

# Alleviating Poverty and Hunger through Irrigation Schemes in Nigeria: A Study Case of Lower Anambra River Basin Authority in Omor Anambra State

Umobi, C.O.<sup>1\*</sup>; Umeghalu, I. C. E.<sup>2</sup>; Nwanna, C. C.<sup>3</sup>; Maduegbuna, J.I.<sup>4</sup>; Anizoba D. C.<sup>5</sup>; Akwuobi, S.I.<sup>6</sup>; Chinwuba, C. J.<sup>7</sup>

Department of Agricultural and Bioresources Engineering, Faculty of Engineering, Nnamdi Azikiwe University, Awka, Nigeria

\*Corresponding Author

Received:- 01 September 2024/ Revised:- 09 September 2024/ Accepted:- 14 September 2024/ Published: 30-09-2024

Copyright © 2024 International Journal of Environmental and Agriculture Research

This is an Open-Access article distributed under the terms of the Creative Commons Attribution

Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted

Non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

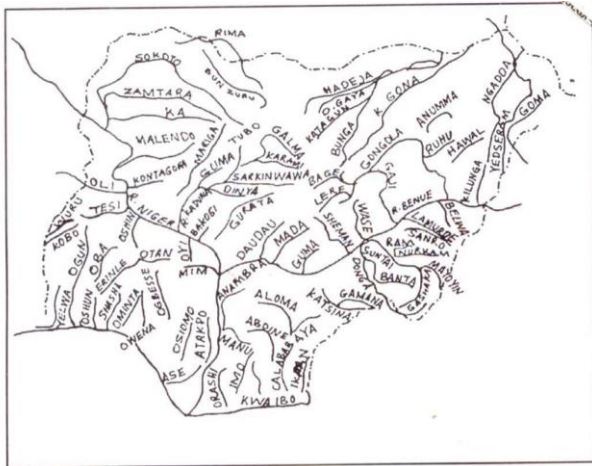
**Abstract**—Agricultural production in Nigeria is mainly carried out by subsistence farmers who depend heavily on rain-fed agriculture and use of rudimentary traditional methods for their production. But despite abundant water resources and rainfall in addition to wide diversity of ecological conditions with which Nigeria is blessed, the amount and timing of the rains are not adequate to meet the water requirement of the crops. This has led to low agricultural yields resulting to low income earning among farmers, diseases, hunger and malnutrition. Therefore, in order to meet national target on poverty reduction, and food security, the Federal Government of Nigeria embarked on establishment of irrigation facilities to make water available for agricultural production all the year round. One of such irrigation projects is the Lower Anambra-Imo River Basin Irrigation Project at Omor, in Ayamelum Local Government Area of Anambra State, Nigeria. This study was undertaken to investigate the contributions of Lower Anambra-Imo River Basin Irrigation Project in Omor, Anambra State, Nigeria; towards alleviating poverty and eradication of hunger and malnutrition. Primary data for this study was collected from 200 farmers who were randomly selected and given structured questionnaire designed to seek information in such areas as age, literacy level, and number of farm holdings, efficiency of irrigation water supply, and other challenges encountered by the farmers. The study revealed general switch from low-value subsistence farming to high-level market-oriented production resulting in increase in farmers' production, increased income, and provision of basic infrastructure such as roads, hospitals, schools in the area.

