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Analysis of rural farmers water management practices for climate change adaptation and livelihood improvement in Isiala– Mbano area of Imo State, Nigeria

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Abstract

Water is the primary medium through which climate influences our ecosystem and thus the livelihood and well-being of societies. Higher temperatures and changes in extreme weather conditions are projected to affect availability and distribution of rainfall, river flows and even deteriorate water quality. This study thus investigates the effects of climate variability on water availability for agriculture; the management practices employed by respondents to adapt to the changing climate; and the possible implications on livelihoods of respondents in the study area. Questionnaire was administered to 120 randomly selected farmers in the study area and data analyzed using sample descriptive statistics. Majority of the farmers falls written the age bracket of 51 – 60 years. Because these have been in farming for many years, they are aware of climate change evidence through various avenues. The study showed that frequent floods, droughts, heavy loss of water area effects on climate variability on water for agriculture. To adapt, certain management practices are employed-building of local cistern for water storage, treatment and re-use of water, pollution control, diversion canals, planting puts and other practices. The study also reveals that adequate availability and use of water improve the well-being farmers enhancing productivity of land, higher wages, lowers food prices, reduction of vulnerability, employment creation and diversity of cropping. For long lasting measure to make water available, irrigation facilities shown be put in place since it enhance of ready, adequate and efficiently water supply system.

Key words- water, climate change, management, livelihood, adaptation

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1.0 Introduction

Water has always played, and continues to play a central role in human societies. Water is a source of life and prosperity. It is an input to almost all production; in agriculture, industry, energy, transport, by healthy people in healthy ecosystems. Water is also a cause of suffering and devastation [1]. It can be force for destruction, catastrophically through drought, flood, land slides and epidemics, as well as progressively through erosion, inundation, desertification, contamination and disease. This destructive aspect of water as a consequence of its extraordinary power, mobility indispensability and unpredictability, is arguable unique. Achieving basic water security, harvesting the productive potential of water and limiting its destructive impacts, has been a constant struggle since the origin of man society. Many of the earliest civilizations and particularly those on the floodplains of the world's great rivers succeeded by harnessing water, thus increasing production and reducing the risk of destruction [1].

As then so today water resources development and management remain at the heart of the struggle for growth sustainable development and poverty reaction thus has been the case in all industrial countries, most of which invested early and heavily in water infrastructure, institutions and management capacity [2]. It remains the case in many developing countries today, were investment in water development and management remain an urgent priority. In some developing countries – often the poorest, the challenge of managing their water legacy is almost without precedent. Yet if these challenges are not met, we believe that sustainable growth and poverty eradication cannot be achieved [2].

Throughout history, water has also been a source of dispute and even conflict between uses and users at both local and large scales. As water becomes ever more source relative to demand, there are emerging fears of trans-boundary waters becoming a source of conflict, constraining growth; conversely, there is also emerging experience of cooperation on trans-boundary waters, supporting regional integration as a driver of growth. Water is the lifeblood of the planet and the state of resource affects all natural, social and economic system. Water serves as the fundamental link between the climate system, human society and the environment [3]. Climate change is severely impacting the hydrological cycle and consequently, water management thus will in turn, have significant effects on human development and security.

Climate change has substantial impacts on both water resources demand and availability. It is critical to understand the processes driving these changes, the sequences of the change and their manifestation at different spatial and temporal levels. These changes are likely to be an increasingly powerful driver of water availability, acting with other drivers that are already having a serious impact on its quality and availability [4]. Increased water related risks associated with the changes in frequency and intensity of extreme events, such as droughts, floods, storm, surge and landslides, will put additional strain on water resources management and increase uncertainty about quality and quantity of water supplies. These risks will continue regardless of mitigation measures applied over the coming decades. Society needs to find ways to adapt to the changes that are expected and to render its water infrastructure and services more resilient in coping with new conditions and extreme weather pattern .

