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Geospatial Assessment of the Spatio-Temporal Land Cover ChangesinIwoLocalGovernment Area,OsunState.

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ABSTRACT: This research focused on the geospatialassessment ofthe spatio-temporal land cover changes inIwolocalGovernmentAreaOsunState,Nigeriawithaviewtomonitoringtherateofurbanization in order to aid the sustainable development.Medium resolution satellite images-Landsat 8 Operational Land Imager (OLI) of year 2015 & 2020, Landsat 7 Enhanced ThematicMapper (ETM) of year 2000 andLandsat5 Thematic Mapper(TM) of 1985 wereacquired forthe study. With the help of ArcGIS 10.5 software, the area of interest (AOI) from images wereobtained pre-processed and enhanced to restore and rectify them, and increase their resolution forgood quality interpretation. The images were thereafter subjected to supervised classificationalgorithm into forest, grass land, shrub, built-up, water body and barelandland cover classes.Pixel oriented image analysis was performed on the classified imagesto assess the rate anddirection of urbanization in the study area using the built-up as the index of urbanization. Resultsobtained, revealed that forest land cover depleted continuously from 51.9% in 1985 to 24.9% in2020, while others increased- grassland (15.0% to 25.6%), shrub (16.8% to 25.7%), and built-uparea (4.9% to 10.3%). A forecast into the future shows that forest landcover is expectedtodeplete from 42.1 sq.km in 2030 to 9.6 sq. km in 2050,bare-land a decrease to 25.9 sq.km in theyear 2030and an increaseto 26.2 sq. km in the year 2050,grassland (61.4 sq. km to 76.0 sq.km), shrub (54.7 sq. km to 68.8 sq. km), built-up area (24.8 sq. km to 31.5 sq.km), water body(1.0 sq. km to 1.1 sq. km) will also experience increase. The result of the Land Use/ Land Coverserves as a good source of information for urban planners interested in sustainable developmentand agricultural investors looking for a good place to invest their money for maximum yield intheir agricultural practice. The research is highly recommended as a guide for developmentalplanning and decision on the study area such as preservation of forests in Iwo Local GovernmentArea, (as the study have shown a depletion of forests and continual depletion in the next thirtyyears);alsocheckingincessantanduncontrolledexpansion;monitoringofallindexesofurbanization.

KEYWORD: Landcover,Landuse,Monitoring,RemoteSensing,Spatial,and Urbanization.

I. INTRODUCTION

Urbanizationaccording to Ogunlade and Enisan (2016), have been considered as an essentialindicators of economic growth and development of a country. Due to inevitableincrease inpopulation, cities are observed to be growing rapidly and developing at a very speedy andsporadic manner in the past few decades. These has been adduced to the several inter- and intra-dynamics of the landcover and land use which is usually indexed through the built-up land coverand its various land use dimensions. Changes in the built-up landcover has always bear itsconsequences on other land cover viz: vegetation, bare land, water body, rocks as classified byAnderson (1976). Ogunlade (2018) observed that changes in landcover has always been a resultof the underlying land use. Thus, a study of land cover can not be separated from the study oflanduse, andstudying land use and land cover dynamics is essential in order to examine variousdevelopmental consequences of the change over a space of time. This makes land use mappingand change detection a relevant inputs into decision-making for implementing appropriate policyresponses thataffectsurbanization(FasonaandOmojola*etal.*,2005).Land usechangedetectionallows for the identification of major processes of change and, by inference, the characterizationoflandusedynamics (Ademiluyi,*et.al*, 2008).The impact of Geospatial technology on landcover assessment has been tremedous in monitoringthe environment in recent times. It has provided a fast, in-depth, all inclusive and all roundassessmentthathasyieldeduntoldresultsforenvironmentalmanagementandsustainabledevelopment.WolfandGhilani(2018)observedtherecenteraasoneofhighavailabilityandflow of geospatial information brought about by advent of computers, technology in instrument,instrumentation,techniques,methodsandmethodologies.Thesebeingthesubstanceingeospatial technology techniques. Remote Sensing and Geographic Information System (GIS)techniques are playing a leading role in the impact of geospatial technology on the modern world.Their integration provide users the ability to acquire and extract useful information for decisionand policy making fromsatellite imagery of an area of interest (AOI) without physical contactwith the area; and a supply of proper software environment for the Land use and Land covermappingandanalysisofsuchareadoneeffectivelywithlessstress,time,andofcoursecost.Theinformationacquiredfromthe integrationisofvariousbenefitsuchastohelpmonitorthe urbanexpansionwithinanarea,performsitesuitabilityanalysisforinfrastructuraldevelopment,smartplanning of an area, etc.according toDonny *et al.*,(1999)andRao,(1995). The study utilized the integration of Remote Sensing techniques to study the changes in the studyarea's environment which according to Ogunlade and Oyewole (2018) are mostly achievedthrough the landcover.The use of medium resolution satellite imagery such as Landsat satellitedata,wereadoptedbecauseaccordingtoArvidsonetal,2006arethemostwidelyuseddatatypes that have as observed by Fan, Weng and Wang (2007) and Lu Junfeng et al. (2011) yieldedgreat success in monitoring LULC changesof monitoring and mapping land cover and land usechanges. The status of the study area as the most populous Local Government in the State ofOsun, Nigeria(2006 NPC) necessitated thegeospatialassessment ofits spatio-temporal landcover changesso asto monitoritsurbanizationinordertoaiditssustainable development.

