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# Wetland Loss in Makurdi Town and Its Environs in North Central Nigeria: Implication for Gender

**Stephen Hemba[1], Enoch T. Iortyom[2] and Olusesan A. Adelabu[3]**

*[1]Department of Geography, University of Nigeria, Nsukka, Enugu State, Nigeria*
*[2]Department of Geography and Environmental Science, University of Fort Hare, Alice Campus, South Africa*
*[3]Department of Microbiology and Biochemistry, Faculty of Science and Agriculture, University of Fort Hare, Alice Campus, South Africa*
*E-mail: aolusesan@ufh.ac.za*

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**ABSTRACT** The study examined wetland loss in Makurdi Town and its environs in Benue State, North Central Nigeria 1976-2006. Remote Sensing Technology and Geographic Information System technology were used in carrying out its analysis. Four epochs of Land Sat images 1976, 1986, 1996 and 2006 were acquired, classified and analysed using Land use Land cover change analysis techniques. The result showed that between in 1976 to 2006 wetland had declined from thirty-seven percent to fifteen percent of the study area. The study concludes that there is significant loss in the total amount of wetland in the study area. The loss of wetland in the study area could have significant implication on gender due to potential impact on ecosystem function leading to loss in function and benefits the wetlands provide. The study recommends the protection of wetlands and further investigation in the loss of wetland in the entire region.

## INTRODUCTION

Wetlands according to Batzer and Boix (2016) is the "Area of marsh, fen, peat land or water whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed six meters." Elsewhere, Keddy (2010), in McCarthy et al. (2015) defines wetland as "an ecosystem that arises when inundation by water produces soils dominated by anaerobic processes, which in turn, forces the biota particularly rooted plants to adapt to flooding." These unique characteristics of wetlands result in an ecology usually very rich in biological diversity. The biodiversity endowment of the wetlands supports the livelihood of the communities around them. (Zinhiva et al. 2014). Nigeria's wetlands as elsewhere play vital ecological roles in the Nation's landscape. Generally, wetlands are known for prevention/ amelioration of flood, protection of shorelines, and recharge of groundwater (He et al. 2015). Wetlands are important in purification of underground water polluted by wastes and sediment from natural and human input. Other benefits of wetland include habitat for some aquatic animals, birds, terrestrial animals and plants. In addition, they are considered as part of the cultural heritage across many communities. They are related to religious and cosmological beliefs constitute a source of aesthetic inspiration; provide many opportunities for recreational activities, such as bird watching, hunting, fishing, trapping and hiking.

Despite the importance of wetlands, they are continuously been depleted across the globe (TEEB 2013). According to von Behren (2007), the wetlands in America are among the fastest disappearing habitat. Examples of major wetland losses include a fifty-six percent reduction of the ChepeCarriel Sur freshwater-salt wetland in Chile (Pauchard et al. 2006), a ninety-two percent reduction of New Zealand's original wetlands (Brinson and Malvarez 2002), and a ninety-four percent reduction of the al-Hammar Marsh in Iraq (Lawler 2005). According to Olhan et al. (2010), 21 wetland areas covering about 93,582ha have dried completely in Turkey. They add that Turkey's total loss of 236,538ha is less compared to many European countries. In Bangladesh, forty-five percent of her mangrove wetlands have been destroyed due to shrimp farming and other anthropogenic influences (Khan et al. 1994).

Nigeria has an estimated 18,000km$^2$ of wetlands spread throughout the various ecological regions of the country collectively representing 2.23 percent total area of Nigeria (Oludayo 2007). Nigeria is part of the global effort to protect wetlands and is signatory to the wetland protection convention. It has designated the Nguru Lake and Marma Channel Complex, an estimated area of about 58,100ha as wetland of international and historic importance. On the other hand, an estimated 7000km$^{2,}$ about thirty-nine percent, of Nigeria's wetlands, located at the coastal area, is threatened by a projected possible sea level rise due to climate change (Oludayo 2007). Others, especially inland wetlands, are also threatened due to urban growth and expansion as shown by the work of Adefioye and Ujoh (2012). This paper evaluates the rate and impact of wetland loss in Makurdi town of Benue State and its environs in North Central Zone of Nigeria.

