

# Assessment of Impact of Land-Use Activities at the Confluence of Otamiri and Nworie Rivers, Watershed Owerri Nigeria with Remote Sensing Application

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**Abstract**—This study examined the impact of land-use activities on the confluence of Otamiri and Nworie rivers watershed quality in Owerri metropolis, Imo State, South-East Nigeria. Satellite image of the area was got from Ikonos satellite image. The image was classified with ArcGIS 10.1 which reveals the amount of impact of land-use activities on the area. The classification shows that vegetation of the buffered area has been seriously reduced with a lot of other human activities going on around the watershed. The analysis shows that the human impact has totally devastated the entire watershed of the confluence. About 30% of the entire area is Urban land, while the vegetation is about 27%. Eutrophication has taken over part of the rivers and the rivers are struggling to flow which could be from debris from the residents, therefore all efforts should be made to restore the watershed of the confluence of Otamiri and Nworie rivers before the rivers go dry and the aquatic animals die.

## INTRODUCTION

With the start of the new millennium, humankind faces environmental challenges greater in magnitude than ever before, because the scale of the problem shifting from local to regional and even to global ones (Igbokwe, 2005). Indeed, the footprint of activity continues to expand to the point that it is exerting a major effect on nearly all the earth's systems. Global Environmental problems such as global climate change, terrorism, and unsustainable development in many parts of the world are evolving as significant issues for the future of the planet and mankind.

Generally, watershed management seeks to protect drainage basin from degradation and for an urban area dependent on the water, from pollution (Nweze, 2009). Within Owerri metropolis, the confluence of Otamiri and Nworie watershed is an indispensable source of water. A watershed in its natural setting, is also a grooming place for biodiversity and hence a tourism potential. Apart from other natural potentials, which a typical watershed is noted for, Otamiri and Nworie watershed is a major

source of potable water for various uses in Owerri Metropolis.

However, a careful observation of the watershed and its environment reveal that it is under serious stresses. This is due to indiscriminate socio economic exploitation of the watershed over the years, and also the ongoing dredging going on the two rivers. These includes amongst others; Rapid and indiscriminate deforestation, unchecked and uncoordinated sand mining, construction and dumping of wastes (organic and solid). All these culminate into widespread vegetation loss which exposes the top soil for erosion and deposition of eroded materials into the watershed. Such degradation requires studies to restore the watershed of the confluence. However, most of these require assessment of impact of land-use activities at the confluence of Otamiri and Nworie rivers, watershed, which involves using Remote Sensing Technology to classify the land-use and land-cover type of the area to know how society's activities have impacted negatively to the watershed. This will most likely yield reliable results in determining land-use options that will be suitable for sustainability for the confluence of Otamiri and Nworie watershed.

A modern nation must have adequate information on many complex interrelated aspects of its activities in order to make decisions (Ogunbadewa, 2008). Land use is only one such aspect, but knowledge about land use and land cover has become increasingly important as the Nation plans to overcome the problems of haphazard, uncontrolled development, deteriorating environmental quality, loss of prime agricultural lands, destruction of watershed and important wetlands, and loss of fish and wildlife habitat. Land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels (Anderson et al, 1976).

## Aim(s) of the investigation:

To evaluate the contribution of the society's activities in the environmental degradation of the

watershed at the confluence of Otamiri and Nworie rivers.

### Study Area

Owerri is the capital of Imo State in Nigeria, set in the heart of the Igboland. Owerri consists of three Local Govern Areas including Owerri Municipal, Owerri North and Owerri West, it has an estimated population of about 400,000 as of 2006 population census and is approximately 40 square miles (100 km<sup>2</sup>) in area. Owerri is bordered by the Otamiri River to the east and the Nworie River to the west (Acholonu, 2008).

The study area is that area of Otamiri watershed that extends from 160000mN to 164500mN and

507000mE to 511000mE of Modified Traverse Mercator (MTM) projection grid coordinate system. This area is chosen because of it is the most active part of the generalized watershed. Apart from containing the confluence of Otamiri and Nworie, it has the Imo State Water Corporation (ISWC) Headworks, Owerri Dumpsite, Nekede Gullysite, and other important study areas which include the Owerri Zoo, Nekede Farm, and Njoku sawmill.

