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CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH

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PREFACE

There is a growing concern on the adverse impacts of climate on biodiversity. This phenomenon is greatly manifested in form of shifting weather patterns threatening global food security, health and species existence. Humanity is at the receiving end of the consequences of climate change hence there is a need to step up actions on all fronts- overtime, everywhere all at once.

This calls for collaboration, partnership and networking to strengthening synergy among relevant stakeholders in a bid to tackling climate change menace. This forms the basis for the theme of this year world Environmental conservation conference: **CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH.** The theme is conceived with a view to create an interface for information sharing and offer opportunities for participants to refine their commitments and pledges in the quest to achieving Sustainability in the face of climate change.

This year World Environmental Conservation Conference is memorable in the sense that it received overwhelming funding from the host - West African Science Service on Climate Change and Adapted Land use). WASCAL is posed to provide information and knowledge at the local, national and regional level to cope with the adverse impacts of climate change. Thus, this conference will offer opportunities for participants to learn from good practices demonstrated and showcase by WASCAL during the course of the conference. It will also strengthen staff-student exchange and provide prospect for Doctorate Research Doctoral Research in West Africa Climate System Programme (DRP WACS) – WASCAL among others.

Special appreciation goes to the management of The Federal University of Technology, Akure the host institution, National Park Service and African Regional Center for Space Science and Technology Education-English (ARCSSTE-E) that co-host this conference. We equally acknowledge other private, individual and corporate organizations that have contributed towards the success recorded in this event.

All the submitted articles were subjected to strict double blind peer-review process by the reviewers that are experts in the area of the particular submitted manuscript. The accepted manuscripts are published in WECC 2023 proceedings and also available for download on the organization website (www.necorng.org).

The accepted manuscripts fall within the underlisted subthemes:

- Climate change adaptation strategies in Agriculture, Forestry and Other Land Use (AFOLU)
- Climate smart city and architectural landscape design
- Retrofitting and decarbonization in tourism and hospitality industry
- Indigenous knowledge and local innovation in climate change adaptation
- Climate risk management, health, safety and hygiene
- Carbon credit-offset marketing/circular economy
- ICT development in environmental conservation (image processing and acquisition, computer vision, graphics, speed, interface technology, HMD devices, GIS: Body Tracking, AI and IOT, VRT, IVE).

We commend our keynote speaker Prof. Douda Kone Director Capacity Building Department, WASCAL Headquarter, Ghana and other guest speakers Prof. Babatunde Rabiu, Director General, Chief Executive Office, African Regional Centre for Space Science and Technology Education-English (ARCSSTE-E) and Dr. Goni I. M., Conservator General National Park Service.

It is hoped that researchers, students and policy makers will find the papers in this book very useful. Even though all the papers were reviewed and edited, the content and option expressed remain essentially that of the authors and not necessarily that of Netlink Environmental Conservation Organization.

Dr. Oladeji S. O.

President Netlink Environmental Conservation Organization

Convener World Environmental Conservation Conference

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ASSESSING THE EFFECT OF LANDUSE /LAND COVER CHANGES ON CARBON EMISSION AND ABSORPTION: A CASE STUDY OF AKURE AIRPORT ONDO STATE NIGERIA

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ABSTRACT

The research is an assessment of the effect of landuse/land cover changes on carbon emission and absorption using the techniques of remote sensing geospatial technology. The Airport in Akure Ondo State Nigeria was used as a case study. The acquisition boundary of the study area and Landsat imageries of different epochs (2020, 2014, 2000, and 1990) datasets were acquired. Maximum likelihood algorithm of pixel based supervised classification was used to map the development around aviation land use and Landcover over the different epochs. The land cover types in the image were classified into built environment, bare land, forest, shrub and grass land. The rate of change in the level of carbon emission (CO_2) in the area and the effects on the health of the inhabitants were evaluated by mapping the level of the carbon emission (CO_2). The future extent of non-aviation land use/landcover was carried out using linear trend method in order to determine the probable future development and also the carbon emission (CO_2). The effects of the land cover on the carbon emission (CO_2) were thus evaluated. The result showed that land use and land cover controls carbon emission and absorption, as the higher the urban area, the higher the carbon emission while the higher the vegetation, the higher the carbon absorption and vice versa. The results showed that the built environment is the major source of carbon in the study area due to several human activities. A critical consideration of factors that can reduce Carbon (CO_2) emissions was recommended.