**Keywords**—Irrigation; Rain-fed; Alleviation of Poverty and Hunger; Food Security and River Basin.

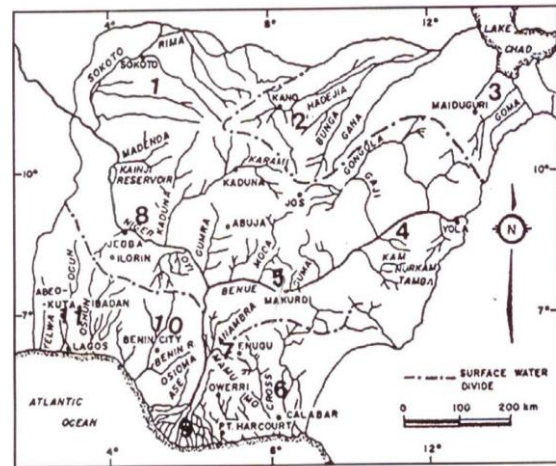
## I. INTRODUCTION

Nigeria has a total area of 923,768km<sup>2</sup> with a population of about 219,949,958 and estimated growth rate of about 2.4% per annum (NPC, 2017). According to World Bank, (2021) about 100 million of Nigerian population live in rural areas with average annual population growth of about 1.54%. The country has fertile soils and climate suitable for production of variety of crops that can provide enough food and raw materials for the industries that will alleviate hunger and poverty (FAO, 2012). Nigeria is also blessed with abundant water resources which include about 267 billion cubic metres of underground water, many rivers and streams, lakes and abundant rainfall in the southern part of the country; however, the amount and timing of rain falls are not adequate to meet the water requirement of crops (Ahameku, 2010; Umeghalu, *et al.*, 2013). The country is well drained with a close network of rivers and streams (Iloje, 1980; Ladokun, *et al.*, 2013). Figure 1, showing some major rivers and streams in Nigeria (FAO, 2015).

### 1.1 Nigeria's Surface River Basins:



**FIGURE 1: Map of Nigeria showing some major rivers. (Source: FAO, 2015)**



**FIGURE 2: Nigerian's surface River Basins. (Source: FAO, 2012)**

Nigeria is blessed with many rivers and streams. Among these numerous rivers and streams, are four principal surface water basins namely; the River Niger, the Lake Chad, the West Coast and the West Central also known as South-eastern Littoral Basin (Oshodi, 2006). These surface water basins are further subdivided into twelve river basins; the Benue, Delta and Cross River, the Imo – Anambra, Hadejia- Jam'are, Chad, Sokoto-Rima, Lower Niger, Upper Niger, Benin-Owena and Ogun-Osun River Basins.

Studies by Mahmood (1994) observed that over US\$3 billion had been invested on the construction of these irrigation and drainage projects that constitute over 300 dams and reservoirs. Figure 2, above shows river system in Nigeria and their organization into River Basins (FAO, 2016). The country is also endowed with over 79 million hectares of arable land of which only about 3.14 million hectares have potential to be irrigated (Okigbo, 1986; Eni, 2008).

### 1.2 Status of agriculture in Nigeria and pressure of increasing population:

Agricultural sector holds second position after oil and gas as the key to the development of the socio-economic and political life of Nigeria, contributing over 60% of her Gross Domestic Product (GDP), and employs over 70% of the country's economic active population. Regardless that more than half of the active population of the country are occupied in the agricultural sector, the sector could not produce enough food for the populace and raw materials to feed the industries. This is attributable to heavy reliance on rain fed agriculture, use of rudimentary traditional methods and techniques, shifting cultivation farming systems and subsistence farming which have led to low agricultural yields (World Bank, 2008; Ahameku, 2010; Umeghalu, *et al.*, 2013; Odigbo, 2016).

The pressure of population explosion and low agricultural yields has resulted to poverty and food insecurity in the country (Umeghalu *et al.*, 2013). Poverty is defined as a condition of lacking money and the necessities, such as food, water, education, healthcare, shelter and clothing needed to successfully live, which is often measured in terms of daily income of US\$1.25 and US\$2.0 (Akande, 2006; Ravallion, 1992). Thus, poverty is one of the global phenomena that have left the level of food insecurity in developing countries at alarming proportions. Poverty situation tends to worsen in reaches of a system where surface water availability is low, groundwater quality is poor, agricultural productivity is low and opportunities in the nonfarm sector are limited. Olatide *et al.* (1980) posited that, poverty remains a persistent feature of many developing countries, despite over a century of debate and action and over forty years of international aid to transform the livelihoods of the poor. The causes of poverty are complex and context-specific, but in general poverty tends to be linked with factors such as poor national economic performance, unequal distribution of income and political structures that render poor people powerless (Cohen and Reaves, 1995). According to World Bank (2000), Sub-Saharan Africa had an estimated poverty headcount of 47% in 1990 and 46.7% in 1998. United Nations (2015) also reported that overwhelmingly, the majority of people living on less than \$1.25 a day reside in two regions of the World: Southern Asia and sub-Saharan Africa and they account for about 80% of global total extremely poor people. Furthermore, nearly 60% of the World's 1 billion extremely poor people live in just five countries: India, Nigeria, China, Bangladesh and Democratic Republic of Congo (UN, 2015). But in contrast, those regions such as the

Middle East, East Asia, who have the greatest proportion of cultivated land, have experienced the greatest poverty reduction, compliment to exploitation of irrigation (Lipton and Litchfield, 2002). Improvements in crop yield have been made possible by the development of hybrid and improved seed varieties used in combination with good water control and fertilizer application. It is important to note that one of the infrastructures which irrigation provides is access road. Bacha *et al.* (2011) noted in his studies, that farmers could easily access irrigation facilities, improve farm productivity and subsequently increase their household consumption.

