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IMPROVING THE SOCIOECONOMIC WELLBEING OF THE PEOPLE OF AGULERI AREA THROUGH WATER RESOURCES DEVELOPMENT

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Abstract

Use of water for irrigation and food production constitutes one of the greatest pressures on freshwater resources. Meeting the water needs and food security of the people can be met by irrigation, from surface water sources, groundwater withdrawals and rain fed agriculture. The study area covers Anambra East, Anambra West, and Oyi Local Governments of Anambra State Nigeria, and hydrologically falls within the Anambra River Basin of the country. The Geology of the area is sedimentary and comprises of Alluvium, Nanka Sands, Ameki Formation. The geologic units are Tertiary formed less than 65 million years ago. Precipitation is heavy and between 1500 and 2000 mm a year. Elevation is generally less than 62 meters above mean sea level. The area lies within the Humid Tropical Belt of the country and vegetation found are the marshy waterlogged type and light forest. There are enough water resources and surface waters include rivers, streams, springs and wetlands. During the rainy season the marsh lands of the River Niger and Anambra River are water logged and flooded culminating in rich alluvial deposits for agriculture. The flow rates and discharge for both rivers throughout the year are harnessed to optimum levels for irrigation purposes. The sedimentary deposits encountered are highly aquiferous and are exploited for domestic, commercial, agricultural and industrial purposes. Groundwater is exploited by hand-dug wells, tripod bored wells and hydraulically driven wells. Hydrogeologic studies reveal hydraulic heads range from 15-19 meters and 5-8 meters for water depth in the Alluvium. Hydraulic heads range from 30-60 metres in Nanka Sands, while water level varies from 20-70 meters. Surface water harnessing and groundwater exploitation is of immense benefit to the people for improving their living conditions, alleviating poverty and uplifting the socio economic status of the semi-urban and rural population. Improved infrastructural development based on the water resources potentials of the region has boosted agricultural production and the growth of agro-based industries. This has, to an extent, helped to achieve the objective of the Millennium Development Goals targeted at the developing economies of the world.

Keywords: *Anambra River, groundwater exploitation, irrigation, poverty alleviation, water resources.*

INTRODUCTION

The use of water for irrigation and food production constitutes one of the greatest pressures on fresh water resources while agriculture accounts for approximately 70% of global freshwater withdrawals. Over the next 40 years projections of global populations growth of 2-3 billion people will result in a predicted increase in food demand of 70% by 2050 (WWDR4, 2017).

About 2 billion people worldwide depend on groundwater supplies which include 273 transboundary aquifer systems. (UNESCO/IHP, 2009; Puri & Aureli, 2009).

Concerns about food insecurity are growing in the globe and more water will be needed to meet increasing demands for food and energy. Meeting the water needs and food security of the people can be achieved by irrigation mainly from surface water sources, groundwater withdrawals and rain fed agriculture. World population is predicted to grow from 6.9 billion in 2010 to 8.3 billion in 2030 and to 9.1 billion in 2050 (UNDESA, 2009a). By 2030, food demand is predicted to increase by 50% due to increase in population. The U.S. Energy Information Administration (2010) estimates that global energy consumption will increase from approximately 500 quad trillion BTU to 700 quad trillion BTU for non-OECD countries. It also estimates a similar increase from 250 quad trillion (BTU) to 280 quad trillion BTU for OECD representing increase in energy consumption of 84% in non-OECD countries and 14% in OECD countries. In the industry ~20% of the world's freshwater withdrawals are channeled to this sector and the water demands is generally proportional to the average income level representing only ~5% of water withdrawals in low-income countries.

Water sources have always been a determinant of human settlements and access to improved water supply add to the wellbeing of a healthy and empowered population. Worldwide 87% of the population gets its drinking water from improved sources and the corresponding figure for developing regions is as high as 84%, while only 76% of rural populations have access to improved sources (WHO/UNICEF, 2010). From the findings of the International water management institute (2007), groundwater is crucial for the livelihoods and food security of 1.2-1.5 billion rural households in the poorer regions of Africa and Asia as well as for domestic supplies of a large part of the population elsewhere in the worldwide.

Human health risks are no doubt linked to water quality. It is reported that each year ~3.5 million deaths are related to inadequate water supply, sanitation and hygiene and occurs in predominately developing countries (WHO, 2008b). Diarrhea diseases associated with drinking water are estimated to cause death of more than 1.5 million children under the age of five per year (WHO/UNICEF, 2010).

Significant part of the total burden of disease worldwide ~10% could be prevented by improvements in drinking water supply, sanitation, hygiene and use of environmental management and health impact assessments. Cholera is endemic in regions with poor socio-economic conditions, rudimentary sanitary systems, absence of waste water treatment, and were public hygiene and safe water is lacking. (Hug, Chowdhury, Islam, Montilla, & Colwell, 1996).

Water resources abound in the region and surface waters include rivers, streams, springs and wetlands. The sedimentary deposit in the region is highly aquiferous and exploited for domestic, commercial, agricultural and industrial purposes. Living standards are uplifted by exploitation and use of water for intended purposes. Groundwater is exploited by hand-dug wells, tripod bored wells and hydraulically driven wells. Surface water is harnessed for irrigation for all year round food production.

