THE IMPACT OF CLIMATE-CHANGE ON FISH PRODUCTION: A CASE STUDY OF ARGUNGU AND YAURI LOCAL GOVERNMENT AREA IN KEBBI STATE OF NIGERIA

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Abstract

The study examined fish farmers awareness regarding climate-change influence on fish farming yield in Argungu and Yauri Local Government Areas in Kebbi State of Nigeria. A total sample size of 140 was selected divided into 70 sample size per Local Government. Multi stage sample was used in the selection of respondents. Primary data was collected through face to face interview administered on respondents. Data was analysed using arithmetic mean, percentages and descriptive statistics. The major conclusions drawn from this paper were: Data presented regarding perception of Fish Farmers on climate change revealed that, 24(34.2%) Argungu and 28(40%) Yauri reported drastic change in weather. While 3(4.2%) Argungu and 10(14.2%) Yauri agreed on poor harvest of Fish. Similarly, 26(37.1%) Argungu and 15(21.4%) Yauri increase harvest of Fish. About 4(5.7%) Argungu and 3(4.2%) Yauri reported Fish disease infestation. Perception of respondents regarding techniques to reduce effect of weather due to natural variability on Fish production have shown that 10(14.2%) Argungu and 15(21.4%) Yauri reported building ponds close to water sources. While 6(8.5%) Argungu and 3(4.2%) Yauri

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agreed on bore-holes and well-construction to supply water during season when rain does not fall. Majority of the respondents 26(37.1%) Argungu and 33(47.1%) Yauri reported on seeking / listening to information about climate change. On the basis of the above conclusions, it is recommended that there is a need for active collaboration among Fish Farmers and other stakeholders to create more awareness on the climate change impact on aquaculture in the study areas. Therefore, H0 hypothesis 1 is accepted and HA alternate hypothesis is rejected and HO Null hypothesis 2 is rejected while Alternate hypothesis HA 2 is accepted.

Keywords: *Climate Change Awareness, source of information, perception on Impact and Strategies to reduce effect on Fish Production*

Introduction
Climate change is today recognized as one of the mankind's greatest challenges in the 21st century if left unchecked, its effects will seriously harm economies, societies and ecosystem all around the world especially in developing countries. (Adebite, 2013).

Changes in climate can place different burdens on men and women because of existing gender influences that is socially and culturally construed roles, interest and division of labour. The vulnerability of women and men are different due to differences in how they are affected by climate change and differences in their adaptive capacities.

The causes of climate change have been scientifically studied and showed that industrialization, urbanization, water pollution, deforestation and transportation are among the highest contributions (IPCC, 2007, Hengeveld, et al, 2005). Other researchers have concentrated on the effects of climate change and revealed that it has started impacting and will continue to impact on human health.

Too many literatures are available on climate change. It has and is still the subject of many academic gatherings. Several international instruments are in place to underscore the importance of the issue and to awaken humanity to the realities of changes in the climatic conditions due to activities of men.

There are serious implications of global fisheries and aquaculture associated with climate change. Apart from physical and financial drivers, the aquaculture sector growth and sustainability is achieved through climate and it is a main driver. The change of temperature, air and humidity affect the fish production in the mechanism of ponds (Aphunu and Nwabeze, 2012). Above mentioned issues have significantly caused a major loss among farmers. This includes, increased output, increase in socio-economic and income as well as physical harm or damage among farmers.

According to FAO, 2009 International aquaculture came about 144 Million-Metric Tones (MMT) this consists of 92 MMT from capture and about 51 MMT from aquaculture. Fish farming output of 92 MMT represent a decrease of 2.2 MMT compared to figures for 2005. According to the Federal Department of Fisheries, Nigeria, the fish farming production of is over 1.7 MMT comprising to 201,300 MT offshore fisheries) whereas 288,200 MT (in-land fisheries) and 1,180,211 MT aquaculture.