Keywords: *Assessment, carbon absorption, carbon emission, landuse, landcover.*

INTRODUCTION

Landuse/land cover and Carbon Emission and absorption are intertwined phenomena. While Land cover is the natural existence of the earth, land use is its human intervention and alteration, the use to which human has put the land cover into, otherwise called anthropogenic activities (Ogunlade, 2019, 2020). Geospatial technology has been the modern way the earth's landcover is measured and monitored (Ogunlade 2021a). Part of this activities is the detection of landcover changes from where the landuse is inferred since it cannot be measured or detected in remote sensing image analysis that is the substance of the modern geospatial technology. Land use is the underlining factor in every landcover change or dynamics (Ogunlade 2022a).Carbon emission has become a phenomena of global concern because of its causative effects on the ecosystem in all ramification. Its strong hold on climate has made it a subject of serious attention because of the place of climate in human and animal life, the environment and the general ecosystem. Climate change is the driver of most happening in the universe today. Almost all phenomena have a bearing with climate change, and the underlining driver is the carbon emission. The place of the carbon in animal and plant living is pivotal. Animal breathes in oxygen and gave out carbon dioxide while plants take in the carbon dioxide and give out oxygen. Plants are a major source of carbon probability because they act as carbon sinks through their consumption of carbon dioxide. Thus the vegetation landuse/landcover is highly required when carbon absorption which is the negative (opposite) of carbon emission is a concern.

The airport, also called air terminal, aerodrome, or airfield, is a site and installation for the take-off and landing of aircraft. (Ashford, 2020). Airports, with the facilities and services they provide, are considered as one the most important parts of the infrastructure required for the regular operation of aircrafts. Airports considerably contribute to local economy and employment. However, together with the socioeconomic benefits they offer, environmental costs and impacts are the inseparable results of the operation of airports (Sameh and Scavuzzi, 2016). According to Wiebusch (2014), though airports provide positive contribution to the economic welfare they also provide negative impacts to the environment, one of which is most dangerous negative impact called emission of CO_2, which have a very negative impact on the global warming.

Emissions of greenhouse gasses (CO_2) from aircraft, both at ground level and at altitude, can give rise to numerous negative effects on air quality, climate and the ozone layer. The gases and particles emitted from aircraft engines can cause harmful effects in different stages of the flight, from the ground to higher altitudes. At ground level, where airports are involved, one of the adverse effects of aircraft emissions is degradation of the air quality, which may directly impact human health (Andre, 2004, Sameh and Scavuzzi, 2016).Greenhouse gases trap heat and make the planet warmer (United States Environmental Protection Agency, 2019). According to the European Centre for Medium-Range Weather Forecast (2017), there are both natural and human sources of carbon dioxide emissions. Human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years. The largest source of greenhouse gas emissions from human activities is from burning fossil fuels for electricity, heat, and transportation United States Environmental Protection Agency, USEPA (2019).

Kazmeyer (2018) stated that carbon (CO_2) is a natural result of life, and a vital part of the growth cycle of plants, too much of it in the atmospheric bubble that surrounds the Earth traps the heat from the sun, raising temperatures on Earth. CO_2 is not harmful to health at low concentrations. It is not flammable and will not support combustion. However, at high concentrations CO_2 is a recognised workplace hazard where it can cause headaches, dizziness, confusion and loss of consciousness. Carbon dioxide becomes a poisonous gas when there is too much of it in the air human breathe which can lead to central nervous system damage and respiratory deterioration in humans and other breathing creatures. Land Use and Forestry generated 12% of 2019 greenhouse gas emissions, as land areas can act as a sink (absorbing CO_2 from the atmosphere) or a source of greenhouse gas emissions.

The research has its motivation from several other research on global warming whose effect climate change such as excessive unpredictable rainfall, flooding, temperature and other anti-living factors currently in vogue, to assess the effect of landuse/landcover on underlining factor of global warming which is the carbon emission.

The Study Area

The study area chosen as the case study is the airportin Akure North Local Government Area (LGA) of Ondo state Nigeria (Figure 1). It has its geographicallocationwithin latitudes and longitudes (7° 15' 40"N, 5° 16' 8"E), (7° 16' 8"N, 5° 19' 3"E), (7° 12' 46"N, 5° 18' 53"E), and (7° 12' 14"N, 5° 17' 19"E. The total land acquired for aviation land use is approximately 32 Sq.km, with about 3.1Sq.km is being currently utilized for aviation purpose (Figure 1.1) as calculated from the study area land acquisition map. The study area has an average elevation 338 m above the mean sea level. The average annual temperature is 25.3°C. The rainy period of the year lasts for 10 months of the years, with an approximate annual rainfall of 1455mm (Climate-Data, 2020).