**Statement of Problem**

Wetlands are continuously been depleted across the world mostly due to inadequate protection. It is estimated that as much as fifty percent of wetlands worldwide have been lost through the centuries (Dugan 1993). On February 3rd 1971, in Ramsar, Iran the treaty for the international protection was signed by 18 countries of the world. However, this has failed to protect small but equally very important wetlands of concern to small communities, and which deserve protection (Oludayo 2007).

In Africa, inadequate researches and poor environmental monitoring amongst other factors have created a vacuum in understanding the status of most of her wetlands. A few studies conducted shows that wetlands in Africa are under threat and create the need to investigate the wetlands of Africa. An example is the work of Baker (2008) in the wetlands of Lake Victoria region. It was reported that the wetlands are experiencing rapid degradation and currently considered to be some of the most threatened ecosystems in the world. In Kenya it is estimated that wetlands are disappearing at rate of 1050 kilometres per year and has been as such described as the country's rarest ecosystem (Mironga 2005).

In Nigeria and indeed Benue state, not much is known about wetland loss due a few published studies. This paper would serve as a major contribution in this regard. It draws attention to the depletion of this important ecosystem, generate concern for wetland protection in the study area and provide a background for further scientific investigation on the subject in the country and raises questions about the effectiveness of the Ramsar convention to protect wetlands in their entirety.

**Study Area**

Makurdi is the capital city of Benue state. It lies in the flood plains of the River Benue within the north central region of Nigeria about the middle of the eastern half of Nigeria between latitude $07^0$ 38' N and $7^0$50'N and longitude $08^0$24'E and $8^0$38'E. In the pre-colonial era up to 1920 Makurdi was just a system of scattered Tiv settlements and Jukun fishermen (Iorliam 2008). The population of Makurdi town was considered within a range of a few thousand people but according to the current National population Census data, it has a population of and 300 000 (Tyubee and Anyadike 2015). The growth of Makurdi town put pressure on natural resources within its environs including wetlands.

Makurdi climate is characterized by wet and dry seasons dominated by N.E and S.W monsoon. The convergence of these wind masses is the highest influencing factor of rainfall within Makurdi. The rain begins in April and stops in October. The mean duration of rainy season is 182 days, with highest monthly rainfall total of 221mmis recorded in August. Tyubee (2005) has identified three temperature periods of cool dry season (November to January), hot dry season (February to April) and hot wet season (May to October). Seasonal atmospheric humidity are eighty percent for the wet and thirty percent for dry seasons respectively.

**METHODOLOGY**

This study used the Level 1 wetland evaluation methodology as recommended in Mack (2006), Fennessy et al. (2007), Hychka et al. (2007) and Wardrop et al. (2007). Level 1 method do not require a site visit, instead utilizing land use and land cover (LULC) data obtained from maps, digital sources, and geographic information systems (GIS).

The study integrated remote sensing technology with GIS technology for its analysis

which has been used in similar studies including Weng (2001), Alphan (2003), Zubair (2006), Esbah (2007), Hula (2005) and Johnson et al. (2014). The integration of geographic information system and remote sensing can provide a useful approach to analyzing data with high-level spatial details (Algharib 2008).

## Data Acquired and Sources

Satellite images showing past and present land use/land cover of Makurdi was acquired for the study from the National Centre for Remote Sensing Jos, Nigeria. The study also made use of land use and topographic maps of Makurdi to determine the political boundary of Makurdi and environs as a reference to compare all the results.

The satellite images were four epochs of cloud-free Landsat images acquired from the archives of National Centre for Remote Sensing. The data comprised Multi Spectral Scanner (MSS) image of the study area acquired in 1976, Thematic Mapper (TM) imagery of the study area 1986 and 1996 and Enhanced Thematic Mapper (TM+) imagery of 2006. The maps were geometrically inter-matched and converted to Universal Transverse Mercator Map Projection Sensing.