There are range of barriers in the increased fish farming output yield in Nigeria. Among others climate- change effects; sea level rise, coastal erosion and flooding increase in environmental temperatures and wind storms are noteworthy factors which is decreasing the fish farming. In view of the foregoing therefore, the research helps in analyzing the level of awareness of fish-farmers on the effects of climate change on aquaculture production as well as identify techniques to be adopted to cope with impact in Argungu and Yauri Local Government Areas in Kebbi State of Nigeria.

Problem Statement:
Majority of Nigerians have very poor global knowledge of the causes, effects and remedial measures of climate change. Aquaculture Production has greatest potential for reducing lands from capture of fisheries arising from weather variability, pollution, over exploitation and use of abhorrent fishing methods. Available evidence made us to believe that the fisheries sub-sector in the Agricultural sector is experiencing a range of issues. Mostly, such issues are and challenges are associated with climate change. The above mentioned issues are more likely to compounded if certain measures are taken to address them in totality. For this reason, this research study is being carried out in Kebbi State where we have large numbers of fish farmers in Northwestern Nigeria.

Objectives
The specific objectives of the study were presented as follows:

1. Assess fish-farmers level of awareness on climate-change issues.
2. Identify the information sources on weather variability.
3. Examine Fish-farmers level of awareness on the impact of weather variability on fish production.
4. Identifying techniques that will assist in alleviating the effect of climate change.

Hypothesis

The following hypotheses are presented as follows:-
1.   Ho   Fish farmers have no knowledge on the effects of climate change on the production of fish.
       HA   Fish farmers have knowledge and awareness on climate-change on the production of fish.
2.   Ho   Fish farmers have no knowledge on mitigation of climate- change on fish production.
       HA   Fish farmers have knowledge on mitigation of climate change on Fish production.

REVIEW OF LITERATURE

The review of literature related to this research paper is presented as follows:-

Tijani, (2012) stated that, huge sum of money is spent on Fish Importation should be used on fish farming. About 97billion Naira was spent, if invested on fish production will create jobs and reduce poverty in rural areas. Government goal is to create an enabling environment for increased and sustained production of over a million metric tons of aquaculture fish and to generate over 500,000 jobs in five years.

Akiri, and Mabawonku (1985) concluded that, the existing infrastructure appears inadequate for fishing production in Nigeria. Such as lack of strip ways or dry docking facilities, Jetties and storage and processing facilities. Sea going personnel and fishing crew are presently scarce in the country. It is estimated that more than 80 percent of fishing crew employed in the country are expatriates. This situation calls for serious consideration. It is recommended that future fishermen of Nigeria project be designed whereby school children especially in coastal areas be exposed to basic training on fishing skills.

Aphunu and Nwabeze, (2012) assess fish-farming workers awareness on the influence of climate-change on fish-farming and its production in the state of Delta. From the selected area, the respondents of the sample become aware of

climate-change factors which include; change of temperature, air, increased humidity and total rainfall in the area. Findings of the study further revealed that, respondents become more aware regarding low yield from fish-farming and understand the associated factor i.e climate change. It is responsible for detrimental impact on fish-farming. It is recommended that more active involvement of stakeholders in formulating policies related to climate-change mitigation can find a lasting solution to the problem.

Yaragal, 2006 have identified problems that affects achieving sustainable Fisheries Development in India to be (1) lack of peoples empowerment and participation (2) Fish farmers show negative attitude for adoption of new technology (3) Resistance to change in harvesting/ production regime because the aquaculture shrimp production infrastructure is large and heavily invested (4) changing international markets for Fishery and aquaculture products. (5) Incomplete information on status of many fisheries projects (6) Improper legislation and implementation.

Verde, 2006 stated that fisheries provide food for billions of people through science, new medicines and materials from diversity of marine life forms are being discovered. The oceans living resources and benefits are threatened by fisheries operations, chemical pollution and eutrophication and invasion of exotic species. The key to success will depend on sound science and strengthened partnerships with all stakeholders to conserve and use sustainably the nations marine living heritage.

Aboribo, 2001 confirmed that at present, over fishing is a high priority as fishing is the most important economic activity in rural Delta communities. About 400,000 artisanal fishermen supply 80% of the total catch. Supporting local initiatives in improved fisheries management, equipment, storage and distribution will probably be another very cost effective management intervention. Degradation of fisheries habitat is of moderate importance because on a regional level habitat destruction in mangrove areas and freshwater swamps is not widespread.