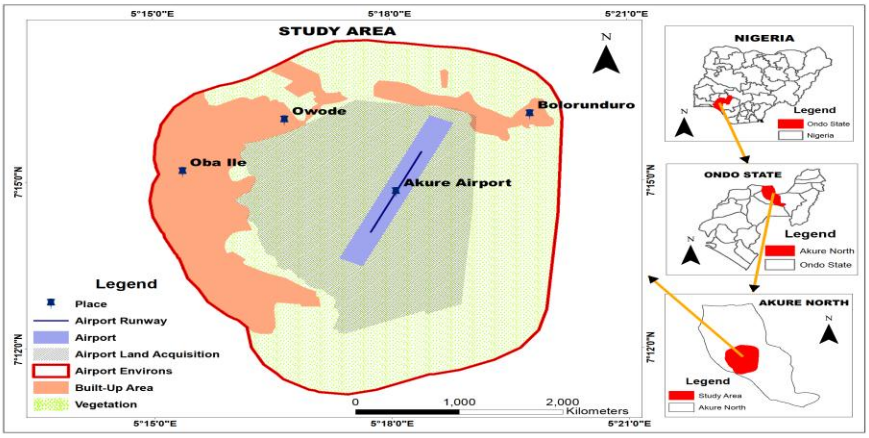

Figure 1.1: Study area map showing the study area and its environs.

MATERIALS AND METHOD

The dataset used for the research are LANDSAT TM of 1990, Landsat ETM+ of 2000, Landsat OLI/TIRS of 2020 & 2014, all of 30m resolution and obtained from the United State Geological Survey (USGS); Worldview 3 image 1.24m resolution of 2019 obtained from google earth, Administrative mapof 1978 at a scale of 1:1,300.000obtained from the office of the Surveyor General Akure Ondo State Nigeria, the study area land acquisition map of 1979 at a scale of 1:15000, and GPS coordinates of ground points acquired from field survey in the year 2020.

Mapping of the Land Use and Land Cover (LULC) of the study area was performed by extracting the zipped Landsat images using WinRAR software to assess the image bands. Supervised classification method of the pixel-based image analysis was adopted in the processing. Three Landsat image bands were combined to create band composite which were used to produce composite images to generate the Land use/Land cover classes and information about the study area. These were achieved through the image colour codes and were visually interpreted. To map the urban (built-up) section of the study area, false color composite (FCC) of bands 7, 5, 3 on Landsat 7 ETM+ and 7, 6, 4 on Landsat 8 OLI/TIRS were used. These have the ability to display urban area and other land cover types distinctively (Prasomsup *et al*., 2020; Karanam, 2018; Mst-Ilme and Bo 2018; Zha*et al*., 2003), and vegetation appears in shades of dark and light green during the growing season; urban features appear in white, gray, cyan or purple; sands, soils and minerals appear in a variety of colors (USGS, 2014). There was the need to increase the resolution of the resultant composite image from 30m low resolution to a 15m high resolution to aid visualization and interpretation during image classification because the study area was small in size. This was done using the panchromatic band of 15m resolution to pan-sharpen the low-resolution composite image. The land acquisition plan (which is the raster image) of the study area was digitized to obtain a vectorized format of the boundary in shape file (.shp) format.

The environs of the study area were created from a 2km buffer of the vectorized boundary using the “Buffering Tool” in the ArcGIS 10.5 software environment. The 2km buffer was then used in sub-setting or clipping the derived images of the various index-based algorithm, from the ArcGIS 10.5 software environment, derived images of various index-based algorithm was clipped in order to focus on onlythe study area.

The image was classified into built-up, bare land, forest, shrub and grass land use /landcoverby subjecting it to maximum likelihood algorithm of the supervised classification method. Pixels samples were selected for each land cover type to create training samples which were then converted into spectral signatures, and used to create landcover classes having the same pixels values. To determine if the classified maps is good for further processing, accuracy assessment was carried out to compare the classified image with ground data: 50 locations (10 samples for each LULC Class) which were the points picked with a differential GPS receiver and from the higher resolution image (Worldview image 3). The result was fixed into the confusion matrix to determine the accuracies desired.

RESULTS AND DISCUSSION

Estimating carbonemissions coefficients for landuse/landcover (LULC)

The carbon emissions coefficients for each LULC classes generated (forest, shrub, grassland. Bareland) were estimated (Table 1) using Equation 1 as propounded by Cui *et al.,* (2018):

$$E_i = \sum e_i = \sum S_i \times \delta_i \times \frac{MC0_2}{M_C} \quad \text{...............Equation } \mathbf{1}$$

Where; E_i*= carbon emissions from land use;* i*=the type of land-use;* $S_i =$ *is the area of land i; and* δ_i *is the carbon emission coefficient for LULC type (Table 1), whose positive values indicate carbon emission while negative values indicate carbon absorption;* M_{CO2}/M_C *is the ratio of the mass carbon dioxide molecules to a carbon atom, which is 44/12.*

Table 1: Carbon emission coefficients for the land-use types

S/N	Land-Use Types	carbon emission coefficient (kg (C)*m^{-2} a^{-1})
1	Forestland	-0.0586
2	Shrub	-0.0586
3	Grassland	-0.0021
4	Bare land	-0.0005
5	Built -up	2.38

Source: Cui *et al* (2018); Rong *et al* (2020).