Physiography and Drainage

Rolling plains characterize the western and eastern parts of the study area while towards the southeast around Aguleri are elevated uplands up to 122 m, above mean sea level, sloping towards the west bounded by the River Niger. (Figure 1)

Major surface water bodies found in the study area are the Anambra River, perennial and seasonal streams and springs drain the area and these water bodies interact with groundwater systems. Infiltration, percolation movement and discharge are phases of hydrologic cycle taking place within the basin.

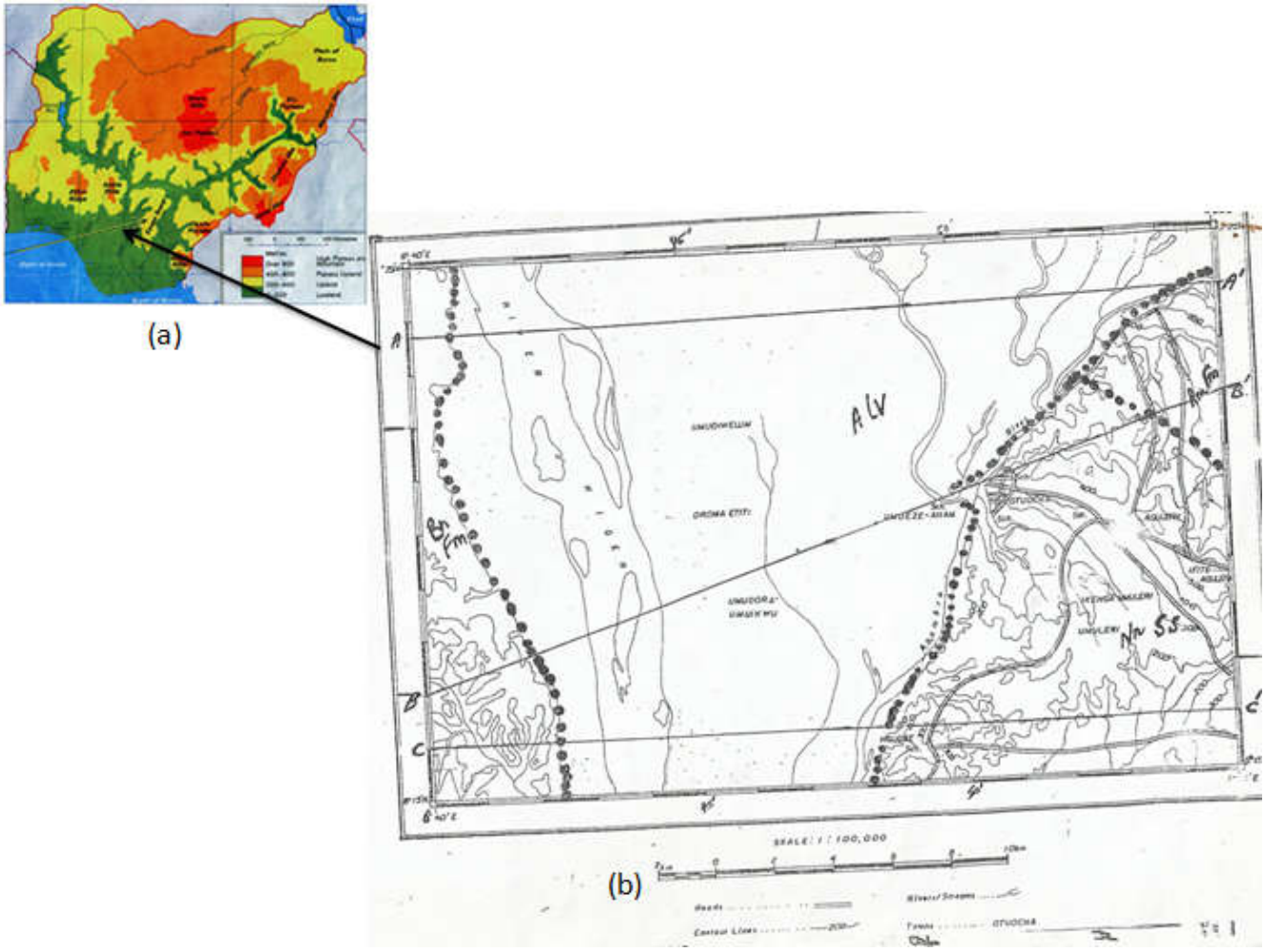

Figure 1: (a) Map of Nigeria arrow showing study area. (b) Map of study area.

Source: (Federal Surveys of Nigeria, 1977)

Climate and Vegetation

The climate experienced in the study area is the Humid Tropical belt type with average rainfall ranging from 1500 mm to 2000 mm a year. (Nagle, 2006; Waugh, 1996; NIMET, 2012), (Figure

2a). Average maximum and minimum temperatures are 33°C and 24°C respectively. The relative humidity for the wet months is 60% to 70%. Evaporation rates are as low as 2.2mm in the rainy season and as high as 5.1mm in the dry season.

