

# Construction of Integrated Farming Apartments Suitable For Islands and Areas with Limited Land Resources: A Case Study of Bonny Island Rivers State Nigeria

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**Abstract—** *The need to tackle the ever growing demands of food and engender a self sufficient environment that will meaningfully engage youths, maximize natural resources while contributing to the economy gave rise to this work. Animals and agricultural production are united in a single segmented unit that offers zero waste to the entire system. Birds are positioned to provide direct feed to a fish pond that will in turn supply nutrients to the grown crops. Land resource consumption in size is approximately one hundred by one and fifty (100 x 150) square meter of production area housing storage facility, staff unit; processing area, field etc., all designed to comfortably accommodate each unit including the sales area. The entire system is projected to yield not less than five hundred (500) birds, five hundred (500) fishes and not less than two (2) tons of agricultural produce. Various fields of study ranging from Mechanical and Electrical Engineering, Biology, Economics, Architecture etc worked together to ensure the success of the project. Authors believe that reducing food Insecurity in any locality can contribute to economic growth as drivers of development notably human resources can only deliver optimality when working under healthy and sufficient food supply. Most Islands are limited in production of food because of access and other environmental conditions. Bonny Island is no exception as many sources of livelihood are shut down due to varying situations which include but not limited to terrain and oil related activities. This paper seeks to establish a low technology but unique Integrated Farm Apartment for the Production of Consumable Foods and ensure food security as well as reduce the burden of Importing daily foods into the Island through professional synergy of Engineering and related fields that can be affordable by average citizens of developing nations.*

**Index Terms—** *food security/provision, integrated farming and youth engagement/employment.*

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## I. BACKGROUND

Food security is of inestimable importance, particularly to areas of limited land resources such as an isolated island economy where a constant supply of food is not as easy as demands requires. Agricultural provision challenges are predominantly due to unpredicted natural disasters such as storm, heat waves and other environmental changes. To a large extent for these small islands, household food supply is the only option for survival when natural disasters occur. This is particularly true for Bonny Island where industrial activities have further restricted the limited land resources and water bodies increasing the dependence of residence to food supply from outside the locality. Ironically, however, domestic food supply in Bonny Island as with most likely other Island has been neglected for a long time, leaving residences at the mercy of merchants. Kakazu (2012) in his work on Changing Agricultural Environment in Small Island cases of the South Pacific and Okinawa rightly cited his 1994 work that Subsistence agriculture, which has provided basic necessity of foods to indigenous islanders, has been rapidly

disappearing in all Pacific islands. Bonny Island is no exception from the above Kakazu's assertion. The report, processed in collaboration with the Federal Ministry of Agriculture and Rural Development -FMARD and other stakeholders, quoted United Nations Food and Agriculture Organisation that about 19.4 million people will face food insecurity across Nigeria between June and August 2022.

The upsurge in food security as a result of non-farming and Agricultural activities on Bonny Island has left the residents of the coastal city in the pity of agricultural produce merchants. These merchants whose only sources of supply remain the farmers in neighboring towns and states face the trans-Saharan ocean as a major barrier. At the present, little or no effort has been geared towards food security on the Island by promoting locally grown agricultural product. Observation has shown that unlike other coastal and oil producing communities in Niger Delta region, where oil-related pollution had impacted adversely on the soil texture and ability to produce agricultural yields, Bonny Island has not recorded any major pollution resulting from oil spillage, thus, the present project aims to establish a low

technology but unique Integrated Farm Apartment for the Production of Consumable Foods and ensure food security as well as reduce the burden of Importing daily foods into the Island through professional synergy of Engineering and related fields that can be affordable by average citizens of developing nations as a solution to food insecurity that has negatively impacted on the economy of the Island.

Extant research shows that virtually all food consumed in Bonny Island are brought from Neighboring states and Port Harcourt. These foods often spend weeks and months on the ocean in open boats that expose them to harsh weather conditions (extreme sunlight, salt water and rain, in most cases). This practice has among other things resulted in the consumption of unhealthy food and food scarcity in the Island. Boat capsizing has become a frequent occurrence leading to loss of goods and services (and death in some instances). The consumption of contaminated foods brought into the Island has often been associated with increased risk of food-related morbidities such as stomach infections and food poison-related deaths. Other studies show that food scarcity in Bonny Island is associated with youth restiveness, which at long run could lead to malnutrition of children and adults. Unfortunately, the adverse effects of food insecurity and poor economic well-being have not attracted the needed research attention on the Island. To the best of our understanding, there is paucity of empirical evidence of the fertility of the Bonny soil for agricultural activities. Specifically, there is lack of data on the suitability of Bonny soil for farming activities. Therefore, the present project enhances the fertility of Bonny Soil for integrated farming through reinjection or circulation of nutrients, produce a template for sustainable construction of integrated farming apartments in any Island particular in Bonny Island by average families, and production of birds (broilers), catfish and crops for consumption of Bonny residents. The scope of the work is limited to 100' x 150' project site on Bonny Island, while the study location and coordination point is the Federal Polytechnic of Oil and Gas which incidentally is the only Tertiary Institution in Bonny Island.

