

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology

CHIGBU, Njike; NMEREGINI, Chiawolam Susan; ARUNGWA Ikenna Donald

Keywords: Reclamation, food, urbanization, industrialization, geospatial technology

SUMMARY

It is common knowledge that the three basic needs of man are food, shelter and clothing. In a bid to meeting these basic needs, one or two of these basic needs tend to suffer immensely. The rising rate of industrialization and urbanization has taken a great toll on land meant for agricultural purposes. One major means of acquiring land for development through the land reclamation process. This paper highlights the impact of land reclamation on food security and role of geospatial technologies play in efficient land reclamation exercise for improved agricultural enhancement and food security. The study was done by assessing the radical and drastic changes in developmental expansion and growth as a result of reclamation in Umuahia of Abia state of Nigeria. The study also examined the effects of spatial disintegration and rapid urbanization and encroachment into agricultural land in the study area. The dataset used in the study includes base map of the study area obtained from Ministry of Lands and Survey, Umuahia, Abia State, projected population data from National Population Commission (NPC), Quick bird satellite imagery (0.5 meters resolution) updated from Google Earth 2017 with 32 meters resolution, used in land use and land cover analysis, Digital Elevation Model (DEM) to obtain slope, aspect and contour, and geological map of the study area. From the study, it was discovered that the relief pattern is the major limiting or predisposing factor on land reclamation exercise within the study area and therefore, affects agricultural activities in the study area. The study, therefore, advocates that the Government of the day and policy makers should encourage further research on use of to d geospatial technologies in the land reclamation exercise and other related land based activities for food security.

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)

Njike Chigbu, Susan Nmeregini and Ikenna Donald Arungwa (Nigeria)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology

CHIGBU, Njike; NMEREGINI, Chiawolam Susan; ARUNGWA Ikenna Donald

1. INTRODUCTION

Reclamation is the combined process of land treatment that minimizes water degradation, air pollution, damage to aquatic or wildlife habitat, flooding, erosion, and other adverse surface effects, it leads to habitat restoration when the intent of the reclamation project is to restore native vegetation and recreate wildlife habitat reflecting the biodiversity of the region. (Craig, 1999). The processes claim back submerged land from water bodies or water logged areas due to the soil type, oceans, sea, swamps, bays and rivers. All around the world, cities are edging further into the sea. Plans are afoot to build huge islands and giant constructions in coastal areas, featuring the dredging and dumping of millions of tonnes of material (Emma *et al.* 2018). Countries bounded by coastal areas like Singapore, South Korea, Japan, etc. reclaimed their land for agricultural and urban development or use. However, with the current review of global demographic trends of roughly 83 million people who are added to the world population yearly, according to UN report, and the upward scaling of the global population size that is expected to continue despite the decline in fertility levels, reclamation exercise becomes inevitable. The prospects for the future land reclamation becomes big flourishing business, therefore, many countries will continue to take back land from the sea or refill an eroded land to expand their coastlines and territories. Land reclamation, therefore, is seen as a good way to accommodate growing population, as well as a way of boosting economic development and food security.

The increasing rate of migration of people out of rural areas to urban centres has resulted in massive urbanization lately globally. This is, particularly more prominent in Latin America, with about 75 percent urban population. Asia and Africa are expected to have major urban areas within the next two decades (Montgomery 2008). This shift in population from the country side to cities, especially in developing countries, necessitates and calls for increased land reclamation. In the developed as well as some developing economies, like United State of America, Italy, Greece, Hungary, Bolivia and Belgium, land has been reclaimed in very recent times (Labjonsky, 1980). Germany, Finland and Denmark also undertook extensive reclamation programme which led to the provision of housing, agricultural land and other land uses (Labjonsky, 1980). It is apparent that, global demands for land and forest resources are the underlying factors that promote reclamation and deforestation (Rudel, 2007). Reclamation is prompted when the supply of land fall far below the demand for it. Reclaimed

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)

Njike Chigbu, Susan Nmeregini and Ikenna Donald Arungwa (Nigeria)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

land impacts on biodiversity, residential, agriculture, recreational and commercial use. Land reclamation is continually modifying the landscape, creating urban centre areas, roads, airport etc. Half of the world's wet land have been drained, dredged and even built upon (Getis et al. 2002).

