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ORIGINAL RESEARCH PAPER

Human population growth as proximate cause of wetland dynamics

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ABSTRACT: The study examined the influence of population as proximate cause of wetland dynamics in the lower Ogun river basin of southwestern, Nigeria. Both primary and secondary data were used for the study. The primary data included 100 questionnaires administered and distributed among the fadama users group representing 10% of the estimated population of the group. Satellite images of years 1972, 1984, 2000 and 2015 were analyzed using GIS technique, while corresponding year's census figures were analyzed using descriptive percentage method. The results revealed among others that availability of fertile wetlands for farming accounted for 56% of factors responsible for sudden growth in population, followed by availability of economic trees (16%). The results further revealed that population which was 1033 in 1972 increased by about 121.69% in 1984, 62.777% in 2000 and 33.80% in 2015. The study concluded that population grow was responsible for the instability reported in all the land use classes during the period mostly affected were forested and the non-forested wetlands.

KEYWORDS: *Environment; Fadama Users Group (FUG); Land uses; Population-growth; Wetland dynamics*

INTRODUCTION

The population status determines to a large extent the available land per individual and proportions of various land uses contesting for space on the earth surface. The prevailing land class (es) on the other hand ascertains which land use will have an edge by encroaching upon all others (Ehrenfeld and Schneider, 1991). This became so as more people are coming into the area either by birth or other population growth mechanisms with the intent of engaging in the prevailing land use activity. Land resource exploration is therefore intensified further by mass in-migration of different groups (Kachali, 2009; Olanusi and Funmilayo, 2015). Thus, there is likelihood of land use sought by such dominant activity to increase at the expense of other land uses; in order to accommodate land needs of other in-migrants. Among the sought after land use aside settlement is farming, which most time expand at the expense of forestlands (Ekanade and Orimoogunje, 2012; Orimoogunje, 2014). Coupled with forest loss to urbanization as a result of growing population; land scarcity and of course forest protections by various federal and state laws. Such laws as which forbade the cutting and removal of forest for the purpose of protecting the environment generally and to check desert encroachment (Lohmann, 2006; Jimoh *et al*., 2012; Omosuyi, 2015).

Therefore, the burden of land use needs for farming in the recent past has now been shifted to the available wetlands around, which in the past centuries in Europe were considered as waste and unproductive land due to their wet nature, though the perception has changed (IWMI, 2004). Whereas in Africa wetlands are an important source of water and nutrients necessary for biological productivity and often sheer survival of people (Kachali, 2009).

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As a result of which wetlands are sought by various interest groups for different uses; most importantly in the urban area where wetlands are sand filled for developmental purposes which many times involved settlement needs. And other anthropogenic related land uses, while in some cases urban farming in the form of market gardening and construction of fish ponds.

Without exemption in the study area the wetlands are seriously exploited for the purpose of wetland farming in the production of vegetables all the year round. The practice which has been going on for decades and has attracted so many people within the closest upland rural communities as well as Abeokuta township. Population growth from these surrounding areas are principally responsible for rapid rates of wetland drainage, forest conversion, burning, degradation and loss which are connected to other range of socioeconomic parameter including ready market for wetland products (Murdiyarso *et al*., 2012). The population of the study area has been growing alarmingly and promoting the rate of wetlands conversion in the locality (Badiru and Olaoye, 2015).

This according to (Central Statistical Office, 2000) was responsible for the population growth of rural wetlands in Zambia that is urban-rural migration due to job scarcity in the urban area. The study showed evidence of lower employment opportunities in urban areas versus employment opportunities linked to agricultural and fishing in rural areas (Central Statistical Office, 2000).

Various researches have established that the largest water extent reductions occur in regions of large population growth over the last two decades. This is consistent with an expected higher anthropogenic effect in the areas of human population growth and the expansion of economic activities that are known to collectively place great demands on local hydrology, including draining of marshes and wetlands for constructions and water withdrawals for agriculture and human needs (Prigent *et al.*, 2012). The study therefore provided insight to the response of wetland loss to the population changes by singling out population as proximate and an important factor responsible for wetland dynamics in the study area.

