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Environmental Change and Ecological Services in System I Drainage Area of Lagos

Olubunmi Adegun Shakirudeen Odunuga
Department of Geography, University of Lagos

Youpele Appia
Nigerian Institute of Oceanography and Marine Research

Abstract
The study examines the implications of urban land uses on hydrological processes and ecological services in system I (Odo Iya Alaro Channel) of Lagos Drainage Master Plan. Aerial Photography (1965) and Ikonos Imagery (2008) were used to assess the land use and land cover changes in a GIS environment. Field survey to inventories plant and fish species within the wetlands was carried out. Study of land use-land cover changes between 1965 and 2008 shows that about 79% of the area has been built-up. Based on environmental change projectisons using precipitation and land use drivers it is expected that runoff and peak flow would increase by 6.34, 14.24, and 20.36% for 50 years medium climate change, 50 years high climate change and 100 years high climate change respectively. Some of the flora expected to be lost from wetland and creeks based on landuse changes include Thuja sp and Ficus sp. This would affect some of the ecological services offered by these plants. Effluent discharge from industries is also putting the fish supply at risk, as species such as Sarotherodon melanotheron and Liza falcipinnis are reducing. The study advocates conservation approach for sustainable urban land uses.
Keywords: Land Use-Land Cover Change; Wetland; Ecosystem; Urbanisation; Watershed

1. Introduction
Over the past five decades the catchment of System I of Lagos Drainage Master Plan has experienced a high level of urbanisation as manifested in rapid population growth and increasing economic development. With the intensification of urbanisation, there have been significant changes in the pattern of land use and land cover in the area. This trend has culminated in a significant reduction in vegetal cover, especially a reduction in the extent of the ecologically sensitive wetlands that made up a significant proportion of the watershed.

Judging by current developmental trend, the remaining wetlands within the drainage area would be subjected to a number of changes. Firstly the ecological character of the wetland would undergo a number of modifications. Secondly, important ecosystem services provided by the wetlands would be adversely affected (Millennium Ecosystem Assessment, 2005). Furthermore, increased hydrological fluxes brought about by intense urban land use change may result in flooding, especially in the face of unguided developments as revealed by the extent of imperviousness within different watersheds in Lagos (Odunuga, 2012).

Within the study watershed, increased imperviousness driven by land use and land cover changes has resulted in about 18.34 % of the total landmass being used for industrial purposes. Due to the high concentration of industries in this area, high volumes of inadequately treated industrial effluent are discharged into System I. The myriad of chemicals introduced into the water body could have negative consequences for ecosystem services provided by the stream. These include amongst others, impaired ability to retain, transform and process organic matter entering the stream (Gibson & Meyer, 2001), and changes in biotic community structure and functions of the aquatic ecosystem (Emmanuel et al., 2008).

Due to the integral role that land cover plays in controlling the hydrologic response of a watershed, and the role that land use modification could play in the degradation of ecological services provided by the wetlands, this study examined the implications of urban land uses on hydrological processes and ecological services in System I (Odo Iya-Alaro Channel) of Lagos Drainage Master Plan. It determined the extent of land use and land cover changes between 1965 and 2008 and assessed the impact of environmental change projections and scenarios on the generation of runoff and peak flows within the waterhed. The implications of land use changes and industrial activities on ecosystem services were also examined.

2. Study Area
2.1 Location and Extent
System I Drainage Channel otherwise known as the Odo-Iya Alaro Channel is one of the six systems of drainage and flood channels in Lagos metropolis, Lagos, Nigeria. Odo Iya Alaro Stream is the main natural drainage within the area. System I Drainage Area (Fig.1) occupies a landmass of about 4235.7ha. Geographically it extends from about Latitude 6^0 33′ 40″ to 6^0 36′ 48″ and Longitude 3^0 21′ 02″ to 3^0 24′ 12″. The drainage channel traverses Agidingbi, Obafemi Awolowo Way, Oregun Link Road, and Ogudu Bridge. Stormwater runoff

and wastewater from the channel is discharged into Ogudu Creek, where it eventually empties into the adjourning Lagos Lagoon. The drainage channel is served by eight tributaries and de-floods several places which include Agidingbi, Oregun and environs, Mobalaji Bank Anthony Way, Ikeja, Allen Avenue, Opebi, Ilupeju, Ojota, Maryland, Anthony Village, Mende, Bariga and Pedro among others.