Land reclamation has been used by different cities in the world to extend the bounds of settlement. When the levelling of the North Salt Lakes region of Calcutta happened, the territory of 3.3/4 square miles gained about 4 miles away. The reclamation gave rise to development of more physical infrastructures such as good roads and parking lots, etc. Reclamation is most times undertaken to needed infrastructures such as pumping stations which has the capacity to restore land that have been destroyed, and revitalize the value for economic gains. Old mine sites are also often reclaimed for commercial, industrial, residential and recreational purposes (Geng-Jie, 2013).

Nigeria as one of the developing countries has undertaken land reclamation in some of her developing or emerging cities as Calabar, Port Harcourt, Asaba, Warri, Yenagoa, Onitsha, Eket, Lagos, etc. In Port Harcourt city for instance, virgin land has paved way for building and other structures, (Mmom, 2003). Banana Island is a man-made Island in Lagos state Nigeria, the idea here is that of Adebayo Adeleke in reclaiming a land that is slightly curved in shape like a banana. The reclaimed land is located in Lagos lagoon; it occupies a sand filled area of approximately 1,630,000 square metres, and also divided into 536 plots. This site is described as the most expensive neighbourhood in Nigeria (Forbes, 2011). Land reclamation is usually a response to increasing demand for land for both social and economic purposes (Tantu, 2011). Nevertheless, as these developments are spreading out into the oceans, what are the implications for ocean life and the marine ecosystems? Definitely this will impact food security. Food security as a measure of the availability of food and individuals' ability to access it, according to Food and Agriculture Organization of the United Nations (FAO), has four key pillars that would be impacted by reclamation. These identified key areas are availability, access, utilization, and stability of food security.

2. AIM AND OBJECTIVES OF STUDY

The aim of the research is to analyse the impact of reclamation (orchestrated by urbanization and infrastructural development) on food security for a sustainable development in Umuahia urban of Abia State of Nigeria while projecting the positive role of geospatial technologies in ensuring optimal and sustainable land reclamation processes. To achieve the above aim, the study examined the different land uses and recent infrastructural development domiciled in the area of study before and after the reclamation activities as the city expanded. Also this study went further to determine the extent and impact the reclamation on housing and economic development through supervised land classification algorithm, changes that took place in the study area during the time epoch of study and the overall impact on food security issues of Umuahia urban area in particular and Abia state of Nigeria at large.

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)

Njike Chigbu, Susan Nmeragini and Ikenna Donald Arungwa (Nigeria)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

3. THE STUDY AREA

Umuahia Urban is the study area. It is the capital city of Abia State in South-Eastern Geopolitical zone of Nigeria; it became a capital city in August 27th 1991 when Abia State was created from the then old Imo state. It is located between longitude 7° 25' 30" to 7° 39' 0" and latitude 5° 19' 30" to 5° 42' 00" at the central part of Abia State (Ministry of Lands & Survey, 1991). It is bounded in the north by Bende LGA, in the south by Isiala-Ngwa North L.G.A, in the east by Ikwuano L.G.A, which also forms part of the capital city called Umuahia, in the west by Imo State. Umuahia metropolis has approximately total land area of 657km² and projected population of 815810 based on Nigerian Population Commission data (NPC, 2020).

3.1 PHYSICAL CHARACTERISTICS OF THE AREA OF STUDYCLIMATE:

The dry and wet seasons are the two distinct predominant seasons in Umuahia of Abia state. The wet season starts from April and ends around October. The dry season starts from Novembers and ends around March or sometimes April. The annual rainfall ranges from 1905mm to 3668.7 mm, while the mean monthly temperature of this area is 27.2 °C.

3.1.1. VEGETATION:

This city is located within the equatorial belt of Nigeria, it is dominated by tropical rainforest and expansive vegetation; however, in the urban center, the vegetation is disappearing due to high rate of conversion of vegetal cover to urbanization and other land uses.

3.1.2. RELIEF AND DRAINAGE

Umuahia urban has a low-lying to moderately high plain topography while the new town, Umuahia-Ibeku, rests in the valley of a two rolling hills, on the upside, Umuopara and Ugwunchara and on the down side, Ibeku town. The general surface elevation ranges between 59.5 and 164.5m above the sea level (Olobaniyi and Owoyemi, 2006).