Area of Coverage of each LULC classes in the study area and its environs were determined by calculation from which thepercentage epochal changeswere evaluated (Table 2). The data from Table 2 were extracted to estimate the land-use specific carbon emissions (Carbon Sources) and absorptions (Carbon Sinks), the total carbon emissions and absorptions, and the net carbon emissions in tons (Table 3).

Table 2: Area of Coverage of LULC within the study area and its environs.

Land Cover	Area (Sq.km) 1990	%	Area (Sq.km) 2000	%	Area (Sq.km) 2014	%	Area (Sq.km) 2020	%
Bare Land	7.0	7.9	5.1	5.7	7.3	8.2	14.4	16.2
Built -up	5.8	6.5	8.0	8.9	9.6	10.8	12.6	14.2
Forest	59.8	67.2	24.2	27.2	32.8	36.9	23.4	26.3
Grass Land	5.0	5.7	22.2	25.0	18.1	20.3	16.8	18.8
Shrub	11.3	12.7	29.5	33.2	21.2	23.8	21.8	24.5
TOTAL	**89.0**	**100.0**	**89.0**	**100.0**	**89.0**	**100.0**	**89.0**	**100.0**

Table 3: Carbon Emission (+) / Absorption (-) in Tons

Year	Forest	Shrub	Grass Land	Bare Land	Built Environment	Total Carbon Emission	Total Carbon Absorption	Net Carbon Emission/ Absorption
1990	-13552.18	-2560.86	-3.88	-1.30	5107.48	5107.48	-16118.22	-11010.74
2000	-5487.61	-6686.71	-17.25	-0.94	7008.43	7008.43	-12192.51	-5184.07
2014	-7444.84	-4796.38	-14.07	-1.35	8414.40	8414.40	-12256.63	-3842.24
2020	-5301.60	-4941.20	-13.02	-2.66	11113.00	11113.00	-10258.48	854.52

NB: The positive carbon values correspond to carbon emission (carbon discharge), while negative values correspond to carbon absorption (Carbon sink).

The distribution of LULC specific carbon emissions and absorptions in the study are and its environs for the study years 1990, 2000, 2014 and 2020 is shown in Figure 2. The epochal analysis is thus:

Year 1990

The distribution of carbon emission and absorption in the year 1990 revealed that the vegetation LULC (Forest, shrub and grassland) was dominant (76.1%) in the study area which resulted in a corresponding dominance of carbon absorption within and outside it.

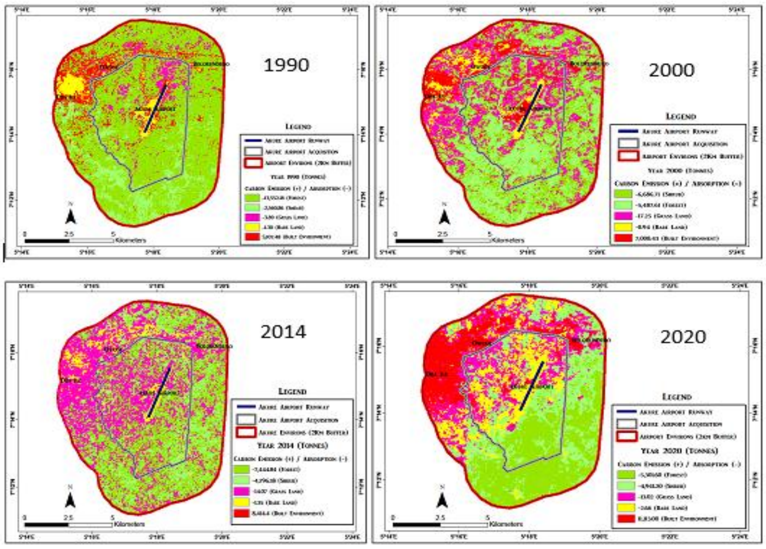

Figure 2: Maps of the distribution of carbon emission and absorption in the study years