3. Materials and Methods

3.1 Land Use and Land Cover Mapping

Aerial Photograph of 1965 and Ikonos Imagery of 2008 were obtained from Lagos State Survey and Department of Geography University of Lagos respectively. Change detection through overlay analysis was performed using ArcGIS 9.3 after hydrological significant classification and vectorisation of the geospatial data had been performed.

Specifically, the percentage of change and rate of conversion were determined. Since the study is on hydrological response and ecological services, land use analyses focused on imperviousness of the land area rather than detailed classification of urban land use change.

3.2 Environmental Change Projections

Environmental change projections based on precipitation and land use for the analysis of future runoff and peak flows under different climate change scenarios was adopted from Odunuga et al., (2012). Peak flow was stimulated with Precipitation Inundation Model (PWIM) using four rainfall events with total amounts exceeding 45mm, with an intensity of not less than 20mm/hr between June and July 2008.

3.3 Identification of Flora and Fauna

Field study was conducted to inventory the different plant species available in the wetlands. The plant species were photographed and collected for proper identification in the Laboratory. Information on the available species of fishes and other aquatic life within the System I were obtained over a month period through observation of catches and interview of artisanal fishermen.

4. Results

4.1 Land Use and Land Cover Changes

The land use analyses of System I of Lagos metropolis are as presented in Table 1. As earlier stated, the land use analyses focused on the extent of built-up and wetland areas. As at 1965, the extent of imperviousness (Built-Up Area) was 321.06ha (7.57%), while the extent of inland wetlands and coastal wetlands were 1840.41ha and 2074.22ha respectively. As at 2008, the extent of imperviousness had increased to 3346.20ha, while the extent of inland and coastal wetland had reduced to 222.37ha and 667.12ha respectively. The increase in the extent of imperviousness is indicative of the conversion of wetlands in the study area to other uses. As shown in Table 1, extent of imperviousness increased at a rate of 70.35ha per annum, while inland wetland and coastal wetland decreased at a rate of 37.63ha per annum and 32.72ha per annum respectively.

Removal of vegetal cover and increases in the extent of imperviousness implies significant changes in the area's hydrology due to reduced interception of rainfall by vegetation, compaction of soil, and increased stormwater runoff. With respect potential impacts on the remaining wetlands, increased stormwater runoff which a major hydrologic stressor can lead to a number of conditions which include, increased ponding within the wetland, increased water level fluctuation (hydroperiod) and flow constrictions. Increased ponding and increased water level fluctuation has been shown to aid conditions that contribute to the spread of invasive wetland and dominance of invasive species due to their level of tolerance of hydrologic change, loss of sensitive species and loss of species richness (Azous et al., 1997; Chow-Fraser et al., 1998; Wright et al., 2006).

4.2 Environmental Change Projections

An earlier study by Odunuga et al., (2012), shows that runoff and peak flow are expected to increase under different environmental change scenarios due to increased imperviousness within System I. Results based on the projected land use change are presented in Table 2, while results of peak flow based on the integration of precipitation and increase in urbanisation drivers using PWIM are presented in Table 2. As shown in Table 2, extent of impervious area will continue to increase, from an extent of 3346.20ha in 2008 (the base year) to 3663.88ha under the 100 years High Climate Change (HCC) scenario.

Increase in the Total Impervious Area (TIA) signifies a concomitant increase in the runoff coefficient of the watershed. It has been observed that urbanisation generally increases storm runoff response to rainfall as a result of higher stormwater peaks generated by impervious surfaces. Depending on the extent of imperviousness within an urban watershed, peak flows may increase by a factor of 3 to 8, and runoff volumes by 2 to 2.5 above pre-urbanised conditions as urbanisation progresses (Oyebande, 1990).

Furthermore, peak flow generated as a result increased and continuous increase in imperviousness within the drainage area is expected to have significant impacts on the hydraulic and ecosystem of receiving water bodies within the waterhed. In the case of Odo Iya Alaro Stream, frequent high flows within the stream may lead to bank and bed erosion of the stream.