Otamiri is drained from Egbu (upland) to the southern part i.e. Nekede and Ihiagwa. Nworie River flows into it from North West. The area under study is within Owerri North, Local Government Area of Imo State Nigeria.

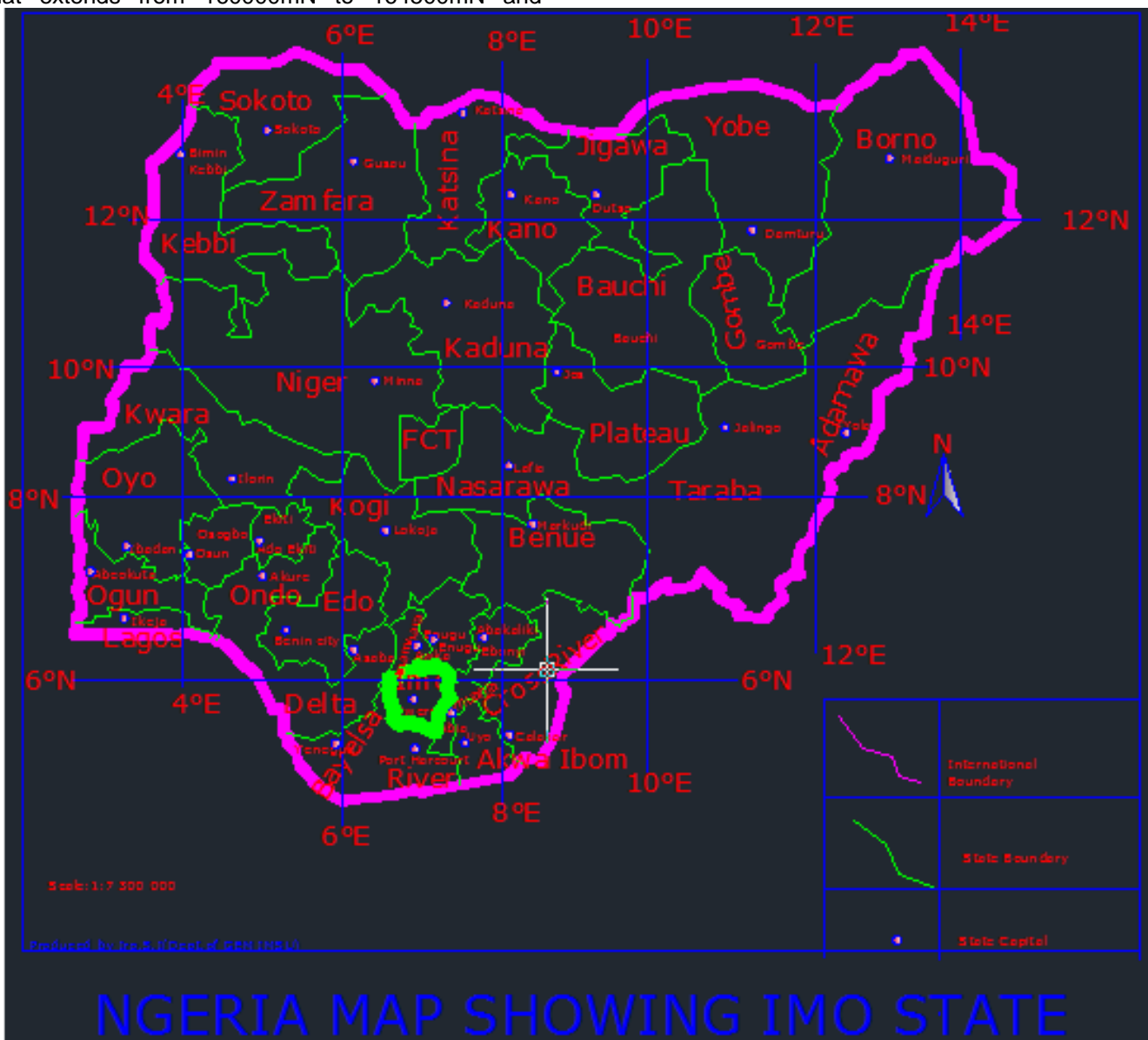


Figure 1: Nigeria map highlighting Owerri in Imo state in context (Iro, 2010)