## **II. ECONOMIC VIEW OF BONY BONNY ISLAND WITH RESPECT TO AGRICULTURAL PROVISION**

Bonny Island is presumed to be less endowed with agricultural land, freshwater, forests, and fauna. Just like other Niger delta communities, the Island has huge amount of wetlands and the largest mangrove swamps in Nigeria, where cash crops, including rubber, cocoa, oil palm and coconut, and food crops such as cassava, yam and plantain, may be produced (UNDP, 2006). Fishing was the bastion of the domestic economy of the Ibani, Bonny Island main dwellers. Fishing as an enterprise took place in the Bonny Sea and various creeks and ponds where different species of fish like agbara (red snapper), atabala (tilapia), deghe (mullet), sungu (sardines), kigbo (bonga fish), ofuruma (sharpened shark),

ona (croaker) et cetera were harvested (Orji 2011). Regrettably most of the indigenous farming culture is no longer attainable. This work offers a bail out on household food security, specifically opening up ways to access sufficient supplies of safe and culturally-acceptable food on the Island. Drawing on environmental observations, authors believe that the subjective assessment of the local people is a critical determinant of household food security in Bonny Island.

Oil-producing activities have impacted on the land and rivers that have long generated the food relied upon by people residing in Bonny Island, and thus, have long faced the threat of declining food production. The recent Global Food Security Index, 2019, ranked Nigeria 96th out of 113 countries, and Bonny is worst affected going by inaccessibility since it is locked by the sea. In sampled oil communities of the Niger Delta, food that has traditionally been produced and consumed in local communities has become scarce and at times, unavailable. Even when imported, the food provided may not be affordable and culturally-acceptable. These interlocking issues are critical when assessing the vulnerability of local people, in particular, their levels of food security.

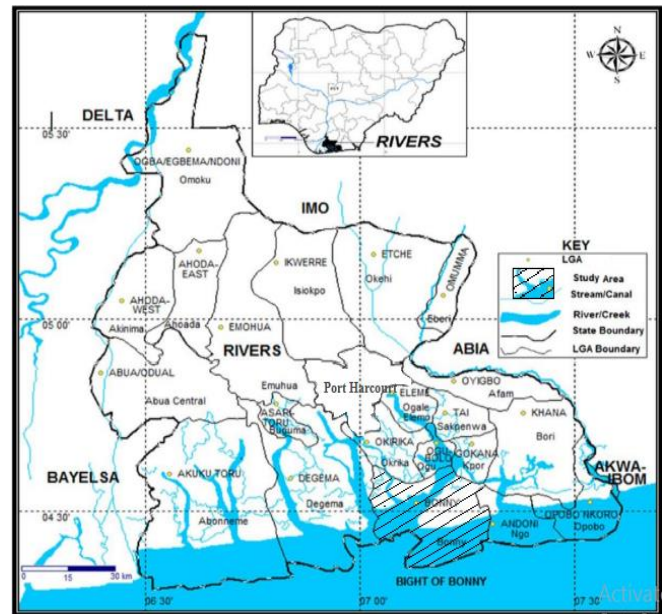
The Niger Delta region of Nigeria is one of the most crude oil impacted deltas globally. The region has experienced over five decades of oil related contamination of the total environment (air, soil, water and biota) (Sam & Zabbey, 2018). To date, several studies have been undertaken that examine the adverse impact oil production has had on the livelihoods of the local people in Bonny. The broad-spectrum accord is that oil exploitation activities which fail below global and local environmental standards and regulations have ruined the Bonny Island's landscapes, causing severe damage to flora and fauna, degrading water quality, and impairing the aesthetic value and utility of land for agricultural and other vital purposes. The oil spillages ongoing for several decades have characterized the area by contaminated rivers, stream and forest, which constitutes the major income source for the majority of the local population inhabiting the region, which are mainly dependent on ecosystem services (Kadafa 2012). Despite the various environmental laws enacted to address environmental pollution specifically, including the Petroleum Drilling and Production Regulation (1969), Oil in Navigable Waters Act (1968), Associated Gas Re-injection Act (1979), Federal Environmental Protection Agency Act (FEPA) (1988), and Oil Pollution Act (OPA), oil pollution in the Niger Delta continues to intensify at an alarming rate (Ibaba, 2010).