Similarly, increased TIA may further exacerbate or increase the vulnerability of Odo Iya Alaro Stream to more degradation and urban stream syndrome. This is because pollutants and suspended matter in the stormwater generated in the Contributing Drainage Area (CDA) is likely to change the substrate within the stream, threatening aquatic life forms and modifying or altering biodiversity.

The results of the PWIM peak flows and area inundated for different area presented in Table 3 shows that runoff and peak flow will increase by 6.34%, 14.24%, and 20.36% for 50 years Medium Climate Change (MCC), 50 years HCC and 100 years HCC respectively. On the average area inundated will increase by 2%, 3% and 4% for 50 years MCC, 50 years HCC and 100 years HCC respectively.

Sustained increase in runoff and peak flow as presented in Table 3 portends increased risk of flooding, especially flash floods within the CDA. A recent example is the 16 hour rainfall event of July 10, 2011, in which some communities around Mende area of Maryland were inundated and properties worth millions of Dollars were destroyed. Under the different scenarios in which runoff and peak flows were simulated, flooding events would be aggravated as a result of lack of maintenance of drainage facilities due to clogging of drainage systems, and sediments and solid wastes or debris transported with stormwater.

Loss of riparian vegetation along Odo Iya Alaro Stream will further worsen flooding in some localities such as Arowojobe within the drainage area. This is because the high hydraulic roughness and flow resistance of riparian vegetation contributes to the dissipation of kinetic energy of floods. These scenarios also have negative implications for biodiversity in the watershed as flooding and water logging may change habitat conditions for biodiversity leading to changes in species composition within the remaining wetland area.

4.3 Ecosystem Services

4.3.1 Wetlands

Inventory of plant species within the wetland of Ojota-Maryland gorge and the wetland of Ogudu foreshore indicated that the wetlands consist of a variety of flora. The inland freshwater wetland of Ojota-Maryland consists of Carica papaya, Luffa cylindrica, Ipomoea involucrate, Mariscus alternifolius, Ficus Specie, Eclipta prostrate, Sacciolepis africana, Amaranthus spinosus, Thuja Specie, Musa sapientum and Elaesis guineesis. The mangrove wetland of Ogudu foreshore consists of Rhizophora racemora, Avicennia nitida, Cyperus articulates, Cyperus papyrus, Paspalum vaginatum, Achrosticum Specie, Marsilea Specie, Cyclosorus Specie, Ceratopteris Specie, Pandanus candelabrum, Raphia hookeri and Phoenix reclinata.

The provisioning services rendered by the different species of plants at these wetlands include food, fibre and fuel, biochemical and genetic materials. Details on the ecosystem services provided by individual plant species are presented in Table 4.

Agricultural benefits are also derived from these wetlands. At Mende area of Maryland, the wetlands are used for the cultivation of different crops. Field visit to the area revealed the wetlands is used for the cultivation of different staples, fruits and vegetables including Cocoyam (Colocasia esculenta), Plantain (Musa sapientum var paradisiacal), Banana (Musa sapientum), Sugar Cane (Saccharum officinarum), Bitter Leaf (Vernonia amygdalina), Red Spinach/Plumed Cock's Comb/Silver Cock's Comb locally called Soko (Celosia argentea), (Fig.2), and West African Mallow Leaves locally called Ewedu (Corchorus olitorius).

The ecosystem services provided by these wetlands are however being threatened by increased rate of changes in land use and land cover, and global climate change. According to the Millennium Ecosystem Assessment (2005), climate change will not only further worsen the loss and degradation of many wetlands and the extinction or decline in their species, but the human populations that are dependent on their services will also be negatively impacted. Based on the Reactive Global Orchestration and Order from Strength scenarios of the Millennium Ecosystem Assessment (2005) the degradation of these wetlands is expected to increase while the extent of the wetlands is expected to decrease due to increases in human population.

Furthermore, encroachment on or loss of these remaining wetlands would result in loss of refugia for the biotic communities inhabiting the wetlands. Sedell et al (1990), defined refugia as habitats or environmental factors that convey spatial and temporal resistance and / or resilience to biotic communities impacted by biophysical disturbances. Loss of refugia provided by these wetlands would result in loss of shelter from fast moving currents, loss of hiding place from predators, and loss of reproduction site (spawning and nursery sites) for aquatic, amphibian and terrestrial life forms. Loss of these wetlands would also mean loss of an important role of providing refugia for recovery of natural hazards such as floods.