Orubu (2000) have identified the negative side of petroleum exploration and production which have adverse effects on fish production and farming in the Niger Delta. This has been the traditional means of livelihood to the people of the oil producing communities. However, this neglect to protect the environment particularly fish production and Agriculture has resulted in huge losses. The

current experiences and policies demonstrate that it is possible to protect the environment, promote growth and enhance competitiveness at the same time.

Use of natural resources techniques is the mitigation strategies to address Climate-change issues. These techniques will assist the effective and utilization of soil as well as water-resources, control the biodiversity decline and address critical issues such as increased need for renewable-energy resources (Nzeadike, et al, 2011). Additionally, farming communities must respond by both minimizing and reducing the concentration of green-house gases in the air and identifying ways to adapt to the impact of climate-change. Such strategies will bring more awareness in the farming communities, change their opinions and practices and increase capacity to face more challenges such as frequent-extreme weather events and rising sea level occurrences.

Adaptation means efforts to adjust to ongoing and potential dangers of climate-change (Mani, et al, 2008). With regards to climate-change impact reduction, fish farming community is suppose to be pro-active and take initiative to take action in applying adaptation strategies to reduce potential effects of climate change

3.0   **METHODOLOGY**
Methodology is defined as a philosophy of research process which includes the assumptions and values that serve as rationale for researching conclusions. The method of research for this study was the use of available data and survey method.

3.1   **Background Information About the Study Areas:**
Kebbi State is in North-western Nigeria with its capital in Birnin Kebbi. The state was separated from the former Sokoto State. It has a total area of 38sqKm with a population of 5.4million. temperature is generally high with a mean annual temperature of about $26A^0C$ in all locations. However, during the harmattan season (December to February) The temperature can go down to about $21A^0C$ and up to $40A^0C$ during the month of April to June.

Argungu: is a Local Government Area in Kebbi State situated on Sokoto River. As at 2007 Argungu has an estimated population of 47,064. The city is the seat of Argungu Emirate. It has a major Agricultural Centre for the Area with key crops including tobacco, peanuts, rice, millet and sorghum, fish farming is also practiced in the area. The city also hosts an annual international fishing competition sponsored by the Kebbi State Government.

Yauri: is a Local Government Area in Nigeria, Kebbi State and location of the Yauri Emirate. The population of Yauri was about 112,000 people inhibiting a land area of 3,380square Km (1,306square miles).

Yauri's ethnic group include: Shangawa, Kambari and Hausa people. The climate include rainy season which is usually between June and October, however, rain sometimes starts in April. During the rainy season most farmers favour harvesting their crops planting crops and repairing their farms. Festivals and commemoration dominates the rainy season.

Population for the Study: The population for the study consists of Fish Farmers in Argungu and Yauri Local Government Areas in Kebbi State of Nigeria.

Sample Selection: In this research, A multi-stage research sampling-technique is used to select 140 Fish-farmers in Argungu and Yauri Local Government Areas. In the first stage, 02 Local- Government jurisdictions were identified through random selection. In the stage second, seven (07) farmer workers-communities were selected randomly. In the final stage, out of fish farmer community, ten (10) farmer-worker were equally identified from each of the fish farming-community, giving a sum of 140 farmer-workers.

Data Collection: Data was collected on the personal data obtained form the sample of respondents. For instance; sex, age of respondent, marital-status, level of education, years of fish-farming work-experience, number of fish-ponds, cooperative or society membership of, Household size, and farmers income.

Data Analysis: Descriptive statistics such as arithmetic mean and simple percentages were used to achieve the above objectives. Results of the study were interpreted to draw up conclusions.

4.0 RESULTS AND DISCUSSIONS:
4.1 Socio Economic Characteristics of Fish Farmers N = 140:
Table 1

4.1.1 **Sex:** According to information presented in Table 4.1.1. regarding Age of respondents. The results shows that 54(77.1%) Argungu and 60(85.7%) Yauri are male. While a total of 16(22.8^) Argungu and 10(14.2%) Yauri are Female population in the study areas.

