IOSR Journal of Economics and Finance (IOSR-JEF)
e-ISSN: 2321-5933, p-ISSN: 2321-5925.Volume 11, Issue 2 Ser. III (Mar –Apr 2020), PP 35-40
www.iosrjournals.org

Climate Change, Adaptation Efforts and Sustainable Growth in Rice Productivity: A Conceptual Framework Towards Self-Sufficiency in Nigeria.

Mohammed BabaAbdullahi[*a], Shri-DewiApplanaidu[b], Bakti Hassan-Basri[c]
[a,b,c]*Department of Economics and Agribusiness, School of Economics, Finance and Banking, Universiti Utara Malaysia*

Abstract: *Numerous challenges deter the decadesof effortsand huge investment by government to revitalize the rice sector in Nigeria. Fromissues of low self-sufficiency level to continuous stagnation in productivity growth. This study embarks on an extensive review of empirical literature to establish relevant factors limiting rice productivity.The findings indicates numerous challengesthat influences productivity and consequently could be responsible for the persistent failure to improve rice productivity in Nigeria.Themajor factors include: policies, technologies and climate change. Consequently, the study conceptualises the role of each factor in determining rice productivity and presents a framework that could be employed to maximise the National goal of improving rice productivity.Among the policy factors affecting productivity are;weak adaption technologies, lack of appropriate government institutions and policy inconsistencies. These factors indirectlyaffect productivity bydiscouragingmajor or capital investment to boost rice productivity. The climate related factors includes; lack of improved and climate resilient production inputs such as: seed varieties, unpredictable weather, droughts and inconsistent rainfall pattern. The technology factors are; irrigation technologies, and low machineries use.All these factors poses a strong negative implication on rice productivity. Furthermore, subject to many of these constraints and the wide variations across AEZsin Nigeria,the relentless efforts to improve national productivity have continued to experience setback. The review further indicated that literature pertaining to studiesacross AEZs in Nigeria arescanty. Hence, indicating a gap in knowledge concerning the level of vulnerability and impact of these factors across different AEZs in Nigeria.*

Keywords*: Rice productivity; climate change; policies; Conceptual Framework; Adaptation technology, Self Sufficiency.*

Date of Submission: 16-03-2020 Date of Acceptance: 01-04-2020

I. Background of the Study

There are over 60% of the population in Africathat are dependent on agriculture for their means of livelihoods (UNDP, 2018). Among the agricultural crops, many in Africa depends on rice either as food or as cash crop hence, it is a major source of their livelihood. Given the high dependency on rice, it is regarded as a priority and strategic crop for eradicating food insecurity, poverty and hunger across the world and especially in Africa (FAO, 2016). While generally the global demand for rice is rising, meeting the demand for rice is critical for food deficit regions such as Nigeria. In meeting its rice demand, Nigeria basically depends on three options; increasing import, expanding cultivated area, and to improve productivity (van Oort et al., 2017). Thus productivity increase in Nigeria has been insignificant and unable the meet up the average productivity rate in the world or even some countries within the Africa's region (FAO, 2016). Increase in total output has always resulted from expanding production area with only a small contribution from improved productivity.

In view of the stagnation in the productivity of rice in Nigeria, the inability of domestic rice production to meet the rising consumption need, Nigeria has failed to achieve self-sufficiency in rice production. That is the total output of rice from domestic sources does not meet up the local consumption need in the country. This situation has led the country into becoming heavily dependent on import.Government policies have been identified as contributors to the current issue of low rice productivity in Nigeria (Boansi, 2013). The productivity is still far below world average of about 4.2 tons/ha, while most projections also points to the fact that Nigeria and the rest of Africa will suffer the highest decline in productivity (IRRI, 2018).The imminent threats on rice productivity growth in Nigeria continues to challenge the effort towards economic diversification and posing a threat to food security. Nigeria's rice productivity has been widely acknowledged to be low compared to productivity across the world. Thus productivity increase in Nigeria has been insignificant and

unable the meet up the average productivity rate in the world or even some countries within the Africa's region (FAO, 2016).