3.1.3. TRANSPORTATION

The major transportation routes in use comprise` the railway and road. The road transport network is the most dominant means of transportation. The major roads link Umuahia to other cities within the state and other states within the South-Eastern Geo-political zone while secondary roads, streets and footpaths link buildings within the town and other settlements/hinterlands. The railway route links Umuahia to other towns in the State such as Uzuakoli to Ovim to Enugu State in the North side and Aba in the south, though, this means of transportation is not often in use but it still has a role to play in the history of Umuahia urban development. The most common means of transportation in Umuahia urban area is by Tri-cycle , while the commuter buses ply only major roads.

3.1.4. AGRICULTURE

Umuahia is well known as an agricultural market center since 1916 (NRCRI Umudike). It is also a railway collecting point for crops such as yams, cassava, corn (maize), taro, citrus fruits, palm oil, and palm kernels and there is also a palm-oil-processing plant and Nigeria's National Root Crops Research Institute, at Umudike town.

3.1.5. HOUSING AND SETTLEMENT

There are numerous housing estates in Umuahia urban area built by the state government to meet the housing needs of the growing urban population. The government owned housing estate includes World Bank, Agbama, Ehimiri, Isieke, kings' court, Federal Low-cost, Adelebu. Amakama, IBB Phase 1 and 2 Housing Estates, Umuobia, Government section layout, etc. There are also individual housing buildings and private estates in Umuahia urban area.



Figure 1: Nigeria showing Abia State
Source: Ministry of land and survey Umuahia {Digitize and Updated by the Researcher (2019)}.

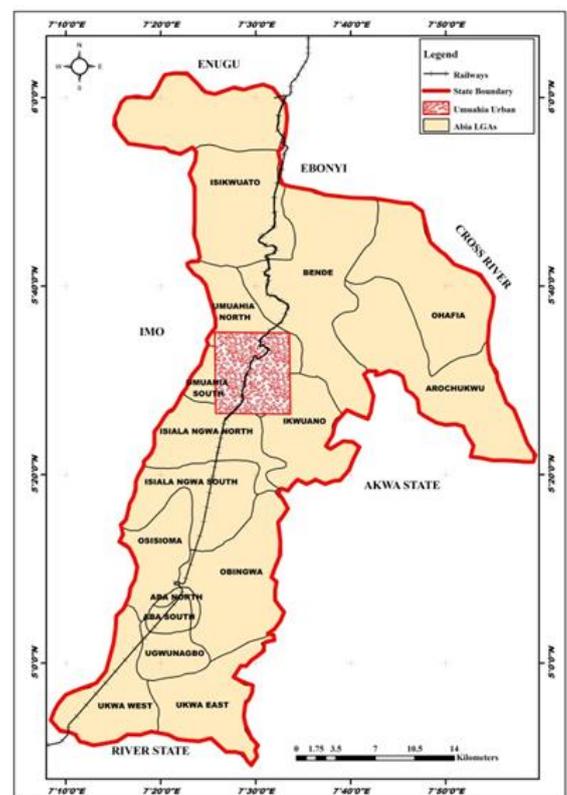


Figure 2: The study area and its location on Abia State,
Source: Ministry of land and survey Umuahia {Digitize and Updated by the Researcher (2019)}.

4.1. METHODS, DATA AND SOURCES

Reconnaissance survey was conducted to enable the researcher have a better understanding of the study area; ground truthing of the area was equally carried out. Data were collected from both primary and secondary sources. The primary sources of data were from ground truthing and measurements with Global Position System (GPS), personal observations especially from field completion exercise. A structured questionnaire was designed to capture demographic/personal data of the respondents to assess the effect of land reclamation on housing development in the study area. Secondary sources of data includes information from Ortho-photo maps and satellite imageries of Ubani-Ibeku area acquired from Landsat 2007 and Quickbird 2017 update from Google earth imagery, base maps, journals, magazines, encyclopaedia, internet, etc.

Ground truthing of the area was carried to determine the areal extent of the reclaimed land and other land cover type using Quick bird satellite imagery (0.5m) resolution. The identified areas were now transposed on the geo-referenced Ortho-photo map of the area and the satellite imagery to create the area of interest (AOI) using the bases map of Umuahia-the study area.