Year 2000

In the year 2000 the vegetation LULCclasses (forest, Shrub, Grass land) (85.4%) was also the dominant LULC class. The order being Shrub 33.2%, Forest 27.2%, Grass land 25.0%, Built up 8.9%, Bare land 5.7%. The pattern acronym is ***Sh-Fr-Gl-Bu-Bl*** *a*nd as a result of the dominance of vegetation LULC classes, carbon absorption were also observed to dominate within and outside the study area and only the built up LULC class had a dominance of carbon emission. The carbon emission in the built up LULC class measured 7008.43 tons. All other LULC classes absorbed carbon with shrub having the highest of -6686.71 tons, forest -5,487.61 tons, grass land and bare land -17.25 tons and -0.94 tons respectively. The absorption pattern acronym was observed to be ***Sh-Fr-Gl-Bl.***

Year 2014

In the year 2014, it was also observed that vegetation classes (Forest, shrub and grassland) was the dominant class (81%). The order being Forest 36.9%, Shrub 23.8%, Grass land 20.3%, Built up 10.8%, Bare land 8.2%. The dominance of vegetation classes was greeted with a corresponding dominance of carbon absorption while carbon emission was dominant in the built up class. The Built up LULC class was also the only LULC class with carbon emission. The measure was 8,414.4 tons. All other LULC classes had Carbon absorption. Forest had the highest absorption with -7444.84 tons, followed by shrub with -4,796.38 tons, then Grass land and bare land with -14.07 tons and -1.35 tons respectively. The absorption pattern acronym is ***Fr-Sh-Gl-Bl.***

Year 2020

The distribution of carbon emission and absorption in the year 2020 showed that vegetation class (forest, shrub, grass land) dominated the study area (69.6%). The order being Forest 26.3%, Shrub 24.5%, Grass land 18.8%, Bare land 16.2%, Built up 14.2%. The pattern recorded being ***Fr-Sh-Gl-Bl-Bu***. It was observedthatwhile carbon emission was dominant only in the built up LULC class, higher carbon absorption occurred in the western part of the study area due to the dominance of the vegetation classes within and outside the airport. The quantity of the carbon emission in the built up LULC class was estimated to be 11,130.00 tons. All other LULC class experienced carbon absorption quantity in the order: Forest -5301.60 tons, Shrub -4941.20 tons, Grass land and bare land with -13.02 tons and -2.66 tons respectively. The absorption pattern acronym was ***Fr-Sh-Gl-Bl.***

Trend of epochal LULC Carbon Emission and Absorption in the study area and Environs.

The Carbon Emission and Absorption for each LULC class in each of the study year was analyzed as follows:

Forest

In the year 1990, the carbon absorption for forest was 13552.18 tons, and it reduced to 5487.61 in the year 2000, then increased to 7444.84 tons in the year 2014 but decreased to 5301.60 tons in the year 2020 (Figure 6).

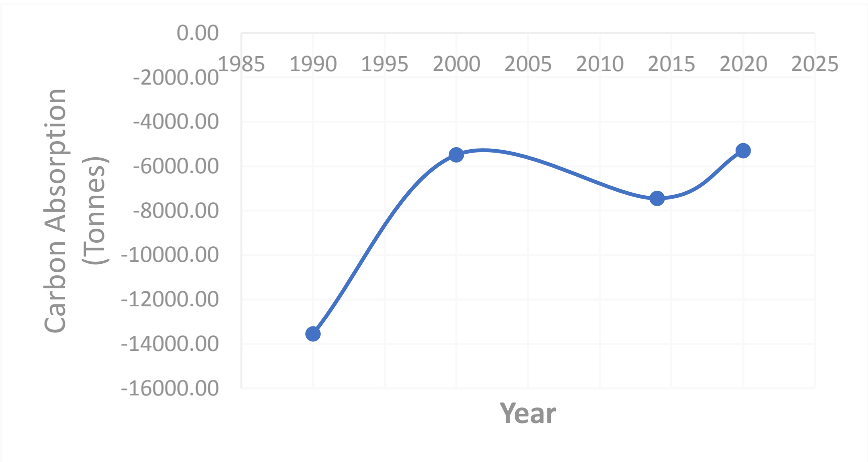

Figure 6: Carbon absorption of forest from 1990 to 2020

Shrub

In the year 1990, the carbon absorption for shrub was 2560.86 tons, and it increased to 6686.71 in the year 2000, then decreased to 4796.38 tons in the year 2014 and slightly increased to 4941.20 tons in the year 2020 (Figure 7).