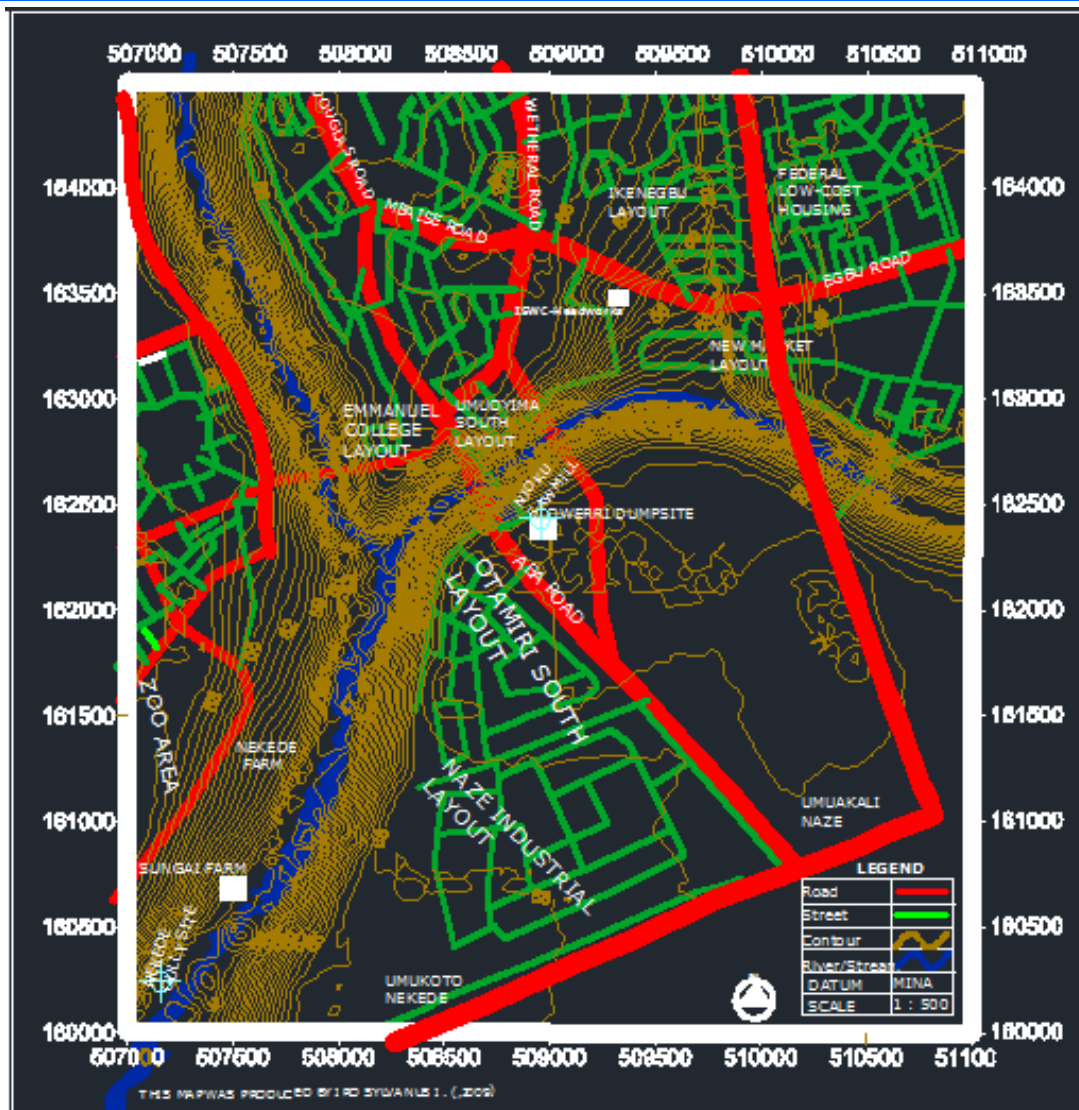


Figure 2: Owerri city with the confluence of Rivers Otamiri and Nworie watershed (Iro,2009)