5.1. ANALYSIS AND DISCUSSION OF RESULTS

5.1.1. The land use analysis of the study area showing land cover/land use was carried out to generate necessary geo-spatial data. Here, the Quick bird satellite imageries with 0.5m resolution updated with Google earth image of 2017 was supervised, superimposed and overlaid to ascertained changes that had taken place over time on the study area. Furthermore, the housing layers which was digitized, was superimposed on the supervised imageries and both showed the extent of land use/land cover changes and housing development in the study areaas shown in figure 3 and figure 4. The supervised imageries comprise of water bodies, forest, and other vegetation features and built-up area depicted in colours thus- blue, green, light green and brown.

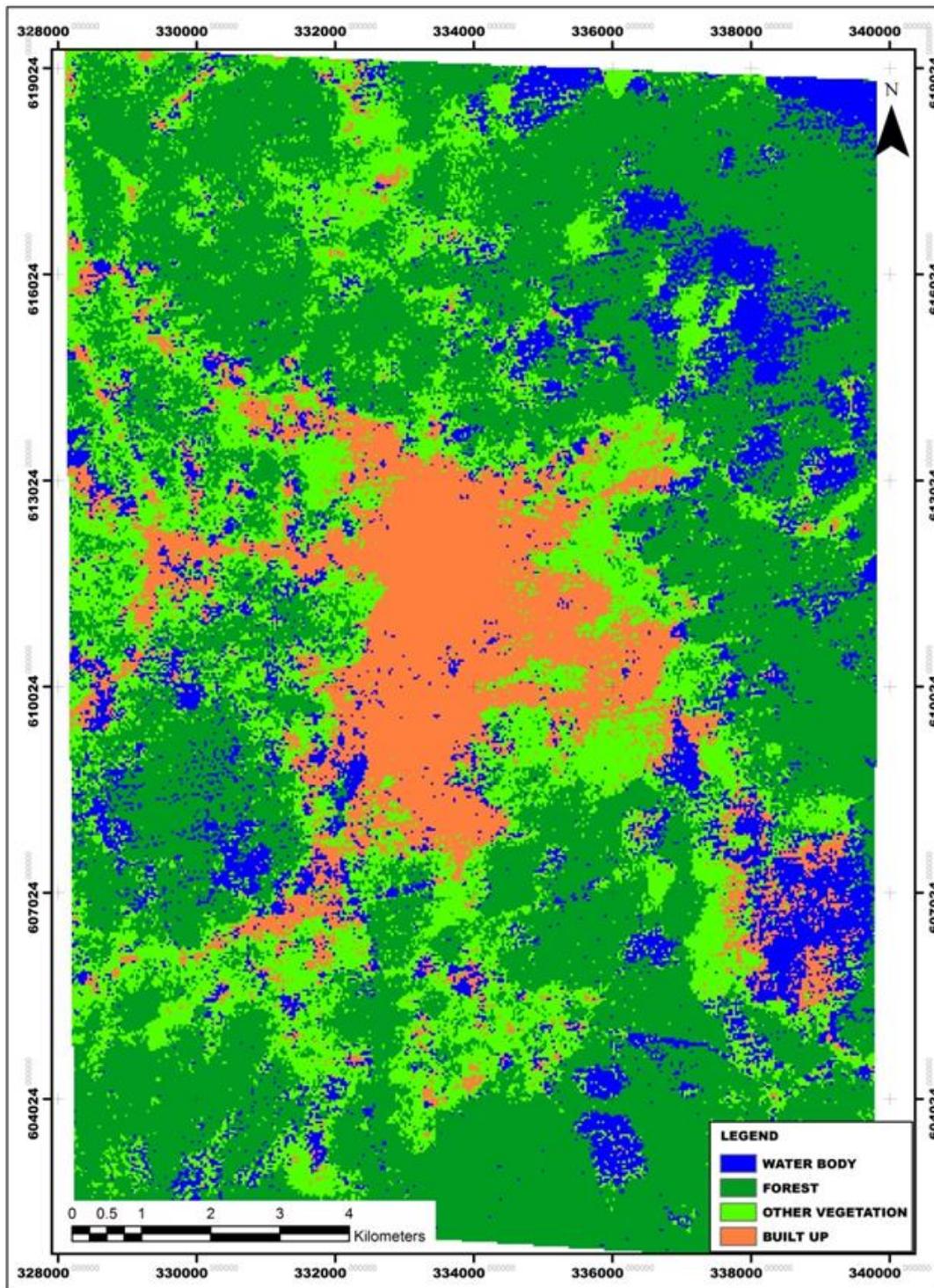


Figure 3: The Land use/ Land cover Analysis of Umuahia Urban
 Source: The researchers' supervised image analysis indicating land use and land cover changes (2019)

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)

Njike Chigbu, Susan Nmerregini and Ikenna Donald Arungwa (Nigeria)

