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Influence of Climate Change Information on Climate Change Adaptation among Pond Fish Farmers in Kajola, Nigeria

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ABSTRACT

This study examined how available information on climate change and the reliability of such information determine the adaptation to climate change by pond fish farmers in Kajola (a rural fish farming community in Ogun State, South-West Nigeria). The study used the complete enumeration sampling method to sample 107 pond fish farmers who responded to a questionnaire. Linear regression was used to test the hypotheses. The study found that Kajola pond fish farmers had information on treatment options for fishes diseased due to changes in climatic conditions as well as new knowledge on how changes in climatic conditions affects fish farming and weather condition such as temperature for fish survival in climate change conditions. As such, the farmers relied on available sources of information deem to be dependable. Their use of fellow fish farmers, fish farmers' meetings as well as social media and extension workers as sources of information was low. Farmers adapted to climate change conditions by creating embankments that could withstand flooding; improving water management techniques, and applying treatment options for fishes diseased due to climate change. The study, recommended extensive use of extension workers by government to provide expert knowledge through education to fish farmers on better ways to adapt new fish farming techniques. They also recommend a working synergy between extension workers and opinion leaders among the farmers who could serve as an informed sources of information to other farmers. The farmers' association could equally serve as a source of information to educate other farmers on climate change.

Keywords: Information, Pond Fish Farming, climate change adaptation, Kajola Community

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I. INTRODUCTION

The inconsistent weather condition all over the world impacting land and sea indicating the reality of climate change has assumed a worrisome dimension as its negative impacts have become a threat to human survival, particularly on agriculture. This can be seen in the pattern of rainfall, the nature of flooding, increase sea level and devastating earthquakes, high temperature, desertification and drought.

This development has brought about the destruction of farm lands, death among aquatic animals and negative economic impacts (Hall., 2015). The prevailing climatic condition has not only become a global concern but equally cast doubt on the possibility of sustaining fish farming with economic implications (Faruque & Kabir., 2016; Adeleke & Omoboyeje, 2016; Misganaw, Bezezew & Getu., 2015. Asiedu., Adetola & Kissi., 2017). All these suggest that human existence is threatened by the recent changes in climatic conditions. Currently, this phenomenon is changing species distribution in freshwater. The species in warm-water are experiencing changes in productivity and size . Similarly, climate change has lead to the alteration of food webs in both marine water and freshwater. This is not without a high level of consequences on fish production (Halim, Mondal, Salam, & Hossain., 2017)

In a study carried out in Bangladesh, 62% of fish farmers stated that high temperature is a major factor that has hindered reasonable fish harvest in recent time due to climate change. Outbreak of disease as well as insufficiency of water were also identified as problems as a result of climate change. The study further found that less rainfall results in lower fish growth. These consequences of climate change, have made most fish farmers to abandon fish farming. As such, most of the fish farmers in Bangladesh are faced with the the challenge of loosing their means of livelihood. Currently, there is lower fish production as well as reduction in egg production as a result of seasonal fluctuations caused by climate change, (Halim et al, 2017).

Presently, scholars are calling for techniques in adaptation and mitigation to cushion the impacts of changes in climatic condition. While adapting to climate change, requires the farmers to adjust their farming techniques in response to the current demands of climate change mitigation calls for adequate measures to reduce human influence such as greenhouse emissions on the climate. ***Adaptation to climate change by fish farmers, which demands collective efforts has become imperative to combat the damaging effects of climate change on fishing business (Zhao, et al., 2018).***

Communication channels including conventional mass media and information communication technology (ICT) could bridge knowledge gap on climate change by creating awareness to enhance knowledge needed to form the right attitude for adaptation by individuals, groups and societies. (Osberghaus., Finkel, & Pohl, n.d.). ***Timely information and awareness are critical to build stakeholders' capacity in strategy formulation and adaptation at all levels including use of social media platforms and community radio among other media channels. These are increasingly available in most developing countries to improve the creation, application, exchange and management of relevant climate change information needed to acquire the right knowledge necessary to take informed decisions in the face of climate change challenges.*** (Upadhyay & Bijalwan., 2015)

Accessing credible information on fish farming, particularly on adaptation to climate change, is important at every stage in the fish farming value chain to track measures, developments and innovations needed to achieve effective results as well as to manage crises resulting from changes in climatic conditions. Information access and feedback are within the framework of agricultural communication for development.

