availability of water irrigation in Dutse Local Government Area of Jigawa State, Nigeria. Dutse is a largely semi-arid region; its situation is being affected by increasing problems with water-related agriculture arising in consequence of rising temperatures, variable rain conditions and the depletion of surface and groundwater. It employed both mixed-method with the use of structured questionnaires to 400 irrigation farmers, focus group discussion (FGDs) and key informants (KI) participant interviews. Descriptive statistics and Likert-based assessments were applied to quantitative data, which is used in drawing conclusions on the knowledge of local adaptation strategies and gaps in policy, whereas qualitative data provided a contextual interpretation of a local adaptation strategy. Findings show that most of the farmers have observed that rainfall pattern is changing and that water supply to irrigate their farms is lower which have led to low productivity and income. Very poor adoption of new irrigation technologies had been linked to financial factors and absence of awareness. Conventional alleviating measures like water rotating and early planting are still common but they are a less efficient measure nowadays. The government was deemed to play a minor role, and there were more of self-managed or community-based adjustments. The research summary is that the threat of climate change risks suggesting on the irrigation agriculture in Dutse LGA and recommends the adoption of comprehensive policy interventions involving increased investments in more water efficient technology, climate adaptive infrastructural development along with capacity building to enable rural farmers. This study improves our knowledge on the effects of the climate on local food systems and gives evidence-based recommendations on sustainable agricultural water management in northern Nigeria.

Keywords: Climate Change, Irrigation Farming, Water Availability, Farmer Perception, Dutse LGA, Jigawa, Nigeria, Adaptation

1. Introduction

Agriculture has continued to be central to rural activities in Nigeria especially the semi-arid north where farming encounters climatic and ecological pressure since it relies on rainfall. LGA of Jigawa State Proposed research site: Irrigation agriculture in Dutse LGA in Jigawa state is very important in improving food security, boosting household incomes, and creating agro based jobs. The significance of the irrigation in the area is evidenced by the climatic conditions in this area that involve low and fluctuating rainfall, which averages between 600mm and 900mm per year, and prolonged dry spells that render it very hard to attain sustainable farming production without supplemental supply of water (NIMET, 2022) [26]. Consequently, irrigation practices (both the traditional surface irrigation systems and the modern ones that are supported by boreholes) have now been a necessity in the production of year-round food in Dutse and other similar areas as well.

However, the climate change threat is becoming extremely problematic in terms of reliability and sustainability of irrigation-centered farming approaches. Climate change has been known to be one of the most urgent threats to the agricultural productivity, especially among the vulnerable developing nations. In recent reports and publications, the Intergovernmental Panel on Climate Change (IPCC) focused on the increased vulnerability of freshwater resources to the impacts of climate change that constitute growing temperatures, changes in extreme weather conditions, and precipitation patterns, as well as a tendency towards the increased intensity and occurrence of such extreme weather events like droughts and floods (IPCC, 2021,

2022). Within the Dutse LGA, both the local experience and new climate models have shown that the average annual temperatures have increased and the timing and the length of the rainy seasons have further become more erratic, which is threatening both the sufficiency and the reliability of the availability of the irrigation water.

The area is especially sensitive to the occurrence of water shortage given the fact that it extensively depends on rivers, seasonal streams, and even more overexplited groundwater aquifers that extensively get utilized in irrigation. Many farmers in Dutse have complained that their wells have run dry over the last few years, that rivers were flowing less in the Hadejia and its tributaries and that access to water in motorised boreholes was being increasingly rationed (Jigawa State Ministry of Agriculture, 2022) [16]. These changes are made worse by erosions, creation of dams on the upstream and poor process of governance of water. Provision and reliability of irrigation water in this case are becoming the key channels through which the climate change over impacts agricultural production in LGA.

To come up with adaptive agricultural policies and sustainable plans of water management, it is critical to get an understanding on how these changes are perceived on the ground. The subjective experiences and perceptions of water-related stress by the farmers will give critical first alerts that occur before the collection of empirical data as well as scientific surveillance. Being the main users and guardians of irrigation water, farmers are the people with particular knowledge that is formed at a specific location and that is described very precisely. How they perceive things like the declining reliability of rainfall, the rising costs of irrigation, or that the traditional way of water conservation is inappropriate can guide the development of policy measures as well as what should be regarded as research priorities. Moreover, these perceptions are relevant in determining adaptive behaviours which can be a shift of crops, a shift of planting periods, creating water-efficient technology, or a pullout in farming.

This, therefore, means that this research is going to assess the perception of the farmers about effects of climate change on the availability of irrigation water in Dutse LGA. Giving voice to farmers, the study adds to the growing body of literature in support of participatory methods of climate adaptation planning. The research study also seeks to point out the socio-economic nature of water insecurity, institutional and infrastructural gaps that influence capability to adapt to rural regions of Jigawa. It is expected that the results will cognitively contribute into policy frameworks in the vicinity and state level which shall be in support of climate resiliency and the sustainable provision of water to be used by irrigation farming in the order of changing climate.

2. Literature Review

Climate change can be defined as a long-term change and transformation of the world or regional climatic patterns, which can be accredited to the effect of both natural processes and man (Tanko, Magaji, & Musa, 2025) [29]. In its definition, it encompasses shifts in temperature, precipitation, wind patterns, and many other Earth climate system elements during long periods, usually decades and more (IPCC, 2021) [10]. Whereas the natural change in climate conditions is not a novelty in history, the climate change concept is currently associated predominantly with anthropogenic (human-made) changes caused by the increased greenhouse gas (GHG) levels, including carbon dioxide (CO 2) methane (CH 4) and nitrous oxide (N 2 O) produced through industrial activity, deforestation, burning of fossil fuels (Magaji, Ahmad, Sabiu & Yunusa, 2024) [20].