## Data Analysis

The data analysis involved image processing and a land use/land cover change analysis of the study area. The land use/ land cover change (LULCC) analysis was aimed at determining the extent and change of various land cover types over the study period. This analysis formed the frame for achieving the objective

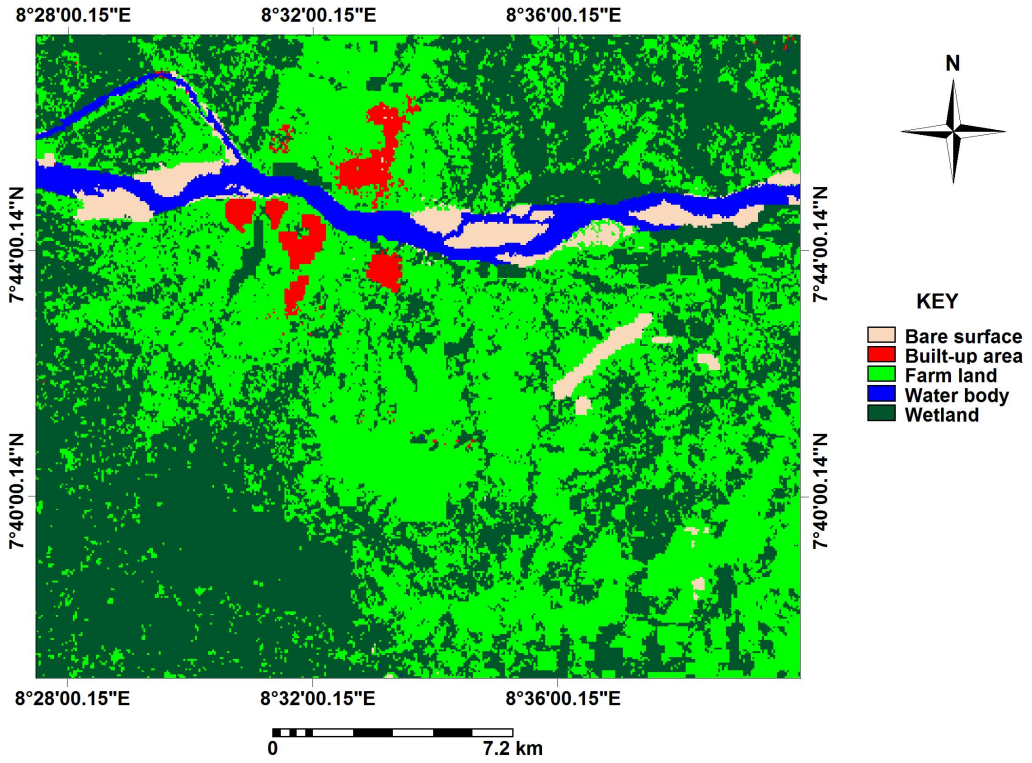


**Fig. 1. The 1976 land use classification of Makurdi**
*Source:* ILWIS land use classification 2011

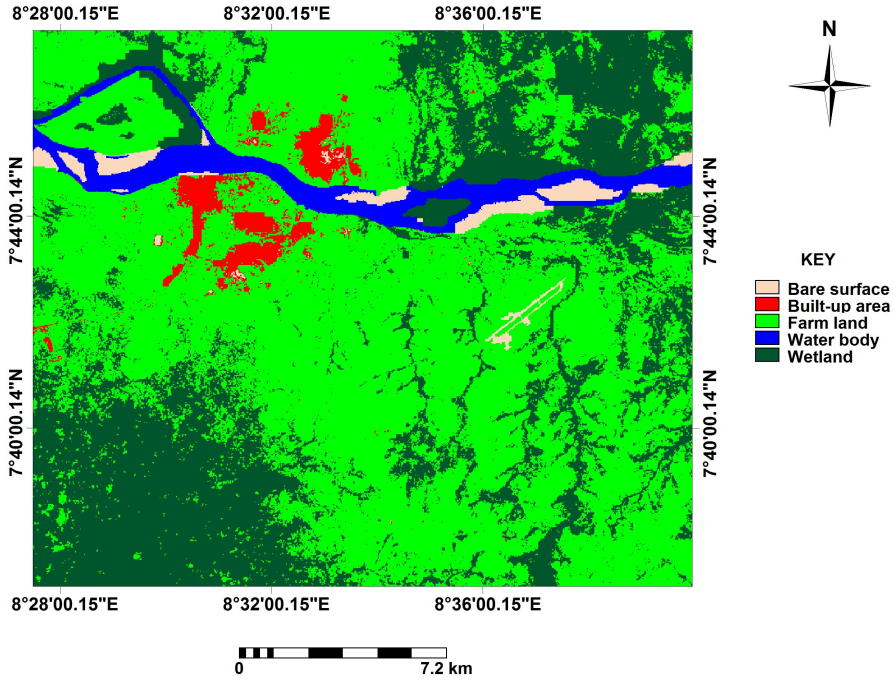