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This involve the use of radio, television, newspapers, social media, group and interpersonal communication to mobilize people for participation in agricultural development. This is important as over 1.5 million metric tons of fish is required annually to meet the protein needs of Nigerians. However, only 500,000 metric tons are produced locally (Wake & Geleto, 2019). Considering the dynamics of climate change, fish farmers need updated and regular information. This will keep them informed on effective and adaptable methods for sustenance. Failure to mobilize fish farmers through information to adopt measures against the effect of climate change could lead to a reduction in production, loss of livelihood, and revenue in a sector that has contributed to food security and nutrition by supporting the sustenance of over 10% of the world's population. (FAO, 2018)

Knowledge shared from information on climate change provides direction on when and how actions can be taken to protect and sustain the ecosystems as well as manage freshwater resources. (Malhi, Franklin, Seddon,, Solan, Turner, Field, Knowlton., 2020). Much as fish farmers can acquire farming skills through informal processes to cop with regular demands of the profession, technical and unexpected challenges could be frustrating and cause some damages without knowledge base information to guide them. As such fish farmers by the demand of the prevailing climate change challenges, need new and knowledge base information from reliable and perhaps scientifically base sources *to take informed decisions and effective action.* Several studies have examined the information needs of farmers (Obwanga et al., 2018; Ijatuyi, et al., 2016; Uzezi, 2015, Soliman, & Yacout., 2016). However, very few have looked at the availability of information needed in relation to the reliability of the sources of such information to pond fish farmers. This gap necessitated the present study aimed at examining how available information on climate changes can influence fish farmer's adaptation to climate change.

Strategically, the study underscores the importance of information in fish farming as it relates to availability of information as a required knowledge baseline for climate change adaptation, the management of such information, the application of the information by way of transferring available knowledge to required skill for maximal fish farming operation and consequent optimal results for profitable economic benefits. To this end, the study on one hand, is expected to encourage fish farmers to seek the right information from informed sources such as agricultural extension workers to adapt to the effect of climate change instead of relying on personal experience without knowledge of the climate change phenomenon. On the other hand, the study is expected to motivate agricultural agencies with the right knowledge and information to reach out to the fish farmers with a view of educating them to boost their fish farming skills, know how to adapt to the effect of climate change to enhance fish productivity. This will in turn improve agricultural chain value of food production and the consequent economic benefits.

2. METHODOLOGY

The study employed the survey research method. The total population of the fish farmers is 107. Consequently, the complete enumeration sample size method, also known as the total enumeration sample size method or census sample size method was adopted. This method is often used in studies with small populations. A total of 107 copies of questionnaire were administered but 98 copies were retrieved.

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Data was analyzed using frequency and percentage for the demography and linear regression for the test of hypotheses. The scales in the questionnaire were subjected to reliability test. The Cronbach's Alpha values for climate change information available to fish farmers was 0.846 and sources of climate change information available to farmers was 0.785, thus establishing adequate internal consistency. The study was carried out in Kajola, in Odogbolu local government area of Ogun State, South-West of Nigeria. Kajola is known for pond fish farming, (particularly catfish) which provides over three hundred direct and indirect jobs with a fish feed mill as a subsidiary.

3. RESULTS AND DISCUSSION

Table I: Demographic Characteristics of Respondents

Variable		Frequency (n)	Percentage (%)
Age	21-25	17	17.3
	26-30	5	5.1
	31-35	30	30.6
	36-40	25	25.5
	41 and above	21	21.4
	Total	**98**	**100**
Gender	Male	74	75.5
	Female	24	24.5
	Total	**98**	**100**
Academic Qualification	Primary School Leaving Certificate	9	9.2
	West African School Certificate	17	17.3
	National Diploma Certificate/NCE	33	33.7
	HND/BA/B.Sc	34	34.7
	Masters degree and above	5	5.1
	Total	**98**	**100**
Years of experience in Fish Farming	1-5 years	36	36.7
	5-10 years	41	41.8
	11-15 years	17	17.3
	16-20 years	4	4.1
	Total	**98**	**100**

Table I shows that the greater number of the study participants were males between 31 and 41 years (75.5%). This provides evidence that fish farming is a male dominated vocation as found by Benard, Dulle, Lamtane, 2018, and Ejiogu-Okereke, 2016. Male preponderance in fish farming could be due to the physical energy demands of fish farming for which a greater number of women may not be disposed to in comparison with their male counterparts. 30.6% of pond fish farmers in Kajola were relatively young persons within the age bracket of 31-35 years. 41.8% of them had been involved in fish farming for 5-10 years while 17.3% have been into fish farming for