## METHODOLOGY

### Supervised Classification

Materials used for the study include ikonos satellite image with pixel value of 7meter resolution, street guide of Owerri metropolis with scale of 1: 20,000m and published by Imo state survey department in 1985, reconnaissance survey carried on the study area.



Figure 3: Ikonos satellite image of the study area

Softwares used include ArcGIS 10.1, for image classification, GPS to pick coordinates of the study area

Supervised classification is much more accurate for mapping classes, but depends heavily on the cognition and skills of the image specialist (Short, 2006). The strategy is simple: the specialist must recognize conventional classes (real and familiar) or meaningful (but somewhat artificial) classes in a scene from prior knowledge, such as, personal experience with the region, by experience with thematic maps, or by on-site visits. This familiarity allows the specialist to choose and set up discrete classes (thus supervising the selection) and the, assign the category

Based on the knowledge of the study area, reconnaissance survey and additional information from previous studies in the area, a classification scheme was developed after Anderson *et al*, (1976). The scheme gives a broad classification where each of the land use/ land cover was identified.

Table. 1: Land-use classification scheme (after Anderson et al, 1976)

LANDUSE/LANDCOVER CATEGORIES	DESCRIPTION OF THE LANDUSE/LANDCOVER
1. Water	Dam, rivers streams.
2. Vegetation	Forest, primary and secondary vegetation
3. Agriculture	Shrubs, plantations, cropped land.
4. Rock/urban lands	Roads, buildings, open spaces

The classification of the image in ArcGIS covers, creating training areas, creating signature files and classification of imagery. The ikonos satellite image was added in ArcMap environment.

1. Open the image classification Toolbar and make sure the satellite imagery is selected in a layer drop down menu.

2. Open the simple manager and click “draw polygon” icon to start selecting the training areas.

3. Polygon was drawn on areas with known land-use purposes.

4. The classes identified include (1) water, (2) Vegetation (3) Agriculture, and (4) Rocks/Urban lands

Polygons were drawn on the land-cover types identified; therefore, for example water class polygon was drawn or chosen in multiple training sites to make sure the training areas are selected across the image i.e. some other examples of water should be found throughout the image.

6. After selecting multiple training areas for each water class highlight each row in the training sample manager and click on the merge tool to merge the entire water polygon into one class. Training areas for other classes were created with the same method.

**DATA PRESENTATION/ANALYSIS**

The present study intends to know the impact of human activities on the confluence of Nworie and Otamiri watershed area, which has made the watershed to be highly degraded and the river polluted. From the study, the entire watershed has been highly degraded, according to Eddins, (2006); the term watershed refers to a ridge that divides areas drained by different river systems. A catchment basin is the geographical area draining into a river or reservoir. The classification of the study area reveals that the entire confluence of the rivers has been destroyed from the analysis, the percentage of water is about 27%, Vegetation is about 27%, Agriculture about 17% and Urban lands is about 30%, Table 2. The result reveals how the entire watershed area has been over taken by urban area figure 4; this could be as a result of the residents trying to reside close to the river, to have access to water, sea breeze, flat land,

fertile land for their agriculture and fishing. It goes to show that the watershed is so stressed and polluted; even the agricultural areas have been gradually given way to urban lands.