MATERIALS AND METHODS

Study area

Lower Ogun River Basin is located in Obafemi Owode Local Government Area of Ogun State in the humid tropical rainforest zone between Latitudes 6°50^2 N and 7°50^2 N and Longitudes 3°18^2 E and 3°39^2 E Fig. 1 shows the study area. It is located at about 20 kilometers in the southern corner of Abeokuta, Ogun State capital (Adekunle *et al*., 2012). The relief of the area belongs to the belt of coastal plains which rises from the sandy beaches along the Atlantic Ocean to a belt of fresh water swamps with an intricate network of lagoons and creeks (Awoniran *et al*., 2014).

However, soils of the lower slope positions and close to River Ogun and its tributaries are poorly drained (Badiru and Olaoye, 2015). The study area is located within the sub-equatorial zone and enjoys a tropical climate with distinct wet and dry seasons. The sequence of weather types experienced in the area within a year is determined primarily by the fluctuating surface positions between two air masses called the Inter-Tropical Discontinuity (ITD), (Titus *et al.*, 1989). The study area lies within the tropical rainforest with the tall ever green trees; like the Mahogany genus, *Triplochiton scleroxylon*, Ebony Trees, Lianas, African Teak, *Entandrophragma cylindricum* and Walnut Genus, with an undergrowth of lians and other climbing plants which may become so entangled to make penetration impossible (Tejuoso, 2006; Odine *et al.*, 2012; Awoniran *et al*., 2014). The population estimate of the area for the year 2015 from 2006 population census is about four thousand nine hundred and seventy-four people, (NPC, 2006).

Data sources, collection and research technique

Two sources of data were used to achieve the objective of this study. The primary source of data collection was through field survey. This was done by the administration of questionnaires and conduct of oral interview of Fadama Users Group (FUG) members. Systematic random sampling technique was used to select respondents among the FUG. It was estimated that there are about one thousand members of the FUG who participated in wetland uses in the area. Hence, one hundred copies of structured questionnaires were randomly administered and distributed among them. The secondary data included; satellite images of 1972, 1984, 2000 and 2015 of the area and the corresponding census data from the National Population Office in Abeokuta, of which unavailable years were estimated. Simple percentage was used to summarize and organize questionnaire and interview responses. The selected images were used to classify the various land uses and

wetland status using GIS technique (Awoniran *et al.*, 2014), while population census figures obtained and estimated were used to examine the influence of population changes on wetland dynamics.