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11-16 years. Those who had been involved in fish farming for longer periods were 21.4% This suggests that most of the fish farmers took to the trade particularly in the last ten years probably due to the perceived prospects of the business or the absence of jobs, as graduates of universities and equivalents qualifications in Kajola fish farming community are put at 34.7%

Table II: Climatic change Information

Fish farmers had information on...	$\bar{x}$	SD
Treatment options for fishes diseased due to climate change	3.86	1.10
How climate change affects fish farming	3.66	1.21
Weather conditions and temperature for fish survival in climate change conditions	3.66	1.11
Water management techniques to adopt in climate change conditions	3.65	1.32
How and when to create embankment against flooding due to climate change	3.55	1.21
How to construct ponds that can mitigate climate change conditions	3.42	1.36
Types of fingerlings that can survive the effects of climate change	3.33	1.57
Right fish feeding patterns under climate change conditions	3.12	1.41
Average Mean	3.53	1.29

***Decision Rule: if mean is ≤ 1.49 =Not at all; 1.5 to 2.49 = Very Low; 2.5 to 3.49 = Low; 3.5 to 4.49= High; 4.5 to 5= Very High.

Table II shows that fish farmers had information on climate change about treatment options for fishes affected by climate change ($\bar{x}$=3.86), followed by how climate change affects fish farming and weather conditions; and temperature for fish survival in climate change conditions at $\bar{x}$=3.66. Climate change information on how to construct ponds that can withstand climate change conditions made available to the fish farmers was low ($\bar{x}$=3.42). Information on types of fingerlings that can survive the effects of climate change put at $\bar{x}$=3.33 and the appropriate feeding patterns under climate change conditions at $\bar{x}$=3.12 was equally low. Overall, climate change information available to the fish farmers was high at the average mean score of $\bar{x}$=3.53. This finding contrasts with that of Onyango et al., (2014) on the climate change information needs of small scale farming and fishing communities in Kenya for enhanced adaptive potential to climate change, which found that the fishermen had need of information on short-term forecast of wind direction and movement of water current.

This noticeable differences on availability of information between the targets of these studies can be explained by the obvious difference in fish farming methods in the two studies. Whereas our study looked at pond fish farmers, Onyango,, *Ochieng,, and Awiti, (2014),* examined river-based fish farmers, thus suggesting that information needs could vary by methods of fish farming . The concerns of these respondents about treatment options for fishes diseased due to climate change could be germane as indicated in previous studies. For example, Mallick and Panigrahi (2018) reported that temperature resulting from variability in weather due to climate change affects the development of parasites and pathogen bacteria and could also reduce the resistance of fish to disease.

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Similarly, Boyle (2020) reported a study by researchers from the Institute of Evolution Sciences at the University of Montpellier, France, which found that resistant bacteria in aquaculture can spread genes to non-resistant bacteria that affect humans, causing diseases that are difficult to treat. The import of this is that fishes diseased due to climate change could cause huge financial losses to the fish farmer and possible health hazard to society.

Sources of Climatic change Information

Table III: Sources of Climatic change Information

Sources of information on climate change	$\bar{x}$	SD
Fellow fish farmers	3.08	1.62
Fish farmers' association meetings	2.74	1.56
Social media/Internet	2.18	1.33
Agricultural extension workers	2.13	1.28
Farmers' journals	1.78	1.14
Television	1.69	1.06
Radio	1.50	0.90
Magazines	1.49	0.82
Newspapers	1.42	0.76
Average Mean	**2.00**	**1.16**

Decision Rule: if mean is ≤ 1.49 =Not at all; 1.5 to 2.49 = Very Low; 2.5 to 3.49 = Low; 3.5 to 4.49= High; 4.5 to 5= Very High

Table III shows the sources from which pond fish farmers got information on climate change. The farmers' use of fellow fish farmers and farmers' association meetings as climate change information sources was low ($\bar{x}$=3.08 and $\bar{x}$=2.74), Equally low were farmers' journals $\bar{x}$=1.78, television, $\bar{x}$=2.18 and radio $\bar{x}$=1.50. The use of social media and agricultural extension workers was very low at $\bar{x}$=2.18 and $\bar{x}$=2.13 respectively. Magazines and newspapers were not used at al. This outcome contrasts with Uzezi's (2015) study on availability of information and seeking behaviour of migrant fishermen in Delta state, Nigeria which revealed that 71.9% of the 115 respondents listed previous knowledge as the source of information. This is similar to the finding by Okoro, et al., (2020) that 98.1% of their respondents relied on personal observation as their source of information.