The present project introduces the conceptual and theoretical framework aimed at achieving food security challenge in Bonny Island while maintaining minimal impact on the nature. In general terms, food security has to do with peoples' freedom from want and deprivation and the right to a life of dignity in which they have access to adequate supplies of food. Over time, application of the concept has

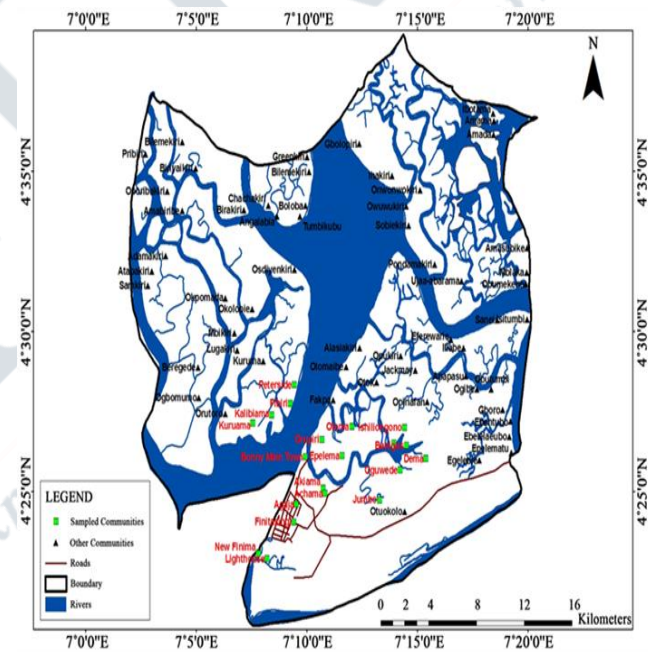
expanded to nutrition planning, rural development, livelihoods and environmental sustainability. According to the Food and Agricultural Organization, food security is achieved when groups or individuals have access at all times to nutritious, sufficient, quality and safe supplies of food capable of satisfying the energy required of all family members to live healthy, active and productive lives (FAO, 2009). Food security is not just about availability, however; it is also about accessibility, including the purchasing power possessed by individuals when it comes to purchasing supplies (FAO, 2015). Food security is a crucial building block of the Sustainable Development Goals (SDGs). It is particularly tied to Goals 1 and 2, which seek to put an end to poverty and hunger by 2030. Many studies have highlighted the intersection between food security, livelihoods and ecological sustainability (Thomas, 1991; De Waal 1989). The vulnerability of the Bonny Island's people to food insecurity is particularly serious for vulnerable groups, most notably, women, who account for a significant share of the region's agricultural labor force and food production.

**III. PROJECT IMPLEMENTATION ON BONNY ISLAND**

Bonny Island, the area of the present project, is a coastal town located in the Rivers state, Niger Delta region of Nigeria. It has a population of about 3.9 million people spread across 2 major towns (Bonny and Finima). It is currently believed to have the largest natural gas deposits in Nigeria. Oil and gas exploration and production have gone on in the Island following the inauguration of the Liquefied Natural Gas (NLNG) gas plant in the Island in 1996. Bonny Island spans across about 321 square kilometers in land mass. A prominent feature of the Niger Delta is the acquisition of land for oil and gas activities. Consequently, oil and gas activities have occupied tremendous expanse of land space in the Niger Delta. Aside from the land space for construction of office complexes and operational facilities, the entire landscape of the Niger Delta is crisscrossed with a complex network of oil and gas pipelines, below and above ground level; in the sea and mangrove swamps and forests; and in the neighbourhood of residential quarters (Igoni, 2018). The land acquisition is to the extent of dislodging and relocating communities from their traditional sacred homes to new and strange sand-filled locations, as was the case of Finima community in Bonny Kingdom that was displaced in 1986 for the location of the Nigerian Liquefied Natural Gas (NLNG) complex. The NLNG plant occupies a land area of over 2.27 km<sup>2</sup> in Finima, Bonny Island. (Igoni, 2018).