**Fig. 2. The 1986 classified image of Makurdi**
*Source:* ILWIS land use classification 2011

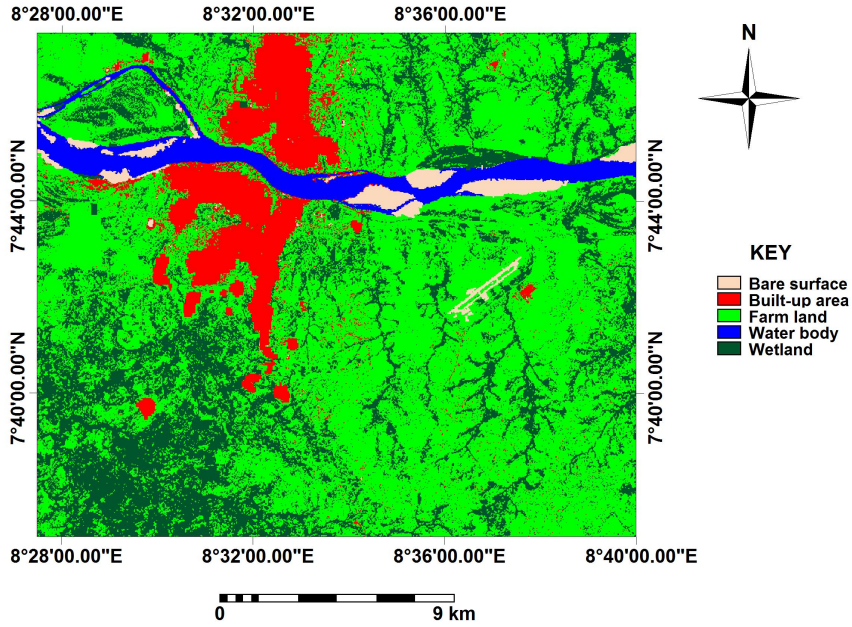


**Fig. 3. The 1996 land use classified image of Makurdi**
*Source:* ILWIS land use classification 2011

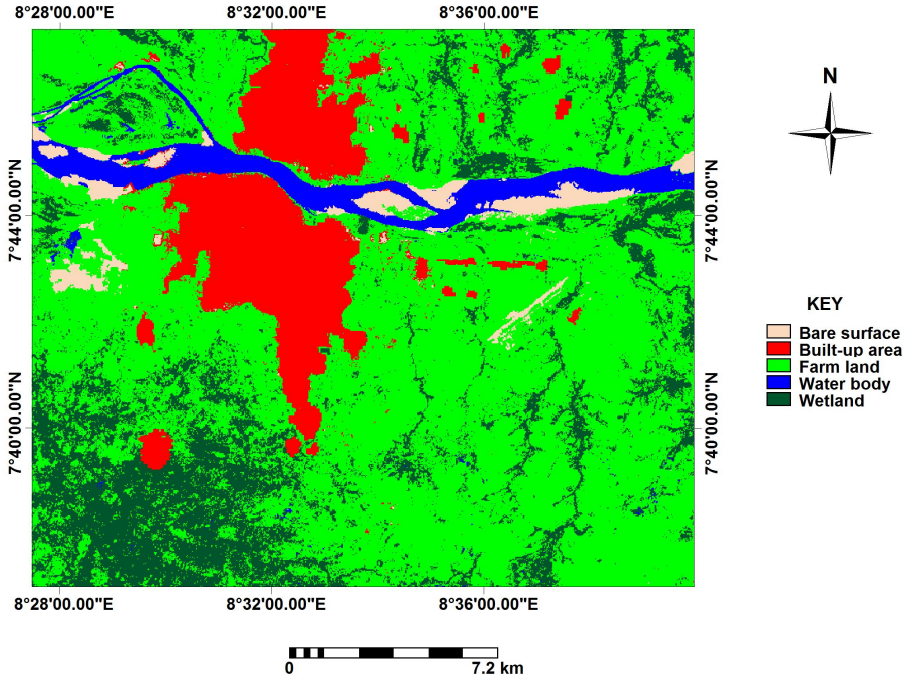


**Fig. 4. The 2006 land use classified image of Makurdi**
*Source:* ILWIS land use classification 2011

of the study. ILWIS Academic 3.2a image processing GIS software package was used to perform the analysis using the process in the proceeding sections.