The real world consequence of climate change comes in the form of a perceived global average temperature rise, a rise in sea level, increased severity of weather extremities (floods and droughts among others), impediments to water supply and food production (Magaji, Tanko, & Musa, 2025) [23]. In vulnerable regions like semi-arid landscapes of north Nigeria with the LGA of Dutse in the Jigawa state climate change is of particular concern to this region since it causes worsening water shortage, reduced crop yields, and jeopardizes the livelihood of all irrigation dependent farmers. It is crucial to appreciate that climate change is not only a physical phenomenon but a socio-economic one, which can be useful in the development of sustainable, inclusive and context-specific adaptive strategies (Jafaru, Aliyu & Sule, 2025) [15].

2.1 The Climate Change and Water Resources in Nigeria

The hydrological cycle is growingly being modified by climate change in Nigeria and poses serious threats to water supply both at household, industrial, and agricultural uses. In the course of the last several decades, the parameters of the climate in Nigeria have considerably changed whereas these changes have been constant but substantial. According to the Nigeria National Water Resources Master Plan (2013), the country has experienced a decreasing trend of the average annual rainfall by about 1.7 percent between 1960 and 2009, approximately. At the same time, the average temperatures have increased by over 3 percent with the northern parts such as the Jigawa State being disproportionately affected (Federal Ministry of Water Resources, 2013) [8]. These changes have inhibited groundwater recharging, decreased surface runoff and increased evaporation levels, therefore, imposing a significant burden on scarce sources of water (Sabiu & Magaji, 2024) [28].

There is a certain level of susceptibility by the semi-arid region of northern Nigeria to the compounding effects of the unpredictability of rainfall combined with increased warmth. Climate forecasts show that it will lead to further decreasing rainfall amounts annually and increasing their uncertainty in the wet season, worsening the shortage of water. Another study (According to Aquamaya 2022, a research initiative) [5] into water problems pointed to this statement that high temperatures and low, irregular rainfall patterns are underlying facts that lead to frequent droughts as well as diminishing seasonal rivers and lakes in northern Nigeria. These changes are directly related to the social tension, as the competition over the water sources, in particular, with farmers and pastoralists, is significant, often results in a violent conflict and displacement (Magaji, Musa & Salisu, 2022) [18].

Moreover, the situation is worsened by poor institutional capacity, absence of investment in climate-resilient infrastructure, and the poor water governance. According to MDPI (2021), many rural populations in northern Nigeria do not have an official system of distributing, managing, and keeping water. Presence of such institutional gap compounds the susceptibility of rural irrigation systems towards climate change. In essence, unless there are major

mitigation/adaptation strategies, the problem of water insecurity will intensify thus endangering remnants of livelihoods and food production in already deprived LGAs like Dutse LGA.

2.2 Western African West Africa effects on Irrigation

The West African sub-region in general has been facing such climatic problems that threaten the sustainability of irrigation-based farming. It is projected that West Africa will suffer a setback because of reduced rainfall and increased evapotranspiration that tend to increase because of rising temperatures (IPCC, 2022). Such hydrological alterations are expected more drastic in Sahelian and Sudanian ecological zones that largely rely on steady seasonal water supply to support their farming activity. In Nigeria, especially in the north Western states like Sokoto and Zamfara, the farmers are reporting dwindling numbers of smaller rivers and boreholes which provided dry-season agriculture. As it was mentioned in reports about AP News (2022) [4], some rivers, which previously flowed during the entire year, now dry out in the middle of the planting season. Furthermore, the cost of energy is rising thus making the extraction of water to be more expensive amongst many smallholder farmers due to the need to use an irrigation pump operated by either petrol or diesel. This has resulted in reduced irrigation, inefficient production and economic losses to the families and individuals practicing the small-scale agriculture production (Magaji & Musa, 2015) [19].

The impacts of climate-induced water stress on irrigation are actually socio-economic besides the physical impacts. Agriculturalists have no choice but to abandon certain types of production, reduce the size of their farms, or move to other regions where agro ecological conditions are favorable. Food security is affected, and as the irrigation systems move in to failure, poverty is likely to occur, and rural-urban migration becomes a probability (Magaji, Musa, & Ismail, 2025). Therefore, local experiences and views of these changes should be understood to have an appropriate sustainable plan of adaption.

2.3 International World views of Farmers doing Irrigation

It is essential to assess the perceptions of the farmers with regards to any changes in soil water conditions and the variability of climatic conditions in a bid to make effective adaptation strategies. The same is the case in many low-income countries where the perceptions of farmers are the basic window through which climate change is identified and tackled. Educational issues, poor institutions and conflict on water sharing policies have been cited as major issues inhibiting effective use of the available resources (Magaji, Ismail, & Musa, 2025) [21].

The above observations are pretty relevant when it comes to the setting of Dutse LGA where official weather services are minimal and a number of farmers rely on indigenous knowledge systems to understand climatic conditions and utilize water resources. The recording of these perceptions provides a unique source of climate adaptation planning, based on which it is easy to develop the initiatives that would match the local realities.

2.4 adaptation and Water-Efficient Practices

Due to the increasing water scarcity, the need to incorporate water-efficient agricultural practice is vital in the establishment of climate resiliency. Some technologies and methods have been proven to be effective in the management of scanty water supplies especially in arid and semi arid regions. As an example, drip irrigation feeds directly to the roots of plants thereby eliminating waste and reducing water-use efficiency by up to 50 percent compared with other more common techniques. Off-grid areas Solar-powered irrigation pumps have also become commonplace as eco-friendly substitutes to diesel-powered versions, especially in the rural setting. According to research conducted by Itelemedia (2021) [14], the innovations also reduce costs of operation to smallholder farmers besides reducing carbon emissions.