FIG Working Week 2020

Smart surveys for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

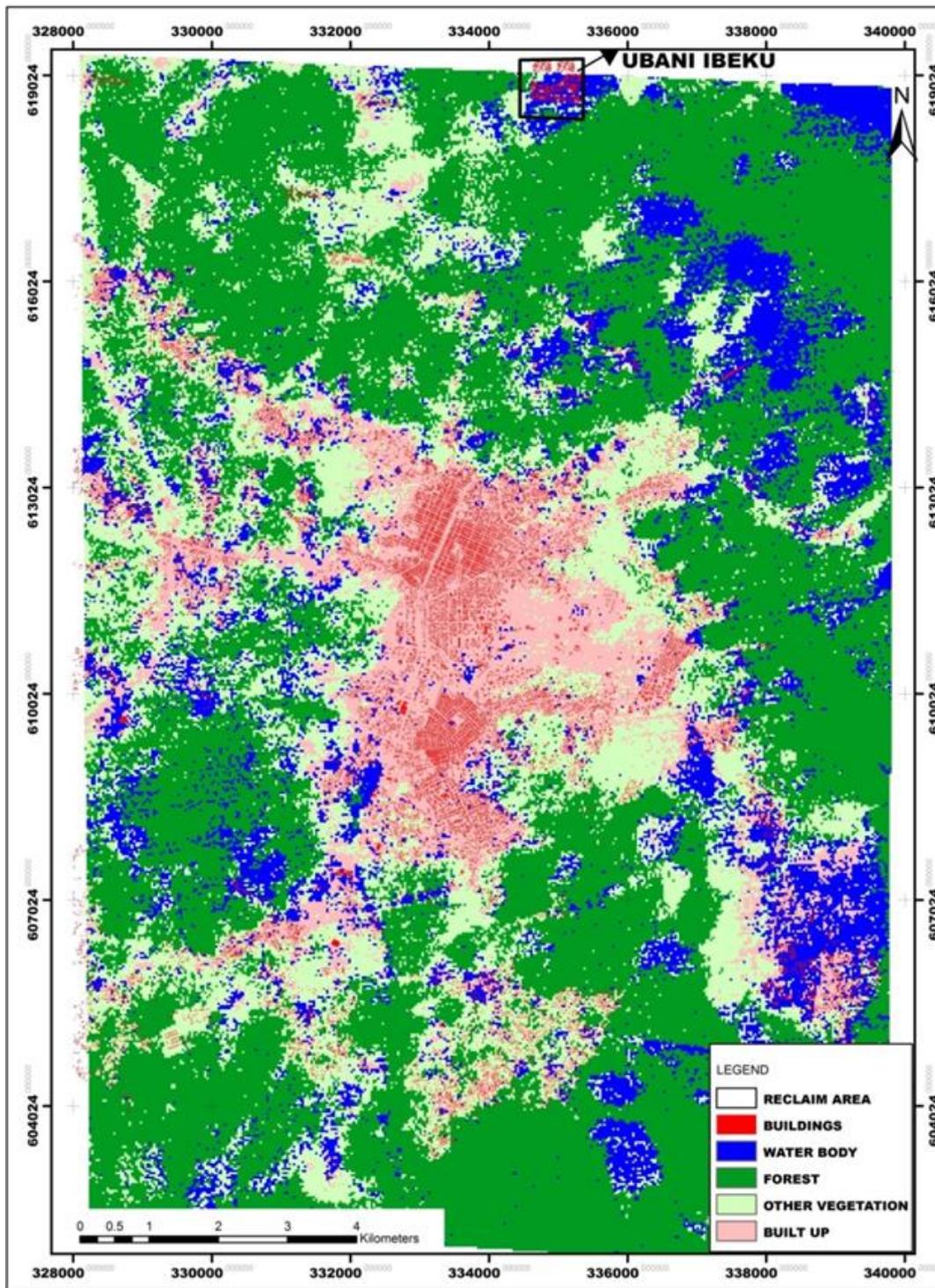


Figure 4: The Overlay of Land use and Built-up area of Umuahia Urban Area showing the Reclaimed Area
 Source: The researchers' supervised result and overlaid buildings (2019)

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)

Njike Chigbu, Susan Nmeregini and Ikenna Donald Arungwa (Nigeria)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

5.1.2. From the satellite image, it can be inferred that patches of forest can be found within the residential area. This is largely due to the relief of the area (forest), which is undulating, giving rise to hills and valleys. The relief is a constraint to regular development pattern, hence, development of buildings are usually along areas that are less difficult to develop, that is on parcel of land that are relatively flat with gentle slope, and land area not liable to flood. The relief pattern clearly seems to be a key factor or limiting criteria when undertaking land reclamation to meet the demand for housing development in the study area. The above is validated by Figure 5.



Figure 5. The Contour of Umuahia Urban showing undulating terrain
 The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)
 Source: The researchers' Analysis (2020).

Njike Chigbu, Susan Nmerigini and Ikenna Donald Arungwa (Nigeria)

5.1.3. It is also observed that most of the areas that indicated water and forest covers were eroded areas which have formed valleys and water retained in such places, especially, during raining season.

FIG Working Week 2020
 Smart surveyors for land and water management
 Amsterdam, the Netherlands, 10–14 May 2020

