

Full Length Research Paper

Economics Effects Of Climate Change On Pearl Millet (*Pennisetum glaucum* L) Production Among Farmers In Kebbi State, Nigeria

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Accepted 29th August, 2020.

This study economic effect of climate change on pearl millet (*Pennisetum glaucum* L) production among farmers in Kebbi state, Nigeria was conducted to examine the economic effect of climate change on pearl millet production in Kebbi state, Nigeria. Purposive sampling method was used in selecting the respondents for the study. Two local government areas were proportionately selected based on the preponderance of millet farmers in the study area. Primary data for the study were collected with the aid of the structured questionnaires designed and administered to the respondents. The data collected were analyzed through the use of descriptive statistics, gross margin, five-point Likert scale rating, Spearman's correlation coefficient and Ricardian model. Results of the study indicated that majority (98.5%) of the farmers were males and within the age range of 46 and above years, among which there were 85% married. 37.50% had their household size ranging from 1-5. Thirty one percent (31%) of the respondents were literate with mostly secondary school education. Farming was the major occupation of the farmers (57.26%) and it was their major source of income with 68% of the respondents sourcing their income from farming. Inheritance with 70.25% was the major land tenure system practiced by the farmers in the area of study. The hypotheses developed for the study were tested using Spearman's correlation coefficient (0.998). The null hypothesis was therefore rejected and the alternative hypothesis accepted. The gross margin per hectare was estimated at ₦37,878.28. While the gross farm income (Net Farm Income) per hectare which represents the return to management was calculated at ₦76,713. The total variable costs incurred for pearl millet production per hectare was ₦38,834.73 out of which labor alone accounted for 77.9% of the production cost. The net return on investment was found to be ₦1.025. The results of the Ricardian model indicated that the coefficient of rainfall (0.0429), rainfall² (0.2115) and temperature (1.2479) were positive and statistically significant at 1% level of significance respectively. The coefficient of the temperature² (0.0109) was positive and the coefficient of the wind (-0.0075) and wind² (-0.7617) were negative. The coefficient of wind² (-0.7617) was found to be negative and statistically significant at 1% level. The study recommended that government should create more awareness about the phenomenon of climate change and highlight changes in rainfall and temperature which are critical in millet production and in facilitating the adoption of climate change related strategies. Agricultural extension services should be widely available to farmers in the study area in order to boost the adoption of climate-smart adaptation strategies. More agricultural extension agents could be employed and effective group dissemination techniques, such as farmer field for a, could be adopted.

Keywords: Climate Change, Pearl Millet, Gross margin, and analyses.

INTRODUCTION

Pearl millet (*Pennisetum glaucum* L) is an annual cereal crop which belongs to the family *Poaceae*, sub family *Panicoideae* and genus *Pennisetum* (Rai *et al.*, 1997). Pearl millet is predominantly a cross-pollinated crop with 75 – 80% out-crossing (Rai *et al.*, 1999). It is a highly tillering diploid tropical C_4 cereal crop. It bears grains on the surface of erect candle shaped terminal spikes. Grain size varies from 0.5g to over 2.0g/100, and, depending on the size of the spike, grain number per spike ranges from 500 to 3,000 (Andrews, 1990). The geographical origin and the center of domestication of pearl millet are situated in Western Africa (Brunken *et al.*, 1977; Rai *et al.*, 1997; Syngenta, 2006). Ojedran *et al.*, (2010) ranked pearl millet as the most important cereal in the dry sub humid and semi-arid zones of Nigeria. The crop is annually grown on more than 29 million hectares in the semi and tropical regions of Asia and Africa. Filardi *et al.*, (2005) reported that pearl millet produces higher protein levels than other grains and have approximately 85% of the energy content compared with corn. Pearl millet crop had been grown for over 5000 years all over the Sahel and the tropical countries of West Africa and is the crop plant best adapted to arid and semi-arid zones. It is the major staple food crops for over 50 million of poor and vulnerable people in the Sahelian and Sudanian zones of West Africa, (International Research Development, IRD 2009).