II. THESTUDYAREA

The study area, Iwo Local Government Area (Figure 1)is one of the thirty Local GovernmentAreasin Osun State Nigeria with its headquarters situated in Iwo, arich agricultural area withdistance of about 45 kilometers from Ibadan the capital of Oyo State and Osogbo the capital ofOsunState.

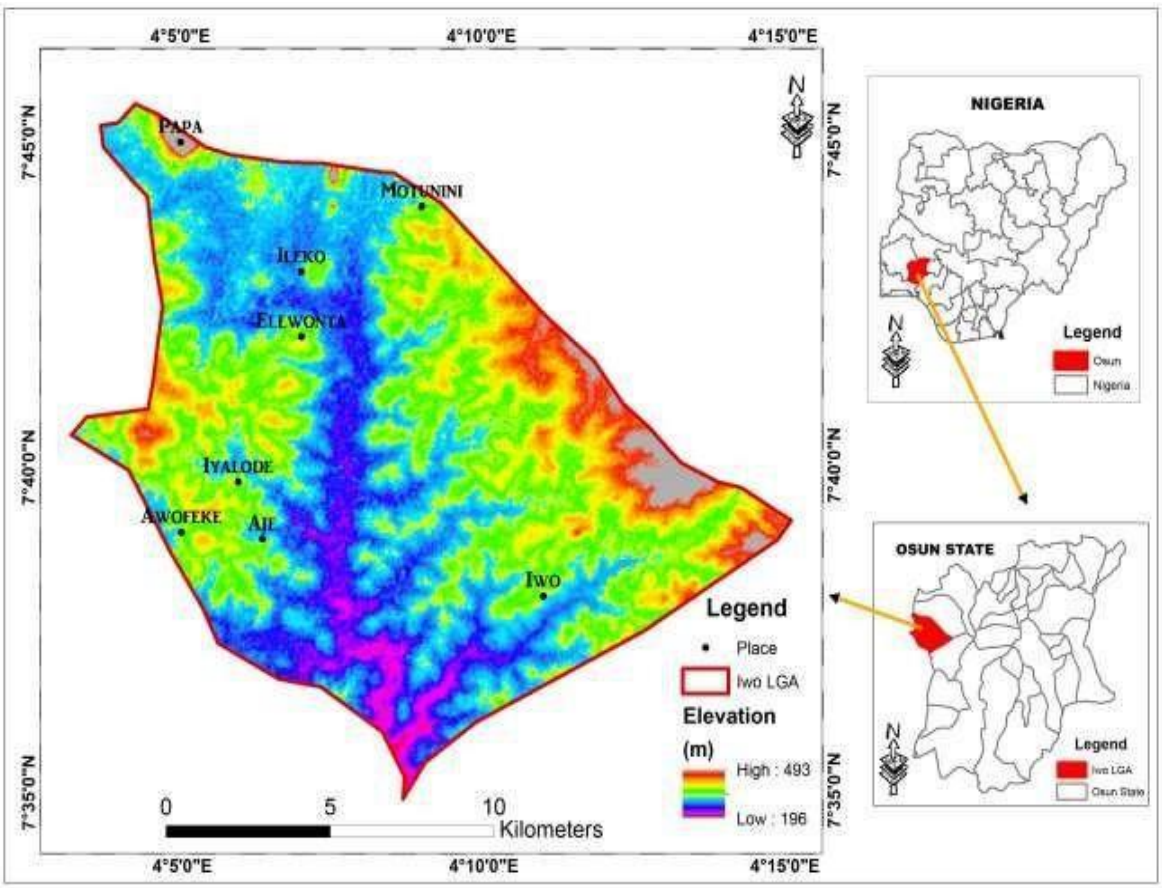

Figure1:MapofNigeria-Osun State-IwoLocal GovernmentArea

It has an area of 245km^{2}and a population of 191,348 making it one of the mostpopulousLocalGovernmentinStateofOsunby2006NigeriaNationalcensusfigures.It lies within the latitudes and longitudes (7°45'N, 4°04'E), (7°39'N,
4°15'E), (7°35'N,4°09'E),and (7°41'N, 4°03'E).

III. MATERIALANDMETHODS

Landsat satellite imagesof Iwo local government for year 1985, 2000, 2015 and 2020 and theadministrative map were acquired for the study. Table 1 is a summary of the data acquired,source,yearas well astheresolution ofthedata.Theimages of the four years 1985, 2000, 2015 and 2020 under studywere imported intoERDAS Imagine 10.3 software environment by their bands and composite images weregeneratedbycombiningbands selected asappropriatefor thestudy.Theresultantimageswerepre-processed to correct their geometric and radiometric distortions and restoring theirgeometric andradiometricquality.

Table1:DataDescription

Data	Source	Year	Resolution
LANDSAT8OLI/TIRS	UnitedStateGeologicalSurvey(USGS)	2020 & 2015	30 m
LANDSAT 7ETM+	UnitedStateGeologicalSurvey(USGS)	2000	30 m
LANDSAT 7TM	UnitedStateGeologicalSurvey(USGS)	1985	30 m
Administrativemap	OfficeoftheSurveyorGeneralof OsunState		-

