Hypothetical Assessment of Climate Variability performance in Anambra – Imo River Basin using Pearson's Product Moment Correlation Analysis [1]

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Abstract

The aim of the study is to carry out hypothetical analysis of the climate variability performance using Pearson's product moment correlation in Anambra-Imo River basin. The objective is to achieve climate change solution in the river basin planning and management in order to bring together fragmented water users into integrated planning, allocation and management framework essential for climate change adaptation with goal potential to multiple sustainability challenges. The methodology involves the use of questionnaires to elicit responses of project workers and staff of the river basin. The result of the questionnaire responses show that the computed coefficient of correlation (r) is a linear trend line based on the scatter diagram. The work concluded that the responses of respondents are consistent. It was recommended that since many uncertainties in climate change projections impact on the ecosystem, optimal strategies should incorporate delivering benefits irrespective of climate conditions, through status assessment, understanding assumptions made, long term consistent monitoring of data, effectiveness and cost of efficiency.

Keywords: Climate variability, optimal strategies, sustainability challenges, effectiveness.

1.0 Introduction

Climate variability has a serious impact with wide range of implementation strategies. These include changes in water temperatures river flow, recharge of groundwater, water availability, intensity and frequency of extreme events such as floods and droughts, rise in sea level and saltwater intrusion, pollution land changes and water quality which are the most relevant physical and chemical factors (Bates, kandzawicz, Wu and Palutikof, 2008). There is a clear indication that River basin problem in a climate change situation is a decision problem and the issues on decision are bordering on the following:

(i). Fluctuation in rainfall, temperature, and other climate change conditions which affect the delivery of benefits to the River Basin Development.

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(ii). Lack of clear understanding of the assumptions made and uncertainties related to such assumptions on projections and scenarios based on climate change models affects improvement in Anambra – Imo River Basin Management Planning.

(iii). Inadequate use of range of climate projections and scenarios by Managers in the River Basin Management planning in order to accept and work within the content of uncertain future

(iv). Lack of primary consideration of direct impact of climate change for water bodies as well as secondary impacts (indirect impacts of climate change due to society's adaptation and mitigation activities)

(v). Lack of proper use of climate change indicators with long term consistent monitoring data to improve prediction of flood risks and forecast for water scarcity and drought.

(vi). Non employment of long-term effectiveness and cost efficiency under changing climatic conditions evaluation as programme of measures for River Basin Management.

(vii). There is food insecurity and freshwater quality pollution at various locations due to overflows, heritage source/cultural sites damage as a result of climate change.

(viii). Erosion induced gullies at various sites of the basin, unbalancing of the ecosystem and greenhouse gas emission resulting from climate change problems.

(ix). There are various flood disasters in many communities which have led to loss of lives, properties, infrastructures, human suffering and precipitation fluctuations as a result of climate change in the river basin.

(x). There is problem of deforestation resulting to failure of ecosystem, erosion and other issues which poses threat to climate change solution.

(xi). Problem of land tenure systems hamper investment in dams and heavy engineering projects that require arable land with associated compensation and resettlement expenditures affects capital for project development of water resources in the river basin.

(xii). Financial constraints and effect of logical cost sharing with resultant overlapping of functions affect the optimization of resources in multi-purpose/multi-objectives capital development projects of Anambra-Imo River basin.

2.0 Aim and Objectives

The study aimed at carrying out hypothetical analysis of climate variability performance in Anambra – Imo river basin using Pearson's product moment Correlation and regression analysis. The objective is to achieve climate change solution in the river basin planning and management in order to bring together fragmented water users into integrated planning, allocation and management framework essential for climate change adaptation with goal potential to multiple sustainability challenges.

3.0 Methodology

The methodology involved primary data based on the information obtained from the questionnaire responses.

3.1 Method of data Analysis

Analysis of Questionnaire Responses

The analysis of questionnaire responses was done using mean scores, coefficient of correlation on a five-point Likert scale. In analyzing the data, the mean scores were used to answer the research questions which guided the study. A cut-off mean score of 3.25 and above was regarded as constituting a problem, while a mean score of less than 3.25 was regarded as not constituting a problem. In calculating the mean, the five point rating scale was given the following values;

(i)	Strongly Agree	(SA)	5 values
(ii)	Agree	(AG)	4 values
(iii)	Undecided	(UD)	3 values
(iv)	Disagree	(DA)	2 values
(v)	Strongly Disagree	(SD)	1 value.