Other water conservation practices are harvesting of rain water, zai pits (small-scale in situ soil and water conservation practices planted in degraded soils) and mulching to conserve soil moisture. When they are all practiced, these practices have the potential to make a tremendous increase in efficiency of irrigation and in reducing vulnerability to climate-related shocks. In most parts of Nigeria however, uptake is still quite low as it is costly to acquire in the beginning, lack of technical knowledge and weak extension services. Further, lack of proper coordination amongst stakeholders such as the government, NGOs and farmers incurs most of the time the duplication of efforts and lack of sustainability of the introduced technologies.

Water-efficient practices may allow solutions in the region where irrigation mainly relies on the use of shallow wells and small river diversions and is observed in Dutse LGA. However, establishing adoption requires the necessity to understand the technical feasibility of these innovations as well as the socio-economic issues that face the local farmers. It, therefore, becomes critical to align the climate adaptation initiatives to the needs and requirements of end-users, knowledge, and capacities to ensure water security against climate change.

2.5 The Theoretical Framework

The paper has been written by relying on two related theoretical frameworks, including a Vulnerability Framework and the Theory of Planned Behaviour (TPB). These paradigms can be useful in explaining the relation between climate change, availability of irrigation water and the perception and response of farmers who live in Dutse LGA, based in Jigawa State, Nigeria. According to the Intergovernmental Panel on Climate Change (IPCC), vulnerability may be explained in terms of the exposure, sensitivity, and adaptive capacity (IPCC, 2014) [12]. In this research, Exposure denotes the strength to which farmers are struck by weather depressions, including unreliable rainfalls, droughts, and surging temperature. Sensitivity shows how these climatic factors impact on the irrigation practiced agriculture and water (rivers and boreholes). Adaptive capacity is the ability to adapt to or cope with the effects of climate by farmers, and often depends on the resources, knowledge and acting institution of farmers.

This framework will allow the study to not only research the physical implication of climate change but also the socio-economic aspect that could mitigate or worsen the vulnerability of the population in the rural agricultural areas (Adger, 2006 [2]; IPCC, 2022). This framework provides a useful means of analysing water-related agricultural risks and adaptation gaps in Dutse LGA where most of the

farming is practiced by smallholder farmers and the sector is highly climate dependent.

According to Theory of Planned Behaviour (TPB) proposed by Ajzen (1991) [3], individual behaviour depends on three primary factors, namely, attitude, which implies the views of the farmer on the impact of introducing certain behaviours namely, the use of water saving technologies. Subjective norms refer to the social constraints or the perceived pressure of peers, institution or leaders to take action on climate adaptation. Perceived behavioural control the ease or difficulty as farmers perceive they might be able to implement adaptive measures such as economic and informational barriers.

The TPB is useful in understanding the reasons and mechanisms through which farmers accept or refuse to use a specific irrigation method in response to climate adversities. Studies have indicated positive attitudes, community norms encourage the use of climate-smart practices in farming and a high degree of control greatly increases the chance of practice adoption (Moser & Ekstrom, 2010; Wuepper *et al*., 2018) [25, 32].

Combining the Vulnerability Framework and the TPB, this study explores both internal and external issues that irrigation farmers in Dutse are exposed to, including cognitive-behavioural issues in addition to climate-related problems. Looking at these two theories is important in realizing why farmers can recognize water stress but still not take any adaptive behavior. The degree of the social influence and local norms on the choices involved in irrigation and water conservation signify the systemic and behavioural barriers to climate resilience at a local level.

This theoretical background as well as advantage of the study provides its capabilities to explain several things and thus provides advantage to the study in its research design, interpretation of results, and formulation of recommendations which should be able to address the needs of social and environmental concerns.

2.6 Empirical Review

Empirical studies have progressively focused on the effect of climate change to irrigation water availability especially in the areas that are prone to agricultural activities. Such studies outline the perceptions of farmers as the evidence of the local climate impacts and approaches to policy-making.

The study conducted by Bello *et al*. (2022) [6] in Northern Nigeria on 600 irrigation farmers in Kano and Jigawa States found that 76 percent of the respondents reported large reductions in the amount of water available to them in dry seasons because of infrequent and irregular rainfall and declining water levels. Most complained of poor yields and increased cropping risks especially rice and vegetables which need regular irrigation.

Similarly, Abubakar and Suleiman (2023) [1] in another mixed-methods study in Sokoto and Kebbi States also established that the surface irrigation by use of local streams had reduced more than 40 percent over the dry months compared to 15 years ago. Their studies revealed that over 65 percent of the respondents had witnessed an increase in the price of bore holes owing to the need to dig deeper. The result indicated that there was climate induced water stress that was already causing big changes in traditional patterns of irrigation.