The area of interest (AOI) was clipped from the images and subjected torectification. Image tomapregistrationotherwisecalledgeo-referencingoftheimageswasperformedontheimagestoconverttheimagepixelsinrowsandcolumnstocorrespondinggroundcoordinatesinEastings and Northings. Points used as controls were selected on the imagery of the study area.These points adjudged to adequately represent a good coverage of the image areawere visitedwith a differential GPS instrument and their coordinates were obtained and used for the geo-referencing. Enhancement was carried on the images to increase the resolution for goodqualityinterpretation.Pansharpening,whichistheintegrationofhigh-resolutionpanchromatic and lower resolution multispectral imagery to create a highly improved-resolution colour imagefor small was used to improve the resolution of the image output for good classification. Thepanchromatic band (band 8)Landsat 7 (ETM+) and Landsat 8 (OLI/TIRS) with a resolution of15m was used for this process.The images were processed digitally using maximum likelihoodmethodof**s**upervisedclassificationalgorithmtoclassifythepixelsbasedonthespectralreflectance into their land cover classes, so asto produce the landcover maps of the study areafor thefouryears(1985,2000,2015and2020)underconsideration.Thelandcoverclassification adopted for the study as modified from Anderson *et al.,* (1976) are bare land,grassland,forest, shrub,water body andbuilt-uparea(Table2). The purpose of the research isto monitor theurbanization in the study area for sustainabledevelopment. This necessitated a forecast into year 2030 and 2050. a prediction from the resultsofthepreviousyears wascarried outusingthelineartrendmethodinMicrosoftExcel software

Table2:Landcover classesandtheirdescriptions

BareLand	Landarealwithoutbuildingsnorvegetationcover:
Forest	Landcoveredwithtreesandwoodland,heavygreen areas..
Water	Streams,Rivers,Swampsetc.