In Kebbi State of Nigeria, pearl millet is one of the main staple foods and is dominant in the agricultural production systems. With development and cultivation of improved farmer-preferred cultivars with specific adaptation to the environments, the pearl millet can significantly contribute to food security in this region and the world at large. The ability of pearl millet to grow in dry and marginal environments clearly makes it a crop with an important role in the future. It is extremely resistant to drought and well adapted to poor soils with high resistance to diseases and pearl millet remains the only crop that has promise of food security for the growing world population under the changing climate. It seems likely to spring back as the world's best crop as the world gets hotter and drier due to climate change. (National Research Council, NRC 1996) described pearl millet as tough, as it produces grain and fodder under very hot and dry conditions and on poor soils to poorest soils make it impossible to beat in the world's harshest agricultural production environments, pearl millet can withstand drought, heat, insect and flash flood. Hussein *et al.*, (2008) reported that pearl millet yields reliably in regions too hot and too dry to support good yields of corn and sorghum. The optimum rainfall requirement of pearl millet ranges between 350mm to 500mm.

Overcoming Africa's stagnant dry land food production trend requires the growth, expansion and diversification of markets for dry land crops such as millet so that farmers will be rewarded for increasing their production and productivity. In recent years, new major trends show that an increasing demand for dry land cereals has begun to emerge which in turn will provide a renewed opportunity for the millet in the market place. Furthermore, pearl millet grain is also a valuable animal feed, comparable to corn for poultry but with a higher protein content and better-balanced amino acid profile so less protein concentrate is required in a pearl millet-based feed ration. Pearl millet grain is also highly valued as a human food especially by those engaged in hard physical work due to its high energy content and slower rate of digestion compared to lighter cereals like rice and wheat. Its relatively slower digestion rate is also advantageous for diabetics. The challenge for global agriculture in the 21st century is to produce 70 per cent more food by 2050 to feed a projected increased population, while implementing more sustainable methods and responding to climate change (FAO, 2009). Much concern about feeding the world in 2050 relates to the slower increase in yields of the major cereal crops over the past three decades (Alston *et al.*, 2009). The pearl millet crop is one of the staple food crops grown in Kebbi State, Nigeria and is cultivated as rain-fed crop, its (the Pearl Millet) yield is greatly affected by the effect of climate change. The crop is amongst the cereal crops hoarded by the farmers in anticipation for increase in price during dry season, and thus called for research in order to determine whether the farmers are economically profiting or loosing as a result of the variability in the climate (climate Change).

Climate change is the most severe problem that the world is facing today. It has been suggested that it is more serious threat than global terrorism (King, 2004). Rough estimates suggest that over the fifty (50) years, climate change may likely have a serious threat to meeting a global food needs than other constraints on agricultural system, as climate change has brought about possibly permanent alterations to our planet's geological, biological, and ecological systems

(Inter governmental Panel on Climate Change IPCC, 2007). (Building Nigeria's response to climate change, 2008). This worrisome trend indicates that a rising demand for food over the next century due to population and real income growth will lead to increasing global food insecurity and a worsening of hunger and malnutrition problems particularly in developing countries (Wolfe *et al.*, 2005).

It is now well known that climate is changing worldwide. The past two decades have witnessed

globally a rapid increase in the awareness about climatic changes. This triggered widespread apprehension among scientists and governments about their global implications (Gadgil, 1996). The major environmental concern regarding increased concentration of CO₂ and other trace gases is their greenhouse potential that is able to trap solar energy in the atmosphere. This trapped solar energy causes global warming and other changes in the world's climate (Houghton *et al.*, 1996). Climate change is primarily caused by the developed countries. However, it is the bitter irony of destiny that Africa contributes least (920,000 tons of CO₂ each year, less than 4% of the global production) of all the continents to the climate change, but will probably suffer most from its consequences. Economists refer to this as a typical case of negative external effects, an externalization of costs: A non-involved party bears the costs of a third party's actions (Medugu, 2008).