4.1.2 **Age:** Opinion regarding Age of respondents revealed that, 12(17.1%) Argungu and 18(25.7%) Yauri are in the Age group 21 – 30 years. About

14(20%) Argungu and 5(7.1%) Yauri belong to the age range 31 – 40 years. Similarly, 22(31.4%) Argungu and 10(14.2%) Yauri are in the age group of 41-50 years. While 13(18.5%) Argungu and 30(42.8%) Yauri belong to 51-60 years of age and finally 9(12.8%) Argungu and 7(10%) Yauri are more than 60 years and above.

4.1.3   **Marital Status:** Perception of respondents on Marital status is presented in Table 4.1.3. The table shows that 18(25.7%)Argungu and 22(31.4%) Yauri are single. While 30(42.8%) Argungu and 25(35.7%) Yauri are married. The lowest number of respondents 10(14.2%) Argungu and 16(22.8%) Yauri are divorced. Similarly, 12(17.1%) Argungu and 7(10%) Yauri are widowed.

4.1.4   **Level of Education:** Data presented in Table 4.1.4 shows that 30(42.8%) Argungu and 28(40%) Yauri had no formal education.   While 26(37.1%) Argungu and 22(31.4%) Yauri are primary school educated. Similarly, 8(11.4%) Argungu and 10(14.2%) Yauri obtained secondary education. A total of 6(8.5%) Argungu and 10(14.2%) Yauri are tertiary level educated. The above findings are in line with Nwalieji and Uzuegbunam, 2012 who reported that a higher percentage i.e.44% of the selected-respondents were primary school graduates. Out of this , 20% have completed their secondary whereas 6% were higher secondary graduates. The above findings are further supported by Salau, et al (2012) who reported that a large proportion of selected-respondents, 38% were not educated al all whereas 36-67% had primary education and 16% had secondary-level education. Finally, 9.3% attended higher-secondary education.

4.1.5   **Fish Farming Experience:**   Information presented in Table 4.1.5 revealed that 33(47.1%) Argungu and 40(57.1%) Yauri had 1 – 5 years experience. While 35(50%) Argungu and 22(31.4%) Yauri had between 6 – 10 years experience and finally, 2(2.8%) Argungu and 8(11.4%) Yauri had 10 years and above fish farming experience.

4.1.6   **Number of Ponds:** Data presented in Table 4.1.6 shows that 52(74.2%) Argungu and 44(58.8%) Yauri had 1 – 5 ponds. Similarly, 18(25.7%) Argungu and 26(37.1%) Yauri possessed 6 – 10 ponds. This shows that majority of the respondents are small Fish Farmers.

4.1.7 **Membership of Cooperatives:**   Perception of respondents regarding membership of cooperative societies shows that 14(20%) Argungu and 25(35.7%) Yauri are members of cooperative societies. While, 50(71.4%) Argungu and 36(51.4%) Yauri belong to Fish Farmers Associations. A total of 6(8.5%)

Argungu and 7(10%) Yauri made monthly contributions. Only 2(2.8%) Yauri did not belong to any cooperative group. The above findings are in line with (Aphunu and Nwabeze 2012) who reported that majority of the respondents (43.8%) were members of fish-farmers association to enable them benefit from agri inputs and credit facilities given to members. Similarly, (17.5%) are members of Cooperative Societies in the study areas.

4.1.8 **Size of Households:** Opinion regarding size of households in the study areas revealed that 36(51.4%) Argungu and 32(45.7%) Yauri had family sizes 1 – 5. While, 28(40%) Argungu and 25(35.7%) Yauri had between 6 – 10 persons in their households. Similarly, 6(8.5%) Argungu and 13(18.5%) Yauri had 10 and above members.

4.1.9 **Personal Income:** Information available in Table 4.1.9 shows that 6(8.5%) Argungu and 14(20%) Yauri had less than N50,000 as their personal income. While 20(28.5%) Argungu and 12(17.1%) Yauri have between N50,000 to N100,000. Similarly, 28(40%) Argungu and 24(34.2%) Yauri have between N100,000 to N200,000. A total of 12(17.1%) Argungu and 18(25.7%) Yauri possesses N200,000 to N300,000 and finally 4(5.7%) Argungu and 2(2.8%) above N300,000.

