EFFECTS OF ANTHROPOGENIC ACTIVITIES ON VEGETATION OF KWANDE LOCAL GOVERNMENT AREA, BENUE STATE, NIGERIA

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ABSTRACT

Effects of anthropogenic activities on vegetation cover of Kwande Local Government Area was carried out to determine the land used and land cover changes of the study area over the period of 33 years. The study made use of mostly secondary data from pre-existing satellite imageries. The Landsat TM for 1988, Landsat ETM+ for 2009 and 2021 as well as OLI for 2019 images were sourced from the Earth explorer platform from United States Geological Surveys (USGS), Global Land Cover Facility (GLCF) and GloVis. Images were subjected to various image processing techniques and supervised classification was carried out on the various images using Idirisi ArcGIS10.1. Six classes—forest area, agricultural area, built up area, Bare land, grassland/herbaceous cover and water body—were produced by the classification. The trend of LULC in Kwande LG A revealed that built up areas increased considerably from 6.20% in 1988 to 21.31% in 2021. Grass land noticeably increased from 28.46% in 1988 to 31.57% in 2021. Water body increased from 0.74% in 1988 to 1.15% in 2021. Forested area decreased from 19.26% in1988 to 9.18%in 2021. Agricultural areas on the other hand decreased from 37.98% in 1988 to 29.55% in 202. The magnitude of land use and land cover change throughout the course of the 33-year period revealed that built up increased by 645.08 Sq. km, grass land increased by 93.77 Sq. km and water bodies increased by 12.39 Sq. km within 33 years' period. Forested area decreased by -305.27 Sq. km, agricultural area also decreased by -277.89 Sq. km, bare land area lost during that time was -3.31 Sq. km to other land uses. The loss of naturally forested areas in Kwande Local Government Area was linked to anthropogenic activities resulted from increased in population of the area.Sustainable agriculture, reafforestation were recommended for the area to restore the lost vegetation.

INTRODUCTION

According to FAO (2018), forests are crucial for sustaining human life, sustainable agriculture, resilience, renewable energy, adaptation to and mitigation of climate change, and water cycle regulation. According to reports, the ecological and economics services that forests provide assist more than 2.5 billion people who practice subsistence farming globally (FAO 2018). Despite all of the advantages of forest, land use and land cover (LULC) change is the primary cause of the unparalleled degradation of the world's forests and their resources. Land use and land cover (LULC) change has been considered by many scholars as one of the most important threat to

forest conservation and existence (Sala *et al.,* 2000; Haines-Young, 2009; Sodhi and Ehrlich, 2010; Jande *et al.,*2018) Anthropogenic factors are increasingly being recognized as critical factors influencing global land use and land cover change (Nagendra *et al*., 2003' FAO, 2016). FAO (2018) revealed that Nigeria had lost about 409,700ha of forestland each year, within a period of ten years, from 1990 to 2000. This represented an annual deforestation rate of 2.38% within that period. Between 2000 and 2005, Nigeria again lost 55.7% of her primary forest making it the country with the highest rate of deforestation in the world within the period under review (FAO, 2010). The rate of deforestation in Nigeria is now pegged at between 250,000-350,000ha or 3.5% per annum according to the FAO (2020) world forest report. According to Adeola (2004), the geometric increase in human population has led to a matching rise in demand for land and wood products, which has put pressure on Nigeria's forest estates. The situation is getting worse because the cost of alternative energy sources is continuing to rise, making them unaffordable for many people, who now turn to using charcoal and fire wood as inexpensive energy sources. The country's high degree of insecurity is making matters worse since it is forcing many remaining forest guards to abundant their stations out of fear for their safety, leaving forest resources vulnerable to encroachers. Sunday *et al*. (2018) state that the nation "may be setting the stage for catastrophic consequences on its flora and fauna unless conscious steps are taken to replenish the country's scalping forest cover, and return to the old culture of forest reserves." Therefore, it has become a top priority for academics and policymakers worldwide to monitor and mitigate the detrimental effects of LULCC while maintaining the production of necessary resources (Ellis and Pontius, 2011). Therefore, the purpose of this study was to track and quantify how human land use changes are affecting Kwande Local Government Area's forest resources.

MATERIALS AND METHODS
Study Area
Kwande has an area of 2,891 km² and a population of 248,697 as at the 2006 Census.

The study area lies between latitude $6^0.80'10"$ and $6^053' 24.15"$ N and longitude $9^0.4702'$ E, at an elevation of 86.02m above sea level. It is bordered by several other LGAs. On the west, it is bordered by Vandeikya LGA, Ushongo LGA on the north, and Katsina-Ala LGA on the northwest. On the south, it is bordered by Cross River State and in the south east by the Republic of Cameroon. Kwande LGA also shares a common border with Takum LGA of Taraba State on the east. It has fifteen council wards but sixteen traditional districts. (N P C 2006).