The low use of fellow fish farmers and farmers' association meetings as climate change information sources among these respondents raises concern about their main sources of idea in climate adaptation. ***It was expected that they sought information from fellow fish farmers and farmers' association meetings considering the proximity and the common interest that they share with these sources. As noted by Stutsman, Molnar., Atukunda. and Walakira (2017), it is important to prioritize provision of quality information as part of training for fish farmers.***

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Table IV: Techniques adopted by Kajola pond fish farmers in response to climate change

Reliability Rating	$\bar{x}$	SD
Created embankments that can withstand flooding	3.77	1.24
Adopted improved water management techniques	3.72	1.32
Constructed ponds	3.70	1.06
Applied available disease treatment for fish affected by climate change	3.65	1.22
Adopted improved feeding patterns for fish under climate change conditions	3.51	1.38
Stocking the right fingerlings that can withstand climate change	3.41	1.46
Acquired knowledge through reliable sources to manage climate change conditions	3.07	1.70
Average Mean	**3.55**	**1.34**

Decision Rule: if mean is ≤ 1.49 =Not at all; 1.5 to 2.49 = Very Low; 2.5 to 3.49 = Low; 3.5 to 4.49= High; 4.5 to 5= Very High

From the above table, adaptation of fish farmers to climate change may be a function of their fish farming experience. This supports the position by Nkoana, Verbruggen and Hugé (2018), that adaptation strategies are location and context-specific. It equally explains why embankment creation, improved water management techniques, and pond construction were highly adapted approaches to climate change by the fish farmers in this study. The low adoption of stocking the right fingerlings that could withstand climate change by the respondents is understood as fingerlings variation depends on the specific type of fish farmed by the respondents. Seeking new fingerling species might imply moving from one fish farming type to another and thus requires new orientations and knowledge acquisition on the new fish type by the farmers. Most of the respondents did not view knowledge acquisition through reliable sources to manage climate change conditions as important for adaptation

Creation of embankments to withstand flooding was highly adapted at $\bar{x}$=3.77, improved water management was highly adapted at $\bar{x}$=3.72, pond construction was highly adapted at $\bar{x}$=3.70, application of available disease treatment for fishes affected by climate change was high at 3.65 and adoption of improved feeding patterns was equally high at 3.51. Stocking right fingerling species to withstand climate change and acquiring knowledge through reliable sources to manage climate change conditions were low at $\bar{x}$=3.41 and $\bar{x}$=3.07 respectively. $\bar{x}$=3.07).

Test of Hypotheses

Decision Rule

The pre-set level of significance for this study was 0.05. The hypotheses presumed that there was a significant influence between the variables under consideration. If the P-value exceeded the pre-set level of significance (p>0.05), the hypothesis stated in alternate form was rejected, however, if the p-value was less than or equal to 0.05 (P ≤0.05), the hypothesis was accepted.
Influence of Information on Climate Change Adaptation

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H1: Information significantly influence adaptation to climate change

Table V: Simple Linear Regression Testing the Influence of Information on Climate Change adaptation.

Variable	Coeff.	t-Stat.	Prob.
C	5.520	3.063	0.003
Information Needs	0.661	9.518	**0.000*** **
R	0.699		
R^2	0.488		
Adj. R^2	0.483		
F-Statistic	90.588		
Prob.(F-Stat)	**0.000*** **		
Dependent Variable	**Adaptation to Climate Change**		

Table V indicates that information significantly influenced adaptation to climate change (β= 0.661, R^2= 0.488, p< 0.05). From a relative perspective, information had a positive moderate significant influence on adaptation to climate change (r = 0.699, p<0.05). This suggests that increase in Information improved their adaptation to climate change. The model explained 48.8 percent (R^2= 0.488) variation of their adaptation to climate change. The hypothesis therefore was accepted.