Climate change is a complex problem that has increased the need for an

integrated multi-sectoral and multi-disciplinary response. Apart from the spheres (finance, trade, energy, housing, regional planning agriculture) must use and consume water efficiently. Sustainable management and development of water resources will play a pivoted role in preparing societies ability to adapt to climate change in order to increase resilience and achieve development goals. These calls for policy and governance shift investments and change in the way water concerns are addressed in development strategies and budgets. The notion of a global water crisis predates more recent narrative relating to climate change, but the focus of water sector debates has moved beyond physical availability and the concept of (per capital) water scarcity, to centre instead on issues of water governance. i.e. putting in place the political social economic and administration systems needed to develop and manage water resources effectively [5]. Specific concerns in the context of increased climate-related variability including managing growing competition for water resources (between sectors and between socio-economic groups) and promoting access on a more equitable and sustainable basis.

Studies have shown that access to water is generally not sufficient for increased agricultural productivity which is contingent on other inputs including land, credit, and access to outputs markets [6]. However, there is growing body of literature which suggest that improved access to water (secure, affordable, reliable supplies and protection from water-related shock e.g. floods and drought is an important factor determining the resilience of poor agriculturalists in the face of increase risk and vulnerability, and their ability to engage in market opportunities where these exist.

African already has significant rainfall variability within year, and across years and decades. Rainfall is likely to become more immedicable under climate change, with an increase in intense events [7]. The dominant issues for water governance in Africa are trans-boundary resources, managing resources use and improving storage. Adaptation measures can be implemented through existing initiatives. Adaptation measure could include improving information and monitoring system. On surface and ground water resources, providing water manage with technical training and applying a range of natural and built water storage solutions climate change expect argued that water should be recognized and formed as a foundation for adaptation to climate change and that water resource management is not currently given enough attention [8].

The broad objective of the study is to analyze water management techniques employed by farmers to cope with climate change variability as it affects water for agriculture. The specific objectives they are to:

(i) Describes the socio-economic characteristics of respondents.
(ii) Determine the various sources of water in the study area.
(iii) Determine awareness and evidences of climate change by respondents.
(iv) Identify the effects of climate change on water availability for agriculture.
(v) Identify water management practices of respondents; and
(vi) Effects of agricultural water management on livelihood of respondents.

2.0 Materials and methods

The study was conducted in five (5) communities in Isiala-Mbano, Imo State, Nigeria. Imo State occupies a land mass of about 5530 square kilometer with a total population of about 4,500,787 million persons 2012 projected 2006 census figure. Isiala-Mbano was

purposely chosen because it is an agricultural area in the state.

Attribute	Frequency	Percentage
20 – 30	10	8.3
31 – 40	13	10.8
41 – 50	38	31.7
51 – 60	50	41.7
60 and above	9	7.5
Sex		
Male	80	66.7
Female	50	33.3
Marital Status		
Married	74	61.7
Widow	26	21.7
Widower	20	16.6
Education level		
Adult education	12	10
Primary	70	58.3
Secondary	35	29.2
Tertiary	3	2.5
Household size		
1 – 4	29	24.2
5 – 8	43	35.8
9 and above	48	40.0
Farm size		
0.25 – 1	21	17.5
1.5 – 2	66	55.0
2.5 – 3	23	19.2
3.5 and above	10	8.3
Farming Experience		
1 – 5	22	18.3
6 – 10	45	37.5
11 and above	53	44.2
Membership of Organization (Number)		
1 – 3	70	58.3
4 – 5	40	33.3
5 and above	10	8.3

Table-1: Socioeconomic Characteristics of Respondents

Isiala-Mbano Local Government Area has a total population of about 140,575 persons in 2012 projected 2006 census figure [9]. Imo State lies between latitude $5^{o}12'$ and $5^{o}56'$ North of equator and between longitudes $6^{o}38'$ and $7^{o}25'$ East of the green which Meridian. [10] Five (5) communities were purposively selected from the study area. The reason for the selection of those communities is because they have people whose occupation is full time farming. The estimated number of households from the communities was 1,200 contained in the lists obtained from the village heads in the area. A total of one hundred and twenty (120) from the sample frame of household respondent was selected. The

household head was used as the sampling unit, the household s widows and widower, who tend for themselves and their families. The study made use of both primary and secondary data. The primary data was collected by administrational questionnaire to house hold heads. Secondary, data source were utilized to provide information and other necessary procedures. Basically, descriptive statistics were used to analyze most of the data. These involved the use of percentages and frequency counts, means presented in tabular form. This was used to achieve all the objectives of the study.