Kwande Local Government Area has a weather that is marked by a single rainy season April-October with an average rainfall range 1500-1750mm and dry season November - March (Nyiatagher *et al* 2019). The mean temperature range is 31 to 38^0C. As a result of its mountainous nature and proximity to the Cameroonian range of mountains, Kwande Local Government Area usually has cold weather which makes it very conducive to traders and investors. The local Government also has big streams (Amile u tamen and Amile u kiliki) among others which could adequately take care of agricultural and industrial needs. The vegetation of the area is that of Guinea Savanna, made of giant annual and perennial grasses and some tree species to include; red mortar wood, locust beans plant, mahogany, red ironwood, shear butter plant, black plum etc. Arable land in Kwande LGA is estimated to be 292,300 hectares (FAO 2020).

The LGA is predominately rural with an estimated 80 percent of the population engaged in rain-fed subsistence agriculture and is popularly known as the "Ancestral Home of Tiv Nation". Cereal crops like sorghum and maize are produced in abundance. Roots and tubers produced include yam, cassava, sweet potato and cocoyam. Oil seed crops include pigeon pea, soybeans and groundnuts while tree crops include citrus, mango, oil palm, guava, cashew and pawpaw. Other crops commonly grown include pepper, tomato, ginger, okra etc. Livestock such as goats, pigs and poultry are reared in the Local Government at small-scale and medium scale levels.
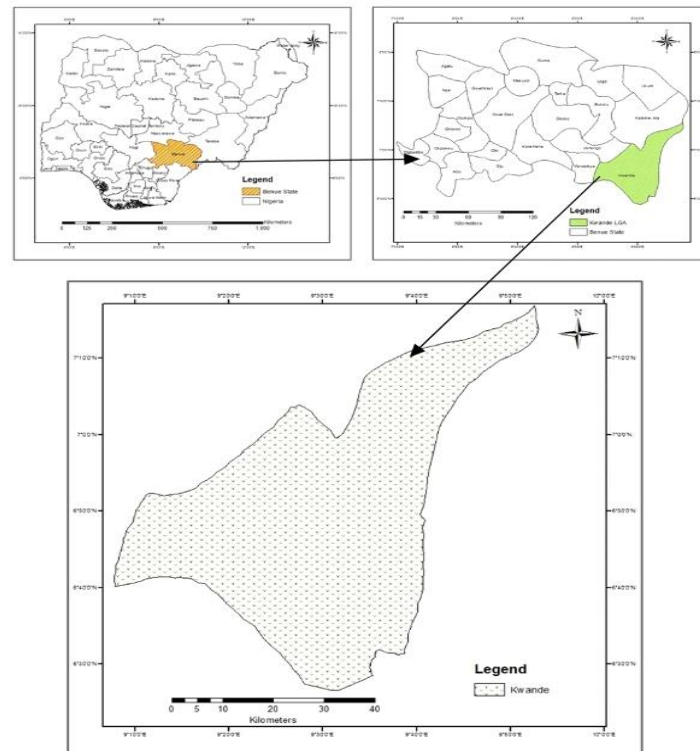
Figure1: Map of Kwande Local Government Area, Benue State

Data Source and collection

Satellite images were prepared, processed, classified and interpreted using appropriate computer software such as Idirisi and ArcGIS10.1 for GIS analysis and classification of Landsat images, Microsoft Excel used for statistical analysis for calculation of percentages and Global Positioning System used for picking coordinates (Table 1). In order to examine the nature of Land Use/Land Cover changes of Kwande LGA, three (3) multi-date Landsat satellite imageries; Thematic Mapper (TM+) of 1988, Enhanced Thematic Mapper (ETM+) 2009 and Operational Land Imager (OLI) of 2021 were used. (table 2) The study area was extracted from the scene, and a supervised classification method was carried out based on level 1 classification scheme of Anderson *et al.* (1976). It was used to classify

the identified land use and cover categories of the study area. Six land use and land cover features were used for the study (i.e., built up areas, forest, grass land, agricultural land, bare surface/rock outcrops and water bodies). Four basic pre – processing operations were used namely; image reconstruction, used to extract area of interest from the general satellite scene, image enhancement, used to improve visual interpretation by increasing apparent contrast among various features in the image. Radiometric correction was used to correct the sun elevation performed on the raw data. A band combination of 2,3,4 was used for 1988 and 2009 images while 3,4,5 combinations was used for the 2021 Landsat 8 (OLI) because it produces superior results due to the sensitivity of band 4 and 3 to vegetation cover and sensitivity of band 4 to water contents (Robert, *et al* 2009).