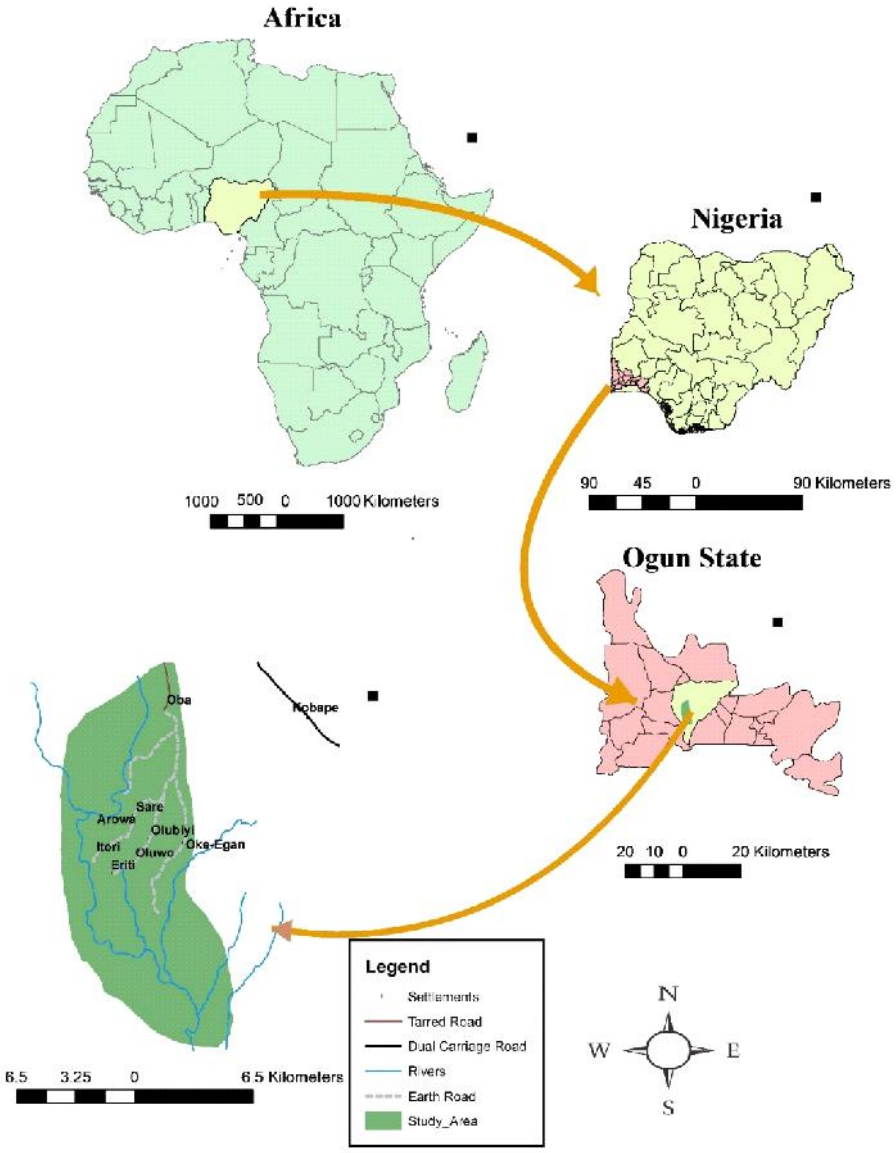

Fig. 1: The Study Area

RESULTS AND DISCUSSION

Factors promoting wetland dynamics

The major pull factors for the unabated influx of people to the wetland areas according to the respondents interviewed (Table 1) is not limited to high demand for wetland products, most especially vegetables.

Scarcity of jobs among the youth has equally forced many of them to embrace the wetlands farming, due to availability of ready market for the produce as posited by Central Statistical Office - CSO (2000) and short span of the farming period. Also included is availability of economic trees in the area for lumbering and abundance sand deposits which are sold within Abeokuta and other major towns. Truckloads of river sands are excavated and moved in droves on daily basis. Due to these pull factors and others, fresh wetlands are cleared every day for both rain fed and irrigated farming through the use of earth dam and pumps for the areas that have become excessively drained due to long time exposure of wetlands as a result natural vegetation removal (Orimoogunje, 2015).

In fact it is fast becoming a traditional practice in the area to augments natural water supply with surface water pump as a result of wetlands soil moisture loss. This loss according to Kachali (2009) may be attributed to the absence of wetlands policy coupled with conflicting sectored policies on matters related to wetlands, poor planning concepts, insufficient information and awareness on the significance of wetlands contribute to continuous degradation and loss of wetlands even in the study area.

Population status of the settlements in 1991 and 1996

Table 2 reveals the status of the population in the area as obtained from the National Population Commissions archive (NPC, 2006). The 1991 population figures came from the 1991 final census exercise, while the 1996 figures were estimated from the 1991 census (NPC, 2006). The figures reveal slight increases among the various settlements in the area; for instance the population increase between 1991 and 1996 in Eriti was 47 people, while Ogunpa was just 11 additional people and so on. It should however, be noted that these ten settlements are just a representative of about thirty five others and more, therefore the effects of such small additional populations are enormous when considered in cumulative term. Table 3 is a followed up for Table 2, the population figures on the table for the years; 1972, 1986, 2000 and 2015 were all projected from the figures of year 1991 for each settlement at 2.86% and 3.18% growth rate (depending on the period) as provided by the NPC (2006).