4.3.2 Fish Supply

Fish supply is an important provisioning service offered by Ogudu Creek. The Creek and the adjoining wetlands serve as important fishing source and bird nesting sites. The availability of different species of Fish (Table 5) within the Creek is of immense socio-economic value as these serves as a source of livelihood for artisanal fishermen as well as fish mongers.

Interviews conducted at the Ilaje fishing community (at Ogudu) where most of the fishermen are resident revealed that most of the community members are engaged in the fishing industry. The men are mostly fishermen, while the women are mostly fish mongers. Average daily catch of fish is reported to vary according to the type and size of fish caught. Based on interviews conducted with the fishermen, a small sized basket of Sarotherodon melanotheron (Blackchin Tilapia), (Fig 3) which weighs between 6 to 7kg is sold for Dollar equivalent of between 15. 15 and 21.21 Dollars, while a big basket is sold for an equivalent of 48.48 Dollars.

Responses from the fishermen on the yield of the creek revealed that there has been a decline the quantity of fish caught by the fishermen over the years. Another complaint of the fishermen is that their fishing nets sometimes get entangled by water hyacinth and debris from refuse dropped in the creek.

The biotic integrity of this aquatic ecosystem is however being threatened by different anthropogenic activities especially the discharge of industrial effluents from nearby industrial establishments and domestic waste and sewage from settlements along the creek. This situation renders the fish species within creek vulnerable to bioaccumulation and biomagnification of pollutants such as heavy metals and synthetic organic contaminants that might be present in the industrial effluents, rendering them unsafe for human consumption. The polluted status of the creek is evident in the proliferation of water hyacinth (Eichhornia crassipes) and other floating aquatic weeds such as Pistia and Vossia cuspidate. Indiscriminate discharge of improperly treated industrial effluents has the potential to adversely affect the survival and physiological activities of fishes and other aquatic organisms (Baby et al., 2010). Similarly, changes in water quality as a result of pollution may lead to loss of fish species which could result in significant shifts in ecosystem dynamics (UNEP GEMS, 2008).

5. Recommendations and Conclusion

The study has brought to the fore the implications of urbanisation and environmental change on hydrological processes and ecosystem services provided by System I Drainage Area of Lagos metropolis. In the light of the changes that have taken place in the area, there is a need for a review of the Lagos Master Plan to promote environmental and natural resources conservation. With regards to the adverse hydrological impacts of urbanisation, a multi-disciplinary approach via the integration of structural and non-structural measures is strongly recommended. Furthermore, the expected increase in runoff and peak flow under different climate change scenarios calls for maintenance and improvement of the drainage system. Also recommended is awareness campaign and education on the hydrological and ecological benefits of wetlands. Lastly, there is need for the strict enforcement of policies including those protecting wetlands in Lagos.

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Table 1: Land Use Analysis of System I

	Static Land Use 1965		Static Land Use 2008		Change Statistics		
Land Use Type	Area (ha)	% Total	Area (ha)	% Total	1965-2008 Area (ha)	% Change	Annual Rate of Change
Built-Up	331.06	7.58	3346.20	79	3025.14	7035	70.35
Inland Wetland	1840.41	43.45	222.37	5.25	-1618.04	-3762	-37.62
Coastal Wetland	2074.22	48.97	667.12	15.75	-1407.10	-3272	-32.72
Total	4235.7	100	4235.7	100	-	-	-

Table 2: Projected Future Impervious Area for Different Climate Change Scenarios

Drainage Area (ha)	Impervious Area (ha)				
	2008 Base Year	50 Years Scenario		100 Years Scenario	
		High	Medium High	High	Medium High
4235.7	3346.20	3557.99	3388.56	3663.88	3452.10

Source: Odunuga et al., (2012).