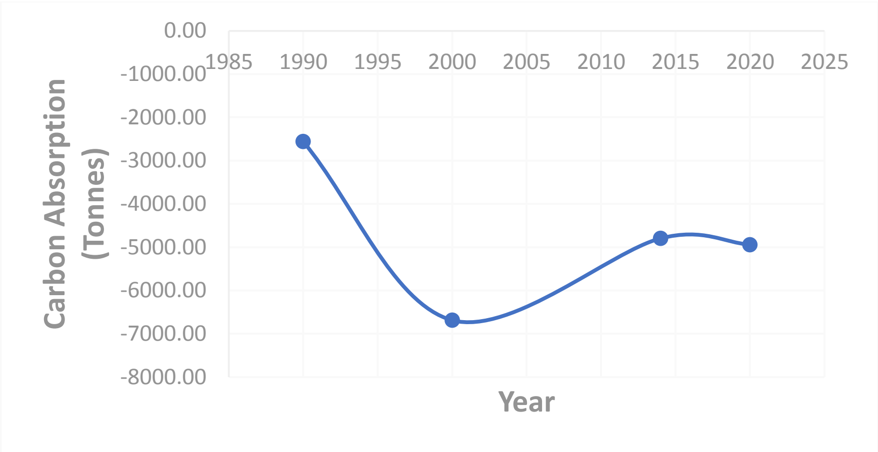

Figure 7: Carbon absorption of Shrub from 1990 to 2020

Grass land

In the year 1990, the carbon absorption for grass land was -3.88 tons, and it increased to -17.25 in the year 2000, then decreased to -14.07 tons in the year 2014 and further decreased to -13.02 tons in the year 2020 (Figure 8).

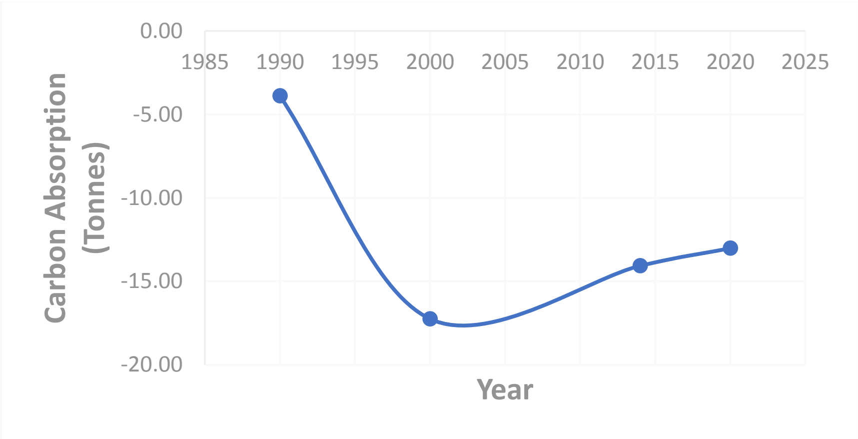

Figure 8: Carbon absorption of grass land from 1990 to 2020

Bare Land

In the year 1990, the carbon absorption for bare land was 1.3 tons, then it decreased to 0.94tons in the year 2000, but it increased to 1.35 tons in the year 2014 and further increased to 2.66 tons in the year 2020 (Figure 9).

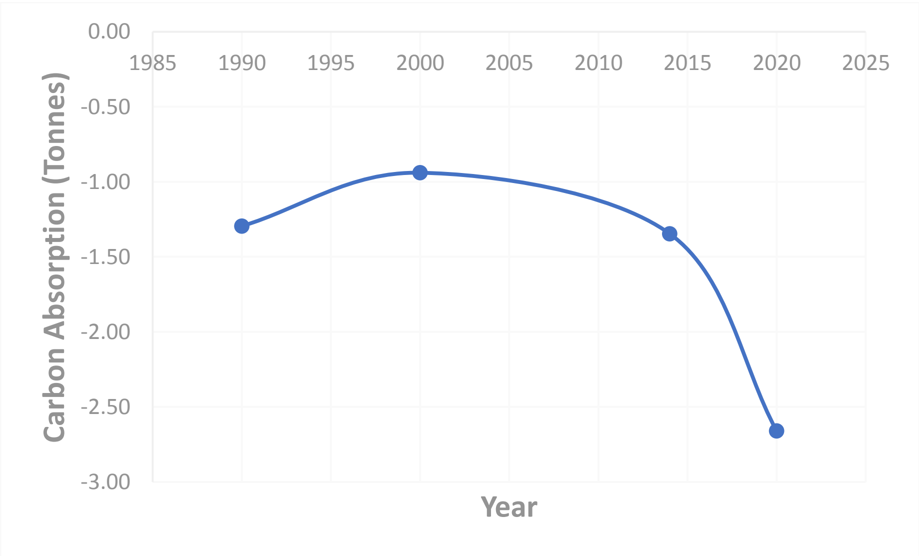

Figure 9: Carbon absorption of bare land from 1990 to 2020

Built up

In the year 1990, the carbon emission for built environment was 5107.48 tons, and it increased to 7008.43 tons in the year 2000, and further increased to 8414.40 tons in the year 2014 and finally increased to 11113.00 tons in the year 2020 (Figure 10).