Table1: Software Components of the Research

S/N	Software	Purpose
1	Idrisi & ArcGIS 10.3	GIS analysis & classification of the Landsat images
2	Microsoft Excel	Statistical analysis for the calculation of percentage
3	Global Positioning System	For picking geographic co-ordinates

Table 2: Characteristics of Landsat Images Used for Kwande LGA

Date of Acquisition	Sensor	Path	Row	Multispectral Band	Thermal Band	Spectral Range (micrometers)	Spatial Resolution (pixel spacing)	Source
1988	TM	190	56	1to5 & 7	6	10.45-12.45	30	
2009	ETM+	190	56	1to5 & 7	6	10.45-12.45	30	USGS
2021	OLI and TIRS	189	56	1to7 & 9	10 & 11	10.60-12.51	30	

RESULTS

Land use practices and land cover pattern of Kwande Local Government Area. The classified Landsat image of Kwande LGA for 1988 (Figure 2). Land use practices and land cover pattern of Kwande Local Government Area. The classified Landsat image of Kwande

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LGA for 2009 (Figure 3). Land use practices and land cover pattern of Kwande Local Government Area. The classified Landsat image of Kwande LGA for 2021 (Figure 4). LULCC comparison among the various classes presented in (Figures 5)
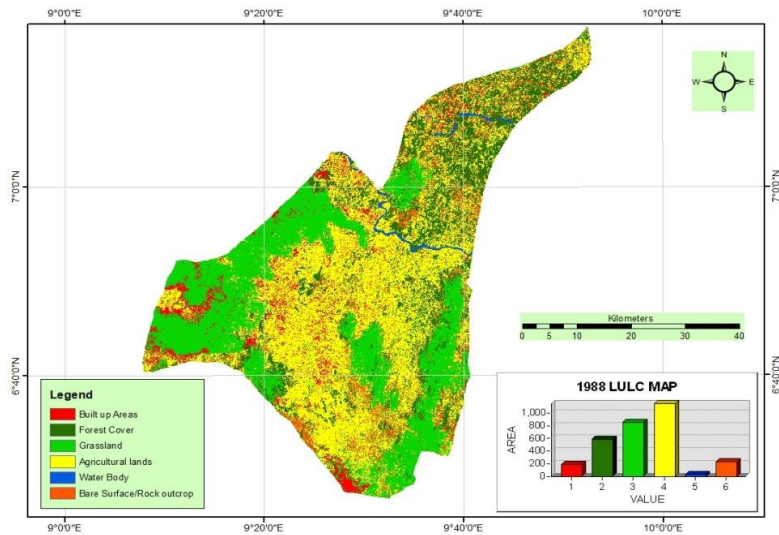

Figure 2: Classified Kwande 1988 Land use and Land Cover Map Generated from Landsat showing LULCC Classes.
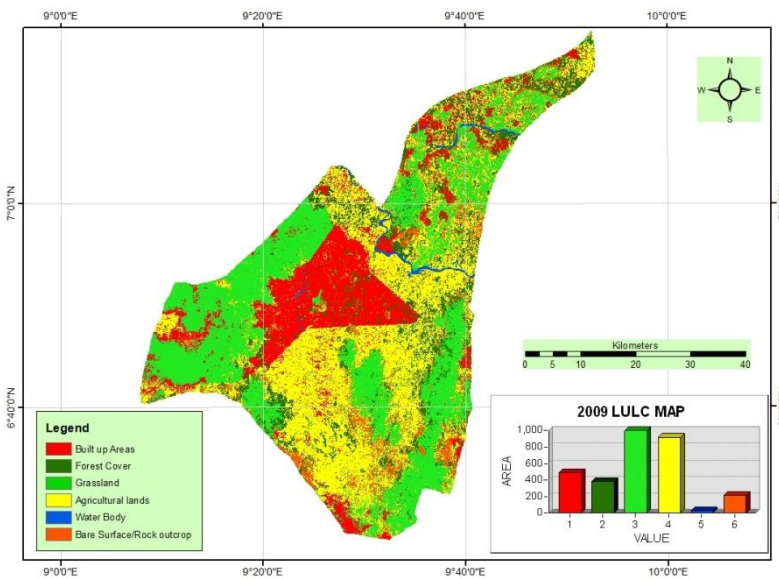