Table 3: PWIM Simulation of Peak Flow and Area Inundated for Different Scenario on System I

2008 Situation				50 yrs HCC			50 yrs MCC			100 yrs HCC		
Date	PWIM RO (mm)	PWIM PF (m^3/s)	PWIM AI (ha)	PWIM RO (mm)	PWIM Peak (Qm^3/s)	PWIM AI (ha)	PWIM RO (mm)	PWIM Peak (Qm^3/s)	PWIM AI (ha)	PWIM RO (mm)	PWIM Peak (Qm^3/s)	PWIM AI (ha)
3/6	1650.37	194.37	1150.43	1885.60	221.87	1172.04	1754.97	206.50	1164.58	1986.46	233.74	1179.71
7/6	2345.62	276.00	1168.73	2679.94	315.34	1194.67	2494.29	293.49	1185.71	2823.30	332.21	1203.86
13/7	4131.00	486.08	1223.63	4719.77	555.36	1262.54	4392.81	516.89	1249.10	4972.26	585.07	1276.33
21/7	2251.12	264.88	1157.75	2571.97	302.64	1181.09	2393.80	281.67	1173.03	2709.55	318.82	1189.37
*RO-Runoff; PF-Peak Flow; AI- Area Inundated												

Adapted from Odunuga et al., (2012).

Table 4: Ecosystem services of Plant Species

Ojota- Maryland Wetland			
S/N	**Scientific Name**	**Common Name**	**Ecosystem Services**
1.	Carica papaya	Pawpaw	**Medicinal uses**: **Leaves**- used in treatment of ailments such as dengue fever and menstrual pain **Fruit**- laxative and remedy for indigestion **Seed**- used for liver detoxification and treatment of ailments such as pile and typhoid **Latex**: used in intradiscal injection and lowering of blood pressure **Roots**- cure for urinary ailments, dyspepsia and worm expeller **Culinary uses**: **Leaves**- used as meat tenderiser **Latex**- used as meat tenderiser **Cosmetics uses**: **Peel**- sunscreen, anti-dandruff and smoothing salve **Latex**- used in shampoo and face lifting operation **Industrial uses**: **Latex**- used for the treatment of commercial beer in the brewery industry; used for de-gumming of natural silk in the textile industry
2.	Luffa cylindrica	Sponge Gourd/Vegetable Sponge	**Medicinal uses**: - Natural remedy in the treatment of degenerative disorders such as inflammatory disorders and liver diseases **Nutritional/Dietary uses**: -Eaten as edible vegetable **Domestic uses**: -Used as bath and kitchen sponge, shoes mats **Wastewater treatment**: -Serves as adsorbent for removal of heavy metals; Serves as immobilisation matrix for plant, algae, bacteria and yeast **Other uses**: -Packing and sound-proof linings
3.	Ipomoea involucrata	Morning Glory Weed	**Medicinal Uses**: **Sap**- stimulant and remedy for gonorrhoea **Leaves**- treatment of jaundice, localised oedema, filarial infection, headache and dysmenorrhoea
4.	Mariscus alternifolius	Mother Grass	**Medicinal Use**: -Treatment of gonorrhoea **Culinary use**: -Rhizome edible after cooking
5.	Ficus Specie	Figs	**Medicinal uses**: -Treatment of ailments such as gastrointestinal problems, asthma, diarrhoea, haematuria
6.	Eclipta prostrata	False Daisy	**Medicinal uses**: -Treatment of asthma, body pains, bronchitis and pneumonia, burns, gingivitis
7.	Sacciolepis africana	Purple Swamp Grass	Animal forage
8.	Amaranthus spinosus	Thorny Amaranth	**Medicinal uses**: -Used as anti-inflammatory, anti-malarial, anti-bacterial, anti-diuretic and anti-viral agent **Nutritional/Dietary uses**: -Serves as vegetable and grains in human nutrition, used forage for livestock