Nigeria has a comparative advantage in terms of rice production, as rice can be produced across all the Agro Ecological Zones (AEZs) of the country. The challenges of climate change (Rainfall, Temperature, CO2 emission), high import dependence, and existing low productivity continues to undermine these potential. This is despite decades of policy policies directed towards the goal of self-sufficiency in rice production. The availability of a suitable environment for rice cultivation across all Agro Ecological Zones (AEZs), places Nigeria at a comparative advantage for rice production. The AEZs in Table 1.1 are formed base on the variations in climatic and soil characteristics across Nigeria. Consequently the productivity of food crops such as rice that are produced across these AEZs will be differently impacted by climate change.

Table 1: *AEZs and Annual climate conditions*

S/N	AEZs	Rainfall (mm)	Temperature (^{0}C)	Growing season in days
1	Sahel Savanna	250-500	21-32	≤ 90
2	Sudan Savanna	500-900	25-30	91-150
3	Northern Guinea Savanna	900-1200	27-29	150-180
4	Southern Guinea Savanna	1200-1500	26-29	181-210
5	Derived Savanna	1500-2000	26-28	211-270
6	Humid Forest	2000-3000	25-27	270-360

Source: Akpa et al., (2016)

The threats from climate change are felt across all aspects of human society, from the natural environment down to the various sectors of the economy (IPCC, 2014). Among the sectors affected include; health, agriculture, forestry, water supply and energy. While out of all these sectors, no sector is more sensitive to climate change as agriculture (Banna et al., 2016; Huber et al., 2014; Mulwa, Marenya, Rahut, & Kassie, 2017). The high sensitivity of agriculture to climate change results from over dependence on nature asinput. The agricultural sector accounts for 70% of global water use and 30% of global energy demand (OECD, 2016; FAO, 2015; FAO, 2011). Similarly, every component of the agricultural sector from production to harvesting, marketing, value addition, storage, productivity, trade supply, prices and inputs will be affected by climate change (Kotir, 2011; Shiferaw et al., 2014).

II. Motivation of the Study

Nigeria's agriculture is already under significant pressure to meet the demand of rising population using finite, water resources and often degraded soil, which are now further stressed by the challenges of climate change (Awotoye& Mathew, 2010).Research into issues of changing climate as it relate to rice productivity, such as establishing the magnitude of and variation in productivity and profits associated with climate change is of priority, as it will enhance management design of interventions aimed at boosting rice productivity, alongside the policy instrument towards enhancing the national interest of self-sufficiency in rice production.

There is a serious campaign by the government to transform agricultural sector of the country to the initial position of self-sufficiency in major cereal crops especially rice as it was in the early 1960s. Hence any policy target on rice will in addition to enhancing productivity, food security and income also help in minimizing hunger and poverty. Projections of the consequences of climate change, adaptation strategies by regions, constraint to adaptation practices and role of current policies in enhancing farmers coping capacity are valuable for policy making towards enhancing adaptation at regional level.

III. Literature Review

According to several studies, the agricultural sector in developed countries exhibits a relatively stronger adaptation to climate change (Ford &Berrang-Ford, 2011**;** Costello et al., 2009). As a result of high technology usage, more diversified economy and intensive research. On the contrary most developing countries are still characterized by weak ability to adapt, and higher vulnerability. This is because, the economies of most developing countries are dominated by agriculture (Hatfield & Takle, 2014).

Climate change poses as a serious threat to rice productivity across the world (Wiebe et al., 2015; IRRI, 2018). According to the report of the Federal Ministry of environment (FME; 2016), agriculture is one of the sectors most sensitive to climate change in Nigeria. In general, studies such as: Castells-Quitana et al., 2015; FAO, 2016; Muller et al., 2011 suggest there is weak level of technology use generally in Africa and specifically in Nigeria. The implication is inarguably complex for food deficit regions such as Nigeria. Especially when factors such as its economic status, weak ability to adapt to climate change and the persistent low productivity that has frustrated series of national efforts towards self-sufficiency are considered. These are responsible for the drift to import dependency. The exporting nations will have to deal with local consumption needs before

considering exports. This nature of policy response by most exporting nations has a number of implications; first is a decline in supply (see figure 1), second is rise in price and lastly considering the poor economic status of most African countries. This will threaten their ability to meet the rising food demand.