### 1.3 Effect of Irrigation on agricultural production:

Irrigation has been regarded as a powerful factor in increasing crop productivity, enhancing food security, expanding opportunities for higher and more stable incomes and employment and for increasing prospects for multiple cropping and crop diversification. The role of irrigation in poverty alleviation has been focus of many international communities and groups in recent years. This is because many reviews have found strong direct and indirect relationships between irrigation and poverty (Hussain and Hanjra, 2004). Irrigation makes higher crop yield possible, less reliance on rain fed agriculture, and encourages agricultural production more than once in a year by providing water which is an integral element to food production. According to Bhattarai *et al.*, (2002), irrigated agriculture significantly contributes towards generating rural employment and maintaining rural livelihoods. Furthermore, Unver *et al.*, (2018) noted that irrigation enables smallholders to adopt more diversified cropping patterns and to switch from low value subsistence production to high value market oriented production. Food is available and affordable when agricultural production is increased.

In an effort to meet national target on poverty reduction, and food insecurity, the Federal Government of Nigeria realized the need to achieve a strategic balance through irrigation than the rain fed agricultural production that accounts for the bulk on Nigeria's agricultural production at lower cost per hectare but is more vulnerable to draught, floods and other impacts of climate change (Umeghalu and Okonkwo, 2012; Enete, 2014; FAO, 2015). It is imperative that to realize the country's agricultural potentials where agricultural production are based on rain fed cultivation, there is need to improve on methods of sourcing sufficient water for agricultural production to compliment whatever water that is naturally available. Expanding small-scale irrigation is one of the necessary steps or method in a larger movement towards more sustainable and equitable agricultural growth which will break the annual cycle of uncertainty and stagnation in securing local food systems and stable economic growth (FAO. 2013b; Liangzhi *et al.*, 2015). Therefore, it becomes pertinent to formulate policies and programmes that will solve the problem of insufficient water for agricultural production. In achieving this, the Federal Government of Nigeria therefore established the National Irrigation and Drainage Policy aimed to achieve sustainable growth and to enhance performance of irrigation, contributing fully to the goals of the Nigerian agricultural sector (FAO, 2015). Various water management projects which include construction of irrigation systems such as river basins, flood, sprinkler and surface water irrigation schemes were established. Thus, a well-developed irrigation system which would provide the boost that is required to make the leap from rain fed to grower led agricultural production in Nigeria (FOA, 2015).

World Bank (2008) noted that the high incidence of poverty in most developing world is attributable to heavy reliance on rain-fed agriculture, subsistence farming and exclusion from trade. However, irrigation brings a range of potential changes in agricultural production and even assures cropping and more secure food supply for basic needs which is often the priority of smallholder subsistence producers. Studies by Hussein *et al.*, (2001), show that comparing agricultural production under rain-fed and irrigation setting, it was observed that poverty was much higher in settings without irrigation; and further shows that poverty incidence varies from 16% to 58% in irrigated settings and between 23% and 77% in rain-fed setting which shows that irrigation has significant impact on poverty. Irrigation encourages agricultural diversification as it makes growing variety of crops all the year round possible such as vegetables, okra and other products of market gardening. This reduces the likelihood of non-poor household becoming poor and poor households remaining poor (Michler and Josephson, 2017).

Northern part of Nigeria experiences lower rainfall with prolonged dry season. Shifting cultivation system of agriculture is predominant and crops cultivated in the region are rice, groundnuts, millet, sorghum, yam, cassava and maize. The southern part experiences average annual rainfall of between 2,000mm and 4,000mm, with shorter dry season is more suitable for cultivation of rice, root crops and maize. Tree crops such as cocoa, oil palm tree are also grown in this part of Nigeria. But regardless the heavy rainfalls in the southern part of the country, its unreliability in terms of onset, duration, intensity and amount for agricultural production calls for irrigation infrastructure to boost agricultural production, by minimizing the risks associated with rainfall unreliability (Onwualu, 2005; Abubakar, 2010; Faborode, 2001; Umeghalu, 2019). Irrigation can change the cropping timetable to take advantage of good weather conditions or avoid periods with hazards like heavy rainfall

or draught. FAO, (1999) reported that irrigation provides about 40% of World's food production on only 17% of total cultivated land.