The vegetation is characterized by the Humid Tropical Rainforest type, widely distributed tall tress such as oil palm, Iroko, mahogany and oil bean are found. Thick undergrowths and shrubs also occur in the area. (Figure 2b)

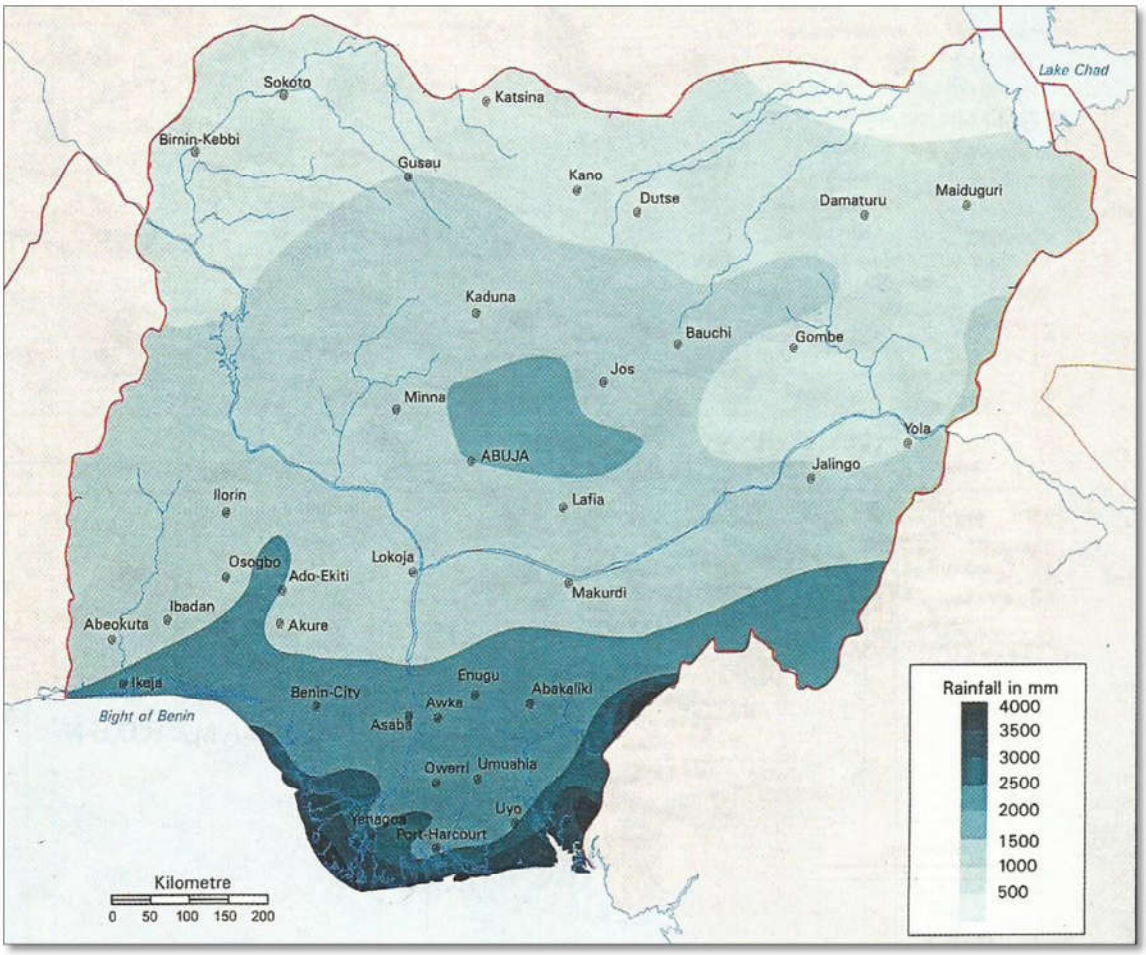

Figure 2a: Climatic map of Nigeria showing rainfall distribution

Source: (Balogun, 2009)