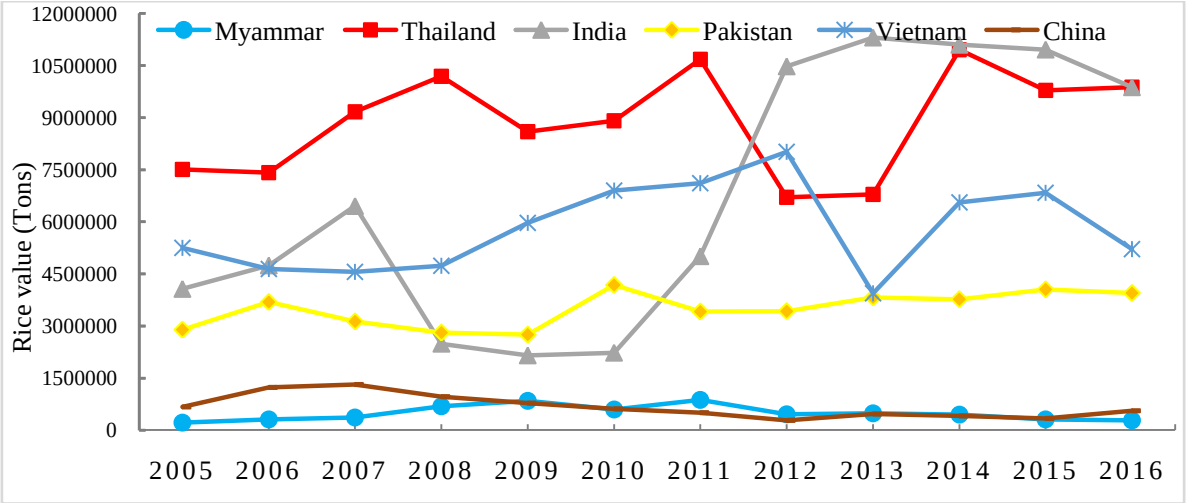

Figure 1.1: *Quantity of Export by Major Export Partners of Nigeria (2005 - 2016)*

The uncertainty in export supply from major exporters to Africa, and the nature of Africa's Agriculture, makes it the most vulnerable continent among the developing world. This is due to the fact that Africa is highly dependent on import to meet its food demand for rice. Consequently Africa is characterized as the most vulnerable continent (Komba&Muchapondwa, 2012). Especially, considering the implications of decline in the value of export supply and its economic status. The challenges are that imported food might not continue to be available as prices will go higher in response to restriction in supply from exporting nations. Therefore, climate change creates some level of uncertainty in the export market. In view of this and the eminent role of rice in terms of abating food security, Africa's existing challenges of food insecurity is further threatened (Kochy et al., 2017).

Though earlier adaptation projects in Africa are largely through agricultural technologies and practices with a mixed level of support for adaptive decision-making, theyare characterized as small scaled and largely focused on investing and diversifying assets (UNDP, 2015). Similarly studies further argued that adapting to a 4°C increase in temperature is not simply a linear extrapolation of adaptation to 2°C.Itwould be a more substantial, continuous and transformative process.Since, the responses of Earth's systems to climate change are non-linear and complex. Indeed, an average global temperature increase of 4°C could result in an increase of as much as 10°C in some parts of the world and could serve as a detriment in the achievement of a country's adaptation plans (World Bank, 2012; UNDP, 2007). This implies adaptation technologies for a particular region might as well not be suitable for another region. This is attributed to the dynamism of climate change impact and its variation across space and time.