3.0 Results and discussion

Socio-economic characteristics of Respondents

Extension Contact

Once	20	16.6
Twice	80	66.7
Thrice	20	16.6

Socio-economic characteristics of Respondents

Table-1 at a glance provides us with the personal characteristics of the respondents. We see the age range of the individuals who responded to the questionnaire. In the study area, farming is considered tedious and only healthy people engage in such business. It is because of this that economically active people between the age of 40 to 60 making over 80%, engage in farm operations. These individuals are considered healthy and strong enough to farm and this tells why they are able to master the art of farming and as it concerns this work, manage water efficiently to counter shortage of it. Again, majority of the respondents are men with 66.7%, while women make 33.3% of the responding farmers. Men are the head of their various families and have absolute control over productive resources especially, land and for this, they seem to be the majority in farm business.

Furthermore, 61.7% of the respondents are married, suggesting that they do farm labour with their wives. Only about 21.7% and 16.6% are widows and widowers respectively. Since these individuals are alone so t o say. Their situation will likely affect their productivity. On the level of education of the respondents, 58.3% did their primary schooling while 29.2% attended secondary school, leaving only 2.5% with tertiary education. Only 10% did attend adult school in the night they had chance. The above result shows that the respondents are not illiterates, because they have the basic education opportunteis of the land. This tells why they become aware of climate change, and knows who to manage water for their own use during shortages. All the respondents have appreciable number of dependents at home. About, 70% have family members ranging from 5 to 10 people who depend on them for survival. Only 24.2% have 1- 4 person in their labour, members of these families in one way or the other, join in the day to day farm business, this affects productively us well.

Again, majority of the respondents (55%) have appreciable farm size of 1.5 to 2 hectares they work on. they are followed by 19% who controls 2.5 to 3 hectares of land. Only about 8% owns 3.5 hectares and above. The size of farm determines prdocutivity and investments on the farm. Due to the appreciable size of holding of these farmers, they have come to realize that water shortage or a lack of it would spell doom for their business. To solve this problem, they have to use multiple water source and also learn to efficiently and effectively manage water instead of wasting it.

Majority (44.2%) of the respondent are old times in farm business shaving put in more them eleven yeas. Again, 37.5% and 18.3% have also put in between 6 to 10 years and less in farm business. Their experiences in farming contribute to their

awareness of climate variability as they observe certain climate change foreign to them. The respondents belong to various social/religious organizations where they interact with people and learn new things as well. This is indicated by 58.3% who belong to more than 1 social organization. More than 40% of the respondents also are members of more than 3 unions. The implication of this is that these organizations help educate their members by providing information's of different nature of those that will benefit. Most of them learn climate variability issues, adaptation and mitigation practices from them fellow members. Finally, the visits of an extension agent is another opportunity the respondents enjoyed to be in tune with recent changes. The respondents at least two times in one month (66.7%), while over 30% said they see the agent two to three times in a month. Such visits are important because majority of the respondents indicated that they because aware of climate variability through the visit of the extension.

Awareness	**Frequency**	**Percentage**
Aware	110	91.7
Not Aware	10	8.3
Sources of Awareness		
Radio	60	50
Television	20	16.7
Extensions agents	80	66.7
Cooperative societies	88	73.3
Fellow farmers	98	81.7
Churches	78	65.5
Evidences of Climate Change		
Changes in temperature	110	97.7
Change in volume of rainfall	108	90.0
Relative humidity of rainfall	93	77.5
Sunshine duration changes	86	71.7
Crop withering	100	83.3
Increase food spoilage	98	81.7
Faster weed growth	101	84.2

Table-2: Awareness and Evidences of Climate change

Table-2 shows that majority of the respondents, 91.7% are aware of climate change while only 8.3% said they are not aware of climate change variability. ON how they got to know, 81.7% said their fellow farmers gave them the information about climate change. Again, 66.7% knew through the visits of an extension agent, while 73.3% knew through the various cooperatives/associations they belong. Other sources of climate change information includes the churches (65.5%), radio (50%) and television (16.7%). The low response on television was due to the fact that power supply in Nigeria, (electricity) is epileptic and may not be available when such information are aimed but they could batteries to power their radios.