Figure 3: Classified Kwande 2009 Land use and Land Cover Map Generated from Landsat Showing LULCC Classes
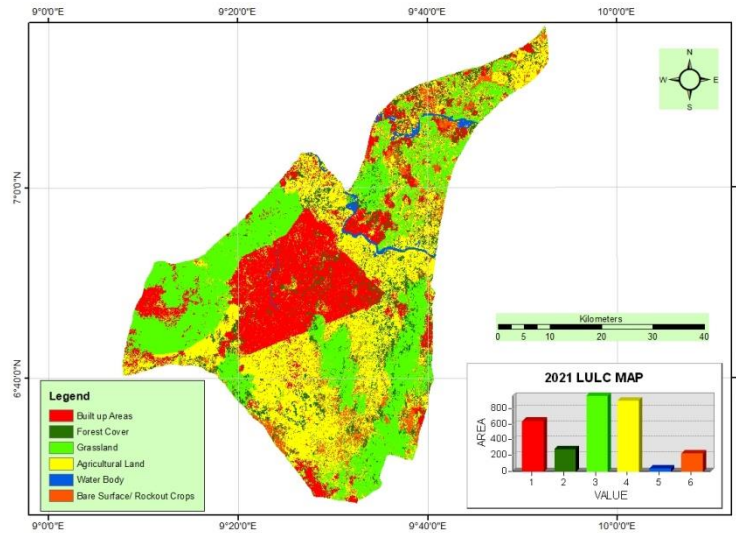
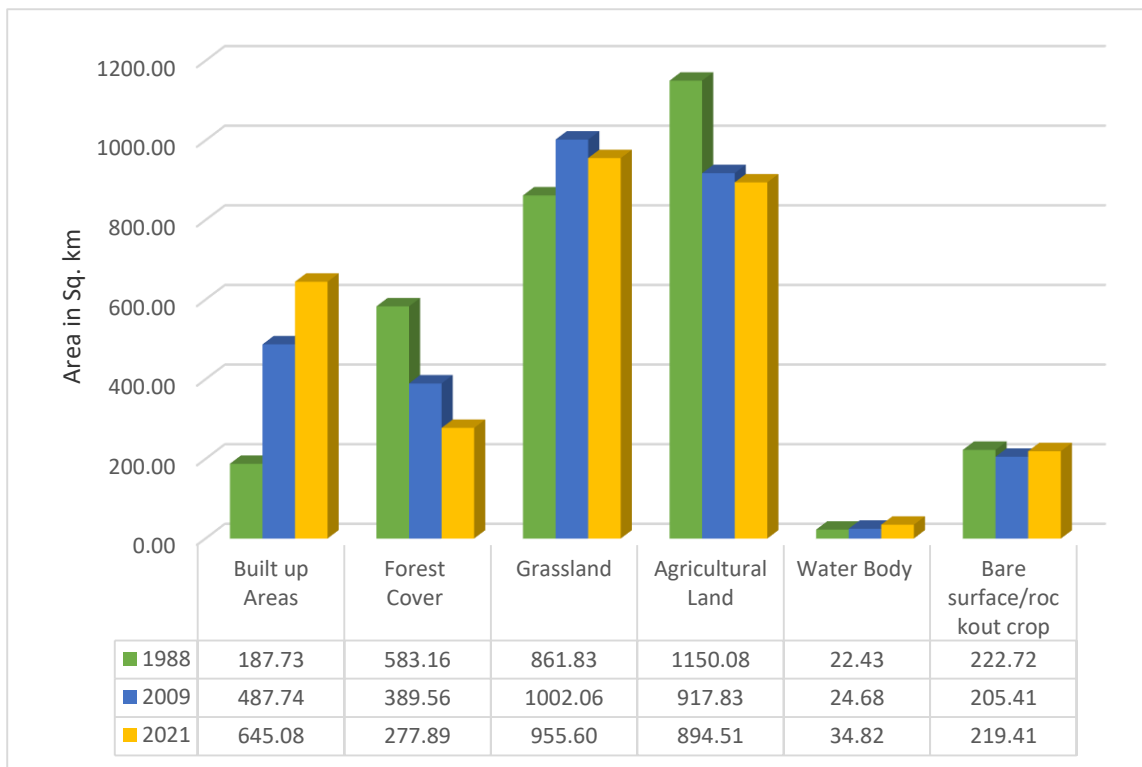**Figure 4: Classified Kwande 2021 Land use and Land Cover Map Generated from Landsat 8OLI Showing LULCC Classes**

	Built up Areas	Forest Cover	Grassland	Agricultural Land	Water Body	Bare surface/roc kout crop
1988	187.73	583.16	861.83	1150.08	22.43	222.72
2009	487.74	389.56	1002.06	917.83	24.68	205.41
2021	645.08	277.89	955.60	894.51	34.82	219.41

Figure 5: Land Use and Land Cover comparison chart among the various classes

Trend of LULC Changes in Kwande LGA in 1988, 2009 and 2021

For the various anthropogenic activities in the study area to be determined with in the period of concern (33 years) 1988-2021: Total land use, land cover types were tabulated to show the changes that occur for each land use category. These classes included: Built up areas, Agricultural lands, Grass lands,Forest land, Water bodies, Bare surfaces/rock outcrops. It is

seen that in 1988, the LULC map of the study area showed Agricultural lands to cover 1150.08 sqkm (37.98%) of the total area. Grass land covered 861.83sqkm (28.46%) of total area. Forest covered 583.16 sqkm by the year 2009 in 21 years' time, the result indicated that grass land was the dominant land use covered 1002.06 sqkm (33.10%) it increased by 140.23sqkm (4.64%) when compares to 1988. Agriculture land decreased from 1150.08sqkm

in 1988 to 917.83 sqkm losing 232.25 sqkm. Within the period of 21 years; Built up areas increased to 300.01sqkm against 187.73sqkm in 1988.Water body reduced from 22.43sqkm to 2.24sqkm in 2009.Bare surfaces decreased from 222.72sqkm to 17.31sqkm by 2009. By 2021 (12 years' interval) built up areas were the greatest with 645.08 sqkm as against 487.74 sqkm in 2009.Forest cover decrease from 389.56 sqkm in 2009 to 277.89 sqkm in 2021.Grass land decreased from 1002.06 in 2009 to 955.60 sqkm in 2021.Farm land decreased from 917.83 sqkm in 2009 to 894.51 sqkm in 2021 (*Table 3*).