A 2024 report (Oladimeji and Ibrahim, 2024) [27] in the Yobe State of Nigeria revealed that 81 percent of the respondents they interviewed attributed the drying of the shallow wells and the riverbeds with shifts in the seasonal patterns of rainfall, in particular, much shorter rainy seasons and a late start of the rainfall. The interviewed farmers were not satisfied with the low measure of government support to adaptation activities. Within the context of the cross-sectional study covering the districts of Mali, Burkina Faso, and northern Ghana, the results provided by Togola *et al*. (2023) [31] documented that 70 percent of the irrigation farmers identified the issue of climate change as the main challenge in their farming. Some of the most significant effects felt are reduction in river flow, increased sedimentation in irrigation channels and drying of the smaller reservoirs. The authors observed a decrease of 15-20 percent of irrigated lands in the regions to be surveyed on an average. Mensah *et al*. (2022) [24] conducted research on the water-use patterns of the rice farmers in Northern Ghana. They got the answer that 58 percent were adjusting their planting timetables because of irregular rainfall, and over 45 percent did not get convenient water pumps particularly in drought years. The similar patterns are confirmed in the global research in similar agro-ecological areas. Taye *et al*. (2021) [30] investigated in the Rift Valley of Ethiopia, with farmers citing the decreasing flows in streams and augments in evapotranspiration as the two greatest problems to irrigation. The authors found that the subjective beliefs were closely correlated to the objective facts in water scarcity through the meteorological records, which confirmed the truth in the subjective knowledge of farmers.

Khanal and Koirala (2024) [17] conducted an inquiry and presented the perceptions of farmers in Nepal Terai plains, where 79 percent of them found that climate change had adversely affected the irrigation effectiveness, especially during the pre-monsoon period. The common factor was that most of them had resorted to informal water sharing and prior planting which are adaptive responses.

A considerable study conducted in Zimbabwe by Dube and Mapfumo (2023) [7] states that 74 percent of the farmers in their research area faced water shortage and of these, only 22 percent got access to government-supported adaptation programs. The study found that access to weather information, extension services and micro credit influenced the behaviours of adaptation strongly.

Comparatively in Senegal and Nigeria, Ibrahim *et al*. (2025) [9] noted that the level of knowledge of the modern irrigation strategies, like drip system, was less than 20 percent. Yet, among the cases in which solar-powered water pumping was implemented, 33 % of the respondents said that they became more resilient to mid-season droughts. According to the literature reviewed, there exist allusions that irrigation farming farmers are aware of the reduced water availability as a direct consequence of climate change. These perceptions are quite often supported with the hydro-meteorological data and additionally depend on the socioeconomic environment, institutional support and the access to the technology. Empirical evidence in Northern Nigeria, and other areas also experiencing similar climate, has indicated a growing seasonal uncertainty together with the consequences of such a trend which include reduced water flows in rivers and drying of the shallow wells. As observed, the awareness and deployment of climate-smart irrigation practices as well as the responses by the institutions are low and there is also an over-dependence on the conventional coping mechanism.

Although there has been an increased research on climate change and irrigation in the sub-Saharan Africa, there are still several gaps especially in relation to Dutse LGA, Biu in Jigawa State. To begin with, an element of localised research is to be done to cover the situational views and modulating experiences of smallholder irrigatenrs at a local and sustainable level, in the context of this semi arid region. Majority of the research done has been on larger geographical areas e.g Kano, Sokoto among others without paying much attention to aggravations experienced in Dutse. What is more, most of the studies do not relate subjective perceptions of farmers to real climatic information restricting the depth of the analysis. Less is known about the social and cultural dimensions of adaptation like sharing of community water, gender identity, and intergenerational practices. During the case of water access and utilisation these elements are important. Another burning question that has not quite been addressed properly is the migration of the youth in search of the dwindling irrigation opportunities and whether the agricultural labor force will survive.

Although it is accepted that the low adoption of the modern irrigation technologies is due to the low uptake, little studies have been done to explore the structural barriers, such cost, technical know-how, and poor extension services that hinder its uptake. Also, the majority of the existing literature applies cross-sectional studies with few data as to how the perceptions and practices of farmers change across time. Finally, the lack of correlation between empirical evidence and useful policy remains weak since most researches do not include realistic context-specific solutions that may be implemented. These weak points must be resolved by interdisciplinary, longitudinal, and community research studies that can support the sustainable irrigation practices in resolving the changing climate.

3. Methodology

3.1 Design of the Research

The study employed a descriptive cross-sectional survey design to study the perceived impact of climate change on the provision of irrigation water by farmers within the Dutse Local Government Area (LGA) of Jigawa State, Nigeria. Relying on the cross-sectional approach permits gathering information about many respondents simultaneously, thus, creating a picture of the perceptions and experience of irrigation farmers of various communities.

Quantitative and qualitative approaches to the data collection were used, and thereby, statistical trends were revealed, along with the in-depth ideas. It applied a structured questionnaire that collected measurable data on experience of respondents on the issue of climate change and its implication on irrigation. Also, focus group discussions (FGDs) and open-ended questions were involved to improve the knowledge of local adaptation measures, water management strategies, and social-cultural perceptions.

This complex study method helped in triangulation of results and the authenticity of information. Besides, the study design aligns with the initial specific objective, which is to assess the perceived impacts of climate change on availability of irrigation water in Dutse LGA. It also provided a basis on policy recommendations to climate-resilient irrigation strategies.

3.2 Area to be Studied

The study site was selected and placed in Dutse LGA of the Jigawa State located at the semi-arid range of Nigeria in the northwest of the country, which relies on irrigation agriculture and is highly susceptible to climate-related challenges ranging between drought, unstable precipitation, and seasonal water crises. There are a large number of small-holder farmers in this region making use of shallow wells, seasonal rivers and small dams and they are special susceptible to changes in water supply.

The terrain is principally flat, with sandy loam soil and tropical savannah climatic condition, with wet and dry seasons. Within the last few years, rains have not been so predictable and farmers have often complained about dry wells, falling rivers, and failed irrigations cycles which jeopardize food security as well as livelihood of households.

3.3 Method of Sampling

It used multi-stage sampling method to ensure there is a wide and representative sample of irrigation farmers across Dutse-LGA.