The formula for the mean,

$$\bar{X} = \frac{\sum fx}{N} \qquad (1)$$

were used to calculate the average score, where

Σ = summation or sum of
f = frequency of observation
X = individual
N = number of samples

Pearson Product Moment Correlation Coefficient (PPMCC) denoted by (r) was used to determine the strength of the correlation between the two variables X which represents responses from sample of eighty (80) respondents selected from the project workers and Y which represents the responses from sample of forty (40) respondents from staff of Anambra-Imo River basin. The PPMCC or r has values $-1 \leq r \leq +1$. As the value approaches +1, the stronger the correlation. The sample linear correlation that have positive correlation shows that both X and Y increase or decrease together while negative correlation is when X increases as Y decreases i.e. change in opposite direction. The value of r = 1 shows a perfect positive correlation.

Decision Rule: The mean score of above 3.25 from the respondents indicates that the problem exists from the responses while below 3.25 shows the problems are regarded as disagreed.

4.0 Analysis and Discussion of Results

4.1 Results Obtained from Questionnaire Responses of Project Workers and Staff of Anambra-Imo River Basin on Climate Change

The results obtained from questionnaire no. 1 were presented as follows.

i. Does fluctuation in rainfall, temperature, and other climate change conditions affect the delivery of benefits to the Anambra-Imo River Basin Development?

Table 1: Scored/Graded Responses of the Respondents in Question No.1 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
A	The fluctuation in rainfall, temperature, and other climate change conditions severely affect the delivery of benefits to the Anambra-Imo River Basin Development Projects.	4.50	4.60
B	The fluctuations in rainfall, temperature, and other climate change conditions have resulted to the damage of ecological systems in the River Basin.	4.84	4.45
C	The effect of fluctuation in rainfall, temperature, and other climate change conditions has resulted to the increase in the cost of investment in erosion control, flood control and other multipurpose projects development in Anambra-Imo River Basin.	4.76	4.55
	Grand mean score	**4.70**	**4.53**

The grand mean scores of 4.70 for X and 4.53 for Y indicates that fluctuation in rainfall, temperature, and other climate change conditions affect the delivery of benefits for the River Basin Development. So, it is a problem.

ii. Does lack of clear understanding of the assumptions made and uncertainties related to such assumptions on projections and scenarios based on climate change models affects improvement in Anambra – Imo River Basin Management Planning?

Table 2: Scored/Graded Responses of the Respondents for Question No.2 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
A	Lack of clear understanding of the assumptions made and uncertainties related to such assumptions on projections and scenarios based on climate change models affects improvement in Management Planning of the River Basin.	4.40	4.25
B	Lack of adequate data on climate change models effects affects the Management Planning of projects development in the River Basin.	4.55	4.70
C	There is lack technical know-how in manipulation of climate change data which has resulted to poor Planning and Management of the River Basin development projects.	4.65	4.45
	Grand mean score	**4.53**	**4.47**

The grand mean scores of 4.53 for X and 4.47 for Y shows that there is lack of clear understanding of the assumptions made and uncertainties related to such assumptions on projections and scenarios based on climate change models affects improvement in Anambra – Imo River Basin Management Planning thus a problem.

iii. Does the use of inadequate range of climate projections and scenarios by Managers in the River Basin Management planning prevent them to accept and work within the content of uncertain future?

Table 3: Scored/Graded Responses of the Respondents for Question No.3 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
A	The Managers in the River Basin do not use range of climate projections and scenarios to accept and work within the content of uncertain future.	4.20	3.95
B	There is no adequate data on climate projections and scenarios to manage climate change problems in the River Basin	4.25	4.15
C	The Managers of the River Basin do not have the knowledge or ability to use range of climate change projections and scenarios to tackle the effect on river basin.	4.67	4.15
	Grand mean score	**4.37**	**4.20**

The grand mean scores of 4.37 for X and 4.20 for Y shows that there is problem that the use of inadequate range of climate projections and scenarios by Managers in the River Basin Management planning prevent them to accept and work within the content of uncertain future

iv. Does lack of primary consideration of direct impact of climate change affect the water bodies as well as secondary impacts on society's adaptation and mitigation activities?