In a nutshell from the existing literature, many studies were conducted in both developed and developing countries on rice productivity challenges. These studies however, have some identified limitations based on the scope covered, model used, the variables included in the study among others. For instance some studies on rice productivity (Ayinde, Ojehomon, Daramola&Falaki, (2013)); Enete, (2014); Nwalieji, &Uzuegbunam, (2012); Kelly et al., (2005)) focused only on specific state to general the challenges across the entire country or region thereby, neglecting the dynamism in the country. The aspect of methodology has also faced some limitations, as many studies including: Aterand Aye (2012); Ajetomobi, Abiodun and Hassan(2010); Gbetibouo and Hassan (2005); Kumar and Parikh (2005) all employed cross sectional approach despite its weakness in observing trends in the sector. These studies argued on the basis on data limitations in developing countries such as Nigeria. Also, some extant studies focused solely on analyses of climatic factors as a source of productivity decline and neglected other factors like; Agricultural policies, adaptation strength, trade policies, despite their influence on both investment and productivity in agriculture.

Certainly, from the reviewed literature, it was revealed that although there are a large number of factors that interact to curtail the rice sector growth, not all factors are of equal importance in determining the pattern of rice productivity growth in Nigeria. Also, the differences in climate types, soil properties, climate change, institutional factor (corruption and government stability) and inconsistency in policies impacted rice

productivity growth in Nigeria. These factors have all contributed to the growth stagnation in the sector and therefore, emerges as the framework for examining the rice productivity challenge in Nigeria.

IV. Conceptual Framework

The riceproductivity determinants in Nigeria constitutes a number of factors that have direct and indirect influence on efficiency of its production. These factors are modelled as a framework that could assist in themaximisation of rice productivity in Nigeria. The identified factors are used in the development ofthe conceptual framework as indicated in figure 2. In the framework, CC is considered to have a strong negative effect on rice productivity, considering the weakness of the Nigerian adaption system. Similarly, the inconsistent policy modification deter rice producers from making major or capital investment towards climate proving their production system and consequently the low productivity. Development of improved and climate resilient seed variety is another major constraint in the productivity of rice. Subject to many of these constraints the various AEZs in Nigeria have continually experience set back in meeting the potential productivity as compared to global attainable productivity.