#### **1.4 Establishment of irrigation system in Nigeria:**

In 2021, the Federal Government of Nigeria through the Federal Ministry of Water Resources reported that it has completed 10 more dams and 4 irrigation projects across 10 states in the country while six irrigation projects are on-going in 5 states meant to boost agricultural production and support the nation's quest for food insecurity by reducing farmers' dependency on rain-fed agricultural practices.

## **II. MATERIALS AND METHODS**

### **2.1 The study area:**

Omor is one of the communities in Ayamelum Local Government Area of Anambra State, Nigeria; and is located within Latitude 6°30'42.1884"N and Longitude 6°57'40.2372"E. The climate of Omor is typical equatorial and is influenced by two air masses namely: the North East Trade Winds which brings harmattan to the area, and the South West Monsoon Winds which brings rainfall to the area. The harmattan wind is felt between the months of November and March. During this period of harmattan, temperature of the area ranges between 40°C in the day and 18°C in the night. The area experiences the influence of South East monsoon winds between April and September and sometimes to October is responsible for precipitation averaging about 1000mm per annum (Iloeje, 1980). Although Omor is located within the Tropical Rain Forest Belt, however, anthropogenous activities through bush clearing for agricultural purposes, regular bush burning for games and overgrazing have contributed sufficiently to turn Omor's vegetation to Derived Savannah.

According to NPC (2017 and 2019), the population of Omor is put at 223,641 and 233,763 respectively. The climate and vegetation of the area provide suitable environment for production of variety of crops especially rice, cassava, yam, maize, potatoes and okra. Agriculture is the major occupation in Omor, engaging over 90 percent of her population. In Anambra State, Ayamelum Local Government Area is the major rice producer among the 21 local government areas that constitute Anambra State. Among these eight communities in that local government area, Omor is the largest rice producer being the largest producer of rice in Anambra State (Nwalieji, 2020).

In Omor, rice is cropped under upland, swamp and rain-fed lowland, and is dominated by small holder farmers who cultivate average of between one and two hectares of land. The cultivable land area of rice production in Omor is estimated to be about 8,500 hectares comprising the Lower Anambra Irrigation Project (LAIP), which covers about 5,000 hectares with net irrigable land area of 3,850 hectares and 1,150 hectares of non-irrigable/undeveloped areas (Nwalieji, 2020).

The Federal Government of Nigeria commenced the development of the Lower Anambra Irrigation Project at Omor in 1978 and completed the project in 1981 with the following major objectives:

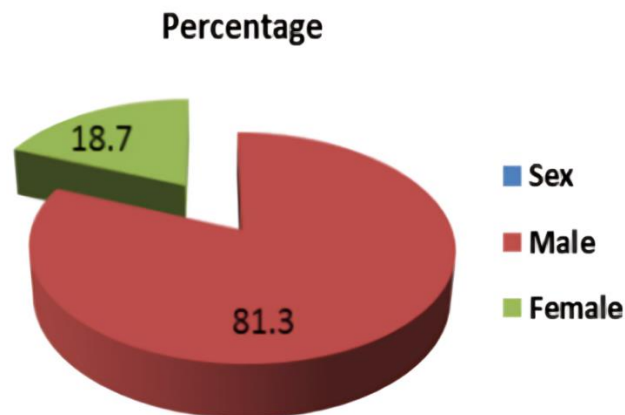
- a) To increase rice yield;
- b) To double rice cropping in a year through irrigation;
- c) To educate farmers modern techniques in rice production;
- d) To eradicate hunger, poverty, disease and improve the standard of living of the communities within the project area;
- e) To improve infrastructure within the project area and environment.

### **2.2 Data collection:**

Primary data for this study was collected through field survey, scheduled-structured questionnaire prepared to collect information from farmers and the staff of the Lower Anambra Irrigation Project. The questionnaire was designed to seek information in following areas: age of participating farmers, literacy level, number of farm holdings for five consecutive cropping seasons, efficiency in supply of irrigation water, and challenges encountered by farmers. A total of 200 participating farmers were randomly selected for the study. Secondary data were obtained from the records of the Lower Anambra Irrigation Project, newspapers and collation of information from online publications.