Source:ModifiedfromAnderson*etal.*,(1976)

IV. RESULTSANDDISCUSSIONS

The resultant LULC change maps of the study area for the four years 1985, 2000, 2015 and2020were produced(Figure3).Theareal extentofeachlandcoverclassesfor thefour yearsunderstudy werecalculated(Tables3-6). Figure3isthevisualexpressionofthe changesinthelandcover ofthestudyarea.Thepatternis best explained through the tables showing the aerial extents. The tables are the numericalinterpretationofthemaps.

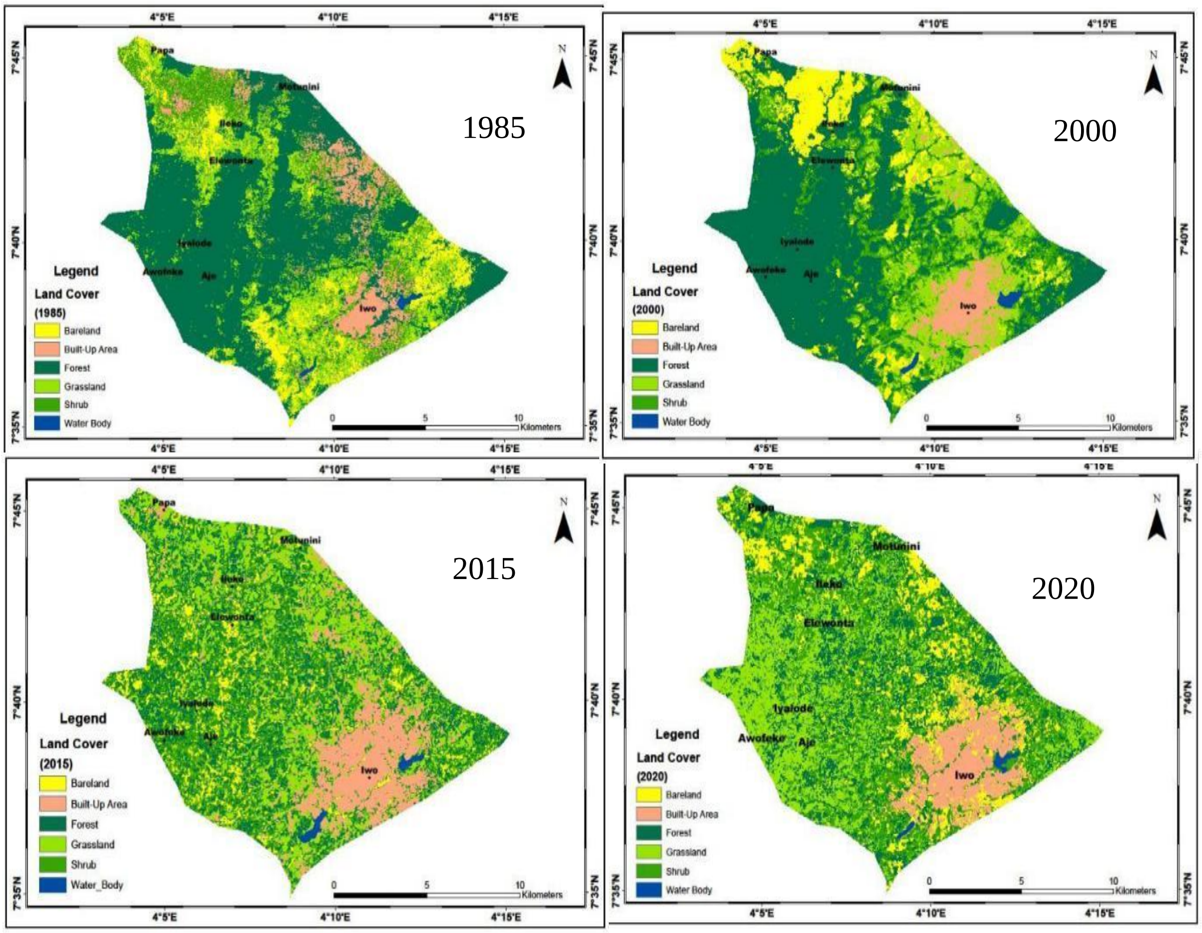

Figure3:LULCchangemapsofthe Iwolocalgovernmentareafor thefour years

Table 3: LULCclassesaerialextentin1985

S/N	Landuse	Area (km^2)	Area(%)
1	Forest	110.7	51.9
2	Grassland	32.0	15.0
3	Shrub	35.8	16.8
4	Built-UpArea	10.4	4.9
5	Bareland	23.9	11.2
6	WaterBody	0.6	0.3
	Total	**213.4**	**100**

Table 4: LULCclassesaerialextentin2000

S/N	Landuse	Area(km^2)	Area(%)
1	Forest	98.1	46.0
2	Grassland	32.9	15.4
3	Shrub	39.2	18.4
4	Built-UpArea	13.2	6.2
5	Bareland	29.0	13.6
6	WaterBody	1.0	0.45
	Total	**213.4**	**100**

Table 5: LULC classesaerialextentin2015

S/N	Landuse	Area (km^2)	Area(%)
1	Forest	69.1	32.4
2	Grassland	53.3	25.0
3	Shrub	49.2	23.1
4	Built-UpArea	19.7	9.2
5	Bareland	20.9	9.8
6	WaterBody	1.1	0.5
	Total	**213.4**	**100**

Table 6: LULC classesaerialextentin2020

S/N	Landuse	Area(k m^2)	Area(%)
1	Forest	53.0	24.9
2	Grassland	54.5	25.6
3	Shrub	54.7	25.7
4	Built-UpArea	22.0	10.3
5	Bareland	28.4	13.3
6	WaterBody	0.7	0.3
	Total	**213.4**	**100**