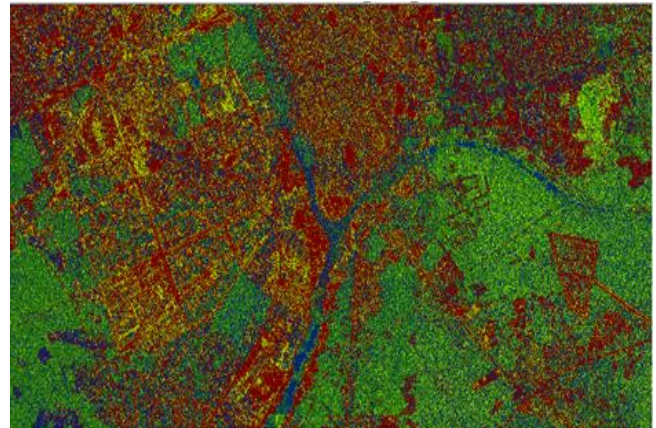


Figure 4: Screen dump of classified satellite image of the watershed of Nworie and Otamiri river confluence.

The urban lands which have been gradually growing from the western part of Owerri city Centre to the eastern part, the intrusion of eutrophication, "Eutrophication is defined as an increase in the rate of supply of organic matter in an ecosystem." (Nixon, 1995). This occurs along the water course, which could be the influence of residents who may be dumping their wastes in and around the watershed and this slows the movement of the river as a result may cause flooding during rainy season. Agriculture which has a percentage of about 17% may suggest that fertilizers both organic and inorganic are being washed into the river during rainy season which also may be responsible to the growth of the eutrophication along the two rivers, which deplete the fish on the river and other aquatic animals. The scenery of the confluence watershed has been totally destroyed by residents who clear the vegetation to construct their buildings, roads, parks etc. This has made the river to change courses and meander in some points, which could be as a result of deposition.

Table 2: Screen dump of percentage of land-cover classes

OID	Value	Count	per_area
0	1	4208416	26.636084
1	2	4197208	26.565147
2	3	2621034	16.58916
3	4	4773021	30.209608

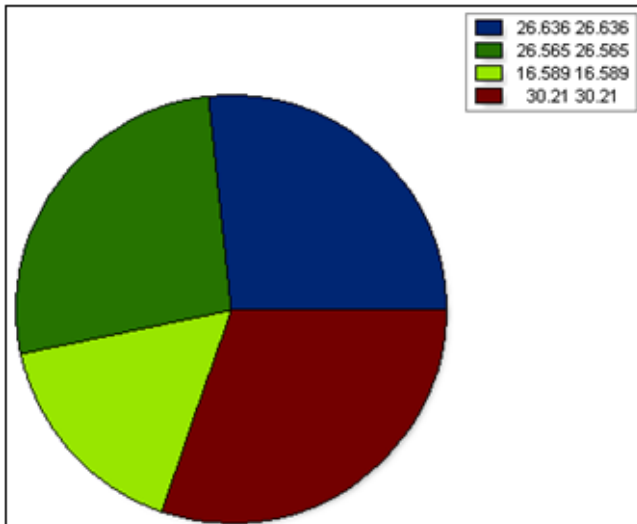


Figure 5: Pie graph of land-cover classes of the study area in percentage

1. Water (blue), 2. Vegetation (green), 3. Agriculture (light green), 4. Rock/Urban lands (brown)

### Conclusion and Recommendations

In this study, attempt was made to assess impact of land-use activities at the confluence of Otamiri and Nworie rivers, watershed Owerri Nigeria with remote sensing application.

The result of the study showed that the degradation at the watershed of the confluence has significant relationship with human negative impact on the river. The study has shown that all these environmental degradation in and around the watershed of the confluence of the rivers could be attributed to human impact, therefore, since human impact has been so pronounced in the devastation in of the study area, efforts should be made by government agents, NGOs, policy makers and the residents of the area to reduce the impact on the river. This can be done by buffering watershed zone of the entire confluence for vegetation regeneration; this will recharge the water table of the area and reduce eutrophication on the river. Much money being spent in the treatment of drinking water from the river will reduce when the area is buffered. The confluence should be made an aquatic splendor for site seeing and revenue generation. The residents should be educated on the possible consequences of the devastation on the confluence like flooding; erosion and possibly the rivers may go dry. Building

development along and around the river confluence should be henceforth stopped to avoid further devastation. The agricultural activities going on around the watershed should be stopped as well to reduce eutrophication effect on the rivers, which will revitalize the aquatic life of the rivers.

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