Reliability of Climate Change Information Sources

H2: Reliability of climate change information sources significantly influences Kajola pond fish farmers' adaptation to climate change

Table VI: Simple Linear Regression Testing the Influence of Reliability of Sources of Climate Change Information on Fish Farmers' Adaptation to Climate Change

Variable	Coeff.	t-Stat.	Prob.
C	13.054	7.572	0.000
Reliability of Sources of Info.	0.843	5.568	**0.000*** **
R	0.498		
R^2	0.248		
Adj. R^2	0.240		
F-Statistic	31.002		
Prob.(F-Stat)	**0.000*** **		
Dependent Variable	**Adaptation to Climate Change**		

Table VI shows that reliability of sources of information on climate change significantly influenced fish farmers' adaptation to climate change (β= 0.843, R^2= 0.248, p< 0.05). Reliability of climate change information sources had a positive weak significant influence on adaptation to climate change (r = 0.498, p<0.05). This implies that increase in fish farmers' reliability of sources of information on climate change improved adaptation to climate change. The model shows that reliability of sources of information on climate change explained the 24.8 percent (R^2= 0.248) variation of fish farmers' adaptation to climate change.

Therefore, the hypothesis that reliability of sources of information on climate change significantly influenced fish farmers' adaptation to climate change was accepted.

The decisive finding from this study is that from a relative perspective, based on the first hypothesis, information on climate change at the disposal of fish farmers had a positive moderate significant influence on adaptation to climate change, suggesting that information improved their adaptation. The second hypothesis shows that reliability of sources of information on climate change significantly influenced fish farmers' adaptation to climate change, implying that fish farmers' reliability on climate change information sources improved adaptation to climate change. This finding aligns with the submission of Upadhyay and Bijalwan (2015) that timely information and awareness are pivotal to building and strengthening the capacity of multiple stakeholders involved in climate change adaptation strategies at the micro and macro levels.

4. CONCLUSION AND RECOMMENDATIONS

Although climate change issues are not new in aquaculture literature and practice, much studies are needed on how pond fish farmers respond and adapt to its challenges. The availability of information on climatic condition, will continue to be dependent on location, context and fish farming typology. Findings from this study show that pond fish farmers in Kajola had information on climate change. The finding further shows that accessing information on climate change from the various sources was low. This could mean that the fish farmers rely on personal experience to find solution to the challenges associated with climate change.

Much as accessing information from the sources were low, the information had significant influence on the fish farmers adaptation to climate change. Consequently, most of the farmers have adapted measures to check the effects of climate change on fishes based on the reliability of such sources of information. It is therefore recommended that agricultural extension workers routinely visit and collaborate with fish farmers to provide technical knowledge and expertise devoid of guesswork or speculations. Some of such visits could be to the fish farmers association meetings to encourage better coverage and impact. Social media could be deployed by agricultural extension workers to reach fish farmers with relevant agricultural and climate change information.

REFERENCES

Adeleke, M. I. &Omoboyeje, V. O. (2010). Effects of climate change on aquaculture production and management in Akure Metropolis, Ondo State, Nigeria. *Nigerian journal of fisheries and aquaculture, 4*(1), 50-58. https://www.academiapublishing.org/jo...

Antoun, C. (2015). Who are the internet users, mobile internet users, and mobile-mostly internet users?: Demographic differences across internet-use subgroups in the U.S. In: Toninelli, D., Pinter, R.,& de Pedraza, P.(eds.) Mobile Research Methods: Opportunities and Challenges of Mobile Research Methodologies, pp. 99–117.London: Ubiquity Press. DOI: http://dx.doi.org/10.5334/bar.g. License: CC-BY 4.0.

Asiedu, B., Adetola, J., &Kissi, I. O. (2017). Aquaculture in troubled climates: Farmers' perception of climate change and their adaptation. *Cogent food and agriculture.* 3 (1) Benard, R., Dulle, F.,& Lamtane, H.(2018). Use of ICTs in sharing agricultural information among fish farmers in the southern highlands of Tanzania. Sokoine University. Retrieved from: http://www.suaire.suanet.ac.tz:8080/xmlui/handle/123456789/2483.

Boyle, L.. (2020, April, 27). Farmed fish at increased risk of disease due to global warming. *The Independent.* Retrieved from https://www.independent.co.uk/environment/fish-seafood-farming-global-warming-climate-change-a9486481.html

Chaffey, D. (2020). Global social media research summary 2020. Retrieved from https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research/

Ejiogu-Okereke, N.E.,Chikaire, J.U.,Ogueri, E.I, &Chikezie, N.P. (2016). Roles of information and communication technologies in improving fish farming and production in Rivers state, Nigeria. *Library philosophy and practice (e- journal)*. 1445, 1-16. http://digitalcommon.unl.edu/linphilprac/1445

FAO, 2018). *Impacts of climate change on fisheries and aquaculture: Synthesis of current knowledge, adaptation and mitigation options*. Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S., & Poulain, F., (Eds.) Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 629 pp.