### III. RESULT AND DISCUSSIONS

#### 3.1 Gender Distribution:



**FIGURE 3: Graph showing percentage of gender distribution.**

Data obtained shows that about 81.3% of the farmers are male while 18.7% are female as depicted in Fig. 3. This may be attributed to the fact that rice cropping is capital intensive. However, it was observed that women mainly engaged in provision of labour in areas of transplanting rice seedlings, fertilizer application, weeding, harvesting, threshing and winnowing of the paddy rice.

#### 3.2 Supply of irrigation water to farmers:

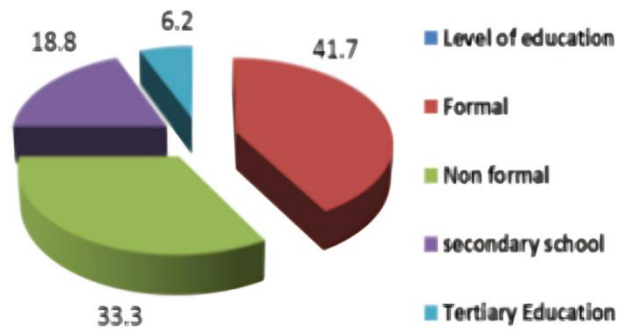
**TABLE 1**  
**EFFICIENCY IN IRRIGATION WATER SUPPLY**

S/N	Level of efficiency in water supply	Percentage of farmers
1.	Efficient water supply.	94
2.	Inefficient water supply.	6
	Total	100

About 94% of farmers interviewed responded affirmatively to efficient irrigation water supply to their paddy fields while 6% of the farmers complained that supply of irrigation water to their paddy field is not efficient as represented in Table 1. This may be attributed to long distance between their paddy fields to the source of irrigation water supply. Also, inadequate maintenance of the irrigation facilities may impede normal flow of irrigation water to some paddy plots. This often led to scramble for water especially during the dry season cropping. Inadequate supply of water especially during the dry season cropping may results to crop failure.

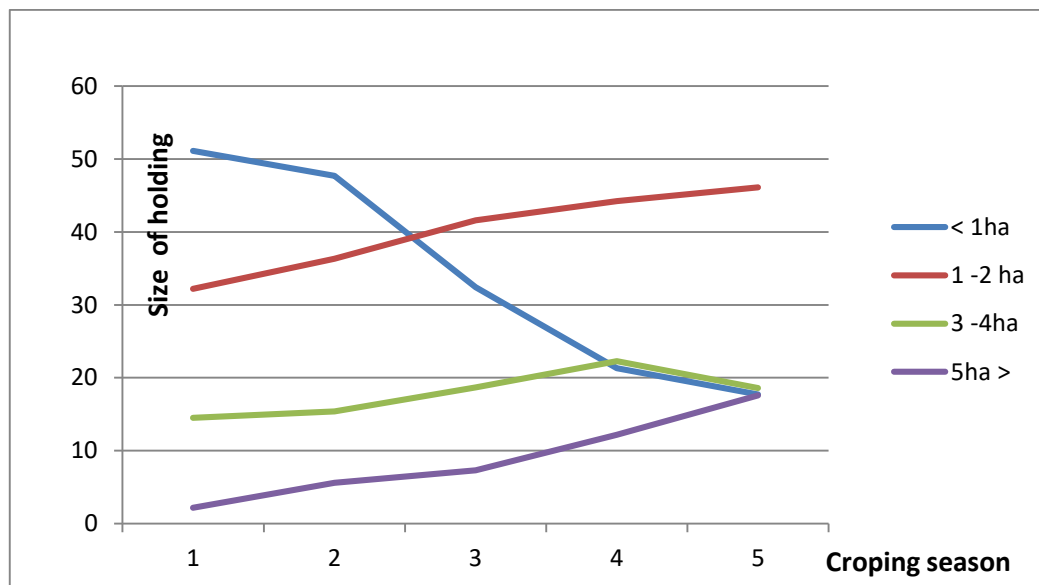
#### 3.3 Education status of the farmers:

Fig. 4 below shows that, about 41.7% of the farmers obtained formal education; 18.8% of the farmers have secondary school education; about 33.3% of the farmers are without formal education, while the remaining 6.2% of the farmers attained tertiary education. This shows that majority of the farmers acquired some level of education that can enhance their taking informed decisions on best farming techniques for their agricultural production. Although the number of farmers without formal education is high, they can improve their farming techniques from other educated farmers in the field.