Table 1: Distribution of Respondents by Personal Characteristics:

Variables	Freq. Argungu	%	Freq. Yauri	%
SEX				
Male	54	77.1	60	85.7
Female	16	22.8	10	14.2
AGE				
21 – 30 Years	12	17.1	18	25.7
31 – 40	14	20	5	7.1
41 – 50	22	31.4	10	14.2
51 – 60	13	18.5	30	42.8
60 and above	9	12.8	7	10
MARITAL STATUS				
Single	18	25.7	22	31.4
Married	30	42.8	25	35.7
Divorced	10	14.2	16	22.8
Widowed	12	17.1	7	10
LEVEL OF EDUCATION				
No formal education	30	42.8	28	40

Primary education	26	37.1	22	31.4
Secondary education	8	11.4	10	14.2
Tertiary education	6	8.5	10	14.2
FISH FARMING EXPERIENCE				
1 – 5 years	33	47.1	40	57.1
6 – 10	35	50	32	31.4
Above 10 years	2	2.8	8	11.4
MEMBERSHIP OF COOPERATIVES				
Cooperative Societies	14	20	25	35.7
Fish Farmers Association	50	71.4	36	51.4
Monthly Contribution	6	8.5	7	10
None	--	--	2	2.8
SIZE OF HOUSEHOLDS				
1 – 5	36	51.4	32	45.7
6 – 10	28	40	25	35.7
Above 10	6	8.5	13	18.5
INCOME OF FARMERS				
Less than N50,000	6	8.5	14	20
N50,000 – N100,000	20	28.5	12	17.1
N100,000 – N200,000	28	40	24	34.2
N200,000 – N300,000	12	17.1	18	25.7
Above N300,000	4	5.7	2	2.8

Source: Survey Data, 2016

Fish Farmer Understanding/Awareness on Climate-change:
According to research-survey outcomes on respondents understanding/awareness on climate-change issues is presented in Table 2. The results indicate that 48(68.5%) Argungu and 33(47.1%) Yauri have knowledge of the climate-change influence on the fish farming business. While 22(31.4%) Argungu and 37(52.8%) Yauri reported lack of knowledge on climate-change. A total of 19(27.1%) Argungu and 22(31.4%) Yauri don't know at all. About 32(45.7%) Argungu and 40(57.1%) Yauri revealed that they know about climate-change impacts in the study areas. The above findings are in line with Ugwoke, et al (2012) whose findings revealed that all the fish farmers have adequate knowledge of climate-change in the study areas i.e 100% of the population. However, large proportion of farmers 45% become aware of climate-change issues to a greater extent and to a very few are not aware.

Table 2: Distribution of Respondents on Awareness on Climate-change Impacts:

Variables	Freq. Argungu	%	Freq. Yauri	%
AWARENESS				
Yes	48	68.5	33	47.1
No	22	31.4	37	
EXTENT OF KNOWLEDGE				
Don't Know	19	27.1	22	31.4
Know Little	32	45.1	40	57.1
Reasonable Extent	16	22.8	5	7.1
Great Extent	3	4.2	3	4.2

Source: Survey Data, 2016

Information Source regarding Climate-change and Fish Farmers/workers:
Opinion regarding information source on climate-change issues is presented, Table No. 3. Results revealed that 5(7.1%) Argungu and 13(18.5%) Yauri reported that they obtain their information through Extension Workers. About 3(4.2%) Argungu and 12(17.1%) Yauri friends/neighbours. Majority of the respondents 28(40%) Argungu and 15(21.4%) Yauri internet. While 6(8.5%) Argungu and 4(5.7%) Yauri personal Experiences. A total of 18(25.7%) Argungu and 20(28.5%) Yauri Newspapers and finally, 10(14.2%) Argungu and 6(8.5%) Yauri reported obtaining their information on climate-change issues through Radio and TV. The above findings are in concurrence with Aphunu and

Nwabeze, (2012) reported that the personal experiences of fish farm farmers are the main sources of information regarding climate change i.e. 33.8%. Furthermore, 21.3% information collected through electronic media i.e. local-radio and news-reports received through local-television channels. Additionally, 18.8% sources of information are through acquaintances and neighborhood. The above findings are further supported by the fact that personal contacts with other community members, family-acquaintances are the main information sources on climate-change matters.