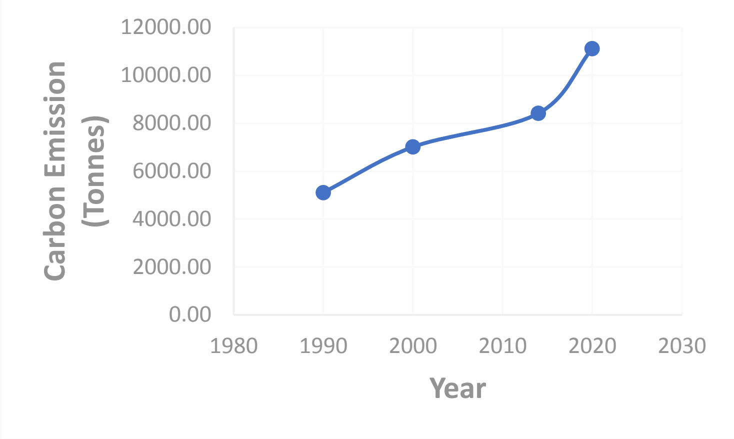

Figure 10: Carbon emission of bare land from 1990 to 2020

Net Emission/absorption

The net carbon emission in the year 1990 was -11010.74 tons (Table 3 and Figure 11). This signified that absorption was dominant in the study area due to dominant coverage of vegetation LULC Classes which absorb absorb more carbon from the atmosphere than that emitted from the built up area.

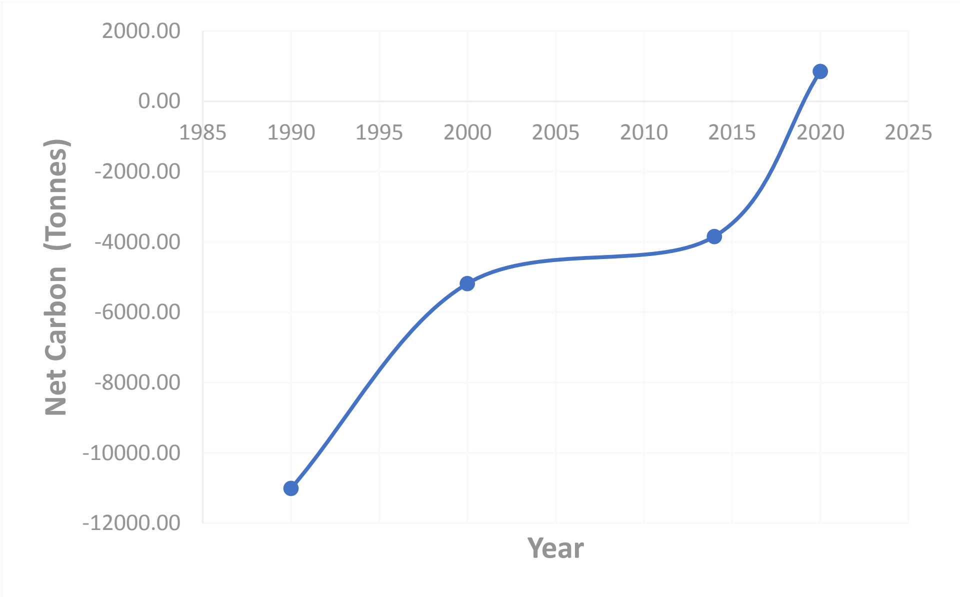

Figure 11: Net Carbon Emission/Absorption from 1990 to 2020 in the study area.

In the year 2000, the net carbon emission was-5184.07 tons, lower than for the year 1990 due to gradual increase in built environment within the airport and its environs. In the year 2014, carbon emission further declined to -3842.24 tons due to the decrease in vegetation and increase in urban land (Built environment) powered by human activities such as consumption of fuel from automobiles and aircraft in the study area. In the year 2020, a positive value of net carbonemission of 854.52tons was observed which implied that carbon emission was greater than carbon absorption. It signified that the carbon produced from human activities within the study area and its environs is greater than the amount of carbon absorbed by the vegetation within the study area. The result showed that land use and land cover controls carbon emission and absorption, as the higher the urban area, the higher the carbon emission while the higher the vegetation, the higher the carbon absorption and vice versa. A look at possible Net Carbon (CO_2) emission and absorption in the study area and Environs for the year 2030in Table 4 and Figure 12projecteda carbon emission of 3,400.09tons from the 854.52 tons in 2020. This means a possible rate of 254.56 tons per annum. This trend poses serious danger with so many effects on human health and animals such as headaches, dizziness, restlessness, a tingling or pins or needles feeling, difficulty breathing, sweating, tiredness, increased heart rate, elevated blood pressure, coma, asphyxia, and convulsions(Wisconsin Department of Health Services, 2023; The Humane Society of the United States, 2023), the environment such as global warming, which causes climate change, resulting in melting of the polar ice caps, the rising of sea levels, the disturbance of animals' natural habitats, extreme weather events, (Green Matters, 2020),, climate change such as supercharging the natural greenhouse effect, causing global temperature to rise(NOAA Climate.gov, 2023), animals