9.	Thuja Specie	Giant Cedar	**Construction uses**: -Manufacture of shingles and deck boards, construction of canoes, furniture, ceiling panelling, roof tiles, interior walls **Other uses**: -Ornamental trees, guitar sound boards
10.	Musa sapientum	Banana	**Nutritional/Dietary uses**: -Consumed as desert, vegetable and made into various confections **Energy use**: -Peel used in the making of banana charcoal
11.	Elaesis guineensis	African Oil Palm	**Industrial uses**: -Fatty acid derivative used in the production of bactericides, cosmetics, pharmaceuticals and water treatment products; - Used as oleochemicals in the production surfactants, personal care products, cosmetics, agrochemicals, lubricant grease, toilet soap, industrial cleansing, printing ink, polyols and polyurethane; -Biomass (oil palm shells, mesocarp fibres, empty fruit bunches from mills, oil palm fronds and oil palm trunks from field during replanting) serves as raw materials for medium density fibre board, particle board, pulp and paper, plastic composites, bio-compost, used as animal feed, fertilizer, briquettes and feedstock for the production of biodiesel **Culinary uses**: Used as cooking and frying oil and production of shortenings, margarine and confectionary fats
12.	Rhizophora racemosa	Red Mangrove	**Environmental Protection/Habitat Provision**: Shoreline protection; enhancement of near shore environments; soil stabilisation; provides wind break along coastal margins; serves a habitat for a wide range of terrestrial and arboreal wildlife; serves as part of the life cycle of many fish species; plays host to marine species such as periwinkle (Tympanotonue fuscatus), Oysters (Crassostrea gasar), Swimming Crabs (Callinenectes Specie), Cockles (Anadara senilie), Whelk (Thais coronta), and Clams (Tagelus adansornia) **Medicinal uses**: Used for the treatment of angina, boils, and fungal infections, leaves and barks are used as antiseptic and in the treatment of diarrhoea, dysentery, fever, malaria and leprosy **Construction uses**: Used for structural components of traditional houses, cabinet works, tool handles, boat anchors and raft making **Other uses**: Used as animal fodder; wood is used as fishing stakes, spears, copra huskers to use as a source of chips for pulp production; bark and hypocotyls are used to make tannin or dye used in the tanning of leather
13.	Avicennia nitida	Black Mangrove	**Medicinal uses**: Bark and leaves are used as a cure for thrush; Resins and seeds are used in the treatment of tumours and ulcers
14.	Cyperus articulatus	Jointed Flatsedge/ priprioca	**Medicinal use**: used as abortifaciant, anti-convulsant, anti-epiletic, antivenin, carminative and contraceptive **Other uses**: Pest control and insect repellent

15.	Cyperus papyrus	Papyrus Sedge, Paper reed, matting plant, Nile Grass	Used in the production of ancient writing material; useful in wastewater treatment, roots used as food, fuel and making of utensils, culms or stalks used in early architecture for shelter, boats, sails, mats, baskets, clothes, sandals, cordage, food , incense, medicinal ash; flowering heads used as garlands
16.	Paspalum vaginatum	Seashore Paspalum, Biscuit Grass	Used for sand dune stabilisation and erosion control in environmentally sensitive sites; wetland restoration and site reclamation on oil and gas well sites; commercial and residential landscaping and sports turf; bioremediation of unproductive soils and forage for cattle and horses
17.	Achrosticum Specie	Golden Leather Fern	**Medicinal uses**: Used as antihelmintic and stypic in traditional medicine; used as worm remedy and astringent in haemorrhage
18.	Marsilea Specie	European Water Clover	**Medicinal uses**: Relieves ailments like hypertension and infantile diarrhoea **Nutritional/Dietary uses**: Bread making and other culinary uses
19.	Cyclosorus Specie	None	**Medicinal uses**: Treatment of ailments like cough, malaria, sores and burns **Other uses**: Used as soap and sponge substitute
20.	Ceratopteris Specie	Water Sprite/Water Lettuce,	Fronds are used as vegetable
21.	Pandanus candelabrum	Pandanus Palm/Screw Pine/Pandan	**Medicinal uses**: **Bark**- used in the treatment of sore throat, diarrhoea, dysentery and enteritis **Leaves**- used in making mats, oil prepared from young leaves used in treating burns **Roots**- treatment of Leucorhoea, abbess, oedema and prevention of miscarriage **Other uses**: **Fibres**-used in making cords and brushes
22.	Raphia hookeri	Raffia Palms	**Leaves**- used for shelter **Stem**- produces palm sap which is drank as beverage **Trunk**- serves as firewood **Ripe Mesocarp**- yields edible oil
23.	Phoenix reclinata	Wild Date Palm, Senegal Date Palm, Swamp Date Palm, False Date Palm	**Construction uses**: **Trunk**- serves as poles for buildings **Leaf Rachis**- wattle for constructing mud houses **Leaflets**- used for building ties **Leaves**- used as door entrance and covers **Other uses**: **Leaf Rachis**- used as fish traps and hand brooms **Leaves**- serves as fans for stoking fires and fanning insects, sleeping and prayer mats, ornamentation **Leaflet**s- used for protecting or curing diseased mango trees **Roots**- used as insect larvae for fishing