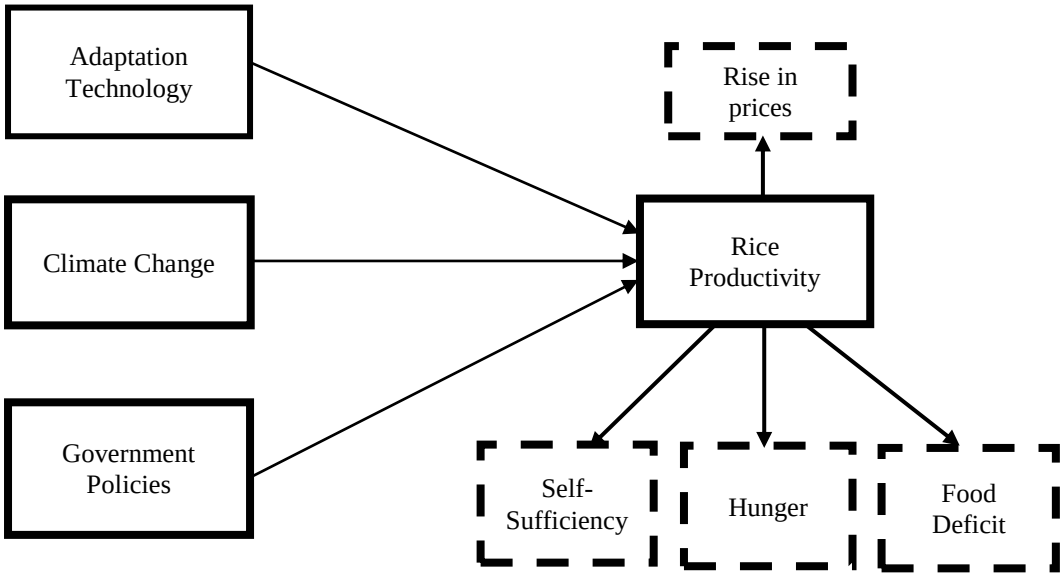

Figure 3.*Model Framework for Assessing Productivity in Nigeria*

The framework constitute of Climate change, adaptation technologies and government policies: Examples of adaptation technologies are: irrigation schemes, climate resilient seeds, water harvesting technology, early climate warning system and institutions to manage climate shocks. Additionally, inconsistencies and lack of Government policy stability impacts directly or indirectly on climate change and agriculture. All these factors pose further threat to the existing low productivity. This can aggravate low self-sufficiency issues, hunger, food deficit and higher price. The review also indicated that the study of climate change impact on agriculture sector as a whole or at global level hides spatial information and could possibly leads to over and under estimation of impact and vulnerability. therefore, the study developed a framework for improving rice productivity base on the factors identified in literature.

V. Conclusion

This paper reviews the various empirical studies on the factors influencing rice productivity growth. The reviews categorises the critical factors into two categories of: the once with direct effect on productivity (such as: lack of improved and climate resilient production inputs such as: seed varieties, irrigation technologies, and machineries). While the second category includes the factors indirectly influencing productivity such as: weak adaption technologies, lack of appropriate government institutions and policy inconsistencies.

Studies have established other factors contributing to the high vulnerability of developing countries including: poor economic status, rain-fed system of agriculture, weak institutions, low technology usage, limited human and financial capacity to anticipate and respond to the direct and indirect effects of climate change have all (IPCC, 2001; United Nation Framework Convention on Climate Change (UNFCCC; 2005); International

Institute for Tropical Agriculture (IITA; 2017). These factors indirectly affects the economies of developing countries such as Africa (Long et al., 2015; Weibe et al., 2015).

Among the major concerns andimplicationsof the decline in productivity of rice as a food crop across developing countries are: increase in food insecurity, hunger, malnutrition and poverty challenges across the world and especially in Africa. Recent event shows how climate change has undermined productivity of rice in major rice exporting countries such as Philippine, Thailand, India, China, Korea. In 2016, for example, Philippine experienced strong winds coupled with heavy rains and localized floods which resulted into losses to the agriculture sector, including its main staple rice paddy crop, as well as maize and other high value crops (FAO 2016).

Base on analytical techniques also, the reviewed studies falls under four major categories: The first category includes studies such as Ladan, (2014); Ethan (2015); Enete, (2014); Uduma, Adeoye and Agbonlahor (2015). Thesestudies employed simple descriptive approaches such as frequencies and percentages, graphs and or correlation coefficient to analyse productivity issues in Nigeria. The weakness of the descriptive approach is that it lacks the power to generalise findings since it is not based on sound econometric tool of analysis.

The second category are those studies that usedcross sectional data with related econometric tool of analysis. Such studies includes: Aterand Aye (2012); Ajetomobi, Abiodun, and Hassan, (2010); Gbetibouoand Hassan (2005); Kumar and Parikh (2005) and are considered weak in analysing the trends of the factors over time, they do not cannot determine cause and effect.The third category consists of those studies that employs time series models (Rahim &Puay, 2017; Kelly et al., 2005).Theyexaminedthe determinants of rice productivity including climate change over some time periods using historical data. These studiesare able to examine the trend in factors as well as interactions over time. One major challenge is that this model considers only the time trend and not variations across panels or regions. While productivity differs across regions base on soil and climate type.The last category are those that employ panel data analysis such as:Isik, Devadoss (2006); Barnwal and Kotani (2013); Chen, McCarl, Schimmelpfennig, (2004).

Furthermore, in terms of scope of the study, it was shown that most of the studies on climate change adaptation technology, rice productivity and national policies are specific in focus;they cover some aspects and dimensions of these challenges and neglect the other relevant factors. Among the various factors that were analysed specifically are:policies on rice, climate change impact, and level of technology use. Only few studies focused onmeasuring the combination of these factors and there interaction effect.