History has it that there is no river or stream in the area before the study, some trees were planted as canopy and shed to hold and stop agent of denudation from eroding the surface away and put the areas in check. In spite of the fact these areas are close to the city, the land cannot be used for agricultural purpose or projects then. This scenario helped in putting pressure on the available land space that are used for agricultural activities as shown in figures 6 and 7 respectively.



Figure 6: The Fallow Land before Reclamation
Source: The researchers' pictorial of the study area (2013)



Figure 7: The Land Use (AGRICULTURE)
Source: The researchers' pictorial of the study area (2013)

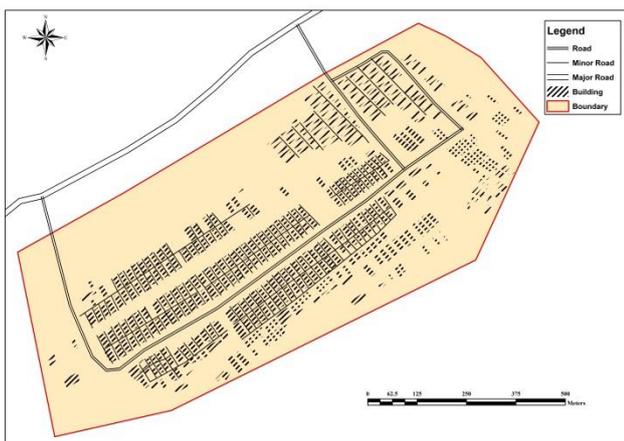


Figure 8: The digitized Commercial Land Use after Reclamation
Digitize by the Researcher (2019)}



Figure 9: The Satellite Imagery of Commercial Land use (2018)

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)

· Njike Chigbu, Susan Nmerregini and Ikenna Donald Arungwa (Nigeria)

FIG Working Week 2020

Smart surveyors for land and water management
Amsterdam, the Netherlands, 10–14 May 2020



Figure 10: The Commercial Land Use after Reclamation (2018)
Source: The Researchers' pictorial of the free zone of the market

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)

Njike Chigbu, Susan Nmerregini and Ikenna Donald Arungwa (Nigeria)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

5.1.4. It was also observed that mainly few years after the reclamation process, some of the infrastructures were observed to be in bad shape as shown in figures 11 and 12. However, there was no indication that the environment was not left out of the negative impact of the reclamation exercise as shown in figure 13 and 14. There was also evidence of flooding, especially, during the raining seasons, indicating lack of proper knowledge of the nature, landform, geology and land suitability in terms of infrastructure.