Faruque, M.H. and Kabir, M.A. (2016).Climate change effects on aquaculture: A case study from north western Bangladesh. *International Journal of Fisheries and Aquatic Studie*s.; 4(5): 550-556.

Hall, G.M. (2015)*Impact of Climate Change on Aquaculture: The Need for Alternative Feed Components. Turkish Journal of Fisheries and Aquatic Sciences. 15: 569-574 (2015).* DOI: 10.4194/1303-2712-v15_2_45

Halim, A., Mondal, D., Salam, M. A., & Hossain, S. (2017). Impacts of climate change on pond fish farming in Amtoli, Borguna, Bangladesh. *International journal of fisheries and aquatic studies. 5(2), 38-41.*

Ijatuyi, E. J., Abiolu, O.A., &Olaniyi, O.A. (2016) Information Needs of Fish Farmers in Osun-state, Nigeria.*Journal of Human Ecology*, 56:3, 309-317, DOI: 10.1080/09709274.2016.11907068.

Malhi, Y., Franklin, J., Seddon,N., Solan, M., Turner, M.G., Field, C.B., Knowlton. N. (2020) Climate change and ecosystems: threats,opportunities and solutions. Philosophy Transactions. Royal. Society.B *375*: 20190104.http://dx.doi.org/10.1098/rstb.2019.0104

Mallick, A. and Ashis Kumar Panigrahi, A.K. (2018).*Effect of temperature variation on disease proliferation of common fishes in perspective of climate change International Journal of Experimental Research and Review.* Vol. 16: 40-49

Misganaw, K., Bezezew, M.,&Getu, A. (2015). Review work on the impact of climate change on fish and fisheries. *Global Research Journal of Fisheries Science and Aquaculture.*2(1). P.015-019.

Nkoana, E.M., Verbruggen, A. and Hugé, J. (2018). *Climate change adaptation tools at the communityLevel: An integrated literature review.* Sustainability.doi:10.3390/su10030796

Obwanga, B., Rurangwa, E., van Duijn, A. P., Soma, K., &Kilelu, C. W. (2018). *A comparative study of aquaculture sector development in Egypt, Ghana and Nigeria: Insights and lessons for Kenya*. (Report 3R Kenya Project; No. 006). Wageningen Marine Research.

Okoro, J.C. Agwu, A.E. &Anugwa, I. Q. (2020). Climate change information needs of rural farmers in Enugu state. *Journal of Agricultural Extension*. http://dx.doi.org/10.4314/jae.v20i2.16

Onyango, E., Ochieng, S., Awiti, A. (2014). Weather and climate information needs of small-scale farming and fishing communities in western Kenya for enhanced adaptive potential to climate change. Proceedings of Sustainable Research and Innovation Conference, 4,187-193.

Osberghaus, D.,Finkel, E.,&Pohl, M. (n.d). Individual adaptation to climate change: The role of information. Centre for European economic research.ftp://ftp.zew.de/pub/zew-docs/dp/dp10061.pdf

Soliman, N.F.,&Yacout, D. (2016). Aquaculture in Egypt: Status, constraints and potentials. *Aquaculture International* 24(5). doi: 10.1007/s10499-016-9989-9

Stutsman E., Molnar J., Atukunda G.,&Walakira J. (2017). Understanding the role of fish farmers' associations as intermediaries for the commercialization of aquaculture in Uganda. Fisheries and Aquaculture Journal*. 8: 214. doi:10.4172/2150-3508.1000214*.

Upadhyay, A.P.&Bijalwan, A. (2015). Climate change adaptation: Services and role of information communication Technology (ICT) in India. *American journal of environmental protection, 4*(1), 70-74. http://www.sciencepublishinggroup.com/j/ajep]

Uzezi, P.O. (2015). Information needs and seeking behaviour of migrant fishermen: A case of Isoko riverine communities, Delta state Nigeria*. International Journal of Scientific and Technological Research.* 4(8).

Wake, A.A. and Geleto, T.C. (2019). Socio-economic importance of Fish production and consumption status in Ethiopia: A review. *International Journal of Fisheries and Aquatic Studies*; 7(4): 206-211

Zhao, C., Yan, Y., Wang, C., Tang, M., Wu, G., Ding D., & Yang Song. (2018): Adaptation and mitigation for combating climate change – from single to joint. Ecosystem Health and Sustainability*, 4:4, 85-94, DOI:10,.1080/20964129.2018.1466632.*