VI. Recommendation

In view of the issue of low input usage across African countries, proper input subsidy policies can help to boost the existing level of input usage. National policies to improve domestic productivity can be a combination of trade oriented policies (in form of liberalized or protectionist trade policies) and producer oriented policies (in form of input subsidy such as: fertilizer and seed allocation).Moreover, the paper, presents the conceptual framework that can be used for analysing factors influencing rice productivity in Nigeria. Lastly from the literature reviewed, it was shown that not all factors have equal importance in determining the productivity growth of rice in Nigeria. Also, regions differ in terms of the severity of impact from the identified factors. Therefore, climate impact can be addressed through region specific adaptation technologies.

References

[1]. Ajetomobi, J., Abiodun, A., & Hassan, R. (2010). Economic impact of climate change on irrigated rice agriculture in Nigeria. The Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, 1–20.

[2]. Ater, P. I., & Aye, G. C. (2012). Economic impact of climate change on Nigerian maize sector: A Ricardian analysis. *WIT Transactions on Ecology and the Environment*, *162*, 231–239. https://doi.org/10.2495/EID120211.

[3]. Awotoye, O. O. & Mathew, O.J. (2010). Effects of temporal changes in climate variables on crop production in tropical sub-humid South-western, Nigeria. African Journal of 166 Environmental Science and Technology, 4(8), 500-505. Retrieved August 12, 2011 from http://www.academicjournals.org/AJEST.

[4]. Ayinde, O. E., Ojehomon, V. E. T., Daramola, F. S., &Falaki, A. A. (2013). Evaluation of the effects of climate change on rice production in Niger State, Nigeria. Ethiopian Journal of Environmental Studies and Management, 6(6), 763-773.

[5]. Banna, H., Afroz, R., Masud, M. M., Rana, M. S., Koh, E. H. Y., &Ahmad, R. (2016). Financing an efficient adaptation programme to climate change: A contingent valuation method tested in Malaysia. *Cahiers Agricultures*, *25*(2). https://doi.org/10.1051/cagri/2016014

[6]. Barnwal, P., &Kotani, K. (2013). Climatic impacts across agricultural crop yield distributions: An application of quantile regression on rice crops in Andhra Pradesh, India. Ecological Economics, 87, 95-109.

[7]. Boansi, D. (2013). Policy. *Munich Personal RePEc Archive*, (48080). Retrieved from http://mpra.ub.uni-muenchen.de/48080/.

[8]. Castells-Quintana, D., Del Pilar Lopez-Uribe, M., & McDermott, T. (2015). *Climate change and the geographical and institutional drivers of economic development*.

[9]. Castillo, C C, Tanaka, K, Sato, Y-I, Ishikawa, R, Bellina, B, Higham, C, Chang, N, Mohanty, R, Kajale, M and Fuller, D Q (2016). Archaeogenetic study of prehistoric rice remains from Thailand and India: evidence of early japonica in South and Southeast Asia. Archaeological and Anthropological Sciences 8: 523–543, DOI: https://doi.org/10.1007/s12520-015-0236-5

[10]. Chen, C. C., McCarl, B. A., &Schimmelpfennig, D. E. (2004). Yield variability as influenced by climate: A statistical investigation. *Climatic Change*, *66*(1-2), 239-261.DOI: 10.1023/B:CLIM.0000043159.33816.e5.