**FIGURE 4: Literacy level of the farmers.**

### 3.4 Trend of farmers' farm holdings for five consecutive cropping seasons:



**FIGURE 5: Trend of the farmers' farm holdings for five consecutive cropping seasons.**

Figure 5, represents the trend of increase in number of farm holdings by the farmers for five consecutive cropping seasons. It is shown that about 51.1% of the farmers commenced cropping with farm holdings less than 1 ha in the first cropping season. This number started declining progressively to 42.7%, 32.4%, 24.3% and 12.7% respectively from the second cropping season and subsequent seasons. Also it is observed that about 32.2% of the farmers that commenced cropping with between 1 and 2 hectares in the first cropping season increased their holding to 36.3% during the second cropping season and progressively to 41.6%, 44.2% and 46.1% respectively during the subsequent cropping seasons. While about 14.5% of farmers that started cropping between 3 and 4 hectares in the first cropping season also increased their holding to about 15.4% during the second cropping season and progressively increased to about 17.7%, 19.3% and 21.6% respectively in subsequent cropping seasons. It is found out too that in the first cropping season, about 2.2% of the farmers that commenced cropping with about 5 hectares also increased their holdings to about 5.6% in the second cropping season, and progressively increased to 8.3%, 12.2% and 19.6% respectively during subsequent cropping seasons.

## IV. CONCLUSION

Observation from the study shows that there is significant increases in the number of farm holdings across board especially farmers with holdings less than one hectare and two hectares during the first cropping season. These increases in number of farm holdings indicate rise in farmers' revenue within the period under review which also translates to switching from low-value subsistence production to high-level market oriented production. Thus, rise in revenue also will translate to the following:

- 1) Rapid reduction in level of poverty and accelerated improvement in the standard of living of the farmers.
- 2) Increase in both holding and labour productivity.
- 3) Maintenance of food self-sufficiency and food security.

### **Challenges facing Lower Anambra irrigation Authority.**

- 1) During the course of this study, it was found out that the distance between River Anambra from where the irrigation water is sourced to the paddy field in Omor community is several kilometres away. This causes enormous quantity of water loss in saturating the earthen canal through which water is conveyed to the paddy field. Thus, the cost of diesel for fueling the pumps that draw water from River Anambra into the canal before it flows gravitationally to the paddy fields is high, thus, exerting enormous financial pressure on the finance of the River Basin Authority. This often result to scarcity of water during the growing stage of the crops. Moisture stress affects overall paddy yield especially during the dry season cropping; and to avoid this situation, farmers resort to scrambling for water.
- 2) Inadequate maintenance of the authority's agricultural machines and equipment leading to their unavailability during the cropping season and delays in agricultural operations such land preparation, harvesting and threshing operations.
- 3) Corruption among the civil servants who engage in illegal land allocation to their cronies and often denying some genuine farmers the chance to participate. These practices led to the collapse of the irrigation and its eventual closure.
- 4) High cost of maintaining the irrigation canal conveying water to the paddy field has forced the River Basin Authority to scrap dry season cropping. This has resulted to drop in the farmers' annual revenue earning as the since they now crop only during the rains.

### **V. RECOMMENDATIONS**

Food security cannot be attained by depending on rainfall for food production because of its timing. To achieve this government has pivotal role to play. The present status of agricultural practices whereby primitive methods are still at play should give way to exploitation of appropriate mechanization technologies. Thus government at all levels should assist farmers with the following:

- 1) Irrigation project is capital intensive and government has invested huge capital in establishing them in the country. There is therefore need to improve on supervisory roles over the investment especially on management of the established irrigation facilities.
- 2) Regular meetings and workshops should be organized between the management of the authority and participating farmers where problems confronting part shall be looked into and resolved for smooth running of the scheme.
- 3) Extension Workers should be employed to train and educate farmers on new farming techniques of using irrigation facilities especially their maintenance culture.
- 4) Farmers should be made or encourage to form co-operative societies to enable them secure loans and other incentives from government which will assist them to increase their holdings for increased production. This will enhance the chances of government to subsidize costs of farm inputs such as fertilizer, herbicides, pesticide etc.
- 5) there is need for re- establishment of tractor hiring scheme – This will increase farmers farm holding; timeliness of agricultural activities which will result to increased production of agricultural products for human and animal consumption as well making available sufficient raw materials for industries.
- 6) Holistic solution should be found thereby water from the Ezu River which flows nearby to gravitationally be supplying the paddy fields with water. This will save huge sum of money that would have order wise be spent on sourcing water from the far distant River Anambra.
- 7) Governments should ensure less involvement of politicians in the running of agricultural projects. Experiences have shown that facilities and inputs provided by government which are meant for farmers at subsidized rates do not reach the farmers. The facilities are diverted to their friends and cronies who often are not genuine farmers. The facilities are then resold to the farmers at exorbitant prices that are out of their reach. Secondly, experience has shown that politicians are fond of dumping programmes initiated by their predecessors resulting to policy inconsistencies in agricultural programmes.

### **REFERENCES**

- [1] Abubakar, C.Z. (2010). Farm Power Utilization in Agriculture. Presentation at the National Workshop on Tractor and Farm Machinery for sustainable Agricultural Production in Nigeria held at NAERLS, ABU, Zaria.