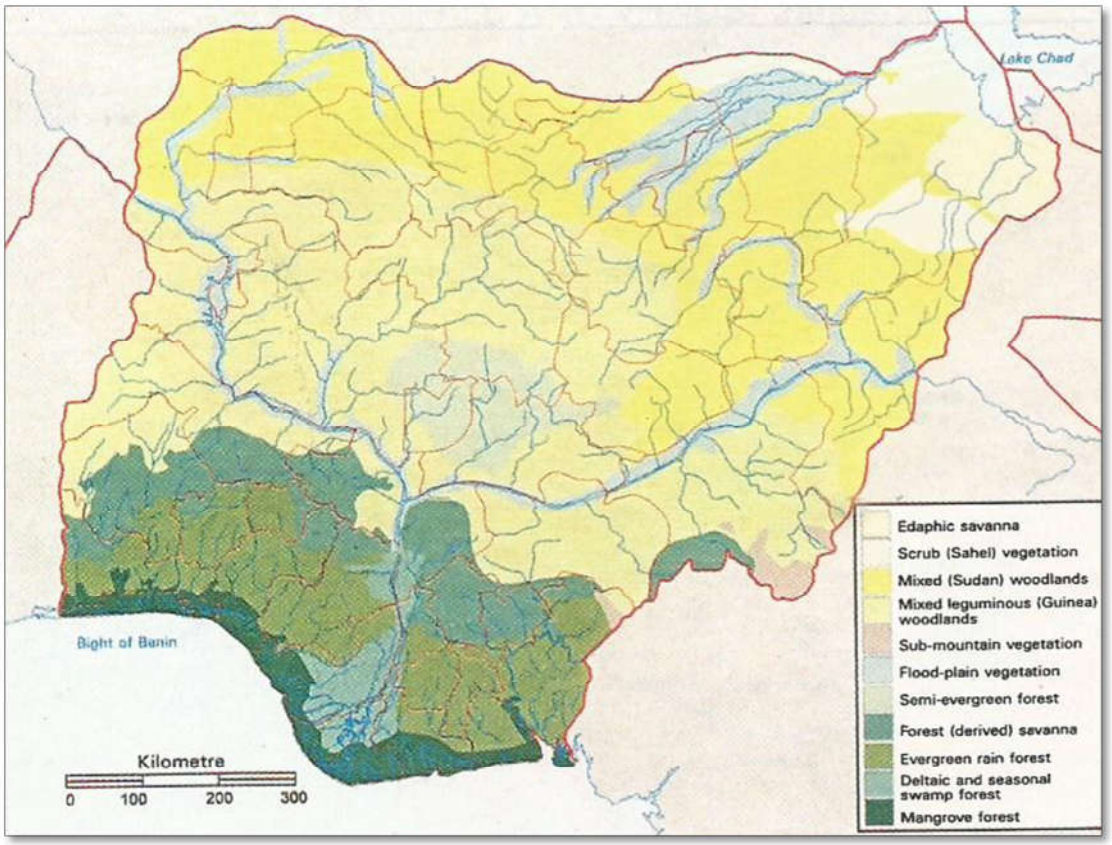

Figure 2b: Vegetation map of Nigeria.

Source: (Balogun, 2009)

Geologic Setting

The geologic formations that underlie the area are the Alluvium, Ameki Formation and the Nanka Sands (Figure 3). Large sediments transported by the River Niger and its major tributaries, including the Anambra River were deposited on either side of the banks of the rivers. The thickness of alluvium ranges from few meters to the order of tens of meters in places and are characterized by sandy deposits. The Ameki Formation has highly fossiliferous, greyish green sandy clay with calcareous concretions and white clayey sandstones. Nanka Sands consist of uncemented loose medium to coarse grained and pebbly quartz sand units (Nwajide, 2013; Egboka, 1993; Reyment, 1965). The Alluvium underlie Umudiora, Umuikwu, Anam, Oroma, and Umueze Anam areas. Ameki Formation underlies Aguleri and Umuleri areas, while Nsugbe and Nteje are underlain by Nanka Sands. The formations are highly aquiferous with good porosity and permeability. (Offodile, 2002; 2009).

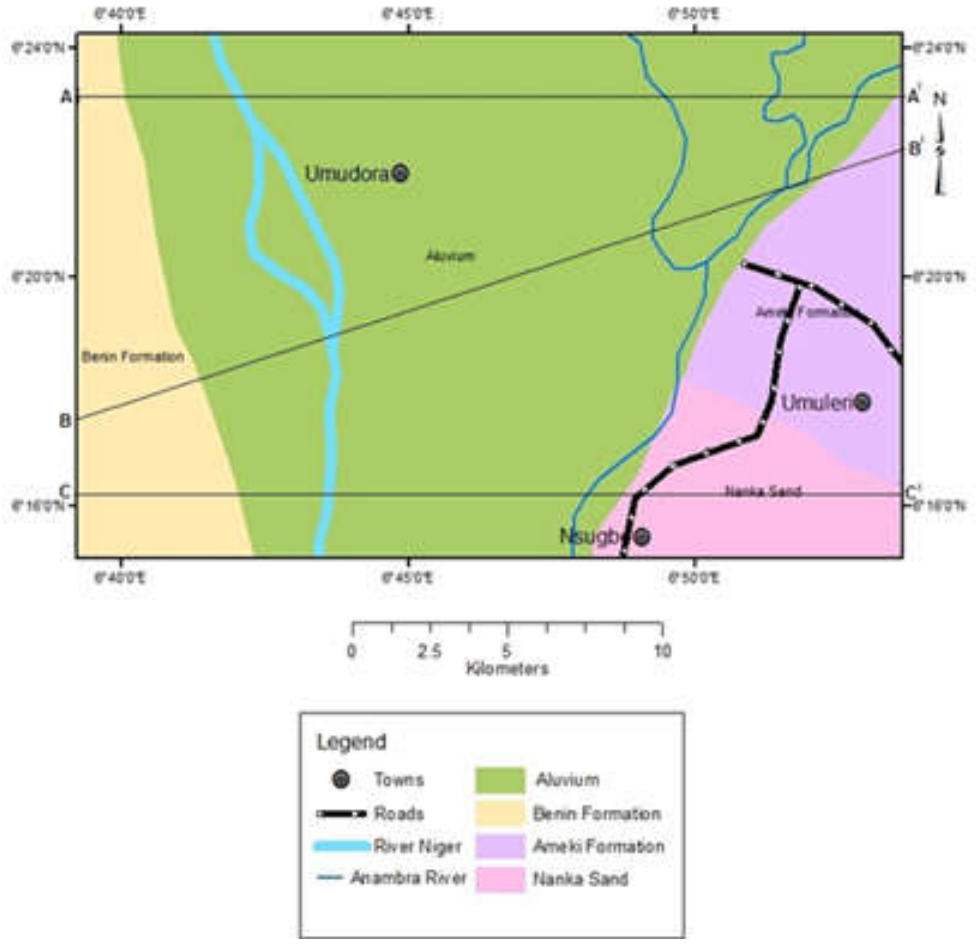

Figure 3: Geologic map of the study area

METHODOLOGY

Base maps were prepared from standard maps of scales 1:100,000 1:250,000 and 1:500,000 obtained from the Federal Surveys of Nigeria, 1977. Relief, drainage systems and road networks were indicated on the base maps produced from topographic maps. The geology, water resources and economic activities of the semi-urban and rural population were observed and studied.