Table 4: Scored/Graded Responses of the Respondents for Question No.4 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
A	Lack of primary consideration of direct impact of climate change affect the full capacity utilization in Anambra-Imo River Basin.	4.52	4.65
B	Lack of secondary consideration (indirect impact of climate change due to society's adaptation and utilization activities) affect the full capacity utilization of the River Basin.	4.46	4.34
C	Inability of the river basin management to integrate the direct and indirect impact of climate change is responsible for lack of full capacity utilization of multi-purpose/multi-objective river basin development projects.	4.44	4.24
	Grand mean score	**4.47**	**4.41**

The grand mean scores of 4.47 for X and 4.41 for Y shows that lack of primary consideration of direct impact of climate change affect the water bodies as well as secondary impacts on society's adaptation and mitigation activities constitutes a problem.

v. Does lack of proper use of climate change indicators with long term consistent monitoring data affect the prediction of flood risks and forecast for water scarcity and drought?

Table 5: Scored/Graded Responses of the Respondents for Question No.5 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
A	The poor prediction of flood risks and forecast for water scarcity and drought is due to lack of proper use of climate change indicators	4.64	4.62
B	The lack of use of long-term consistent monitoring data affect the prediction of flood risks and forecast for water scarcity and drought.	4.22	4.24
C	Lack of capacity of river basin management to use the of climate change indicators with long term consistent monitoring data affect improvement of prediction of flood risks and forecast for water scarcity and drought.	3.85	3.63
	Grand mean score	**4.24**	**4.16**

The grand mean scores of 4.24 for X and 4.16 for Y show that lack of proper use of climate change indicators with long term consistent monitoring data affect the prediction on flood risks and forecast for water scarcity and drought is a problem.

vi. Does non-employment of long-term effectiveness and cost efficiency under changing climatic conditions evaluation affect programme of measures for River Basin Management?

Table 6: Scored/Graded Responses of the Respondents for Question No.6 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
A	Non-employment of long-term effectiveness and cost efficiency, under changing climatic conditions evaluation affect programme of measures for the river basin management	4.02	3.82
B	The programme of measures for river basin management is affected by non-employment of long-term effectiveness under changing climatic conditions.	3.93	3.86
C	The programme of measures for river basin management is affected by non-employment of cost efficiency under changing climatic conditions.	3.87	4.04
	Grand mean score	**3.94**	**3.91**

The grand mean scores of 3.94 for X and 3.91 for Y show that there is problem of non-employment of long term effectiveness and cost efficiency under changing climatic conditions evaluation affect programme of measures for River Basin Management.

vii. Does a climate change condition result to food insecurity and freshwater quality pollution at various locations due to overflows, heritage source/cultural sites damage at the river basin?

Table 7: Scored/Graded Responses of the Respondents for Question No.7 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
a.	Climate change problem result to food insecurity and freshwater quality pollution at various locations.	4.75	4.49
b.	The over flows, damage of heritage source/cultural sites are caused by effect of climate change problems at the river basin.	4.35	3.96
c.	Food insecurity and freshwater quality pollution at various locations due to over flows, heritage source/cultural sites damage as a result of climate change hinder the full capacity utilization of river basin multi-purpose/multi-objective development projects.	4.41	4.27
	Grand mean score	**4.50**	**4.24**

The grand mean scores of 4.50 for X and 4.24 for Y shows that climate change condition result to food insecurity and freshwater quality pollution at various locations due to overflows, heritage source/cultural sites damage at the river basin

viii. Does erosion induced gullies at various sites of the basin affect the balancing of the ecosystem and greenhouse gas emission resulting from climate change problems?

Table 8: Scored/Graded Responses of the Respondents for Question No.8 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
a.	Climate change problems result erosion induced gullies at various sites of the basin.	3.55	3.60
b.	Climate change problems result erosion induced gullies, unbalancing of the ecosystem and greenhouse gas emission.	4.46	4.35
c.	Climate change problems result erosion induced gullies, unbalancing of the ecosystem and greenhouse gas emission which affects the full capacity utilization of multi-purpose/multi-objective projects development of the river basin.	4.32	4.28
	Grand mean score	**4.11**	**4.08**

The grand mean scores of 4.11 for X and 4.08 for Y show that there is problem of erosion induced gullies at various sites of the basin which affect the balancing of the ecosystem and greenhouse gas emission resulting from climate change problems?

ix. Does various flood disaster in many communities which has led to loss of lives, properties, infrastructures, human sufferings and precipitation fluctuations resulted from climate change in the river basin?