Table 1: Trend of LULC changes in Kwande in 1988, 2009 and 2021

LULC Class	1988		2009		2021	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)
Built up	187.73	6.20	487.74	16.11	645.08	21.31
Forest Area	583.16	19.26	389.56	12.87	277.89	9.18
Grassland/Herbaceous cover	861.83	28.46	1002.06	33.10	955.60	31.57
Agricultural area	1150.08	37.98	917.83	30.32	894.51	29.55
Water bodies	22.43	0.74	24.67	0.81	34.82	1.15
Bare Surface	222.72	7.36	205.41	6.79	219.41	7.25
Total	3027.95	**100**	3027.27	**100**	3027.31	**100**

Trend Analysis of Forest decline in Kwande LGA

The period under review was divided in (3) sections to cover from 1988-2009, 2009-2021 and then, the entire period 1988-2021. Magnitude of change was determined for each section (1988-2009, 2009-2021 and 1988-2021). Magnitude of change was also determined for every land use class or category yearly as shown in table 5, 6 and 7. Trend analysis of forest decline was carried out for the base year (1988) to the reference year (2021). In the base year (1988) forest cover stood at 19.26%. After 21 years (from 1988-2009) forest declined to 12.87% (fig.6). At the reference year (2021) it further decreased to 9.18%. All these periods this forest cover was been converted to other land use categories due to increased population in the study areas.
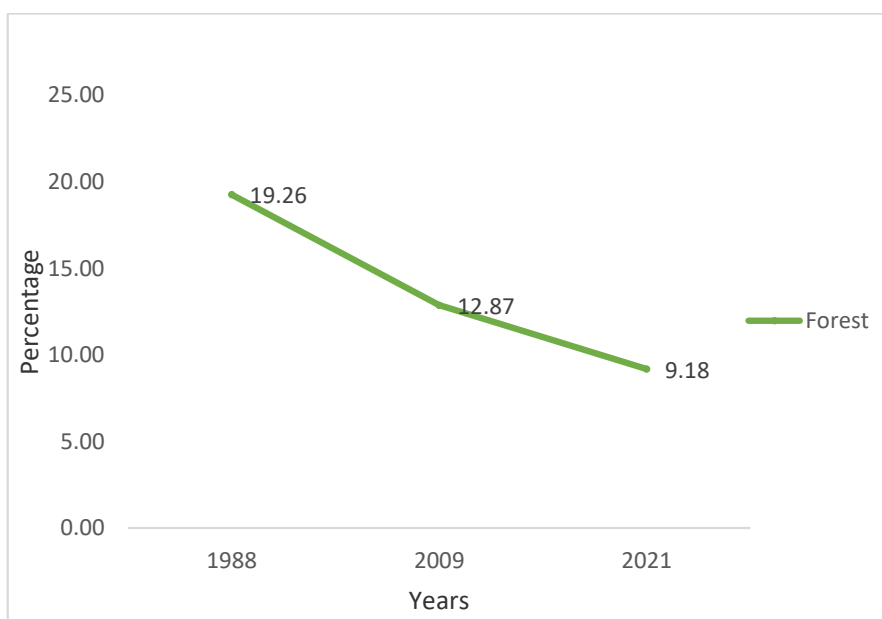

Figure 6: Trend Analysis of Forest decline in Kwande LGA

Magnitude of Land Use/Land Cover Change between 1988 and 2009

The magnitude of forest change for 21 years between 1988 to 2009 showed that forest decreased by -193.60 Sq. km representing a change (33.10%) of the total change for the period (table 4). Forest had an annual rate of change of -1.58%, Agricultural land decreased by -232.25 Sq. km representing a change (20.19%) with annual rate of change of -0.96%

Similarly within the same period bare land decreased -17.31 Sq. km representing a change (7.77%) with annual rate of change of (-0.37%). On the other hand, built up area increased by 300.01 Sq. km representing 159.0% gain with annual change rate of 7.61%, additionally, Grass land increased by 140.23 Sq. km representing (16.27%) gain with annual change rate of (0.77%).

Table 4: Magnitude and Percentage of Change in Land Use/Land cover between 1988 to 2009

LULC Class	1988 Extent (Sq. km)	2009Extent (Sq. km)	Magnitude of Change (Sq. km)	Percentage of Change %	Annual Rate of Change %
Built up	187.73	487.74	300.01	159.80	7.61
Forest	583.16	389.56	-193.60	-33.10	-1.58
Grass land	861.83	1002.06	140.23	16.27	0.77
Farm land	1150.08	917.83	-232.25	-20.19	-0.96
Water body	22.43	24.67	2.24	9.99	0.48
Bare Surface	222.72	205.41	17.31	-7.77	-0.37
Total	3027.95	3027.95			

Magnitude of Land Use/Land Cover Change between 2009 and 2021

The forest area decreased continuously over the following 12-years period from 2009 to 2021, with a decrease of -111.67 Sq. km, or 28.67%, though it was lower than the 33.10% recorded from 1986 to 2009 (Table 5). During that time, built-up area increased by an additional 157.34 Sq. km (32.26%) at an annual chabge rate of

2.69%. Agricultural area decreased slightly by -23.32 Sq. km representing -2.54% of the change at a rate of 0.21% annually, Bare suface also increased 14 Sq. km representing 6.82% of the change with change rate of 0.57% per year. Water body in Kwande increased by 10.14 Sq. km representing 41.08% of the change with annual increase rate of 3.42%.