Water sources	Frequency	Percentage
Rain water (rainfall)	120	100
Streams	70	58.3
Rivers	61	50.8
Ponds	15	12.5
Borehole	5	4.2
Irrigation	10	8.3
Well	18	15.0

*** Multiple Responses**

Table-3: Sources of water availability

Table-3 shows at a glance, the various sources of water available to the respondents in the study area. The major source of water is rainwater (rainfall) which all farmers on earth mostly depend on for agricultural production. This has a total response of 100%. The second source of water is the stream with 58.3%. Water rivers has 50.8% response, while ponds (12.5%), boreholes (4.2%), irrigation (8.3%) and well water (15%0 have low responses as indicated on table 3.

Effects	Frequency	Percentage
Frequent floods	100	83.3
Frequent droughts	60	50.0
Evaporation	74	61.7
Precipitation	70	58.3
High rainfall variability	97	80.8
Heavy loss runoff	80	66.7

*** Multiple response**

Table-4: Effects of climate change on water availability

Table-4 reveals the effects of climate change variability on water availability for agricultural purposes. The respondents all agreed that frequent flooding with 100% is the major effect of climate change. Heavy water loss by runoff is another effect with 66.7% response. High rainfall variability much 80.8% is also an effect of climate change on water availability for agriculture. Other effects are evaporation (61.7%), precipitation (58.3%) and frequent droughts (50%).

The above findings are in line with UNO (2010) that from the supply side, climate change affects the water cycle directly, and through it, the quantity and quality of water resources available to meet the needs of scoeiteis and ecosystems. Climate change can result in an increased intensity in precipitation, causing greater peak run offs but less groundwater recharge. Receding glaciers, melting permafrost and changes in precipitation from know to rain are likely to affect seasonal flows. Longer dry periods are likely to reduce groundwater recharge, lower minimum flows in rivers and affect water availability, agriculture, drinking water supply, manufacturing and energy production, thermal plant cooling and navigation.

Extreme weather events have become more frequent and intense in many regions, resulting in a substantial increase in water-related hazards. At the same time, demographic changes are exposing more people to increased flooding, cyclones and droughts. The impacts of recent major flooding in

Nigeria in 2012, which resulted to many deaths and cost billions of Naira (Nigeria Currency) in damages, is an indication of what could lie ahead from increased climate variability.

Management Practices	Frequency	Percentage
Building local cistern/reservoirs	98	81.6
Treatment and re use of wastewater	88	73.3
Water pollination control	60	50.0
Water conservation and sanitation	83	69.2
Construction of flood diversion canal	91	75.8
Equitable/reasonable use of water	85	70.8
Construction of floodwalls against flooding	77	64.2
Water-rights regulation	67	55.8
Planting pits	90	75
Runoff captures/storages	81	67.5

*** Multiple responses**

Table-5: Water Management Practices of Respondents

Table-5 shows the various water management practices of respondents in the study area to cope with the variability of climate. The table shows that the respondents build local cisterns or reservoirs to store water for use during seasons of water shortage. This has a percentage score of 81.6%. Other practices, are the construction of flood diversion canal (75.8%), treatment and reuse of waste water with 73.3%, equitable distribution and use of sanitation of water and conservation with 69.2%. Again, water pollination control with 50%, construction of flood walls against flooding (64.2%) and regulation of water-rights with 55.8%. During oral discussion with the respondents, they said that the use of water rights help save large quantity of water as unauthorized persons re prevented from watering the farms since such persons lack the technical skills to supply water to their crops. Also the respondents said water is not applied arbitrarily to plants as they know when and how to do the supply of water, this reduces wastage of water. Again, the respondents are of the view that water use globally is governed by allocation or water rights systems that govern who is allowed to take wider from a system, when and in what quantities.

The above situation implies that water-storage has the greatest potential to deliver the improvements in water management. Water storage makes more water available by capturing water when it is plentiful and making it available for use when there re shortages. Storage can also be sued to balance supply and demand over much shorter periods such as storing water from never flows during the night and making it available for farmers to use during the day.