Table 9: Scored/Graded Responses of the Respondents for Question No.9 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
a.	The effect of climate change result to various flood disaster in many communities which have led to loss of lives, properties and infrastructures,	4.11	4.08
b.	The effect of climate change in the river basin led to human sufferings and precipitation fluctuations.	4.46	4.48
c.	The effect of climate change resulting to flood disasters in many communities, loss of lives, properties, human sufferings and precipitation fluctuations affects the full capacity utilization of the river basin assets.	3.80	3.74
	Grand mean score	**4.12**	**4.10**

The grand mean scores of 4.12 for X and 4.10 for Y shows that the respondents are of the opinion that the various flood disaster in many communities which has led to loss of lives, properties, infrastructures, human sufferings and precipitation fluctuations resulted from climate change in the river basin so constituted a problem.

x. Does the problem of deforestation resulting in failure of ecosystem, erosion and other issues pose threat to climate change solution?

Table 10: Scored/Graded Responses of the Respondents for Question No.10 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
a.	The problem of deforestation due to failure of ecosystem, erosion and other issues poses threat to climate change solution.	4.83	4.68
b.	Climate change solutions are hindered by erosion, failure of ecosystem, deforestation and other issues in the river basin.	4.62	4.26
c.	Full capacity utilization of river basin multi-purpose/multi-objective development projects is affected by deforestation, failure of ecosystem, erosion and other issues which poses threat to climate change solution in the river basin.	4.14	4.61
	Grand mean score	**4.53**	**4.52**

The grand mean scores of 4.53 for X and 4.52 for Y show that there is the problem of deforestation resulting to failure of ecosystem, erosion and other issues poses threat to climate change solution in the river basin.

xi. Does problem of land tenure systems hamper investment in dams and heavy engineering projects that require arable land with associated compensation and resettlement expenditures which affects capital for project development of water resources in the river basin?

Table 11: Scored/Graded Responses of the Respondents for Question No.11 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
a.	Problem of land tenure systems hamper investment in dams and heavy engineering projects to enhance full capacity utilization of the river basin.	3.86	3.62
b.	Lack of arable land with associated compensation and resettlement expenditures on available ones affect capital for project development of water resources projects in the river basin.	3.82	4.34
c.	Capital project investment in the river basin is affected by associated compensation and resettlement expenditures which reduces the amount of allocated and/or received for capital project development of the river basin.	3.64	3.48
	Grand mean score	**3.77**	**3.81**

The grand mean scores of 3.77 for X and 3.81 for Y shows that there is problem of land tenure systems hamper investment in dams and heavy engineering projects that require arable land with associated compensation and resettlement expenditures which affects capital for project development of water resources in the river basin.

xii. Does financial constraints and effect of logical cost sharing with resultant overlapping of functions affect the optimization of resources in multi-purpose/ multi-objectives capital development projects of Anambra-Imo River basin?

Table 12: Scored/Graded Responses of the Respondents for Question No.12 above

Item No.	Description of Contents	Score ($\bar{X}$)	Score ($\bar{Y}$)
a.	Financial constraints have affected multi-purpose/ multi-objectives capital development projects' full capacity utilization in the river basin.	4.27	4.58
b.	Lack of logical cost sharing has affected the optimization of the river basin water resources project development.	4.03	3.76
c.	The full capacity utilization includes the optimization of the multi-purpose/ multi-objectives capital development projects for optimal benefits in the river basin.	4.27	4.19
	Grand mean score	**4.20**	**4.18**

The grand mean scores of 4.20 for X and 4.18 for Y shows that financial constraints and effect of logical cost sharing with resultant overlapping of functions affect the optimization of resources in multi-purpose/ multi-objectives capital development projects of Anambra-Imo River basin.

4.2 Calculation of the Product Moment Correlation Coefficient (PMCC)

Table 13: Pearson's Product Moment Correlation Coefficient (PPMCC) Computed Values from Questionnaire Responses

Sample No.	**X**	**Y**	**X^2**	**XY**	**Y^2**
1.	4.70	4.53	22.09	21.29	20.52
2.	4.53	4.47	20.52	20.25	19.98
3.	4.37	4.20	19.10	18.35	17.64
4.	4.47	4.41	19.98	19.71	19.45
5.	4.24	4.16	17.98	17.64	17.31
6.	3.94	3.91	15.52	15.41	15.29
7.	4.50	4.24	20.25	19.08	17.98
8.	4.11	4.08	16.89	16.77	16.65
9.	4.12	4.10	16.97	16.89	16.81
10.	4.53	4.52	20.52	20.48	20.43
11.	3.77	3.81	14.21	14.36	14.52
12.	4.20	4.18	17.64	17.56	17.47
Total	**51.48**	**50.61**	**221.67**	**217.79**	**214.05**