Food and Agricultural Organization (FAO, 2007) reported that up to 11% of arable land could be highly affected by climate change in the developing world. There will be a reduction of cereal production in 65 countries and retardation of about 16% of agricultural GDP. A decrease of up to 30% in world food production due to effects of climate change on agriculture is generally predicted (IPCC, 2007). In Africa, estimates indicate that about 60-70 percent of the population is dependent on the agricultural sector for the employment, and the sector contributes on average nearly 34 percent to gross domestic product (GDP) per country (Adam *et al.*, 1993).

In Nigeria, Agriculture contributed 41.25% of GDP in 2005 almost the same as in 2004 (CBN, 2005). More than 60% of the working adult populations of Nigeria are employed in the agricultural sector directly and indirectly. Over 90% of Nigeria's agricultural output comes from peasant farmers who dwell in the rural area where 60% of the population live (Agricultural Report, 2007). Despite these contributions, Crosson (1997) pointed out that considering the lower technological and capital stocks, the agricultural sector in developing countries is unlikely to withstand the additional pressures imposed by climate change without a concerted response strategy. Nigeria is experiencing adverse climatic conditions with negative impacts on the welfare of millions of people. Persistent droughts and flooding, off season rains and dry spells have sent growing seasons out of orbit, on a country dependent on a rain fed agriculture (Medugu, 2008). Nigerian agriculture is almost entirely rain-fed hence inherently susceptible to the vagaries of weather. Only about a million hectare is currently irrigated in Nigeria out of the total 30.5 million arable hectares of land (Madu *et al.*, 2010). As global warming accelerates, it is expected that agricultural adaptation to climate change can only be meaningful, if irrigated agriculture gains prominence. Agriculture in Nigeria is therefore

particularly vulnerable to the impacts of climate change (FAO, 2008; Medugu, 2008; IFAD, 2007). The consequences are that the increasing frequency and severity of droughts are likely to cause: crop failure; high and rising food prices; distress sale of animals; de-capitalization, impoverishment, hunger, and eventually famine.

METHODOLOGY

Description of the Study Area.

Kebbi State was created in 1991 out of former Sokoto State. It lies in Northwestern Nigeria, with its capital in Birnin Kebbi. The state is bordered by Sokoto State to the north and east, Niger State to the south, Dosso Region in the Republic of Niger to the northwest and the Republic of Benin to the west. Kebbi State has a total land area of 37,698,685 square kilometers (KSG, 2017a). Based on projections from the 2006 census figure, the state is estimated to have a population to have a population of 4,629,880 (NPC, 2006; 2017). The state is divided into 21 local government Areas (LGAs) and has four emirate councils (Gwandu, Argungu, Yauri and Zuru). The state with a mean temperature of 23°C and a maximum of about 40°C, is divided into two ecological zones: The Sudan savanna zone and Southern Guinea zone in the northern and southern parts respectively. This climate peculiarity supports the production of a wide range of arable crops, roots and tubers, agro-forestry, fisheries and livestock. The total cultivable land in the state consists of 320,000 hectares (ha) upland and 170,000 ha of Fadama land, with high potential of surface water and extractable shallow aquifer to support medium and small-scale irrigation activities (KSG, 2017a). The state is transverse by two major rivers, namely River Niger and River Rima as well as minor rivers of Zamfara. The vastness of agricultural land comprising upland, Fadama and several wetland areas creates an opportunity for all-year-round agricultural activities. The major crops produced in Kebbi State are rice, millet, sorghum, maize, groundnut, cotton, wheat, sugar cane, sweet potatoes, and cassava. Sesame, Soya beans, Bambara nuts and Acha are grown as minor crops while vegetables such as tomato, onion, garlic, pepper, carrot, and cabbage are also produced.

Sampling Technique

The target population for the study was millet producing households in Kebbi State. Kebbi State is divided into four (4) agricultural development zones. Multistage sampling procedure was adopted for this study. In stage one, two (2) local governments from each of the agricultural development zone in the state were purposively selected based on the preponderance

ce of millet producing farmers in the local government area given a total number of eight (8) local government areas. In stage two, five (5) villages were randomly selected from each of the selected local government area given a total number of forty (40) villages. The final stage involved a simple random sampling of ten millet producing farmers from each of the selected village given a total number of four hundred (400) farmers to serve as total sample size for the study.