Figure 11: Impact of Reclamation on Infrastructure (Drainage 2018)



Figure 12: Impact of Reclamation on Infrastructure (Drainage 2018)

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)

Njike Chigbu, Susan Nmeregini and Ikenna Donald Arungwa (Nigeria)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020



Figure 13: Impact of Reclamation on Environment (Flood 2018)



Figure 13: Impact of Reclamation on Infrastructure (Culvert 2018)

6.1. CONCLUSION

The study shows that although urbanization has been the force behind land reclamation, relief patterns have been the major influencer of the choice and extent of land to reclaim in Umuahia. The study also shows that reclaimable lands have been greatly ignored due to poor knowledge of their nature existence. Cases in hand were areas that retain water during raining seasons and areas that like valley-like. These area if properly studied viz-a-vis their watershed and flow pattern (using geo-spatial technology), sustainable strategies for reclaiming them can accurately devised.

The study therefore concludes that in the absence of products and deliverables of geospatial technology, government and policy makers are likely to resort to less optimal and unsustainable means of land reclamation that hinders food production and engenders food security within Umuahia.

7.1. RECOMMENDATION

1. As shown in the study, geospatial technology gives one a bird eye view of reclaimable land that ensures sustainable development and food production. It is, therefore, the recommendation of this study, that geospatial technologies be deployed to guide decision making, particularly, as it relates to issues of land reclamation and other land administrative challenges.
2. A study of the urban area shows that bungalow buildings are the most commonly built structures here. This, we discover takes a lot of useful spaces that should be used for other land uses. It is therefore, recommended that, intensive use of land be encouraged by instituting policies that support vertical developments (high rise buildings) over the bungalows, to accommodate the growing population of the study area in order to preserve the agricultural land for food security.

The Impact of Reclamation for a Sustainable Infrastructural Development on Food Security in Umuahia Urban Using Geo-Spatial Technology (10760)

Njike Chigbu, Susan Nmeregini and Ikenna Donald Arungwa (Nigeria)

FIG Working Week 2020

Smart surveyors for land and water management

Amsterdam, the Netherlands, 10–14 May 2020

REFERENCES

- Craig, D. (1999). The use of Geographical Information System (GIS) Technology in Surface Mine Reclamation Monitoring. Proceedings of the National Conference of the American Society for Surface Mining and Reclamation, Scottsdale, Arizona, August 13-19, 1999.
- Emma J. Michael; Kevin, M; Rachel; Ron, G. and Andrew. (2018).The benefits and downsides of building into the sea.The BBC Future's World-Changing Ideas Summit Sydney.
- Geng-Jie, Z. and Zhong-Ke, B. (2013).Study on Ecosystem service value in Pingshuoming Area Based on Land use Change. Advance Journal of Food science and Technology 5(2) 192-196.
- Getis, A, Getis J. and Fellman, J. (2002). Introduction to geography USA; McGraw-Hill.
- Lablonsky, J.D. (1980). Land Use Budgeting on Reclaimed Lands. Reclamation Review Vol.16 Pp 9-17
- Mmom, P.C. (2013). The Niger Delta-A spatial perspective to its Development. ZEUON Enterprises, Port-Harcourt-Nigeria.
- Montgomery, M. (2008). The urban transformation of the developing world science 319, 761-764.
- Olobaniyi, S. B.; Owoyemi, F. B. (2006). Characterization by Factor Analysis of the Chemical Facies of Ground Water in the Deltaic Plain Sands Aquifer of Warri, Western Niger Delta, Nigeria. *African Journal of Science and Technology*, 7 (1):73-81.
- Rudel, T.K. (2007).Changing Agents of Deforestation from state-initiated to enterprise-driven processes, 1970-2000. *Land Use Policy*, 24; 35-41.
- Tantu, A.G,; BoeMarno, Harahab, N. Mustafa, A. (2011). The Dynamics of Landscape Change at Coast Area, in Labakkang Sub-district, Pangkep Re South Sulawesi, *Journal of Coastal Development* 15(2) 133-144.