The Pearson's Product Moment Correlation Coefficient (r) is given by the formula,

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}} \qquad (2)$$

$$r = \frac{12(217.79) - (51.48)(50.60)}{\sqrt{[12(221.67) - (51.48)^2][12(214.05) - (5.61)^2]}}$$

$$\therefore r = 0.9573$$

Discussion of Results in Table 13

(i) Pearson's Product Moment Coefficient of Correlation, r = 0.9573 shows a very strong positive linear relationship between the responses from the sample of eighty (80) respondents for project workers (X) and the responses from respondents of forty (40) staff of the river basin.

(ii) Using another measure, the coefficient of determination, which is the square of coefficient of correlation, we have, $R = r^2 = (0.9573)^2 = 0.9164$ or 91.64 percent.

(iii) The computed coefficient of determination r^2 or R = 0.9164 shows that 91.64% of the total variation in the dependent variable (i.e. responses of staff of the river basin, Y) is explained by the variation of responses in the project workers, X as indicated in the computation above while 8.36% of the variations is attributable to the influence of other factors not explained by the regression function.

4.3 The Graph of the Regression Function

The Graph of the Regression Function was plotted based on the actual responses of the staff of Anambra-Imo River Basin as the dependent variable (Y) against the project workers responses as the independent variable (X).

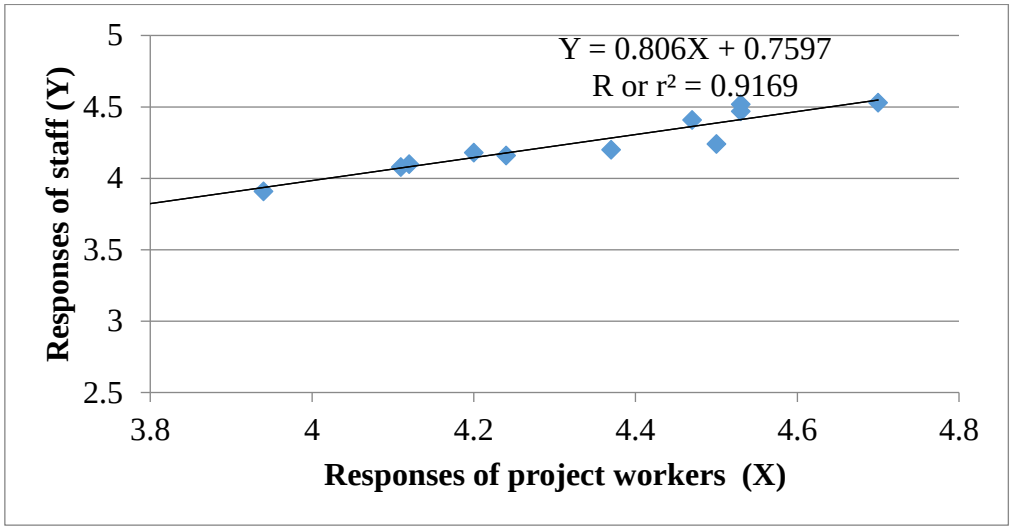

Figure 1: Graph of Questionnaire Responses for Staff and Project Workers

Discussion of Results in Figure 1:

i. The Regression equation linear trend line was estimated based on the scatter diagrams of the two response group as Y =0.806 X + 0.7597.
ii. The estimation of the graphical function shows that r^2 or R = 0.9169. Using this values, the coefficient of correlation $(r) = \sqrt{r^2}\ or \sqrt{R} = \sqrt{0.9169} = 0.9575$.
iii. The r- value (0.9575) is very consistent with the computed r - value of 0.9573.
iv. The degree of freedom (d_f) = $P_1 + P_2 - 2 = 12 + 12 - 2 = 24 - 2 = 22$

Testing of Hypothesis

(i) The critical values of coefficient of correlation (r) of $d_f = 22$ is r = 0.4044 at 0.05 level of significance and r = 0.5151 at 0.01 level of significance.

(ii) Since the computed value of r = 0.9573 and estimated value of r = 0.9575 from the graphical function, is greater than the critical values of $r_{0.05}$ = 0.4044 and $r_{0.01}$ = 0.5151.