Table 5: Magnitude and Percentage of Change in Land Use/Land cover between 2009 and 2021

LULC Class	2009Extent (Sq. km)	2021Extent (Sq. km)	Magnitude of Change (Sq. km)	Percentage of Change %	Annual Rate of Change %
Built up	487.74	645.08	157.34	32.26	2.69
Forest	389.56	277.89	-111.67	-28.67	-2.39
Grass land	1002.06	955.60	-46.46	-4.64	-0.39
Farm land	917.83	894.51	-23.32	-2.54	-0.21
Water body	24.68	34.82	10.14	41.08	3.42
Bare Surface	205.41	219.41	14	6.82	0.57
Total	3027.27	3027.95			

Magnitude of Land Use/Land Cover Change between 1988 and 2021

The extent of the forest's change throughout the 33-year period from 1988 to 2021 in Kwande shows that, the forest land cover was the category most impacted by land use and land cover change. Forest area loss of -305.27 Sq.

km to other land use representing 52.35% at an annual rate of 1.59% indicates that forest is fast declining in the area (Table 6). The farm land decreased by -255.57 Sq. km representing -22.22% of the change with -0.67% annual change. Bare face also reduced by -3. 31Sq.km or -1.49% at the rate of -0.05% annual change.

There was a significant increase in built-up area as it rose by 457.35 Sq.km representing 243.62% at an annual rate of change of 7.38%. Grass land also gain 93.77 sq.km or 10.88% of the area with annual rate of change of 0.33%, Water bodies increased by 12.39 Sq.km or 55.24% with annual rate of change of 1.67%.

Table 6: Magnitude and Percentage of Change in Land Use/Land cover between 1988 and 2021

Land Use/Land cover	1988 Extent (Sq. km)	2021Extent (Sq. km)	Magnitude of Change (Sq. km)	Percentage of Change %	Annual Rate of Change %
Built up	187.73	645.08	457.35	243.62	7.38
Forest	583.16	277.89	-305.27	-52.35	-1.59
Grass land	861.83	955.60	93.77	10.88	0.33
Farm land	1150.08	894.51	-255.57	-22.22	-0.67
Water body	22.43	34.82	12.39	55.24	1.67
Bare Surface	222.72	219.41	-3.31	-1.49	-0.05
Total	3027.95	3027.95			

DISCUSSION

For the various anthropogenic activities in the study area to be determined within the period of concern (33 years) 1988-2021: Human activities recorded in this study were similar to those recorded in others studies in Benue state (Jande *et al* 2018, Jande *et al.,*2018; Ikyaagba *et al.,* 2020a &b; Ali *et al.,*2021; Ikyaagba *et al.,* 2022, Jande *et al.,* 2022). The trend shows sharp decrease in forest land with increased in built up areas this was similar to the works of Ubaekwe, and Engwoh (2020) and Iortyom *et al.* (2022).

Trend analysis of forest decline was carried out for the base year (1988) to the reference year (2021). In the base year (1988) forest cover stood at 19.26%. After 33 years (from 1988-2021) forest declined to 9.18%, about 10.08% of the forest cover was lost. All these periods this forest cover was been converted to other land use categories due to increased population in the study areas. This finding also agrees with that of Jande and Amonjenu (2018) and Ikyaagba *et al.* (2020a) who said that forest decreased is largely due to population increase.

The magnitude of forest change for 21 years between 1988 to 2009 showed that forest decreased by -193.60 Sq. km representing a change (33.10%) of the total change for the period. Forest had an annual rate of change of -1.58%. This was similar to the work of Ikyaagba *et al* (2020a) in Apa Local government of Benue State and reported by Jande *et al.* (2022) in Oju within the same period. Unlike other studies (Jande *et al.,* 2018; Ikyaagba *et al.,* 2022) agricultural land was decreasing this could be due to increase in migration of the young people to urban areas which reduced farming activities in the area. On the other hand, built up area increased this increased in build-up area could be as a result of population increased. This confirmed observation of Jande and Amonjenu (2018) that natural vegetated areas in most Nigeria communities are on decrease in recent years.