Materials and equipment used for the study include camera, Geographic Positioning Systems, and water level sounders, drilling box samples, meter tape, leather bag and cellophane bags. Observations and measurements made were recorded in a field note book.

The coordinates of borehole sites and surface water bodies were measured using the Geographic Positioning System (GPS). Meteorological data for rainfall, temperature and evaporation were obtained from the records of the Nigerian Meteorological Agency, Awka. The installed equipment at the Agency are dry and wet bulb thermometers for temperature, the Piche

evaporimeter for measuring the rate of evaporation and the standard ordinary rainfall gauge and self-recording gauge for measuring amount of rainfall. Hydrogeologic data of boreholes were obtained from the Federal Department of Water Resources, Enugu on visits to sites and also from records.

RESULTS AND DISCUSSION

Surface water and Groundwater systems

Interplay of surface water and groundwater connectivity occurs in the area. The total length of flow of River Niger is 4500 km from its source, across the entire West Africa Sub region discharging into the Atlantic Ocean. Direct precipitation, overland flow lead to rise in water levels, enhanced flow rates and increase in water discharge. There is an overflow of the banks and consequent flooding of the low lying adjoining alluvial plains resulting in deposition of rich nutrient soils suitable for agriculture purposes.

The Anambra River (figure 4a) is a major tributary of the River Niger. It joins the River Niger at an acute angle some 3 km distance north of Onitsha.

Figure 4a: River Anambra at Aguleri with boats in the foreground used by local populace for fishing and ferrying passengers.

Source: (Fieldwork, 2015)

Its source is in the Idah Hills in Benue State; it flows more than a distance of 150 km and empties into the River Niger down south. (Figure 4b) It broadens at the lower reaches and has a maximum width of 500 meters. The discharge is high from heavy precipitation in the rainy season and contributory flow is from its many tributaries and runoff from the uplands of Nkwelle, Nsugbe and Aguleri areas. During the peak rainy season the marsh lands of the River Niger and River Anambra are waterlogged and flooded culminating in rich alluvial deposits for agriculture. The flow rate and discharge for both rivers can be harnessed to optimum level for irrigation purposes.

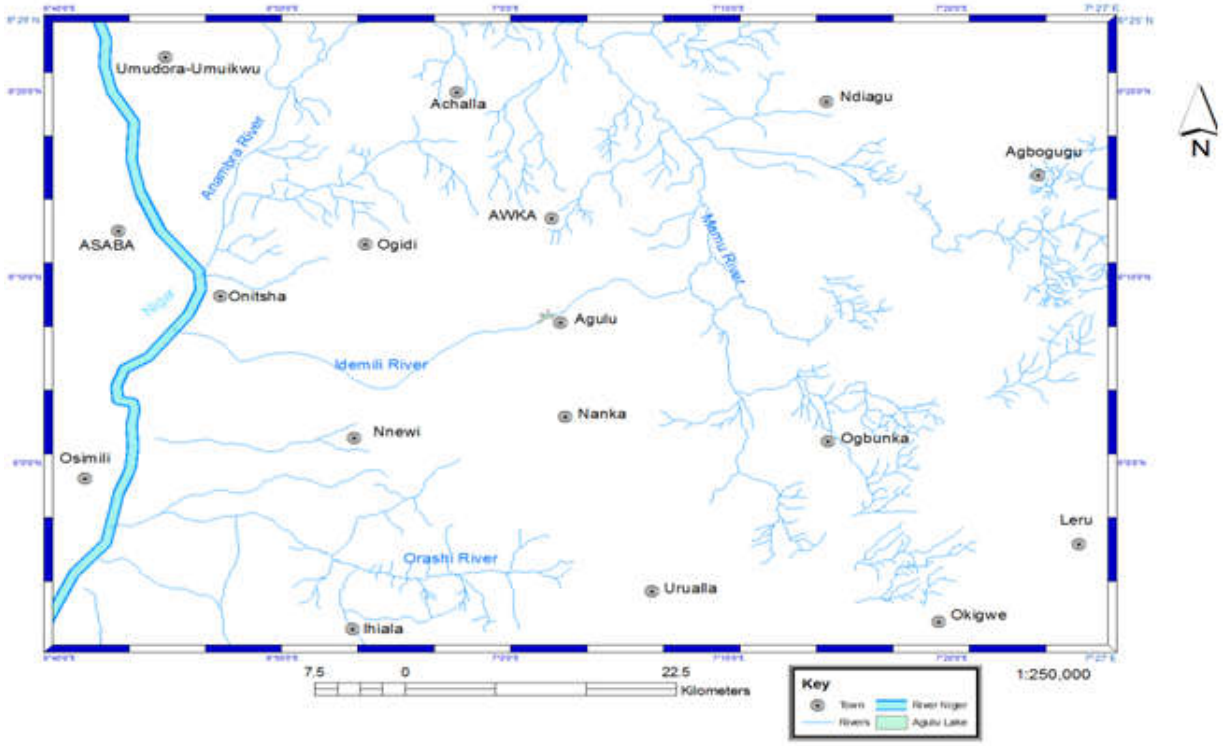

Figure 4b: Map of part of Anambra River Basin showing River Niger and its tributary Anambra River