1. Stage One: Three communities picked out in the rural areas were Sakwaya, Limawa and Katanga and these areas were selected deliberately since they had been witnesses of irrigation farming a long time ago and there had been reports of water shortage.
2. Stage Two: Within the communities, farmers were classified according to the source of irrigation (e.g. river, borehole, well), crops cultivated and size of farms.
3. Stage Three: Then, simple random sampling technique was used to sample under each category so as to have diverse group of irrigation experiences.

The respondents were 400 but the recommended sample size was arrived at by using the Yamane (1967) formula on a finite population with 5 per cent margin of error.

3.4 Measures of Data Collection Instruments

A semi-structured questionnaire was the main research instrument used; containing four sections:

1. Section A: Socio-economic and demographical.
2. Section B: Knowledge and cognisance on climate change.
3. Section C: Personal perception of change in availability of irrigation water during the past 5 to 10 years.
4. Section D: Recognised coping mechanism and adaptation strategies.

The surveys consisted of Likert-like questions, multiple choices, and open-ended surveys to gather both quantitative and in-depth perception. The questionnaires were translated into Hausa, which is the major language in the area and pre-tested on 30 farmers in another LGA to ascertain the clarity, relevancy and reliability. Besides, there were two focus group discussion (FGDs) one with male farmers and another one with the female farmers to have an insight into the water issues at the community level and to have a cultural response towards climate fluctuations. Interviews among the extension officers and the local agricultural officials were also done to complement the views of the farmers and the views of the institutions.

3.5 Analysis of data

Statistical Package for the Social Sciences (SPSS) version 25.0 was used to analyse and process the gained data. Socio-demographic aspects of the respondents and their opinions on changes regarding the climate were described using descriptive statistics (frequencies, percentages and means).

Thematic analysis approach was used on the open-ended comments and the FGD transcripts. Themes that were constantly appearing were concerned with perception sharing about rainfall variability, a decline in river flow, complexities related to accessing irrigation water, as well as, adaptive patterns, which were identified, coded, and interpreted.

The first specific objective governed the analysis and addressed the way, in which the farmers perceive water changes in availability due to climate variability. The comparison of experiences was done using different communities, various kinds of irrigation, and size of farms in order to identify some pattern and difference in ones.

4. Results

Table 1 shows the significant demographic and socioeconomic representations of the surveyed 400 irrigation farmers in Dutse LGA.

Table 1: Socioeconomic and Demographic Characteristics of Respondents (N = 400)

Characteristic	Frequency	Percentage (%)
Gender (Male)	300	75.0%
Gender (Female)	100	25.0%
Age (18–30)	50	12.5%
Age (31–45)	170	42.5%
Age (46–60)	130	32.5%
Age (60+)	50	12.5%
Education (No Formal Education)	80	20.0%
Education (Primary)	100	25.0%
Education (Secondary)	150	37.5%
Education (Tertiary)	70	17.5%
Farm Size (<1 ha)	90	22.5%
Farm Size (1–3 ha)	220	55.0%
Farm Size (>3 ha)	90	22.5%
Irrigation Source (River)	180	45.0%
Irrigation Source (Borehole)	140	35.0%
Irrigation Source (Well)	80	20.0%

Gender Distribution

According to the survey results, the group of respondents is thru 75 percent male and 25 percent female. This is a gender inequality driven by the traditional nature of irrigation farming in the northern part of Nigeria due to the fact that it is men that involve themselves in and dominate in the process of agricultural activities especially in terms of water based activities like irrigation farming.

Age Categories

The majority of the respondents fall in the age bracket of 31-45 years (42.5%) and the next bracket is between 46 and 60 years (32.5%). These age groups are defined as ET, thus meaning that majority of irrigation farmers are mature adults who have a lot of experience in agricultural practice. Moreover, it is only 12.5 per cent of the population aged above 60, and only a small proportion of the senior citizens may still be in the irrigation farming since this is a strenuous activity.

Educational Background

The learning indicator reveals that one in every five respondents is non-educated and a quarter of them is only a primary school education. Set percent is 55 percent which has gained secondary or tertiary education. This degree of formal education is moderate, which means that there is a satisfactory level of reading the information about climate, innovations in the management of water resources, and extension services. And yet the lower educated group could still find the challenge in the comprehension of scientific data.

Farm Size

55 per cent of farmers farm 1-3 hectares of land, which is characteristic of small holder farmers. Small farms of less than 3 hectares cover only 22.5 percent of the respondents, implying that there is limited scope of growth and they may not be flexible to adaptability because of shortage of resources.

Irrigation Sources

Rivers (45%) are the main channel of supply of irrigation water as are the boreholes (35%) and, wells (20%). Such reliance upon surface and groundwater with respect to irrigation highlights the sensitivity of such irrigation systems to changes in the hydrology linked to climate change, including a decline in river flows and groundwater recharge.

Table 2: Perceptions of Irrigation Farmers on Climate Change Impacts (Likert Scale Results)

Perception Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Rainfall patterns have become more erratic	210	130	30	20	10
River and stream water levels are declining	230	120	20	20	10
It is harder to access irrigation water than it was 5 years ago	190	150	30	20	10
Climate change is negatively affecting my crop yields	200	160	20	15	5
I believe climate change is real and impacting farming	250	110	20	10	10

Table 2: Likert Scale Results of Perceptions on Irrigation Farmers on Climate Change Impacts

In Table 2, the personal opinion of farmers in relation to the topic of climate change and the climatic situation and the determinant of outcome on the availability of irrigation water based on likert Scale methodology was retained.