Model Specification

The models applied for the study are specified as follows:

Gross Margin Model Specification

Olukosi and Erabhor (1988) described gross margin (GM) as the difference between total revenue (TR) and the total variable cost (TVC)

$$GM = TR - TVC \dots \dots \dots (6)$$

Where:

GM = Gross Margin, TR= Total Revenue and TVC = Total Variable Cost.

Ricardian model specification

The Ricardian model is a cross sectional model that is used to evaluate the effect of climate change on agriculture. The study assumed a quadratic relationship between gross margin per hectare as dependent variable with the climatic factors having squares in order to capture the nonlinear relationship between net revenue and climatic factors (Mendelsohn *et al.*, 1994; Anthony and Achike, 2014). The equation estimated is stated below;

$$GM = \beta_0 + \beta_1 C + \beta_2 C^2 + e \dots \dots \dots (7)$$

Where:

GM = Gross Margin, β_0 = Constant term, C = Vector of climatic factors, $\beta_1 - \beta_2$ = Regression Coefficients estimated and e = Error term.

Thus, the Ricardian model estimated in this study is specified as follows:

$$\begin{aligned} \log(GM) = & B_0 + B_1 \log(\text{Average } T) + B_2 \log(\text{Average } T^2) \\ & + B_3 \log(\text{Average } W) + B_4 \log(\text{Average } W^2) \\ & + B_5 \log(\text{Average } RF) + B_6 \log(\text{Average } RF^2) + e \dots \dots \dots (8) \end{aligned}$$

Where:

GM = Gross Margin, T = Temperature (0^C), T^2 = Temperature square (0^C), W = Wind (m/s), W^2 = Wind (m/s) square, RF = Rain Fall (mm) and RF^2 = Rain Fall (mm) square.

RESULTS AND DISCUSSION

Table 1: Estimated Average Gross Margin Analysis for Pearl Millet Production

Cost Items and Revenue	Cost (₦) / Ha	% of Total Cost
Variable Cost		
Fertilizer	6,316.20	16.27
Seeds	1,423.83	3.67
Herbicides	504.00	1.29
Pesticides	336.70	0.87
Labor	30,254.00	77.90
Total Variable Cost	38,834.73	100.00
Returns		
Gross Farm Income	76,713.00	
Gross Margin	37,878.25	
Net return on investment	1.03	

Source: Field Survey, 2018

The gross margin analysis and estimates of Pearl millet production in the study area is presented in the table 1. The gross margin is an important tool used to evaluate the economic viability of a business. Accordingly, the table shows that the gross margin per hectare was estimated at ₦37,878.28. While the gross farm income (Net Farm Income) which represents the

return to management and labor was calculated at ₦76,713. Considering these two measures of gross margin and gross farm income, we can conclude that pearl millet farming is generally profitable in the study area. The estimated total revenue and gross farm income obtained in this study further indicates that pearl millet cultivation in the study

area is still at small scale and largely for domestic consumption. Furthermore, the table revealed that the total variable costs incurred for pearl millet production in this study was ₦ 38,834.73 out of which labor alone accounted for 77.9% of the cost of production. This implies that pearl millet production is labor intensive. The table further reveals that fertilizer accounted for 16.27% of the cost of production. Seeds, herbicides and pesticides represented 3.67%, 1.29%, and 0.87% of the cost of pearl millet production respectively. The net return on investment was found to be ₦1.025. This showed that for every one-Naira invested in pearl millet production, ₦1.025 was returned to the farmers as

revenue. These results indicate the positivity, profitability and hence the return to investment. The findings of this study are in agreement with the findings of Kudi and Abdulsalam (2008) who found that labor and fertilizer inputs accounted for a greater proportion of total variable costs in the production of striga tolerance crops. Additionally, the result of this study is in conformity with the findings of Yakasai (2010) and Chidiebere-Mark *et al.*, (2014) findings.