Population growth among the settlements

Table 3 shows various proportions of population increases among various settlements within the years under consideration, however small or minute the increases may seem. The most important denominator to be considered is the cumulative increase in the population from one year to the other. From Table 3, the population of the area increase from 1033 people in 1972 to 2300 in 1986, this increase of 1267 people within a period of 15 years, represented about 122.69% increase (Table 4). This percentage increase revealed

Table 1: Factors responsible for sudden population change in the study area (Adeleke, 2017)

Factors of population growth	Frequency	Percentage
Availability of economic trees	16	16
Availability of fertile wetlands for agriculture	56	56
Increase trading in wetlands products	8	8
Availability of sand deposits	8	8
Total	100	100

Table 2: Final Population Figures of 1991 and 1996 Estimation (NPC, 2006)

Locality	Eriti	Ogunpa	Olubiyi-Isale	Arowa-Odo	Ajegunle	Saare	Itori-Odo	Oluwo-Odo	Saagi	Abore
1991	339	78	170	105	337	461	515	306	274	256
1996	386	89	194	120	384	525	587	349	312	292

an increase of more than 100%. Such an increase could aggravate a serious environmental distortion most especially when it is viewed from the perspective of total increase when all the settlements in the lower Ogun River Basin are considered together. This was in conformity with the opinion expressed by Lambin *et al*. (2003), that, rapid population growth and poverty constitute the main forces of change in land use, in Sub-Saharan Africa. Similarly, the population of the locality increased from 2300 of 1984 to 3744 people in the year 2000, which represented an increase of 1444 people either by birth or in-migration. This is increased of 1444 additional people also represented about 62.78% addition to the population of the area between the years 1986 and 2000 and by implication directly influencing the environment. Since population size together with the associated changes in land use are known to place high burden on the global soil resource and the environment in general (NRCNA, 2009). Also, no simple relationship exists between population size and environmental change, as human numbers have been established to have direct impacts on the environment. More often, the environmental implications of population size are ultimately determined by complex interactions among many forces, including technology, political and institutional contexts, as well as cultural factors (Hunter, 2000). It is however, worth to note that most tropical countries

Table 3: Population estimation for years 1972, 1984, 2000 and 2015 (Adeleke, 2017)

Locality	1972	1984	1991	1996	2000	2015
Eriti	123	274	339	386	447	598
Ogunpa	28	63	78	89	103	138
Olubiyi-Isale	62	138	170	194	224	300
Arowa-Odo	38	85	105	120	138	185
Ajegunle	123	273	337	384	444	594
Share	168	373	461	525	608	813
Itori-Odo	187	417	515	587	679	908
Oluwo-Odo	111	248	306	349	403	540
Shagi	100	222	274	312	361	483
Abore	93	207	256	292	337	451
Total Popn*.	1033	2300	2841	3238	3744	4974
Mean Popn.	103	230	284	324	374	497

*Popn: Population

Table 4: Percentage increase in population within the period among the localities (Adeleke, 2017)

Locality	1972-1984	1984-2000	2000-2015
Eriti	122.76	63.14	33.80
Ogunpa	125.00	63.49	33.98
Olubiyi-Isale	122.58	62.34	33.92
Arowa-Odo	123.68	62.35	34.05
Ajegunle	121.95	62.64	33.78
Share	122.02	63.00	33.71
Itori-Odo	122.99	62.83	33.73
Oluwo-Odo	123.42	62.50	33.40
Shagi	109.90	62.61	33.80
Abore	122.58	62.80	33.83
% Mean	121.69	62.77	33.80

have least capacity to combat the high burden of population and land use on the environmental resources (Areola, 2015).

The same increments in the influx of people into the area continued into the year 2015, but at a reduced rate when considered along with the previous rate. The population of the area still increased from 3744 inhabitants of the year 2000 to 4974 people in the year 2015 this also represented an increase of 1240 additional people. This implied a percentage increase of about 32.85% additional burdens on the wetland resources in the area. It is indeed note-worth to state that such influx of people into the area could influence the environment in a number of ways. One of such was the increase demand for settlement lands for the accommodation of the new entrants. Another was the allocation of additional land for farming to cater for economic emancipation of the new additions in population, which together with the latter cause have been the bane of wetland loss in the area. This unregulated influx of people confirmed the earlier finding of Ouedraogo *et al.* (2010) that population growth is often the result of rural migration in search of suitable farmland. Therefore creating situation of population redistribution through migration, there by shifting the relative pressures exerted on local environments, perhaps easing the strain in some areas and increasing it in others (Hunter, 2000).