Perceptual Range on Rainfall Variability

Eighty-five percent of the respondents (the ones telling strongly agree and agree) are of the opinion that rainfall patterns have become more unpredictable. The finding is in parallel with the meteorological data indicating the increase in seasonal rainfall variability in semi-arid Nigeria. The awareness of such transitions implies the fact that farmers get to be more conscious in relation to the transformation of the climatic conditions.

Decrease in Water Levels
Virtually, 87.5 percent agree or strongly agree that rivers and streams are going dry. This perception is supported by the recorded experiences of poor surface water availability in northern Nigeria, which could be blamed on the decreasing amounts of rain and the rising rate of evaporation. These perceptions are essential because they can motivate the farmers to adopt proactive or reactive adaptive behaviours.

Availabity of Irrigation Water
The result is indeed amazing because 85 per cent of respondents believe that it is even more difficult to access irrigation water today than it was five years ago. This ideology can illustrate real losses in accessible water because of climatic developments or an increment in rivalry in the use of accessible water.

Affect on Crop Yields
Around 90 percent of the people agree that their crop yields will be negatively affected by climate change. This serious agreement implies that the water shortage, seasonal postponement, and drastic weather are causing a real loss of irrigation farmers in the Dutse LGA.

Faith in Climate Change
Remarkably, 90 percent of the respondents admit the presence of climate change and its impacts to the field of agriculture. This wide acceptance would tend to generate a fertile habitat on implementation of water-efficient technologies, climate-resilient seeds, and water retaining measures amongst farmers since they are most likely to embrace any measures that tend to curb perceived perils.
The responses show a farming society that is extremely sensitized to climate challenges and experiencing the impacts of climate change acutely mostly in form of lack of water. Although they are modestly educated and small-scale, the farmers appear to perceive with high gauge of environmental changes, and the matter of fact is that the farmers demand specific policies, professional training, and the improvement of infrastructure at once to strengthen their adaptive skills.

4.2 Responses to Focus Group Discussion (FGD)
4.2.1 Climate Change awareness
All the FGD participants confirmed that they have experienced a lot of climatic changes in the last ten years. In Yalwan-Dutse the farmer said:

> We already knew the time the rains will come and how we would plough our fields ready but now we do not know. It is even so with the rains, Sometimes they are late and Sometimes they clear up too quick."

It can be seen that most of the respondents put the blame on the events as an act of God or rather as natural happenings with a mixture of both the religious and cultural explanation of the change in climate coupled with the awareness of environment.

4.2.2 Presumed Effects on Irrigation Water
Those working in the farming industry (farmers) expressed unanimously that sources of irrigation, especially shallow wells, rivers and ponds are drying up at an earlier rate than expected. One of the participants Dundubus said:

> "Our water has in the past never lasted beyond the middle of the dry season. Then to get at that we have to make deeper or give up some crops."

Another member said:

> "Boreholes are now not reliable. The groundwater level has been displaced very much. We would pump 2 hours and would almost get enough, now we take 4 hours to get enough after pumping."

4.2.3 Livelihood Pressure and Crop Failure
Many of the respondents lost money since they had low farm harvest and complete crop loss as a result of lack of enough irrigation water. One middle-aged farmer of Limawa told:

> Last season, I planted tomatoes three times but each time they died of lack of water before harvest. I had to borrow money to provide for my family."

4.2.4 Adaptation Practices
Although, some farmers showed that they used bucket irrigation, shallow wells, or changed crops to early-maturing ones, most of the farmers expressed their poverty in knowledge or water-conserving methods. One of the female paripcipants of Shuwarin village said:
We read about drip irrigations and solar pumps, but never here did we find them. Can we afford them even when we give them to them?
Others said that the members of the community have begun to apply sandbags to make temporary structures that serve to block areas in the small streams so as to save water to be used later.

4.2.5 Government Support and Institutional Support
A conventional perception existed that the government support to the rural irrigation farmers is weak or does not exist at all. One of the survey participants stated:

> The extension officer himself is only seen once in a way and when he does appear, he comes up with nothing new to propose. Mostly we trust to our own experiences and those things our neighbours are trying.

Another added:

> At the time of elections, they tell us that they would provide us water and machinery but when the elections are over, they do nothing.

4.2.6 Community Strategies and Coping Mechanisms
The respondents have mentioned their frequent involvement in collective irrigation where water is shared among the household in turn. Informal agreements on water sharing have been agreed on by certain communities to prevent conflicts arising in the dry seasons. Village elder of Gidan-Maiunguwa recalled the following:
We organized a team of farmers and decided on timings to go and get water to our farms. It is not optimal but it makes it easier to avoid family infights.

4.2.7 Labour Shortage and Youth Migration

The scarcity of water and agricultural community failure has been one of the reasons why younger people in the community are migrating to cities. One of the females in Zango said:

> The sons are no longer willing to remain. According to them, this is a hard place to make farming. Instead, they would like to work as an okada driver in Kano or in Abuja.

4.3 Findings Summary

This paper reported the perceived impacts of climate change on the accessibility of irrigation water by farmers on the Dutse Local Government Area, LGA, Jigawa State, Nigeria. Based on the field information that was collected using the structured questionnaires which were distributed to 400 irrigation farmers, a number of vital inputs were obtained on the demographic characteristics of the respondents and their perception on climate-induced water stress.

Majority of the respondents were male aged 31-60 years meaning experienced adult men control the irrigation farming in the area. The proportion of respondents possessing at least the secondary education was quite high, and more than a half of all respondents had some sort of formal education. This is very significant educational background because it increases the capability of farmers in terms of interpreting and acting upon the climate-related information and extension services. Majority of the respondents were smallholders and the size of farms was between 1 to 3 hectares. Such small operations are especially vulnerable in climatic stress because of lack of adaptation capability to such small operations. In the case of irrigation water source, most used was the river, borehole and well, which means that both surface water and ground water were used and they are directly affected by climatic changes.