[11]. Costello, C., S.D. Gaines, and J. Lynham. (2009). "Can Catch Shares Prevent Fisheries Collapse?" Science 321: 1678–1681.
[12]. Enete I. C., (2014). Impacts of Climate Change on Agricultural Production in Enugu State,Nigeria. Journal of Earth Science & Climatic Change, 5(9), 9–11. https://doi.org/10.4172/2157-7617.1000234.
[13]. Ethan, S. (2015). Effect of flooding on chemistry of paddy soils: a review. International Journal of Innovative Science, Engineering & Technology, 2(4), 414-420.
[14]. FAO. (2011). Global agriculture towards 2050. High Level Expert Forum-How to Feed the World 2050,https://doi.org/http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf.
[15]. FAO. (2015). El Niño in Asia: Prolonged dry weather in several countries affecting plantings and yield potential of the 2015 main season food crops Highlights:, (GIEWS).
[16]. FAO. (2016). GIEWS - Global Information and Early Warning System, *2014*. Retrieved from http://www.fao.org/giews/countrybrief/country.jsp?code=SOM.
[17]. Federal Ministry of Environment (FME) (2016). "Climate Smart Agriculture 2015" retrieved from http://climatechange.gov.ng/climate-smart-agriculture/#
[18]. Ford, J. D., &Berrang-Ford, L. (Eds.). (2011). Climate Change Adaptation in Developed Nations. Advances in Global Change Research. doi:10.1007/978-94-007-0567-8
[19]. Gbetibouo, G. A., & Hassan, R. M. (2005). Measuring the economic impact of climate change on major South African field crops: A Ricardian approach. *Global and Planetary Change*, *47*(2–4 SPEC. ISS.), 143–152. https://doi.org/10.1016/j.gloplacha.2004.10.009.
[20]. Hatfield, J., &Takle, G. (2014). NCA 2014: Chapter 6 Agriculture. *Climate Change Impacts in the United States: The Third National Climate Assessment*, 150–174. https://doi.org/10.7930/J02Z13FR.
[21]. Huber, V., Schellnhuber, H. J., Arnell, N. W., Frieler, K., Friend, A. D., Gerten, D., … Warszawski, L. (2014). Climate impact research: Beyond patchwork. *Earth System Dynamics*, *5*(2), 399–408. https://doi.org/10.5194/esd-5-399-2014.
[22]. Intergovernmental Panel on Climate Change (IPCC). 2001. Climate change 2001: impacts, adaptation, and vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge.
[23]. Intergovernmental Panel on Climate Change. (2014). Integrated Risk and Uncertainty Assessment of Climate Change Response Policies. *Climate Change 2014 Mitigation of Climate Change*,151–206. https://doi.org/10.1017/CBO9781107415416.008.
[24]. International Institute for Tropical Agriculture. (2017). Synthesis Report of the Nigeria Zero Hunger Strategic Review Synthesis Report of the Nigeria Zero Hunger Strategic Review. Retrieved from http://fscluster.org/sites/default/files/documents/synthesis_report_of_the_nigeria_zero_hunger_strategic_review.pdf.
[25]. International Rice Research Institute IRRI (2018). Rice and climate change: retrieved from: http://irri.org/news/hot-topics/rice-and-climate-change.
[26]. Isik, M., &Devadoss, S. (2006). An analysis of the impact of climate change on crop yields and yield variability. Applied Economics, 38(7), 835-844.
[27]. Kelly, P. M., &Adger, W. N. (2005). Theory and practice in assessing vulnerability to climate change and facilitating adaptation. Climatic Change, 47, 325–352. https://doi.org/10.1023/A:1005627828199.
[28]. Kochy, M., Bishop, J., Lehtonen, H., Scollan, N., Webber, H., Bellocchi, G., … Ferrise, R. (2017). Challenges and research gaps in the area of integrated climate change risk assessment for European agriculture and food security, 1–28.
[29]. KombaCoretha and Edwin Muchapondwa. (2012). Adaptation to Climate Change by Smallholder Farmers in Tanzania Adaptation to Climate Change by Smallholder Farmers in Tanzania, (July).
[30]. Kotir, J. H. (2011). Climate change and variability in Sub-Saharan Africa: A review of current and future trends and impacts on agriculture and food security. *Environment, Development and Sustainability*, *13*(3), 587–605. https://doi.org/10.1007/s10668-010-9278-0