Observation fromtables 3-6 showed that the total areal extentmapped shown in the last rowwas 213.4 km^2. Each land cover class in the second column transformed part of the total aerialextentas recorded in the third column. The fourth column is a record of the percentage aerialextenttransformation. The Summary of the landcover change shows thatForest landcover depleted continuouslythrough out the epoch of study. The trend showed from a depletion from 51.9% in 1985 to46.0% in 2000 to 32.4% in 2015 to 24.9% in 2020 at a rate of 0.6% (1.3km^2 per year) . WhileGrassland (15%-15.4%-25.0%-25.6%), Shrub (16.8%-18.4%-23.1%-25.7%) and Built up area(4.9%-6.2%-9.2%-10.3%)increased by0.3%,0.3% and0.2%peryear respectively. Waterbody (0.3%-0.45%-0.5%-0.3%)increasedby0.01%per year till2015butdecreasedby0.04%in2020.Thesetrend arevisualized inFigure4 Thedepletionintheforestlandcover isexpectedandagreeswithOgunlade(2018) thatitisthelandcoverthatismostlyaltered inLULCtransformationforvarious landusessuchresidential, agricultural, industrial; and many other developmental indexes. Year in year out alteration offorestlandcoverhasbecomeinevitableinthestudyareafor constructions,variousdimensionoffarming, timberandwood works. Theareaisrepletewith sawmills that processforest product.Soalso, theincreaseobservedinthe rest land cover classes can beadduced to the fact that the study area being an agriculturalarea and farming beinga major occupation of the people, coupled with the high population,shrubs and grassland that are light vegetation can not but increased. Horticultural activities in thedevelopingIwo townandothertownsespeciallyaroundeducational, residential,industrialand