The forest area decreased continuously over the following 12-years period from 2009 to 2021, with a decrease of 28.67%, though it was lower than the 33.10% recorded from 1986 to 2009. The area witness continue increase in, built-up area. Agricultural area continue to reduced. These alterations can be linked, among other things, to increased agricultural activity, build up area encroachment, fuel wood, and other uses. Ikyaagba *et al.* (2020b) and Jande *et al.* (2022) reported in Apa and Oju within the same period respectively. Interestingly, while other studies (Ubaekwe, and Engwoh, 2020) shows decrease in water bodies water body in Kwande were on increase. This increased in water body in the area is an indication of the flooding effects on the area. Similar increment in water bosy was reported by Ali *et al* (2021) and Fashae *et al.* (2022) in Benue State and Southwestern Coast of Nigeria. This increase may be attributed to the worldwide trend of sea level rise, which, on the one hand, results in more previously dry regions becoming drowned in seawater (Fashae *et al.,* 2022).

The extent of the forest's change throughout the 33-year period from 1988 to 2021 in Kwande shows that, the forest land cover was the

category most impacted by land use and land cover change. The study revealed that, over the course of 33 years, 1.59% of the Kwande's forest land was lost annually. This rate was lower than -3.53% reported by Jande iet al. (2018*)* in a Gboko, Benue State, -3.26% reported by Ali *et al.* (2021), -3.16% reported by Jande *et al.* (2022) in Oju. Contrasting to other studies in Benue state (Jande *et al.,*2018; Ikyaagba *et al.,* 2020a; Ali *et al.,*2021; Ikyaagba *et al.,* 2022) there was decreased in farm land in Kwande. Farm land in Kwande lost -255.57 Sq. km to other land uses within the period under study. This result is similar to the work of Iortyom *et al.* (2022) in Makurdi who reported decrease in agricultural area due to urbanization. There was a significant gain of land area by built-up, the built-up area gains 457.35 Sq. km of the area. The increase in built-up area was largely due increase in population and most of the areas are now turn in to residential area. This agreed with submission of Ogunmola *et a*l., (2014) and Jande *et al.* (2018) who asserted that rapid population growth, has remained the major factor that has prompted and continued to stimulate environmental resources degradation. This is in line with Carr, (2004) who observed that rapid population growth has caused many environmental problems which has escalated deforestation and loss of vegetation in urban fringes. As population increases, more land is needed for farming, building of houses and other construction, less is left to forest or fallow. The implication of this is that Kwande forest cover will in no distant future be deforested and converted to different land use land cover classes which will lead to decline in biodiversity, increased soil erosion and land degradation and habitat destruction if urgent steps are not taken to halt the ongoing forest conversion in the area.

CONCLUSION
This study reveals that land use activities have directly resulted in varying degrees of vegetation cover degradation in Kwande Local Government Area, Benue State.On an overall, these findings reveal that the study area is currently faced with forest resource degradation, a problem attributed to population explosion which result into build up area expansion and increase in other land uses over forest cover. It is therefore clear that the spatial distributions and changes in forests cover could offer interesting insights into more local-scale processes and activities that are detrimental to the ecosystem service of the area it was recommended that afforestation programmes be promoted in the area.

REFERENCES
Adeola, A.O., Ogunleye, A.J., Ojo, L.O. and Aduradola, A.M. (2004). Impact of farming activities on vegetation in Olokemeji Forest Reserve, Nigeria. *International Journal of Remote Sensing* 6: 131 - 140.

Ali, P., Shabu, T., Hundu, T. W., Nyajo, A. and Udoo, V. (2021). Land Use/Cover Change and tts Implication for Flood Events in Benue State, Nigeria. *Journal of Research in Forestry, Wildlife & Environment* 13(4): 171-181– 45.

Anderson, J.R., Hardy, E.E., Roach, J.T. and Witmer, W.E., (1976). A land-use and land-scover classification system for use with remote sensing data, United States Geological Survey Professional Paper 964, A revision of the land use classification system as presented in United States Geological Survey Circular 671, Reston, Virginia, *United States Geological Survey*, **2**(3):37-45.

Carr, D. L. (2004). Proximate Population Factor and Deforestation in Tropical Agriculture Frontiers. *Popul. Environ.* 25(6): 585-612

Ellis, E. and Pontius, R (2011). "Land-use and land-cover change". In: Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment). Retrieved March 1, 2012 from <http://www.eoearth.org/article/Land-use_and_land-cover_change>

FAO (2018). *Forest and Agriculture: Land-use Challenges and Opportunities*. Rome, Italy: Food and Agriculture Organization (FAO).

FAO (2018). The state of the World Forest. Forest Partways to Sustainable Development. Rome 1-139pp

FAO (2010). Global Forest Resources Assessment: Main report Food and Agriculture Organization of The

United Nations Forestry Paper 163 Rome, 2010.

FAO (2020). In Brief to The State of the World's Forests 2022. Forest pathways for green recovery and building inclusive, resilient and sustainable economies. Rome, FAO. https://doi.org/10.4060/cb9363en

Fashae, O.A., Tijani, M.N., Adekoya, A.E., Tijani, S.A., Adagbasa, E.G.and Aladejana, J.A. (2022). Comparative Assessment of the Changing Pattern of Land cover along the Southwestern Coast of Nigeria using GIS and Remote Sensing techniques. *Scientific African* Volume 17, e01286

Haines-Young, R. (2009). Land use and biodiversity relationships. *Land use policy*, *26*, S178-S186.