On the perception part, a large percentage of respondents explained that they experienced a change in climatic conditions within the last five years. The unanimous view was that rainfall had been increasingly becoming sporadic and unpredictable with reduced growing seasons and more difficulties in the ability to manage irrigation water. More than 85 percent of the respondents referred to a fall in the water levels of rivers and streams with a respective fall in the accessibility to irrigation water. The changes were linked to the increasing challenges in crop yields production where most of the farmers accepted that climate change has had immense impacts on their farm yields and income.

Importantly, 90 percent of respondents reported the existence of climate change which they described as a serious issue influencing their process of irrigation. This sharp consciousness is an indication of the actual farming experiences, whereby most farmers depict lowered crop production, rise in pest and disease outbreaks, and reduced water supply due to changing weather patterns. Nevertheless, the situation with the use of modern, water-saving technologies still remains low although the awareness rates are high.

These findings show that a community of farmers is highly sensitive to the threats posed by climate change, especially as the effects have to do with the scarcity of water and the viability of irrigation farming modalities. Their opinions coincide with the recent meteorological data, stating a trend of an increased climate associated vulnerability of semi-arid agricultural systems. This highlights the urgency of condemned interventions like climate-resilient infrastructure, educational activities among extension workers, assistance with implementation of water-efficient irrigation methods to improve adaptive capacity in Dutse LGA.

As stated in the discussion of the Focus Groups (FGDs), farmers in Dutse LGA have a clear perception of climate change where the main factor that has facilitated this understanding is the variation in rainfall levels and decreased water availability to support irrigation. The changes have resulted in the ran out of the traditional water resources, making irrigation less reliable and creating extensive risks to agriculture. Farmers admitted that modern irrigation technologies bring various advantages, yet the rates of adopting them are as low as stated by farmers because of the financial impact and, what is more, the lack of awareness. The participants constantly expressed their dissatisfaction with the lack of governmental assistance and claimed that adaptive measures are most often community oriented or individuality-dependent. The out-migration of the young was reported as a problem on the rise, inflicted by the drop in sustainable agriculture livelihood, and endangering the working future of agriculture. Going along with the solutions/coping strategies that communities apply to its situation (a) water sharing strategies (b) early planting style and (c) stream damming sourced out by the community, none of these strategies are best just at the community level.

5. Conclusion

Summing up, this study has revealed that farmers that are practicing irrigation in Dutse LGA are not only noting but also recognizing the great effects of climate change on water supply. Most respondents indicated that they have experienced a reduction in reliable rainfall, receding water table levels in rivers and boreholes and increased cases of drought and they also affect irrigation farming negatively. The fact that these observations can correlate with scientific data on climate, as well as act as real-time reports on the vulnerability of the agricultural sector, speaks on its own level. These findings also show that as awareness of climate change is already high, the use of high-quality, water-saving approaches to irrigation is still low because of the financial capacity, a deficiency in technical expertise, and an absence of an institutional preparedness.

The research stresses that climate change should not be considered an abstract or remote issue among farmers in rural Dutse; rather, it is one of their major daily challenges, which undermines their livelihoods and food security practices and overall economic sustainability. There exists a widened gap between awareness and action thereby indicating a dire need to celebrate policy changes, technological development, and community-based interventions to increase the adaptive capacity of irrigation farmers in semi-arid northern Nigeria.

6. Recommendations

1. Promote the Employments of Water-Efficient Technologies

   The government agencies, non-governmental organizations and agricultural extension services must promote the utilization of enhanced irrigation technologies, such as drip irrigation, solar-powered

pumping and water-harvesting. These will considerably help in saving water and in boosting agricultural production.

2. Enforcement of Agricultural Extension Services
   The extension staffs are also to be trained and supplied with resources to provide up-to-date information to farmers on the strategies of climate adaptation, measures of water storage management, and advance information. The communities should also be carried out through regular campaign of awareness.
3. Increase Learning to Climate Finance and Subsidies
   The adaptation of farmers to the challenges of climate change and irrigated farm subsidies should also become available to farmers in Dutse LGA. The provision of monetary rewards will mitigate the wall between the implementation of modern equipment and sustainable procedures. Invest in Community-Based sources of Water.
4. Infrastructure
   The dams, reservoirs and other canal systems at community levels must be rehabilitated and extended so that water can be stored during the rainy seasons and utilized during the dry seasons. It will assist in cushioning against water shortage during seasons.
5. Finance Environmental and Ag Education Support Climate and Agricultural Education
   The inclusion of the climate literacy and resource management in the adult education programs established in rural settings can enhance subsequent decision-making by farmers. Training and cognitive workshops need to be done in local languages that could be understood better.
6. Improve the Monitoring and Data Gathering
   The additional investment should be dedicated to improving the monitoring of climate data, hydrological mapping, and the monitoring of the impacts to facilitate local planning and obligations-based policymaking in governments and research organizations.
7. Policy integration and Multi-Stakeholder cooperation
   Effective adaptation strategies need to be inclusive and need to be formulated through a coordinated effort between policymakers, researchers, traditional leaders, and local farmers. The climate and policies on both national and state levels should embrace the distinct problems experienced by the irrigation farmers within the arid and semi-arid regions.