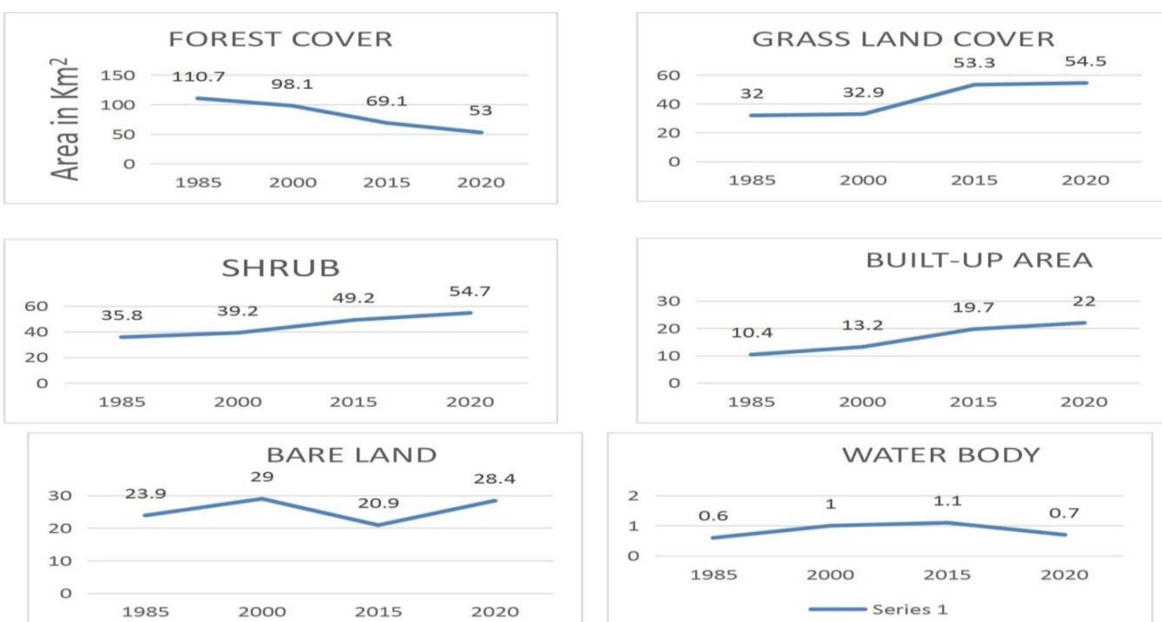

Figure4:thelinegraphof thetrendoflandcovertransformation

commerciallandusesarenoticeable. Suchasforopenfield, sportpitch,aestheticslandscapingofbuildings.Allthesecould havehelpedin theincrease ingrasslandlandcover. The depletion in the forest landcover is expected and agrees with Ogunlade, (2018) that it is theland cover that is mostly altered in LULC transformation for various land uses such residential,agricultural, industrial; and many other developmental indexes. Year in year out alteration offorest land cover has become inevitable in the study area for constructions, various dimension offarming, timber and wood works. The area is replete with sawmills that process forestproduct.So also, the increase observed in the rest land cover classes can beadduced to the fact that thestudy area being an agricultural area and farming beinga major occupation of the people,coupled with the high population, shrubs and grassland that are light vegetation can not butincreased. Horticultural activities in the developing Iwo town and other towns especially aroundeducational, residential, industrial and commercial land uses are noticeable. Such as for openfield, sport pitch, aesthetics landscaping of buildings. All these could havehelped in the increasein grassland landcover. One index of urbanization is an increase in the built-up which is observedin the mapand tables.Even though thebuilt-up hasthelowestrateamongother landcoverclasses it still inform that urbanization in the study area is on the rise. The local government'saerial extent of 213.4 km^{2}remained intact but there have been various transformation betweenand within the land cover classes which according to Ogunlade (2018) is due to the underlyingland uses and its transformation. It has also been evident that the study area has experiencedsteadyurbanization of0.2%perannum.