## Image Classification

A classification scheme was developed after Aderson et al. (1976) based on the prior knowledge of the study area and a ground trothing carried out specifically for the purpose of the study. Five (5) classes of the land use/land cover types were classified from the images based on their spectral signatures. These classes include, Bare surface, Built-up area (Urban), Farm land, Water body and Wetland. Urban area was classified as "built-up" class which depicts residential areas of single houses and apartment buildings, shopping centres, industrial and commercial facilities, highways and major streets, and associated properties and parking lots, which represent urban impervious surfaces. After the classification, false colour composites were created on all the images (LandSat Images Figs. 1, 2, 3 and 4).

## Image Crossing and Change Detection

Change detection technique known as image crossing was used to detect change in land cover of the various land use classes. Image crossing involves the overlay of the classified image of earlier satellite imagery with that of a recent one. This enabled a pixel by pixel comparison of the study year images. Change was then generated; one classified layer was subtracted from the other.

# DISCUSSION

Image differencing on the four epochs of LandSat images 1976, 1986, 1996 and 2006 showed significant changes in land cover. Changes in the distribution of wetlands within the study area were isolated for further evaluation to determine the spatial extent covered by wetland. Based on this, change in wetland amount was measured and

loss determined as change in total amount of wetland. Table 1 shows the change in amount of wetland from 1976-2006.

**Table 1: Wetland areas from 1976-2006**

| *S. No.* | *Year* | *Area covered by wetland ($KM^2$)* | *Percentage of total land-mass (%)* |
|---|---|---|---|
| 1 | 1976 | 20.33 | 37 |
| 2 | 1986 | 14.50 | 26 |
| 3 | 1996 | 12.11 | 22 |
| 4 | 2006 | 8.28 | 15 |

*Source:* Author

As shown in the Table 1, total wetland cover at the base year 1976 stood at thirty-seven percent of the study area. In 1986, the wetland cover was reduced to twenty-six percent indicating an eleven percent change in the baseline amount of wetland. Further evaluation show that in 1996 wetland cover was further reduced to twenty-two percent of the study and down to fifteen percent of the study area in 2006. Within these 10 year interval, wetland loss of ten percent (1976-1986), five percent (1986-1996) and seven percent (1996-2006) occurred. This shows a significant loss amount of wetland in Makurdi from 1976-2006. The period from 1976 to 1986 experienced the highest amount of wetland loss. This loss might be related to increasing population resulting in the takeover of wetlands for construction and agricultural activities (Ajibola et al. 2016). This findings is also related to the conclusion of Adefioye and Ujoh (2012) that urbanisation takes over wetlands and result in change in their spatial pattern. It also confirms the submission that wetland areas of many countries of the world have continued to decline (TEEB 2013). The continuous decline of these wetlands signifies a possible extinction and loss in the environmental services they provide. Loss in wetland services has implications on social relations that define access and control over resources.

It is evident from the findings that significant wetland loss has occurred from 1976-2006. This potentially affects the natural ecosystem since both the biodiversity, social and systemic functions of the wetlands could consequently be altered. When a wetland is degraded or destroyed, its valuable functions are lost from the environment (Semlitsch and Bodie 1998).

A study by Moges et al. (2016) has shown that wetlands are source of uncultivated resources upon which local communities depend for materials, food and income. These resources are collected mostly by women as alternative sources of livelihood since women are denied right to land for the cultivation of crops. The women would thus, be disproportionally affected by the depletion of the wetlands than the men. Relatedly, the disappearance of the wetlands could have significant impact on other natural resources like water. Women are responsible for the collection of water for household use and could be disproportionally affected when sources of water change (Yocogan-Diano and Kashiwazaki 2009).

## CONCLUSION

The trend in the amount of wetland lost in the study area is dangerous for ecosystem functioning because a continuous decline would lead to the extinction of wetlands in the study area. The implications of the depletion of the wetlands are also not gender neutral.

## RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

Wetland monitoring and controlled development should be adopted in the study area to support wetland protection and enhanced ecological functioning of the study area. An evaluation of the ecological condition of the remaining wetlands is important; it will serve as baseline for their rehabilitation and protection. It is overarching to commence immediate protection of wetlands in the study area through the establishment institutional frameworks that support sustainable development. Also, a further study on total wetland loss at a region level and the implication on gender relations within affected communities should be conducted to add to the existing body of knowledge available on the subject.

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