Source: (Fieldwork, 2015)

Groundwater resources are exploited by local technology (hand-dug and tripod bored wells) for domestic needs, livestock (poultry) and fish production. The use of motorized mounted equipment is also used to drill down to deep aquifers of more than 50.00 meters. Groundwater exploration involves a number of stages that will ensure a successful well development program. They include exploration and location of suitable borehole sites, drilling and design of borehole, installation of casing and screens, gravel packing and grouting, water well development, pump installation and pumping test (Offodile, 2014). Hydrogeologic records reveal an average water level ranging from 3.08 meters to 10 meters. Boreholes are drilled down to the upper and middle zone aquifers at depths ranging from 18 meters to a borehole depth of 119 meters at Aguleri.

Hydraulic head of the aquifers are high ranging from 14.4 meters at Otuocha. Groundwater can safely be abstracted for intended uses even at peak dry season. Yields from the boreholes are moderately high due to casing size and size of pump and range from 3.6 m^3/hr at Anam to 5.5 m^3/hr at Umueze Anam. However an exceptional high yield of 68.2 m^3/hr was recorded at Otuocha (Table 1). The yields can conveniently serve the semi urban population and rural households.

Table 1: Hydrogeologic data of boreholes in the study area

Location	Geologic Formation	Cord N	Cord E	Elevation (m)	Depth of BH (m)	Depth to water level (m)	Hydraulic Head (m)	Dynamic water Head (m)	Draw Down (m)	Yield m^3/hr	Specific Capacity (m^3/hr)
Anam I	Alluvium	$6^0 13^1$	$6^0 45^1$	25	24	3.0	22	4.2	1.8	3.6	0.5
Anam II	Alluvium	$6^0 13^1$	$6^0 46^1$	25	24	6.6	18.4	10.8	4.2	3.8	1.1
Umuodi	Alluvium	N.A	N.A	25	24	6.2	18.8	10.1	3.9	3.9	1.0
Innoma I	Alluvium	N.A	N.A	25	24	5.4	19.6	8.6	3.2	3.2	1.0
Innoma II	Alluvium	N.A	N.A	25	24	9.0	16.0	14.9	5.9	4.1	0.7
Oroma I	Alluvium	$6^0 20^1$	$6^0 45^1$	23	24	5.9	17.1	9.5	3.6	3.4	0.9
Oroma II	Alluvium	$6^0 45^1$	$6^0 45^1$	25	18	5.9	19.1	9.5	3.6	3.7	1.0
Umuezeanam	Alluvium	$6^0 20^1$	$6^0 49^1$ 506	18	26	6.2	16.8	10.0	3.8	4.4	1.2
Umuikwu	Alluvium	$6^0 18^1$	$6^0 45^1$	25	29	6.2	16.8	10.1	3.9	4.2	1.1
Onono	Alluvium	$6^0 11^1$	$6^0 46^1$	21	30	6.6	14.4	10.8	4.2	4.6	1.1
Obodo Onu	Alluvium	NA	NA	25	24	5.7	19.3	9.3	3.6	4.1	1.1
Otuocha	Nanka Sands	$6^0 20^1$	$6^0 50^1$	30	119	0.6	29.4	4.1	3.5	68.2	19.44
Umudiora	Alluvium	$6^0 18^1$	$6^0 47^1$	23	29	6.2	16.8	9.9	3.7	4.5	1.2
Umuezeanam	Alluvium	$6^0 26^1$	$6^0 50^1$	18	91	3.0	15.0	8.6	5.6	5.5	0.8

Source: (Federal Department of Water Resources, Enugu, 2007)

The water-saturated soils and high water table enable the production of roots and tuber crops such as cocoyam, potatoes, yams, cassava. Cereal crops mainly rice and maize is cultivated, while fruits and vegetables such as plantains, banana, tomatoes, pepper, okro and leafy vegetables, pineapples and carrot are also grown. Figures 5, 6, 7)

Figure 5: Tubercrops produced all the year round are marketed

Source: (Fieldwork, 2015)