Table 4: Possible Net Carbon Emission and Absorption in the year 2030

Year	Net Carbon Emission/Absorption
1990	-11,010.74
2000	-5,184.07
2014	-3,842.24
2020	854.52
2030	3,400.09

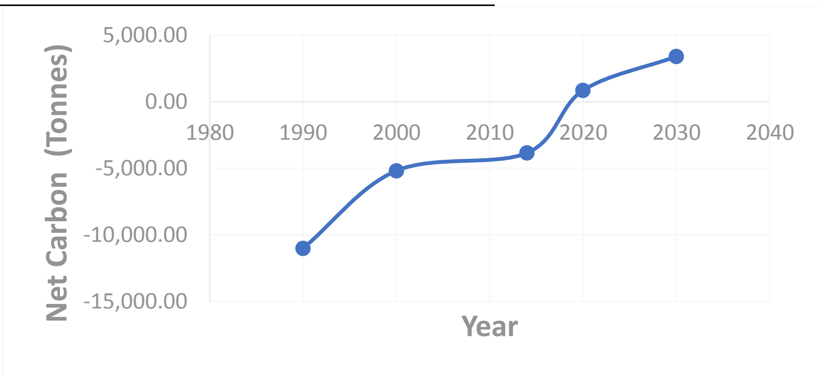

Figure 12: Possible Net Carbon Emission/Absorption in the year 2030

CONCLUSION

The results showed that for the year 2030 there will be serious continual carbon emission as the amount of carbon emission will be more than the amount to carbon absorption in the study area. The net carbon emission for the year 2030 was estimated to be 3400.09 tons. This revealed that as the built up LULC imminently increase, carbon emission too will be on the increase, as it has been ascertained that the built up LULC is the major source of carbon in the study area due to several anthropogenic activities. Increase in urban development in the study area brought about increase in human activities, from which the emission of carbon (CO_2) originated; thus, the urban area was adduced as the major source of carbon hence the carbon emission. The results obtained showed that in the year 1990, the carbon emission greatly exceeded carbon absorption, as a result of low urban areas and high vegetation (Forest, shrub and grassland) in the study area, which was evident in the predominantvegetation absorption of carbon (CO_2). Urbanization was on the increase within the study area all over the study years, evident as residential, commercial, industrial land uses were springing up, attracting more population and increased human activities such as burning of fuel and diesel through vehicles, usage of generators, use of gas cooker, human breathing out CO_2 etc., thus increasing carbon emission. Carbon adsorption reduced as vegetation depleted. The results also revealed that carbon absorption reduced between 1990 and 2000 but increased slightly between year 2000 and 2014 and declined to its lowest in 2020 due to decline in vegetation, while carbon emission kept on increasing from 1990 to 2000, due to increased built up LULC and increased operation in the study area, and other human activities, which gave rise to increased carbon emission. Finally, the net carbon emission/absorption table revealed that carbon absorption was dominant in 1990 but the dominance kept reducing over the years, and became emission in the year 2020 evident through carbon emission becoming greater that carbon absorption. The research thus conclude that increase in development (built up class) has been responsible for most of the carbon emissions in the study area, and according to Cui *et al.*, (2018), urban development (increase in the built up LULC) is the major source of carbon emission while vegetation is the major source of reduction in carbon emission called carbon sinkage, which is consistent with previous studies. Kazmeyer (2018) further explained that the major threat from the increased CO_2 is the greenhouse effect which traps the sun's heat energy in the atmospheric bubble, thereby warming the planet and oceans, which implied that increase in carbon emission in the study area may lead to increase in atmospheric temperature and deteriorate the climatic condition in the area.

RECOMMENDATION

The obtained results of this study further revealed that in the year 2030, urban development (increase in Built environment) will continue to increase, which will lead to increase in the net carbon emission**.** It is thus recommended that a controlled urban expansion is inevitable. A properly planned urban that will reduce carbon emission as much as possible is highly recommended. Control measures such reafforestation where lost vegetation is replaced and deforestation measures where burning are strictly curtailed must be enacted according to Ogunlade (2021a; 2022b). Vegetation that is known to absorb carbon dioxide must be increased to counter the carbon emission and absorb carbon more than emitted. The green economy and ecology must be given more attention by all and sundry. Other policies of carbon emission control arerecommended to be researched into and put in place.

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