Ikyaagba, E.T, Jande, J.A and Eche, A. P (2020b)**.** Impact of Land-Use Practices on Vegetation Cover in Apa Local Government Area, Benue State, Nigeria. *International Journal of Research in Agriculture and Forestry* (7), (1), 1-9

Ikyaagba, E.T., Jande, J. A. and Abiem, M.K. (2020a). Effects of Land use and Land cover Change on Tse Gavar Community Forest, Vandeikya Local Government Area, Benue State, Nigeria. *East African Journal of Forestry and Agroforestry,* 2 (1): 34-46.

Ikyaagba, E.T.,Tee, T.N., Jande, J.I., Ancha, P.U., Igbaukum. E. Usuah, Z, A. (2022). Effects of Land Use and Land Cover Change on Agan Plantation, Makurdi Benue State, Nigeria. Securing the Nigeria's Forest Estates for Sustainable Development Ogunsanwo, O. Y., ,Adewole, N. A., Oni, P.I. and Azeez, I.O. (Ed*) Proceedings of the 43ʳᵈ Annual Conference of the Forestry Association of Nigeria* Held in Akure, Ondo State, Nigeria. 14ᵗʰ -18ᵗʰ March, 2022; 376-389pp

Iortyom, E.T., Semaka, J.T. and Kargbo, P. (2022). The Effect of Urban Expansion on Peripheral Agricultural Lands in Makurdi City. *European Journal of Development Studies* 2(4):100-108

Jande, J. A., Ido , G. O and Ikyaagba, E.T. (2022). Extent of Urbanization Impact on Forest Resources in Oju Local Government Area, Benue State, Nigeria. *Journal of Global Ecology and Environment* 14(2): 39-50

Jande, J. A., Nsofor, G. N. and Mohammed, M. (2020). Prediction of Land Use Change in Katsina-Ala through a Geospatial Approach. Journal of Agriculture and Sustainability 13(18): 1-39

Jande, J. A., Kwaghkohol, G. T., amd Ikyaagba, E. T. (2018). Assessing the Status of Yandev Forest Reserve Using Remote Sensing and Geographic Information System (GIS) Techniques. *Asian Journal of Research in Agriculture and Forestry*, 2(2), 1-13.

Jande, J.A. and Amonjenu, I.O. (2018). Land use/land cover change detection mapping of Apa local government area, Benue State, Nigeria. *Journal of Research in Forestry, Wildlife and Environment*. 10(3):69 - 80.

Nagendra, H., Southworth, J. and Tucker, C. (2003). Accessibility as a determinant of landscape transformation in Western Honduras: linking pattern and process. *Landscape Ecology.*18: 141 - 158.

NPC (2006): National Population Commission, 2006 National Population Census.

Nyiatagher, Z.T, Abiyong, P.A, and Aniah, N.U. (2019) Crop Diversification among Rural Farm Housedholds in Kwande Local Government Area of Benue State. **4**(5): 1308-1314.

Ogunmola, J.K, Gajere, E.N, Jeb D.N, and Agene I.J. (2014) Study of Land Cover Change in Yelwa- Heipang area of Plateau State, North- Central Nigeria: A geoinformatics approach. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume **XL**-1,2014 ISPRS Technical Commission I Symposium, 17 – 20, Denver, Colorado, USA.

Robert, C, Frohn Molly, R., Charles L., and Autrey. B. (2009). Satellite Remote Sensing of isolated wetlands Using Object-Oriented Classification of Landsat-7 data. *Remote Sensing of the Environment,* 79,213 - 224.

Sala, O. E., Chapin, F. S., Armesto, J. J., Berlow, E., Bloomfield, J., Dirzo, R.,

Amagu et al., 2023

Huber-Sanwald, E., Huenneke, L. F., Jackson, R. B., Kinzig, A., Leemans, R., Lodge, D. M.,Mooney, H. A., Oesterheld, M., Poff, N. L., Sykes,M. T., Walker, B. H., Walker, M. and Wall, D. H. 2000. Biodiversity—global biodiversity scenarios for the year 2100. *Science* 287:1770–1774.

Sodhi, N. S. and Ehrlich, P. R. (2010). *Conservation Biology for All.* Oxford: Oxford University Press UK.

O. and Akpeji, C. (2018, September 16th). *Experts alert on depletion of forest resources*. Retrieved from Guardian, available at https://guardian.ng/news/experts-alert-on-depletion-of-forest-resources/.

Ubaekwe, R.E. and Engwoh, I .M. (2022) Assessment of Impact of Land Use and Land Cover Change on Vegetation Cover of Ikorodu Lagos State, Nigeria. Adekunle, V.A.J. *et al.* (Ed) proceedings *of the 42nd Annual Conference of Forestry Association of Nigeria* held in Ibadan 23rd-28th November, 2020. 750-761pp

Sunday, E., Akutu, G., Akpan, A., Akingboye,