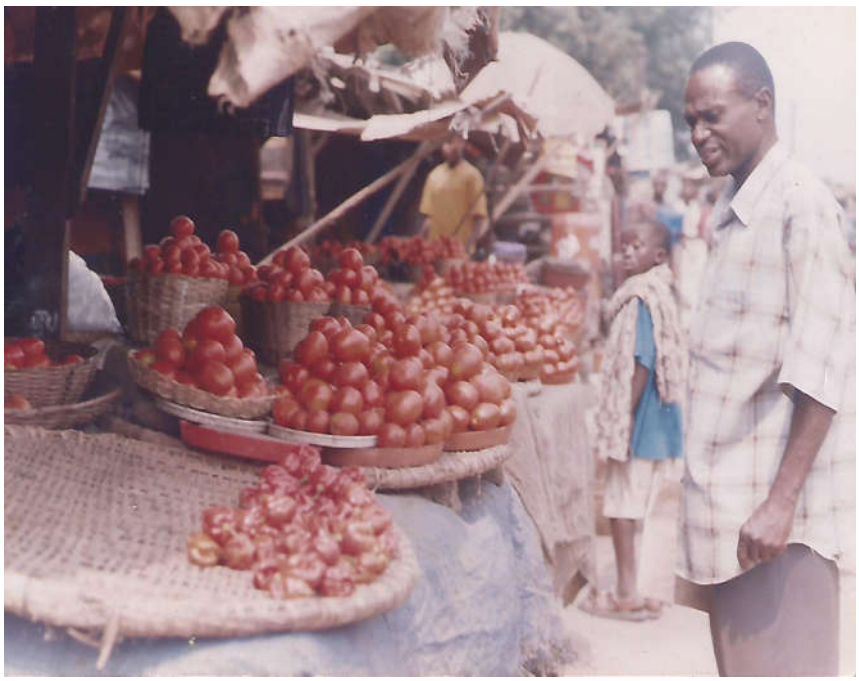

Figure 6: Tomatoes cultivated all year round are sold in the market

Source: (Fieldwork, 2015)

Figure 7: Rice seedling raised in nursery beds

Source: (Fieldwork, 2015)

Figure 8: Irrigation of water through channels into demarcated rice fields

Source: (Fieldwork, 2015)

Agricultural practices are carried out on the low and highland marsh areas of the river courses. The Fadama rice projects ensure the cultivation of rice all year round. Rice seedlings are raised in nursery beds. Water through irrigation is let in through channels into demarcated rice fields. (Figure 8) They are allowed to stand for some time and drained off. Tractors plough the land and young rice plants are later transferred to the prepared lands.

Figure 9: Ploughed lands by tractors preparatory to transfer of rice seedlings

Source: (Fieldwork, 2015)

The water log and dry land habitats are heavens for a variety of wild plant and animal species. Energy and matter are exchanged in the ecosystems of the area. Solar energy is harnessed by plants which transform simple inorganic chemicals into food. Plants are primary producers and classified as autotrophs. Other organisms are heterotrophs and constitute the herbivores, carnivores and omnivores. A network of interconnected and interdependent food chains form a complex food web relationship. In a terrestrial environment we have as food chain

Green plant---Grass cutter---Human

In a fresh water environment the linkage for food chain is thus given as

Diatoms-Copepods---Worms---Small fishes---Large fishes---Human (Cunningham, Cunningham, & Sagio, 2005)

Groundwater is a source of water supply to poultry farms in the rural settlements. The water treated with chemicals serve as disinfectants for hygienic purposes and help speed up metabolic activities and growth. Concrete and earthen fish farms are used to raise fingerlings of a variety of fishes namely catfishes, tilapias, elephant snout fishes and carpio.(Figure 9) Water supplies to fish ponds are by exploitation of groundwater and harnessing of surface/spring water.

Socio-Economic Growth and Improved Livelihood of the People

Crop, livestock and fish production from the agrarian plains of the region have profound effects on the diet of the people as they greatly enhance the nutritional value, make for healthy growth of the citizenry.

The 21 targets and 8 goals of the Millennium Development Goals (MDGs) are yet to be fully addressed as to impact positively to a remarkable extent on the people. The Fadama III project coordinated by the Federal Government of Nigeria and in line with MDG aimed at producing sufficient food is being vigorously pushed by the State Governments in Nigeria. The project aims at establishing Fadama Community Associations with the objective of engaging the rural poor in economic activities in crop farming, livestock rearing and fish and fingerlings production.

Fadama is a flood plain or low land around a river project; they are suitable for dry season cultivation and very fertile. The plains of the River Niger at Anambra West, Anambra East, Oyi, Ayamelum, are beneficial to the farmers in the region.

Food items produced from the riverine settlements are transported in wooden built canoes to urban markets in Onitsha and environs for sale (Figure 10). Yams, potatoes, cassava, fruit and vegetables are brought to the river banks on markets days. The vegetation in the area when cleared during the rainy season preparatory for the farming season provide wood products. These are marketed by the women to the urban dwellers for domestic and commercial purposes and serve as source of fuel energy (Figure 11).

Figure 10: Food items transported from riverine settlements in wooden canoes to urban centers

Source: (Fieldwork, 2015)

Figure 11: Trees cut and as firewood arranged to be sold, serving as source of heat energy

Source: (Fieldwork, 2015)

Figure 12: Concrete fish ponds used for raising fingerlings and breeding a variety of fishes

Source: (Fieldwork, 2015)

Figure 13: Fishes sold in their fresh and dry states generate income for the people

Source: (Fieldwork, 2015)

Figure 14: Harvested grains not sold are stored in silos to guard against wastage

Source: (Fieldwork, 2015)

Fishes are caught and sold in their dry and fresh states (Figure 13). Grass cutters grazing wild are trapped and roasted over wooden fires. A model solution for improving the livelihood of the people and reducing poverty is shown in Figure 15. Federal, State and Local Governments enact favorable government policies that are employed by international firms, organizations, multinational companies, corporate bodies, cooperative societies and individuals for planning, execution, and management and delivery purposes. The solar energy is the driving force for the hydrologic cycle in the area ensuring surface water and groundwater recharge, rise in water levels and flooding of alluvial plains.