Table 2: Regression estimates of climate factors on the gross margin

Independent Variables	Regression Coefficients (b values)	Standard Error	Level of significance (t-values)
Constant	1.0980	0.0661	16.62***
Rainfall	0.0429	0.0171	2.51**
Rainfall ²	0.2115	0.0683	3.10***
Temperature	1.2479	0.0826	15.11***
Temperature ²	0.0109	0.0203	0.54 NS
Wind	-0.0075	0.0339	-0.22 NS
Wind ²	-0.7617	0.23319	-3.27***
R-squared	0.9998		
Adj. R-squared	0.9997		
Prob > F	0.0000***		

Source: Field Survey, 2018

***, ** denote significance at 1 % and 5 % levels respectively. NS denotes not significant

In order to explain the variation in the gross margin per hectare on climatic factors, the estimates from the Ricardian model was used taking into account the model specification as outlined in the methodology (Equation 8). The coefficient of determination of multiple regressions (R^2) was found to be 0.9997 implying that about 99.9% of the variation in the gross margin (which is the dependent variable) is jointly explained by the explanatory variable included in the model. The remaining 0.1% is as a result of non-inclusion of some important explanatory variables as well as errors in estimation. The F-ratio was also found to be statistically significant at the ($P < 0.01$) probability level which suggests that the explanatory variables adequately explained the dependent variable. From the result, it is evident that the gross margins per hectare were sensitive to climatic factors under consideration. It can be seen that the signs of the entire coefficients have the appropriate signs and conform to the priori expectation. These results imply that these six variables are important factors influencing gross margin of pearl millet production in

the study area. The coefficient of rainfall (0.0429) is positive and significant at 1% level of significance and it is indicated that there is a positive relationship between the rainfall and the gross margin per hectare. The positive relationship between the coefficient of rainfall (0.0429) and the gross margin implies that as the rainfall increases so also the gross margin by 0.0429%. Increase in rainfall could lead to an increase in the quantity of output in millet production which will translate into increase in gross margin per hectare. And the coefficient of rainfall square (0.2115) was also positive and significant at 1% level of significance. The positive relationship between the rainfall square and the gross margin per hectare implies that even with nonlinear relationship there was a significant and a positive relationship between the rainfall and the gross margin. This positive relationship entails that squaring a rainfall could lead to increase in gross margin. The coefficient of temperature (1.2479) and the coefficient of temperature square (0.0109) were positive and only the temperature was significant at 1% level of significance. Even though the temperature square was

positive the significant relationship was not indicated. This implies that squaring the rainfall could lead to increase in gross margin. The coefficient of wind (-0.0075) is negative and insignificant at 1% level of significance. The relationship between the wind and the gross margin is said to be negative, this implies that as the wind increases the gross margin decreases. The decrease in gross margin could be as a result of the decline in the output/yield of the millet sourced from high wind. In a similar manner, the coefficient of wind square (-0.7617) is negative but significant at 1% level of significance. The negative relationship between the wind square and the gross margin implies that squaring the wind could lead to decrease in gross margin.

CONCLUSION

Considering these two measures of gross margin and gross farm income, it can be concluded that pearl millet farming is generally profitable in the study area. The estimated total revenue and gross farm income obtained in this study further conclude that pearl millet cultivation in the study area is still at small scale and largely for domestic consumption. Millet production in the study area is labor intensive. The gross margin realized by millet farmers per hectare is ₦37,878.28. It is further concluded that for every one-Naira invested in pearl millet production in the study area, ₦1.025 is returned to the farmers as revenue. Rainfall and temperature are the only climatic variables that have positive bearing with the gross margin for millet production in the study area. This study further concludes that there is strong positive relationship between the farmers' perception on the effect of climate change on pearl millet production and the farmers' perception on the smart adaptation measures on the effect of climate change on pearl millet production.

RECOMMENDATIONS

Based on the findings of this study the following recommendations are hereby made:

1. Government should provide adequate inputs at subsidized and affordable rate for the millet farmers in the study area in order to diversify millet production and go beyond production for domestic consumption but for sell to generate revenue.
2. Government should create more awareness about the phenomenon of climate change and highlight changes in rainfall and temperature which are critical in millet production and in facilitating the adoption of climate change related strategies. Agricultural extension services should be widely available to farmers in the study area in order to boost the adoption

of climate-smart adaptation strategies. More agricultural extension agents could be employed and effective group dissemination techniques, such as farmer field fora, could be adopted.