Table 3 further revealed the mean population for each year; in 1972 the mean population for the area was 103 people, while that of the year 1986 was 230. The mean population increased to 374 in the year 2000 and subsequently to 497 people in the year 2015. The mean increase in population depicted an increase of more than 100 people per period on the average. For such a local community an increase of 100 people from one period to other on the average was enormous and serious and was capable of setting in motion wetland dynamics that is capable of doubling the land requirements of the 100% population increment in the study area.

Wetland density per individual

Table 4 reveals the percentage increase in population of the area between years 1972 and 2015, for instance in Ogunpa the percentage increase in population between 1972 and 1984 was 125%. During the same period the average population increased in the area was about 122 people, this indicated a population increase of more than double, which will ultimately, required more than double the prevailing land uses to accommodate such population changes. Also the period 1984-2000 revealed an increase of 62.77% on the average though on the reduced form when compared with the previous period of 1972-1984 when the percentage increase was more than 100%. Period 2000-2015 equally depicted an era of continuous growth in population of the locality; the Table further revealed 33.80% mean population increase for the time. The growth in the population of the area was such that settlements that should only hold populations of a few hundred have thousands of people living in them, therefore triggering environment degradation (Kachali, 2009). Related to this was that urban poor frequently depend on wetlands for food production and create markets for wetland produce, and thus encourage wetland use and degradation (Tejuoso, 2006).

Human influence and wetland loss

Table 5 compares the population of the years; 1972, 1984, 2000 and 2015 with the corresponding farm lands requirements per individual. This gave the advantage of observing the changes in farmland/ settlements at the expense of the available wetlands, from 1972 to 2015. The table also revealed the farmland density(s) that is farmlands areas available per individual user in the locality. From Table 5 the available farmland per individual user in the year 1972 was 2.9 hectares for the total population of 1033 people and farmlands of 3012.48 hectares. With population increase in the year 1984 to 1388 people and farmlands area increased to 5918.40 hectares the density rose to 4.3 hectares per individual this may not be unconnected with increase in the degradation of more forested land coverage in the locality. In the year 2000 with population growth to 3744 people coupled with decrease farmlands from the 5918.40 hectares to 4748.04 hectares, the density of farmlands per individual decreased to 1.3 hectares per user. This trend in reduction continued into the year 2015 with the farmlands density further reduces to 0.9 hectares per individual as well. It is however important to note that all the farmlands increase was at the expense of the forested and non-forested wetlands in the area as depicted on the Table 6 (FAO, 2005; Orimoogunje and Ekanade, 2010; Abah, 2011; Dahl and Stedman, 2013). Table 6 further revealed the influence of population growth on the various land uses in the study area from the year 1972 to 2015 as covered by the study.

Table 5: Population farming density of the study area (Adeleke, 2017)

Parameters	1972	1984	2000	2015
Population	1033	1388	3744	5290
Farmland	3012.48	5918.40	4748.04	4705.92
Density	2.9	4.3	1.3	0.9

Table 6: Population and land use patterns of the study area in 1972, 1984, 2005 and 2015 (Adeleke, 2017)

Year	Population	Farmland	Water body	Built up/open Space	Fallow land	Forested Wetlands	Non Forested Wetlands
1972	1033	3012.48	1620.00	309.96	2010.96	3972.96	2082.96
1984	1388	5918.40	527.76	773.28	536.40	792.36	4461.12
2000	3744	4748.04	428.04	1110.24	1763.64	2434.32	2525.04
2015	5290	4705.92	408.24	1352.88	2388.24	2172.24	1981.80

CONCLUSION

The study examined the influence of unregulated population growth in a typical rural area in a tropical environment of Southwestern, Nigeria, and it was discovered to be the major factor driven wetland use dynamics in the locality. Land uses analyzed via remote sensing and GIS combined with population data offered exciting possibilities (Aplin, 2004; Clifford *et al*., 2016), to observed dynamics in wetland and population growth from one period to the others between years 1972 and 2015. The study therefore concluded that the growth of population was responsible for the instability reported in all the land uses classified during the period with forested and the non-forested wetlands mostly degraded.

CONFLICT OF INTEREST

The author declares that there is no conflict of interests regarding the publication of this manuscript.

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