Adaptive technologies are put in place to exploit groundwater systems and harness surface water systems. Food crop production, livestock breeding, fisheries and aquaculture farming are enhanced in the agrarian region. Market associations control prices between producers and consumers thus ensuring that all parties benefit from the economic forces at play. Income generated for the people is improved upon thus alleviating poverty. The quality of the diet of the people is greatly improved.

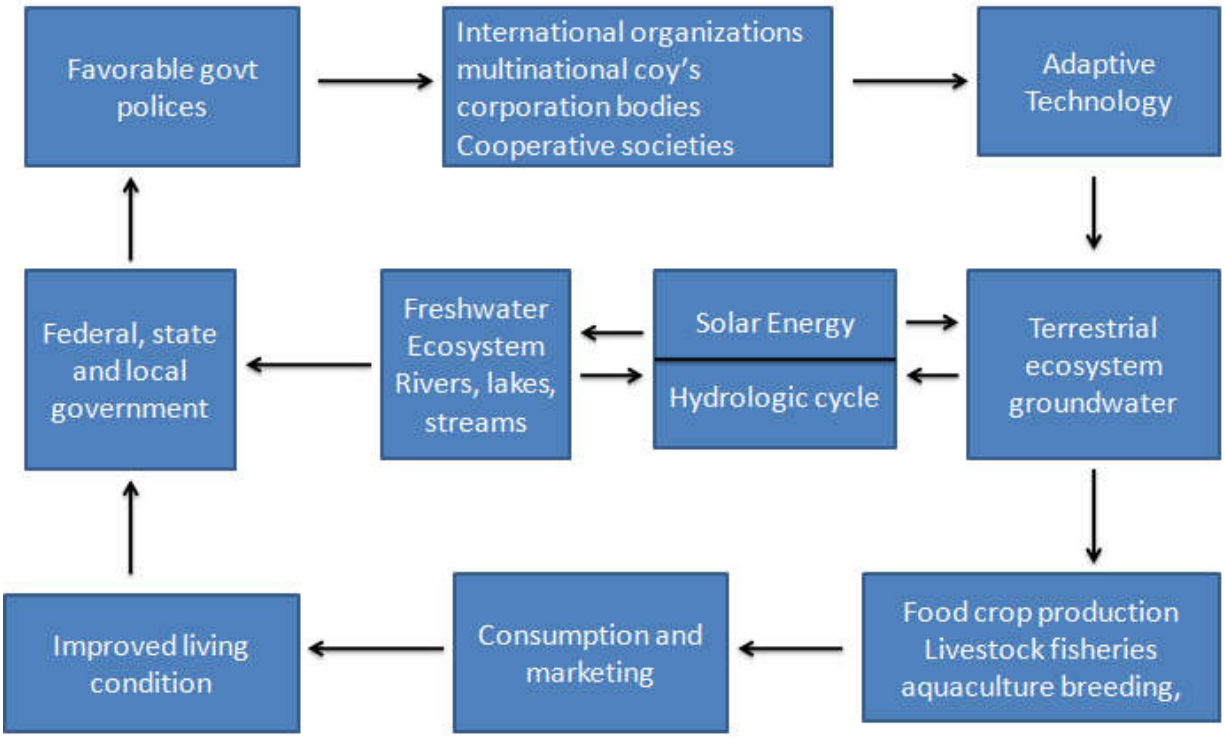

Figure 14: Model showing stakeholders relationship based on water resources exploitation and management for poverty reduction and food production

Source: (Fieldwork, 2015)

CONCLUSION AND RECOMMENDATIONS

The area has abundant water resources and its development has contributed to an extent to improving the socioeconomic well-being of the people. The alluvial plains are flooded during the rainy season and irrigated during the dry season. Hydraulic heads of the aquifers are high and can safely be abstracted even at peak dry season. Yields from boreholes are sufficient to serve the semi urban and rural communities.

The fauna and flora that make up the ecosystems need to be properly investigated and complex food web nature understood. Adaptive modern technology has to be put in place for fish farming, livestock breeding and crop production. Also the water resources of the area should be properly planned for, exploited and managed for domestic and agricultural purposes. In all, a holistic approach incorporating studies on the hydrologic cycle, ecosystems, agricultural practices and favorable government policies need to be carried out for increased food production and poverty reduction.

In the past, many laudable programmes were initiated by the government but unfortunately the desired result for adequate food production for the people had not been met. To achieve the

Millennium Development Goals of food sufficiency and reducing poverty the under listed recommendations ought to be put in place.

a) Favorable government policies on planning, exploitation and management of the river basin water sheds.
b) Preventing pollution of the water resources of the area through effective monitoring of land based activities as not to affect human, livestock and aquatic life.
c) All year round agricultural practice from irrigated water systems.
d) Timely and adequate supply of agricultural inputs to farmers particularly seeds, fertilizers and agro-chemical to boost production.
e) Farmers forming associations for their collective welfare.
f) Granting agriculture loans to farmers as to double harvest yields per hectare during one planting season made possible from irrigated water supply systems.
g) Mobilizing farmers through seminars, workshops, conferences for increased food production from water supply systems.
h) Promoting the production, processing and marketing of farm produce.
i) Providing education and training on water exploration and exploitation, supply, irrigation systems and modern technology.
j) Establish and maintain close link with national and international organizations, corporate bodies, multinational agencies, water companies, agro-allied industries for food production and sustainable economic growth.

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