Again, farmers in the study area also manage water by making planting pits as shown by 75% response. Planting pits are holes of about 30 – 35 cm in diameter and 25cm depth excavated along the contour at a spacing determined by the farmers. The holes are filled with soil and compost which trap runoff and hold moisture, silt and organic debus which favour the growth of tree and field crops. Another water management practice is the construction of runoff capture is a water harvesting system that collect local surface runoff (sheet, rill and gully flows) in small brickwork storage structure of about 100 – 100m^2 capacity and are sued as supplementary irrigation of field crops.

The above findings are in line with Ifejika, (2010) who posited that since climate change will result in increased frequencies of extreme events (droughts, cyclones, floods), and higher rainfall variability in terms of time, space and amounts, a potential adaptation measure would be to secure water availability foe crop and livestock production. One-way of doing this is to harvest rainwater and runoff. At a first glance, inadequate water supply is a major challenge to agro-pastoral systems. However, studies show that the rains provide adequate water quantities for crop production but the water becomes lost through run-off, evaporation from bare soils and deep percolation beyond the rooting zone of annual crops. WOCAT[11] notes that in the dry lands rainwater is lost through seasonal surface run-off in the order of 15-20 percent and another additional 40-70 percent is lost through evaporation from soil surface leaving less than half of the rainfall available for crop and fodder production. In the following, the various ways that smallholders harvest rainfall are analyzed.

While water is available (rainfall streams and rivers) during the rainy season, it becomes scarce during the dry seasons making people (especially women and children) walk long distances in search of water for domestic uses. In many dry regions of SSA (for example, Kenya, Tanzania, Ethiopia and Namibia) people dig holes in the sand beds of streams and rivers to fetch water. This traditional practice has been enhanced by building *sand dams* – a concrete wall at strategic sites across the channel that sometimes serve as a bridge. Sand dams trap sand during flooding thereby blocking extra sub-surface water in the sand bed and thus increase available water for harvesting in dry times]12].

Sand dams have the *benefits* to improve water infiltration, provide drinking water for people and livestock, and control erosion. It also contributes to generating the environment as vegetation prospers in such sites thereby attracting other biological resources. Sand dams are estimated to be *costly* in terms of mobilizing people to participate and labour intensive. Constructing sand dams depends on external financial support to purchase the materials needed for construction and often communities have to be mobilized be external agents (extension officers, NGOs, church organizations) to move from the traditional scooping of water from sand beds to building sand dams. Since the benefits are community-wide, ownership by the community is rapidly achieved. However, it is also culturally acceptable and in many cases a major source of water in the areas where it is used. Thus, the pressure on external dependence for inputs may comprise this adaptation practice. In order to improve resilience to climate change, communities need to be sensitized to maintaining the sand dams. Although they are long lasting, some sand may require stabilsation and repairs due to flood damages. Thus, forming community groups in charge of maintaining the sand dams is a promising way to maintain resilience.

Micro-catchments water harvesting techniques (contour bunds) are used for planting crops and trees. An example of such micro-catchment method is the *trus cultivation,* that is, a traditional water conserving method of cultivation used on clay soils that harvests surface run-off by constructing low earth bunds called *trus*. According to Osman-Elasha et al [13], indigenous *trus* cultivation has gained in importance in recent years, as rain-fed farming on sandy soils became increasingly risky and people became unable to produce enough food for consumption. As a result of the good crops of sorghum from *trus* cultivation, Osman-Elasha et alreported that more farmers started to shift to clay soils and practice *trus* cultivation. Through harvesting rainwater, the destructive

effects of runoff are reduced, thereby contributing to environmental protection. Reduced soil erosion means that the silt-load of rivers is reduced, thereby enhancing river flow, protecting river fauna and helping keep the costs of water purification for urban consumer low. Because of the harvest water, the range of crops that can be grown is expanded, thereby contributing to the diversity of the cropping system, and by extension to resilience. Therefore by having crops to sell when other farmlands are dry and bare, the farmer increases own incomes and can maintain this source of income over time. Through adopting technologies like irrigation the farmer improves own human capital as he/she learns through practice. By recognizing the value of water as a resource, such farmers are more likely to improve the efficiency of resource (water) use with time by adopting such technologies as drip irrigation.