7. References

1. Abubakar H, Suleiman T. Climate Variability and Irrigation Water Constraints in Northwestern Nigeria. Journal of Agricultural Sustainability. 2023; 12(2):95-108.
2. Adger WN. Vulnerability. Global Environmental Change. 2006; 16(3):268-281. Doi: https://doi.org/10.1016/j.gloenvcha.2006.02.006
3. Ajzen I. The theory of planned behaviour. Organisational Behaviour and Human Decision Processes. 1991; 50(2):179-211. Doi: https://doi.org/10.1016/0749-5978(91)90020-T
4. AP News. Nigeria's Farmers Face Drought as Rivers Dry and Boreholes Fail, 2022. Retrieved from: https://apnews.coms
5. Aquamaya. Water Stress and Climate Vulnerability in Northern Nigeria, 2022. Retrieved from: https://aquamaya.org
6. Bello AM, Usman B, Danladi M. Farmers' Perception of Climate Change and Water Availability in Kano and Jigawa States. African Journal of Environment and Climate Change. 2022; 10(1):55-70.
7. Dube M, Mapfumo P. Institutional Gaps in Climate Adaptation: Irrigation Farmers in Zimbabwe. Climate and Society. 2023; 14(1):22-39.
8. Federal Ministry of Water Resources. National Water Resources Master Plan. Abuja: Government of Nigeria, 2013.
9. Ibrahim S, Faye M, Yusuf L. Comparative Analysis of Irrigation Water Adaptation in West Africa. Sustainable Agriculture Research. 2025; 16(1):17-32.
10. Intergovernmental Panel on Climate Change (IPCC). Climate Change 2021: The Physical Science Basis. Cambridge University Press, 2021.
11. Intergovernmental Panel on Climate Change (IPCC). Climate Change 2022: Impacts, Adaptation and Vulnerability. Cambridge University Press, 2022.
12. IPCC. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, 2014.
13. IPCC. Sixth Assessment Report (AR6): Climate Change 2022 - Impacts, Adaptation, and Vulnerability. Cambridge University Press, 2022.
14. Itelemedia. Smart Irrigation Technologies for Climate Adaptation, 2021. Retrieved from: https://itelemedia.org
15. Jafaru Y, Aliyu MD, Sule M. Assessing the Socio-Economic Impact of Climate Change and Poverty in Birnin Kudu Local Government, Jigawa State, Nigeria. African Journal of Social Sciences and Humanities Research. 2025; 8(2):11-31.
16. Jigawa State Ministry of Agriculture. Annual Agricultural Progress Report. Dutse, Jigawa State, 2022.
17. Khanal RC, Koirala D. Farmers' Adaptation to Water Stress in Nepal's Irrigated Plains. Asia-Pacific Journal of Climate Change. 2024; 6(2):113-130.
18. Magaji S, Musa I, Salisu A. Impact of Insecurity on Youth Unemployment in Nigeria: OLS Estimation Technique. Indiana Journal of Economics and Business. 2022; 2(1):4-9.
19. Magaji S, Musa I. Effect of Household Income on Child Labour in Nigeria. Lapai International Journal of Management and Social Sciences. 2015; 8(1):32-56.
20. Magaji S, Ahmad AI, Sabiu SB, Yunusa AA. From Deforestation to Pollution: Unravelling Environmental Challenges in Nigeria and Pakistan. International Journal of Humanities Social Science and Management (IJHSSM). 2024; 4(2):805-814.
21. Magaji S, Ismail Y, Musa I. Impact of Institutional Quality on Human Capital Development in Nigeria. MSI Journal of Economics and Business Management. 2025; 2(2):21-26. Doi: 10.5281/zenodo.14936039
22. Magaji S, Musa I, Ismail Y. Assessing the Impact of Income Inequality on Poverty Level in Nigeria Using Auto Regressive Distributed Lag Model. New Advances in Business, Management and Economics. 2025; 3(7):148-166. Doi: https://doi.org/10.9734/bpi/nabme/v3/1480
23. Magaji S, Tanko Y, Musa I. Effect of Green Loan and

Green Mortgage on Climate Change Mitigation in Nigeria. International Journal of Current Science Research and Review. 2025; 8(6):3124-3138.
24. Mensah E, Agyekum P, Owusu K. Water Use and Irrigation Farmers' Perception in Northern Ghana. West African Journal of Agricultural Economics. 2022; 11(3):144-160.
25. Moser SC, Ekstrom JA. A framework to diagnose barriers to climate change adaptation. Proceedings of the National Academy of Sciences. 2010; 107(51):22026-22031. Doi: https://doi.org/10.1073/pnas.1007887107
26. Nigerian Meteorological Agency (NIMET). 2022 Seasonal Climate Prediction Bulletin. Abuja: NIMET, 2022.
27. Oladimeji A, Ibrahim S. Borehole Dependency and Irrigation Challenges in Semi-Arid Nigeria. Journal of Arid Regions Studies. 2024; 8(1):70-86.
28. Sabiu SB, Magaji S. Effect of Oil Exploration and Climatic Change on the Niger Delta Region of Nigeria. Journal of Development and Society. 2024; 6(1):36-49.
29. Tanko Y, Magaji S, Musa I. Effect of Green Finance on Climate Change Mitigation in Nigeria. International Journal of Economic Perspectives. 2025; 19(7):1-22.
30. Taye MT, Yilma H, Tesfaye B. Climate Change and Perceptions of Irrigation Farmers in Ethiopia. Climate Risk Management. 2021; 31:100271.
31. Togola B, Traore A, Adama M. Impacts of Climate Change on Small-Scale Irrigation in West Africa. International Journal of Agricultural Sciences. 2023; 20(1):33-49.
32. Wuepper D, Hagemann N, Pannell DJ. Which adoption decisions are most important to farmers? A behavioural perspective on adoption of sustainable innovations. Applied Economic Perspectives and Policy. 2018; 40(4):689-710. Doi: https://doi.org/10.1093/aepp/ppy001