(iii) **We reject the Null hypothesis and accept the alternative hypothesis that the responses from the project workers are consistent with the responses from the staff of Anambra-Imo River Basin Development Authority.**

5.0 Conclusion and Recommendations

The questionnaire responses from project workers were consistent with the responses from staff of Anambra-Imo river basin on climate variability indicators analysis at 22 degree of freedom shows that the computed values of coefficient of correlation (r) = 0.9573 and 0.9575 from the estimated value of the regression function is greater than the critical value r = 0.4044 at 0.05 level

of significance and r = 0.5151 at 0.01 level of significance with 22 degree of freedom, therefore the null hypothesis was rejected.

The climate change status assessments in a river basin should incorporate human activities on the status of water bodies, impacts from anthropogenic pressures, primary (direct) and secondary (indirect) impacts due to society's adaptation and mitigation activities, to reduce risk for indirect or long-term drivers for the sustenance of basic infrastructural developments.

Long term consistent series of monitoring data for natural variation in climate induced trends should be in place to establish or safeguard monitoring programmes to assist benchmark and track events as part of surveillance efforts. This is essential to detect and improve prediction of impacts to improve forecast of flood risks, water security and drought.

Long term effectiveness and cost efficiency should incorporate sensitivity analysis under the changing climate conditions to yield beneficial outcomes irrespective of the eventual outcome of climate change.

References

Abaje, I.B. Abashiya, M, On a, V, Masugari. D, Y. (2017). Climate Change Impact and Adaptation-. | framework For Rural Communities in Northern Nigeria

Ahmad, A., Saeed, J., Kaveh, M., Saeed, I. (2014). Climate Change and (Hydropower in loin's Karkheh River Basin. Pp 1-12,

Ahmadreza, S., Dastgerdi, M., Sargolini, S., Broussard, A., Allison, C. and Giuseppe, D. L. (2020). Climate Change and Sustaining Heritage Resources: *A Framework for Boosting Cultural and Natural Heritage Conservation in Central Italy*, **8**: 2-13.

Anastasia, L., Stefan, E., Joao, P. and Nunes, l. D. (2018). Hydrological impacts of moderate and high-end climate change across European river basins. *Journal of Hydrology: Regional Studies*, **18**: 15-30.

Babatolu, J.S. and Akinnubi, R.T. (2014). Influence of Climate Change in Niger River Basin J Development Authority Area on Niger Runoff, Nigeria. *Journal of Earth Science Ohm Change*, **5**: 230.

Bates, B. C., Kundzevicz. Z. W., Wu, S. and Palutikof, J. P. (Eds.). (2008). Climate change and water. Technical Paper of the IPCC., IPCC Secretariat, Geneve.

Chetan-Sharma and Ojha, (2018). Climate Change Detection in Upper Canga River Basin: https://vvww.researchgate.net/publication/323800340

CIS (2009). River basin management in a changing climate. IN European Communities (Ed.).

Cosgrove, W. J. and Loucks, D. P. (2015). Water Management: Current and future challenges and research directions, *Water Resources*, **51**:4823-4839.

David, J., Hoekema, X.J. and Vonkautramana, S. (2015). Climate change and the Payette River basin.

EEA (2008). Impacts of Europe's changing climate - 2008 indicator-based assessment. European Environment Agency.

European Commission (2006). Climate Change Impacts on the Water Cycle, Resources and Quality. Scientific and Policy Report. Climate Change and Natural Hazards series 8 EUR 22422. Climate Change Impacts on the Water Cycle, Resources and Quality, Brussels, Belgium.

Ndhlovu, G.Z. and Woyessa, Y.E. (2019). Modelling impact of climate change on catchment water balance. Kabompo River in Zambezi River Basin. *Journal of Hydrology: Regional Studies*

Nfor, B.N. (2006). An Evaluation of Artesion System of Anambra Basin Southeastern Nigeria. *European Journal of Scientific Research,***15** (2): 140 – 150.

United Nations, River Basin Development: Policies and Planning, Vol. I." Proc. of a UN Interregional Seminar on River Basin and Interbasin. UNDP/National Water Authority of Hungary, Washington, DC. Pp. 16-26,197.

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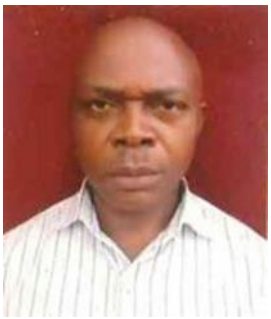

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