[31]. Kumar, K. and J. Parikh, (2005), ‗Socio-economic impacts of climate change on Indian agriculture', International Review for Environmental Strategies 2):
[32]. Ladan, S. I. (2014). An appraisal of climate change and agriculture in Nigeria. Journal of Geography and regional planning, 7(9), 176.
[33]. Long, S. P., Ainsworth, E. a, Leakey, A. D. B., Nösberger, J., & Ort, D. R. (2006). Food for Thought: Lower- Than-Expected Crop Yield Stimulation with Rising CO2 Concentrations. *Science*, *312*(5782), 1918– 21. http://doi.org/10.1126/science.1114722
[34]. Muller, C., Cramer, W., Hare, W. L., &Lotze-Campen, H. (2011). Climate change risks for African agriculture. *Proceedings of the National Academy of Sciences*, *108*(11), 4313–4315. https://doi.org/10.1073/pnas.1015078108
[35]. Mulwa, C., Marenya, P., Rahut, D. B., &Kassie, M. (2017). Response to climate risks among smallholder farmers in Malawi: A multivariate probit assessment of the role of information, household demographics, and farm characteristics. *Climate Risk Management*, *16*, 208–221. https://doi.org/10.1016/j.crm.2017.01.002
[36]. Nwalieji, H. U., &Uzuegbunam, C. O. (2012). Effect of climate change on rice production in Anambra State, Nigeria. Journal of Agricultural Extension, 16(2), 81-91.
[37]. OECD. (2016). Agriculture and Climate Change. *Trade and Agriculture Directorate*, (September), 6. Retrieved from http://www.bioone.org/doi/abs/10.1071/CP11172%0Awww.oecd.org/agriculture%0Awww.oecd.org/agriculture%0Ahttps://www.oecd.org/tad/sustainable-agriculture/agriculture-climate-change-september-2016.pdf%0Ahttps://www.oecd.org/tad/sustainable-agriculture/agricul
[38]. Rahim, S., &Puay, T. G. (2017). The impact of climate on economic growth in Malaysia. Journal of Advanced Research in Business and Management Studies, 6(2), 108-119.
[39]. Shiferaw, B., Tesfaye, K., Kassie, M., Abate, T., Prasanna, B. M., &Menkir, A. (2014). Managing vulnerability to drought and enhancing livelihood resilience in sub-Saharan Africa: Technological, institutional and policy options. *Weather and Climate Extremes*, *3*, 67–79. https://doi.org/10.1016/j.wace.2014.04.004
[40]. Ugalahi, U. B., Adeoye, S. O., & Agbonlahor, M. U. (2016). Irrigation potentials and rice self-sufficiency in Nigeria: A review. African Journal of Agricultural Research, 11(5), 298-309.
[41]. UNDP, (2018). Climate Change Adaptation in Africa UNDP Synthesis of Experiences and Recommendations 2000-2015. United Nations Development Programme October 2018. www.adaptation-undp.org. United Nations Development Programme 304 East 45th Street, 9th Floor New York, NY 10017 USA www.undp.org
[42]. UNFCCC. (2005). Climate change: small island deUnited Nations Framework Convention on Climate Changeveloping States. *United Nations Framework Convention on Climate Change*, 32. Retrieved from http://unfccc.int/resource/docs/publications/cc_sids.pdf.

[43]. United Nations Development Programme (UNDP). 2007. "Fighting Climate Change: Human Solidarity in a Divided World." Human Development Report 2007/2008. UNDP.
[44]. Van Oort PAJ, Zwart SJ. Impacts of climate change on rice production in Africa and causes of simulated yield changes. Glob Change Biol. (2017):https://doi.org/10.1111/gcb.13967
[45]. Wiebe Keith, Hermann Lotze-Campen, Ronald Sands, Andrzej Tabeau, Dominique van der Mensbrugghe, et al., (2015). Climate change impacts on agriculture in 2050 under a range of plausible socioeconomic and emissions scenarios. Environ. Res. Lett. 10 (2015) 085010 doi:10.1088/1748-9326/10/8/085010.
[46]. World Bank, Turn down the heat: Why a 40C world must be avoided, November 2012.Washington. http://climatechange.worldbank.org/sites/default/files/Turn Down_the_heat_Why_a_4_degree_centrigrade_warmer_world_must_be_avoid ed.pdf.