Improvements	Mean Response
Leads to productivity of land	3.65
Leads to high incomes	3.10
Encourage higher wages	2.84
Lowers food prices	2.45
Reduction of vulnerability to shock	4.07
Leads to prdocutivity of labour	2.41
Increased demands for locally made goods	2.01
Generation of employment opportunities	2.50
Increased diversity of cropping	3.50

Table-6: Effects of Water Use on Livelihood of Respondents

Table-6 reveals at a glance the importance of water as a key input in agriculture and its central role in improving the livelihood of farmers who are always the poor. Water contributes to poverty reduction and livelihood improvement primarily by enhancing the prdocutivity of labour and land with means responses of 3.65 and 2.41 respectively. Water, when accessed by farmers leads to higher income and wages accumulation with means of 3.10 and 2.84 as well. The use of water lowers food prices with mean response of 2.45. When water is available and used, it increases the diversity of cropping by the farmers. This has a mean of 3.50 water use enable farmers to achieve higher yield and earn larger revenues from crop production. The reduces vulnerability to shock among the farmers as indicated by 4.07 mean response. Other effects are increase demand for locally produced goods (2.01) and generation of employment opportunities with mean of 2.50.

Supporting the findings, World Bank, said the importance of irrigation to rural livelihoods is highlighted by the fact that irrigated farmland provides 43% of global cereals production and 60% of the gain production in developing counties [14]. Of the near doubling of world grain production that took place between 1966 and 1990, irrigated land (working synergistically with high-yielding seed varieties and fertilizer) was responsible for 92% of the total production. Irrigation is also the key to developing high-value cash crops, and, by helping guarantee consistent production, it stimulates agro-industry and creates significant rural employment.

Robert chambers, a pioneer of livelihood approaches, argued that generation and support of livelihoods has a higher priority than production *per se* [15]. He emphasized that impact of irrigation on

the rural poor depends on who produces the food and who has the ability to obtain it, on who gains and who loses more generally. Overall, he argued that the poor gains from irrigation through increased employment and income, in improved security against impoverishment, from less out-migration and in improved quality of life. The effects are well-known: improved water control increases and stabilizes agricultural yields during the main cropping season. Moreover, it enables another cropping season up to year-round cultivation, which also encompasses the hunger season and seasons in which employment tends to be low. Improved water control reduces the risk of crop failure, which is critical to motivate farmers to invest and adopt higher-yielding varieties of food crops, diversify into higher-value cash crops, apply fertilizers and pest management, and intensify farm labour and practices. Improved water control also prevents soil erosion. First and most directly, where conditions are favourable irrigation can raise the incomes of those farmers with access to irrigated land.

Water control in agriculture may boost productivity and incomes by:

1. Providing adequate water throughout the growing season, thus contributing to higher yields by eliminating water deficits and providing at least a measure of drought protection;
2. Securing at least one crop, by making water available in areas where rainfall in inadequate, highly variable or during drought;
3. Providing a cheaper or more secure supply of fodder for livestock;
4. Supplementing rainfall in humid region to ensure high yield and quality, which generally leads to higher farmgate prices;
5. Allowing experimentation with new crops and varieties for which market opportunities exist;
6. Improving timeliness or crop duration allowing area expansion;
7. Enabling farmers to adapt timing of production to take into account market demand, higher prices, weather conditions and to avoid adverse weather extremes;
8. Reducing production risk and the need for farm output diversification, thereby encouraging farmers to gain the benefits of grater specialization and commercialization;
9. Reducing risk and raising returns in the use of complementary inputs such as improved seed and fertilizer;
10. Reducing problems of flooding, water logging and soil salinisation;
11. Improving the quality of soils through leaching and drainage, especially in the case of tube well irrigation;
12. Enabling management of the micro-climate to reduce incidence of frost or low temperatures that damage crops;
13. Facilitating development of multiple farm enterprises around livestock, crops and agro-processing;
14. Raising farm household and hired labour productivity.