3. There is a need for government and other stakeholders in the agricultural sector to provide small-scale irrigation facilities or schemes to augment natural rainfall. This will reduce farmers' over-reliance on natural rainfall for millet production. While this is expected to benefit the individual farmers, the government would need to ensure that this introduction is cost-effective and that it would not generate negative externalities (i.e., maladaptation).

4. There is also a need to build the capacities of smallholder farmers by engaging them in non-farm-income generating activities such as making handicrafts, petty trading and food processing, so as to diversify their sources of livelihood and income, which could reduce the risk they may face in the event of crop failure as a result devastating effects of climate change.

5. It is recommended that further studies on the economic analysis of the effect of climate change on millet production in the study area should be carried out in order to propel policies that would support and entice farmers to upscale production of pearl millet to commercial scale in order to enable the millet farmers boost their millet production and reap the economy of scales benefit in the production, which means higher profit margin can be anticipated. This signifies a significant contribution to the national gross domestic

REFERENCES

- Achike, A., & Anthonia, O. (2014). Economic Analysis of Climate Change Effects on Arable Crop Production in Nigeria. *Journal of Economics and Sustainable Development*. 5. 76-84.
- Alston, J, Beddow, J and Pardey, P (2009). Agricultural Research, Productivity, and Food Prices in the Long Run. *Science* 325, 1209pp–1210pp.
- Andrews, D. J. (1990). Breeding pearl millet for developing countries. In *INSORMIL Annual Report*. pp. 114-118. University of Nebraska-Lincoln.
- Brunken, J. N., de Wet, J. M. J., Harlan, J. R. (1977). The morphology and domestication of pearl millet. *Economic Botany* 31:163–174.
- Building Nigeria's Response to Climate Change (BNRCC) (2008). The recent global and local action on climate change, 2008 Annual Workshop of Nigerian Environmental Study Team (NEST) held at Hotel Millennium, Abuja, Nigeria; 8-9th October.
- Central Bank of Nigeria. (2005). Annual Reports and Statement of Account 81(1): 39-59.