(a)



(b)

**Figure 1:** map of Rivers State showing Bonny Local Government Area (a) map of Bonny Local Government. Area Source: Oluyemi *et al.* and Adie *et al.*

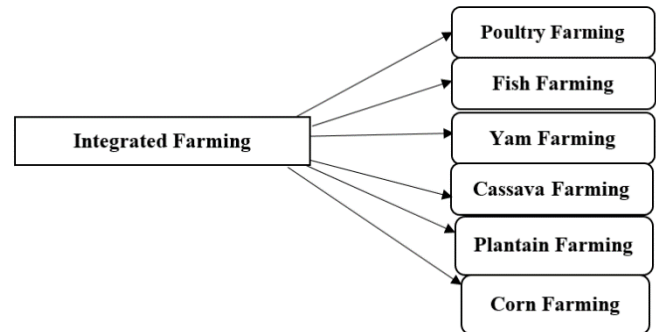
**IV. CONCEPTUAL FRAMEWORK AND PROJECT CONSTRUCTION**

The project attempt zero waste borrowing from green architecture as a broad concept and is devised to solve numerous problems including preservation and expansion of green areas, utilization of renewable energy, elimination of pollution, eradication of stale foods, etc. Below we introduce the idea of integrated farming, which offers solutions to human needs as well as ecological challenges. The broilers is

housed in a customized iron - woods poultry located above the pond to provide direct feed to the concrete catfish pond and the green area at large with its growing plants, all under constantly supervised framework, which excludes any product loss and allows having product most likely throughout an entire year. The poultry is constructed using 8mm 6" x 8".double T column of carbon steel. The columns will be rest on a solid foundation with a 1x1, 10mm<sup>2</sup> plate or y12 cast basket. 6mm (2 1/2)" and 3mm 1" angle bars will be used for the base load and dwarf fence load bearing frame. Hard and medium 1x12 x12 plank/board will be used for the poultry base and space farming base. The space farming will be located above the poultry for the purpose of corn farming and probably vegetables. Bolt and nut joints will be used will minimal welding at joints. Low hydrogen and mild steel electrode will be used for the welding joints to ensure needed load bearing strength. Special Aluminum foil will be used to cover the space farming base before tarpaulin then earth load that will support the crop life. Metal gauze will be used for the space above the dwarf wall. A metal staircase will provide means of accessing both the poultry and the space farming under maximum available safety measures.

A 16' x 10' concrete pond of 9" hollow block with adequate drain system is situated with 3' minimum gap between its top and the poultry base to aid attention. The pond accommodates three units' apartments to provide for sorting, rearing and nursery sections with a borehole supply to provide constant water supply necessary for the fish survival. A minimum of 80'x 50' green land area accommodates the crops/plants grown under pure organic manure supplied from poultry waste, the use of chemical substances during cultivation is avoided thereby having ecological pure crop. Under normal circumstances, owing to this method the harvests of a plot of land undoubtedly exceed the conventional method in more than 3 times. Periodic pest/insect and infection control will be put in place to facilitate no crop/animal loss. Excluding crop and animal loss throughout the entire year, Integrated farming technique provides possibility to resolve the issue of food shortage on any land limited area including Bonny Island.

The project houses a three unit self contain for the project supervisor in the event of compulsory sleep over, female and male staff accommodation/duty room. A security unit with a moderate processing/storage facility and a small office apartment located adjacent side of the project house. The site accommodates provision for car park; with good accessible road for product transportation and a good drainage system that will ensure controlled easy run-off and waste water collection point.



**Figure 2:** Project content



**Figure 3:** Front view of main project structure



**Figure 4:** Integrated Farming Project site

**V. CONCLUSION**

A properly fed, healthy, alert and active population contributes more effectively to economic development than one which is physically and mentally weakened by inadequate diet, stale food and poor health. Thus, the present project contributes several tons not less than one thousand six hundred (1600) kilograms of agricultural produce, healthy birds and aquatic lives to the teaming population of human race food requirements on the Island. It provides a framework to construct an integrated farm apartment that has the capability to solve the challenges of catfish production, poultry/chicken rearing, corn, yam, cassava and plantain farming on Bonny Island and any other land limited area of the world if properly implemented.

**VI. ACKNOWLEDGMENTS**

Authors acknowledge the exemplary leadership and tremendous efforts of Otunba Adebayo Adedayo and the entire council members of the Federal Polytechnic of Oil and

Gas Bonny; they provided the robust environment and working atmosphere that injected life necessary to drive success into the staff team. Authors also remain grateful to Tertiary Education Trust Fund (TETFUND) of the Federal Government of Nigeria who has been the major if not the only sponsor of most researches and projects in the Federal Polytechnic of Oil and Gas Bonny, Rivers State. The wonderful hospitality of the Bonny Kingdom ably led by the Head of the Monarchy – King Edward Asimini Dappa Pepple III, Jp, Con. Perekule Xi, Natural Ruler and Amanyanabo of Bonny the host of the Institution will not go unappreciated. Authors also thank Madam Dame Anengi Barasua, Jp., the First Female Executive Chairman of Bonny Local Government Area for her rare leadership style and her availability to the Polytechnic even at the shortest possible notice and lastly to the much needed leadership of Federal Polytechnic of Oil and Gas Bonny headed by amiable Madam Ibifiri Blessing Pollyn.

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