- [2] Ahameku, I.E. (2010). Lead Paper II. Conservation of soil and water resources for combating food crisis in Nigeria. Proceeding of the First Annual NIAE South East Regional Conference NAU, Awka.
- [3] Akande, L.O. (2006). Empowerment of rural people through agricultural mechanization. Presented at the 2006 School Conference. School of Science, Osun State of College of Education, Ela-Orangun.
- [4] Bhattarai, M., Sakthivadivel, R., and Hussain, I. (2002). Irrigation impact on income inequality and poverty alleviation policy issue and options for improved management of irrigation system. Working Paper 39. International Water Management Institute, Colombo, Sri Lanka. 37pp.
- [5] Cohen, M.J. and Reaves, D. (1995). Causes of hunger. Bread for the World Institute. IFPRI 2020 Vision Brief. Washington DC.
- [6] Enete, i. C. (2014). Impact of Climate Change on Agricultural production in Enugu State Nigeria. Journal of Earth Science and Climatic change. OMICS International. Vol. 5 pp .1-3. <https://doi.org/10.4172/2157-7617.1060234>.
- [7] Eni, H. (2008). How government kills rice production. Tell Magazine No.42, October, 20, pp38-45.
- [8] Faborode, M.O. (2001). Strategies for sustainable national agricultural infrastructural development. Paper Presented at the Proceedings of National Engineering Conference and Annual General Meeting, Port Harcourt.
- [9] Food and Agriculture Organization of the United Nations (FAO). (2007). Modernizing irrigation management—the MASSCOTE approach: Mapping System and Services for Canal Operation Techniques, by D. Renault, T. Facon and R. Wahaj. FAO Irrigation and Drainage Paper No. 63. Rome.
- [10] Food and Agriculture Organization of the United Nations (FAO). (2013b). Multiple uses of water services in large irrigation systems: Auditing and planning modernization—the MASSMUS Approach, by Renault, R. R.
- [11] Food and Agriculture Organization of the United Nations (FAO) and World Water Council (WWC). (2015). Towards a water and food security future. Critical perspectives for policy makers. Rome, Italy and Marseille, France.
- [12] Food and Agricultural Organization of the United Nations (FAO). (2012). Hydrology and Inland Water Resources of Nigeria. Retrieved June 13, 2024 from <http://www.fao.org/docrep>
- [13] Food and Agricultural Organization of the United Nations (FAO). (2015). Agricultural and Rural Development: Land and Soil; Water. FAOLEX Data base.
- [14] Food and Agricultural Organization of the United Nations (FAO). (2015). National Irrigation and drainage policy and Strategy.
- [15] Hossary El O. (1988). Mechanized rice production in small holdings. The Egyptian Experience. Proceedings of C.I.G.R. Inter-Sections Symposium/Nigerian Society of Agricultural Engineers held at the National Centre for Agricultural Mechanization, Ilorin, Nigeria.
- [16] Hussain, I., and Hunjira, M. A. (2004). Irrigation and Poverty Alleviation: Review of the Empirical Evidence. *Irrigation and Drainage*. 53: 1 – 15.
- [17] Hussain, I; Yokoyama, K; Hunzai, I. A. (2001). Irrigation Against Rural Poverty: An Overview of Issues and Pro-poor Intervention Strategies in Irrigated Agriculture in Asia . In *Irrigation against rural poverty: An overview of issues and pro-poor intervention strategies in irrigated agriculture in Asia*. Proceedings of National Workshops on Pro-Poor Intervention Strategies in Irrigated Agriculture in Asia (Bangladesh, China, India, Indonesia, Pakistan and Vietnam), ed. Hussain, I.; Biltonen, E. Colombo, Sri Lanka: International Water Management Institute.
- [18] Iloje NP (1980). A New Geography of West Africa. Sheck Wah Tong Printing Press Limited. Hong Kong.
- [19] Ladokun, L.L., Ajao, K.R. and Sule, B.F. (2013). Hydrological Energy Conversion Systems: Prospects and challenges in Nigerian Hydrological Setting. Nigerian Journal of technology. Vol. 32.No. 3. pp 538-549.
- [20] Liangzhi, Y., Hiroyuki, T. and Hua, X. (2015). Cultivating Growth in Nigeria Agriculture with Small Scale Irrigation. IFPRI Blog: Issue Post. Accessed 04/02/2023.
- [21] Mahmood, I. (1994). Key note address presented by the Hon Minister Federal Ministry of Water Resources and Rural Development at the National Symposium on Water Resources and Rural Development, Kano, Nigeria.
- [22] Nwalieji, H. U. (2020). Omor the Food Basket of South Eastern Nigeria. Omor Renaissance. A Repository of the Art and Culture of Omor People.
- [23] Odigbo, E.U. (2016). Global Food Crisis. Intensified Agricultural Mechanization Imperative for Nigeria. Lead Paper delivered at the 1st. South East Regional Conference of the Nigerian Institution of Agricultural Engineers, South East Chapter, held on 28th. August, 2016 at Nnamdi Azikiwe University, Awka Nigeria.
- [24] Okigbo, B.N. (1986). Towards a New Green Revolution from Chemical to Biological Techniques in the Improvement of Tropical African Agriculture. Paper delivered at the International Meeting of Italian Academy of Science, Rome, Italy.
- [25] Olatide, O.J., Emeka, J. and Osagie, V.E. (1980). Nigerian Small Farmers: Problems and Prospects in Integrated Rural Development. The University of Ibadan, Nigeria.
- [26] Onwualu, A.P. (2005). Survey Report of Ten Selected Agro Raw Materials in Nigeria. Raw Material Research and Development Centre, Abuja.
- [27] Onwualu, A. P.; Akubuo, C.O. and Ahaneku, I.E. (2006). Fundamentals of Engineering for Agriculture. Immaculate Publications Limited, Enugu, Nigeria.
- [28] Oshodi, K.S. (2006). Hydrological Study of Nigeria – A GIS Project, GIS Hydro 2006, Centre for Research in Water Resources, University of Texas, 2005, <http://www.crrw.utexas.edu/gis/gishydro06/Introduction>
- [29] Ravallion, M. (1992). Poverty Comparisons: A Guide to Concepts and Methods. Living Standard Measurement Study. Working Paper 88. World Bank. Washington D.C.

- [30] Sinyolo, S., M.Mudhara, E. Wale. (2014). The Impact of Small Holder Irrigation on Household Welfare: The Case of Tugela Ferry Irrigation Scheme in Kwa Zulu– Natal, South Africa, *Water SA* 40 (1): 145–156 .
- [31] Umeghalu, I.C.E., Ngini, J.O., and Chukwuma, E.C. (2013).Challenges and Prospects of Lower Anambra River Irrigation Project, Omor, Anambra State, *International Journal of Agriculture and Bioresources*. 2 (4); pp. 141-143.[www.ijagbio.com](http://www.ijagbio.com)
- [32] Unver, O., Wahaj, R., Lorenzon. E., Muhammadi, K., Osias, J.R.,Reinders, F., Wani, S., Chchra, J.,Lee, P. and Sangjun. (2018). Key and Smart Actions to Alleviate Hunger and Poverty Y Trough Irrigation and Drainage.Published Online in Wiley Online Library. ([wileyonlielibrary.com](http://wileyonlielibrary.com)) DOI: 10,1002/ird 2225
- [33] World Bank (2021).Global Economy. Nigeria: Rural Population of Total Percentage.