Table 3: Distribution of Respondents by Source of Information on Climate-change to Fish Farmers

Sources	Freq. Argungu	%	Freq. Yauri	%
Extension Workers	5	7.1	13	18.5
Friends/Neighbours	3	4.2	12	17.1
Internet	28	40	15	21.4
Personal Experience	6	8.5	4	5.7
Newspapers	18	25.7	20	28.5
Radio/TV	10	14.2	6	8.5
Total	**70**	**100**	**70**	**100**

Source: Survey Data, 2016

Perception/ understanding of fish-farmer workers on the Impact/influence of Climate-change:
Data presented in Table 4 regarding understanding of fish farmer/workers on the influence of climate-change revealed that 24(34.2%) Argungu and 28(40%) Yauri reported drastic change in weather. While 3(4.2%) Argungu and 10(14.2%) Yauri agreed on poor harvest of Fish. Similarly, 26(37.1%) Argungu and 15(21.4%) Yauri increased harvest of Fish. While 4(5.7%) Argungu and 3(4.2%) Yauri reported increased fish disease infestation. A total of 8(11.4%) Argungu and 7(10%) Yauri agreed on increased cost of fish production. Finally, 5(7.1%) Argungu and 7(10%) Yauri reported reduced cost of fish production in the study areas. The results of the study shows negative impact on weather variability being experienced by sample respondents on the following variables. Crucial change in weather-patterns, low fish harvest yield, increased disease infestations and increased cost of fish production. The above findings were discovered by a

renown climate-change scholar who predicted that significant negative impacts will be realized across twenty five percent of Africa's Inland aquatic ecosystem.

Table 4: Distribution of Respondents According to Perception of Impact of Climate-change.

Variables	Freq. Argungu	%	Freq. Yauri	%
Drastic change in weather	24	34.2	28	40
Poor harvest of Fish	3	4.2	10	14.2
Increased harvest of Fish	26	37.1	15	21.4
Increased Fish disease infestation	4	5.7	3	4.2
Increased Cost of Fish production	8	11.4	7	10
Reduced Cost of Fish production	5	7.1	7	10
Total	**70**	**100**	**70**	**100**

Source: Survey Data, 2016

Actions and approaches to lower the Effects of Climate-change on Fish farming out put yield

Perception of respondents regarding techniques that will minimize effects of climate-change on Fish farming and increasing the yield is presented in Table 5. Results shows that 10(14.2%) Argungu and 15(21.4%) Yauri reported building ponds close to water sources. While 6(8.5%) Argungu and 3(4.2%) Yauri agreed on bore-holes/ well construction to maintain constant availability of water during dry season farming. About 14(20%) Argungu and 9(12.8%) Yauri agreed to building Embankment to prevent floods in the study area. Majority of the respondents 26(37.1%) Argungu and 33(47.1%) Yauri reported on seeking/listening to information about climate-change. The lowest percentage of respondents 2(2.8%) Argungu and 8(11.4%) Yauri agreed to purchase of water-monitoring kits such as Thermometer which will help in coping with climate impact. A total of 12(17.1%) Argungu and 2(2.8%) Yauri favoured using of indoor fish-farming sites. For example, 'Circulatory System' to cope with the climate impact in the study areas. For the climate-change adaptation, the above findings are in line with Aphunu and Nwabeze, (2012) who discovered the various techniques adopted by fish farmers/ workers in Delta State, Nigeria. The results show that about approximately Eight five percent of the respondents were supported the ideas of obtaining / listening to information about climate-change issues and adaptation procedures. While (80%) have agreed to use tarpauline/

water-tank ponds in the hot weather. However, rest of the others (approximately 57.5%) of the opinion that constructing covers or providing shades upon ponds will be efficient in the drought situation will be good enough. Additionally, in such situation, exploring option of bore-holes/ using water-wells to supply water might be useful.