Table 5: Fish Species within Ogudu Creek

Family	Species	Common Name
Cichlidae	Tilapia dageti	-
Cichlidae	Tilapia mariae	Spotted Tilapia
Cichlidae	Sarotherodon melanotheron	Blackchin Tilapia
Cichlidae	Chromidotilapia guentheri	Gunther's cichlid/ Gunther's Mouthbrooder
Mugilidae	Liza falcipinnis	Sicklefin Mullet
Eleotridae	Kribia Kribiensis	-
Citharinidae	Citharinus latus	Moon Fish
Monodactylidae	Psetias sebae	-
Mochokidae	Synodontis ocellifer	Ocellated Synodontis
Bagridae	Chrysichthys aluuensis	-
Elopidae	Elops lacerta	West African Lady Fish

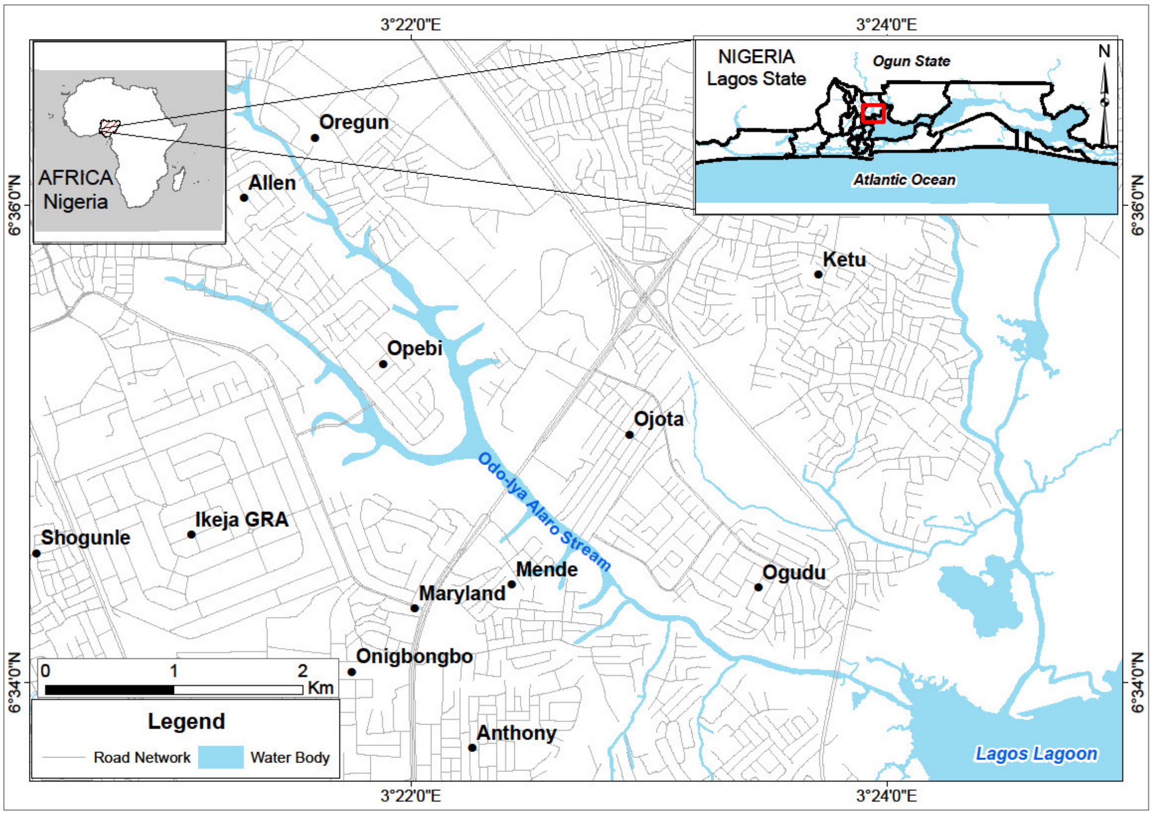

Fig 1: System I Drainage Area of Lagos Metropolis.

Fig 2: Cultivation of Plumed Cock's Comb at Mende, Maryland Wetlands.

Fig 3: Blackchin Tilapia from Ogudu Creek.