- Crosson, P. (1997). Impacts of Climate Change on Agriculture. Climate Issues Brief 4. Resources for the Future, Washington, D.C.
- F.A.O. (2007). The state of food and agriculture (SOFA). Retrieved December 9th 2009 from <http://www.fao.org/WAICENT/FA>.
- FAO. (2008). Hunger on the Rise. Food and Agriculture Organization. Retrieved August 7, 2010, from <http://www.fao.org/newsroom/EN/news/>
- FAO. (2009). How to feed the world in 2050? Proceedings of the Expert Meeting on How to Feed the World in 2050. Rome: Food and Agricultural Organization of the United Nations.
- Gadgil, S. (1996). Climate change and agriculture – An Indian perspective. In Y. P. Abrol, et al. (Eds.), *Climate Variability and Agriculture* (pp. 1-18). Narosa Publishing House, New Delhi.
- Houghton, J. T., MeiraFilbo, L. G., Callander, B. A., Harris, N., Kattenberg, A., & Maskell, K. (1996). *Climate Change 1995. The Science of Climate Change*. Cambridge University, UK.
- Hussein, K.M., Ashraf, and M.Y. Ashraf (2008). Relationship between growth and ion relation in pearl millet (*Pennisetum glaucum*L) at different growth stages under salt stress. *African Journal of Plant Science* 2 (3): 23-27.
- IFAD. (2007). *Rural Poverty in Nigeria: Agriculture in the Federal Republic of Nigeria*. International Fund for Agricultural Development. Retrieved August 7, 2010, from <http://www.ruralpovertyportal.org>
- Intergovernmental Panel on Climate Change, IPCC. (2007). *Climate change: Impacts, adaptation and vulnerability. Working Group II Contribution to the Fourth Assessment Report of IPCC*. United Kingdom, Cambridge University press.
- IRD (2009). Institut de recherche pour le développement. Pearl millet, food for the future in the Sahel. *Scientific bulletin* 325
- J. O. Olukosi and P. O. Erhabor, (1988). *Introduction to farm management: Principles and applications*. Zaria, Nigeria: Agitab Publishers Ltd.
- Kebbi State Government (2017a). About Kebbi State. Retrieved from <http://kebbistate.ng>
- Kebbi State Government (2017b). Governor Bagudu Year One: Snippets from The Agricultural Sector. Retrieved from <http://kebbistate.ng>
- King, D (2004). Climate Change Science: Adaptation, mitigate or ignore? *Science*, 303, 176 -177.
- M. T. Yakasai, "Economic contribution of cassava production (A Case Study of Kuje Area Council Federal Capital Territory, Abuja, Nigeria)," *Bayero Journal of Pure and Applied Science*, vol. 3, pp. 215-219, 2010.
- Madu, D. B., Gundiri, M. N., Musa, I. K., Nwa, E. U., Adamu, M. S., Bala, M. S., ... Ogunniyi, E. O. (2010). *Country Profile – Nigeria*. Abuja: Ministry of Water Resources.
- Medugu, N. I. (2008). *Nigeria: Climate Change – A Threat to the Country's Development*. Retrieved from <http://www.allafrica.com/nigeria/>
- Mendelsohn, R., Nordhaus, W. & Shaw, D. (1994). The impact of global warming on agriculture: A Ricardian analysis. *American Economic Review* 84(4):753-771.
- National Planning Commission (2017). Retrieved from [http://www.population.gov.ng/Kebbi state](http://www.population.gov.ng/Kebbi%20state)
- National Population Commission (2006). *Nigerian Census Report*, Abuja 2006
- National Research Council: NRC, (1996). *Lost Crops of Africa, Vol.1 Grains*, National Academy Press, Washington DC.
- N. M. Chidiebere-Mark, C. S. Nwosu, O. O. Nwankwo, C. Chikezie, H. U. Oduofor, and R. D. Ejiike, "Profitability of cassava-based crop farmers in Owerri agricultural zone of Imo State, Nigeria," *Journal of Agricultural Research*, vol. 3, pp. 10-15, 2014.
- Ojediran, J.O., M.A. Adamu and D.L. Jim-George (2010). Some physical properties of Pearl millet (*Pennisetum glaucum*) seeds as a function of moisture content. *African Journal of General Agriculture* (6) 1
- Rai, K. N., AppaRao S. and K. N. Reddy. (1997). Pearl millet. In: p. 243-258. D. Fuccillo et al. *Biodiversity in trust*. Cambridge University Press, Cambridge, UK.
- Ramstorf, S. (2007). A Semi-Empirical Approach to Projecting Future Sea-level Rise. *Science*, 315: 368-70
- T. M. Kudi and Z. Abdulsalam, "Costs and returns analysis of striga tolerant maize variety in Southern Guinea Savanna of Nigeria," *Journal of Applied Sciences Research*, vol. 4, pp. 649-651, 2008.
- The Syngenta Foundation for Sustainable Agriculture (2006). *Harnessing Modern Science in Africa to Sustain Sorghum and Pearl Millet Production for Resource Poor Farmers*. www.syngentafoundation.com/millet.html
- Wolfe D.W, M.D Schwartz, A.N Lakso, Y Otsuki, RM Pool, NJ Shaulis (2005). Climate change and shifts in spring phenology of three horticultural woody perennials in northeastern USA. *International Journal of Biometeorology* 49:303-309. Meteorological Organization, Geneva.
- Filardi, R.S., O.M. Junqueira, E.M. Casartelli, A.C. Laurentiz, K.F. Duarte and V. Assuena, 2005. Pearl millet utilization in commercial laying hen diets formulated on a total or

digestible amino acid basis. Rev. Bras. Ciencia Avicola, 7: 56-64.

Rai, K. N., Murty, D. S., Andrews, D. J., Bramel-Cox, P. J. (1999). Genetic enhancement of pearl

millet and sorghum for the semi-arid tropics of Asia and Africa. Genome 1999; 42:617- 628