Table 5: Distribution of Respondents According to Strategies to Cope with the Impact of Climate-change.

Strategies	Freq. Argungu	%	Freq. Yauri	%
Build ponds close to water sources	10	14.2	15	21.4
Dig holes/wells to supply water during dry season	6	8.5	3	4.2
Build Embankment to prevent flood water	14	20	9	12.8
Seeking / listening to information about climate-change	26	37.1	33	47.1
Procurement of weather/ water monitoring kits e.g. thermometer	2	2.8	8	11.4
Use of indoor Fish production facilities e.g. circulatory system	12	17.1	2	2.8
Total	**70**	**100**	**70**	**100**

Source: Survey Data, 2016

RESULTS: HYPOTHESIS TESTING
Hypothesis 1: The results of the study have shown that
              H_0 (1) is accepted and H_A Alternate hypothesis is rejected.

Hypothesis 2: Revealed that H_0 (2) Null hypothesis is
              Rejected while H_A Alternate hypothesis is accepted.

5.0   SUMMARY, CONCLUSIONS AND RECOMMENDATIONS
5.1   **Summary:**
The study assess fish-farmers-workers level of awareness regarding climate-change and impact on Fish output /production in Argungu and Yauri Local Government Areas in Kebbi State of Nigeria.

A total sample size of 140 was selected divided into 70 sample size per Local Government.   Multi-stage sample was used in the selection of respondents. Through the help of questionnaire, set of primary data was collected through face to face contact between the researcher and respondents. Data was analysed using arithmetic mean, percentages and descriptive statistics. Results of the study were interpreted in the results and discussion to draw up conclusions.

5.2   **CONCLUSION:**
The major conclusions drawn from this paper were as follows:
1. Opinion regarding source of information on climate-change issues have shown that 5(7.1%) Argungu and 13(18.5%) Yauri reported that they obtained their information through Extension Workers. About 3(4.2%) Argungu and 12(17.1%) Yauri through friends and neighbours. Majority of the respondents 28(40%) Argungu and 15(21.4%) Yauri from Internet. While 6(8.5%) Argungu and 4(5.7%) Yauri personal experiences.

2. Data presented regarding awareness of Fish Farmers on the Impact of climate-change revealed that 24(34.2%) Argungu and 28(40%) Yauri reported drastic change in weather.   While 3(4.2%) Argungu and 10(14.2%) Yauri agreed on poor harvest of fish. Similarly, 26(37.1%) Argungu and 15(21.4%) Yauri increase harvest of fish. While 4(5.7%) Argungu and 3(4.2%) Yauri reported Fish disease infestation. Finally, 5(7.1%) Argungu and 7(10%) Yauri reported reduced cost of fish production in the study areas.

3. Perception of respondents regarding techniques to minimize effect of climate-change on Fish output/Production revealed that 10(14.2%) Argungu and 15(21.4%) Yauri reported building ponds close to water sources.   While 6(8.5%) Argungu and 3(4.2%) Yauri agreed on bore-holes/ water-well construction maintains constant supply of water during dry season/drought. In majority, fish farmers 26(37.1%) Argungu and 33(47.1%) Yauri reported on seeking/listening to information about climate-change. A total of 12(17.1%) Argungu and 2(2.8%) Yauri

favoured using indoor fish production facilities to cope with the effects in the study areas.

5.3   RECOMMENDATIONS
On the basis of the above conclusions, the following recommendations are made.
1.   It is recommended that NGOs should organize enlightenment campaign to educate Fish Farmers on the effects and strategies to overcome with the impact of climate-change in the study areas.

2.   There is a need to explore indigenous adaptive strategies to climate-change that has been used in the past as a second option.

3.   There is a need for active collaboration among Fish Farmers and other Stakeholders to create more awareness on the influence of climate-change on fish farming.

4.   There is a immense demand for research & development and find innovative ways of making fish farming sustainable. Finally there is a need to find out more of adaptation strategies to combat with climate-change challenges.

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