A further benefit for landowners may be appreciation of the value of land with irrigation, which often enhances access to credit, and social standing and influence within the community. Landless labourers, and those with small landholdings but who also depend on on-farm work as a source of income, will benefit from:

1. Increased and more evenly spread farm labour opportunities and improved wage rates;

2. Reduced out-migration and increased return migration;
3. Improved security against improvement.

Raising incomes from wage employment is critical to poverty alleviation because so many of the poor are landless agricultural workers. As with other forms of agricultural intensification, impacts of irrigation on wage employment are both indirect and partial due to the confounding effects of other factors that drive agricultural wages. These include population growth, labour migration, economic policies and change in the non-agricultural sector [16]. All rural households, and particularly those who are net purchasers of stable foods, will also benefit from lower food prices and potentially better nutrition throughout the year.

According to FAO [17] in developing countries irrigation can increase yields for most crops by 100 to 400%, whilst also allowing farmers to reap the economic benefits of growing higher-value cash crops. Higher, less risky and more continues levels of rural employment and income, for both farm families and landless labourers, can result from the higher cropping intensities, higher yields and more intensive and higher value cultivation techniques of irrigated compared to rainfed agriculture.

Scoones [18] argued that in semi-arid areas there is potentially no better way to reduce rural vulnerability and ensure the viability of people's livelihoods than to enhance natural capital and the productive base. Protecting the system against drought requires investment in water management, and it is irrigation and the water storage provided by small dams or enhanced recharge of aquifers that can reduce the vulnerability of rural communities to periods of drought.

For landless labourers, increased cropping intensity has the greatest impact on employment. Chambers cites several empirical studies in different countries that show that irrigation systems directly raise employment, by increasing both days worked per hectare and days worked during a cropping season, as well as creating additional employment in a second or third irrigation season. Irrigation also affects the labour use of different groups in different ways. The employment impact is also felt in rain-fed areas, as landless workers in rain-fed villages can migrate long distances to take advantage of employment opportunities in irrigated areas.

The potential benefits of irrigation to labourers are thus a rise in daily wages, longer and more reliable employment, higher and less variable income, and potentially lower food prices, if higher production brings prices down. Counter-migration effects can be of great social and economic value, for example, when two or three crops a year replace one, the need for labourers and marginal farmers to migrate diminishes and may disappear. Families can stay together, it is less difficult to send children to school and home improvements, such as sanitation, are easier to undertake. There are also indirect gains to other poor people in the areas to which the out-migrants formerly went, since competition for work is reduced and wages may even rise. Through increased employment, irrigation also protects against the impoverishment of having to dispose of assets or enter into debt.

The benefits of irrigation development are passed on from farmers to consumers in the form of lower prices. For example, the fall in rice and wheat prices in real terms in India and elsewhere has benefited the urban and rural poor more than the upper income groups, because the former spend a much larger proportion of their income on cereals than the latter. In fact, 60% of the money spent on food by people living below the poverty line in Asia is apportioned for

cereals (which provide as much as 70% of their total nutrients).

Irrigation schemes may also function as a development 'pole' in rural areas, where increased output and population concentrations attract additional services and infrastructure. Also, the increased incomes from production and employment mean that more families can afford schooling and health care, meaning that services are more likely to be present.

In the past, irrigation has also been used for many political aspects of nation-building being seen to contribute to improvement of national wealth and well-being. It has been used a means to open remote of under-populated areas through new settlement schemes. It has also been used as a means to reduce migration, or discourage landuse practices that governments considered unsustainable, such as pastoralism and shifting cultivation, though it has it sometimes been used unsuccessfully. Irrigation schemes have often been a powerful means for governments to develop closer political links with the rural population.

Tubewell development may also reduce flood-proneness and waterlogging, thus reducing crop damage and expanding monsoon season cropping. As with drought, flood-proneness also reduces risk aversion and as a result farmers may cling to traditional mixed-crop farming systems that offer some insurance against risks and minimize cash costs of cultivation [19].

4.0 Conclusion

Climate change is a reality and it is happening the world over. In the study area, the respondents are aware of its occurrence and evidences having been in the business of farming for many years. They have observed changes in temperature and seasons. They have seen droughts, floods, run off and losses of water in amazing rate and degree. They have also adopted measures to cope during difficult seasons which have help them to continue in the business of farming. The measures taken so far by them have affected their incomes, employment, productivity, prices of food and others. Again, they need irrigation facilities like their counterparts in the Northern part of Nigeria to continue their business all year round.

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