V. ALOOKINTOTHEFUTURE

Table 7 is result of the prediction into year 2030 and 2050 obtained from the linear trendmethod in Microsoft Excel software. The result of the forecast Table 6 shows that by 2030 thearea covered by forest would have deteriorated to 42.1km^2(20%) and further down to 9.6km^2(5%) by 2050. Grass land, Shrub and built-upare expected to gain 29%, 27% and 12%, 36%,32% and 15% respectively. While water body is expected remain same on 0.5% in the two years,bareland is expected to reduce by 12% in 2030 and gain the 12% back by the year 2050. Theimplication of this is that there will generally be a continual transformation of the land cover andurbanizationwillbeontheincrease.Thedeteriorationinforestcoverwillhaveadverseeffecton some forest dependent economy like timber and wood production. The ecosystem of the studyareawill beaffectedas highlighted inOgunlade(2021).

Table5:Forecastingofthelandcoversto2030and 2050

Name	**1985** (sq.km)	**2000** (sq.km)	**2015** (sq.km)	**2020** (sq.km)	**2030** (sq.km)	**2050** (sq.km)
Forest	110.7	98.1	69.1	53.0	42.1	9.6
Grassland	32.0	32.9	53.3	54.5	61.4	76.0
Shrub	35.8	39.2	49.2	54.7	58.1	68.8
Built-Up	10.4	13.2	19.7	22.0	24.8	31.5
Bareland	23.9	29.0	20.9	28.4	25.9	26.2
Water	0.6	1.0	1.1	0.7	1.0	1.1

Table6:EstimatedAerialextentin2030and2050

Year	**Forest**	**Grass**	**Shrub**	**Built-up**	**Bare**	**Water**
2030	-20%	29%	27%	12%	-12%	0.5%
2050	-5%	36%	32%	15%	12%	0.5%

A continualincrease in urbanization is indexed through the built-up which is predicted to keeponincreasing.Thiswillmeansmorepopulation,foodconsumption(thatcanleadtohighpriceof farm produce because many people will be eager to buy just few available commodities),environmental pollution etc except steps are taken to ameliorate these effects (Ogunlade, 2020b)elsethesustainabilityofthecorresponding developmentis ataveryhighjeopardy.

VI. CONCLUSION

This study demonstrated the effectiveness of geospatial technology through the integration ofRemoteSensingandGIStechniquesintheassessmentoflandcoverchangesoveraspaceoftime to monitor urbanization. The study revealed that Forest land cover was the only land covertypethatdepletedcontinuouslyfrom1985to2020(51.9%to24.9%)andwillcontinuethe depletion into the future, while grassland (15.0% to 25.6%), shrub (16.8% to 25.7%), and built-up area (4.9% to 10.3%) experienced a continuous increase from 1985 to 2020 and will alsocontinue to increase. The changes expected in the year 2030 and 2050 have been predicted to beforest land -20% and -5%,Grass land, Shrub and built-upare expected to gain 29%, 27% and12%,36%, 32% and 15% respectively.While water body is expectedremain same on 0.5% inthe two years, but bareland is expected to reduce by 12% in 2030 and gain the 12% back by theyear 2050. These transformations have been observed by Ogunlade (2020a,b,c), Oyinloye (2013)to have its anchor on urbanization which according to Oyinloyeand Fasakin (2014), Oyinloyeand Kufoniyi (2011)is the most socio-economic change role player in all land cover classes .The attendant consequence of the increase in urbanizationis summarilythe sustainability of thecorrespondingdevelopment.

RECOMMENDATIONS

As urbanization increases, all other land cover are affected, sustainable approach as in Ogunlade(2020) and other research is hereby recommendedorder to protect some relevant land covers topreservethegreenecosystem,andtosustainthehealthylivingofhuman.Itisalsorecommended that theassessment of land cover patterns and trend in this research should beadoptedinproperdecisionandpolicymakingthatwillpreventinadequateplannedandunplanned land use and unsecured tenure system as observed by Owoeye (2016), Owoeye andIbitoye (2016) andOlajuyigbe et al.,(2015). The research is further recommended for urbanplannersinterestedinsustainabledevelopmentandagriculturalinvestorslookingforagoodplace toinvesttheirmoney for maximumyield intheiragricultural practice.

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