MAPPING CONCENTRATIONS OF CARBON DIOXIDE OVER CENTRAL KUBWA, ABUJA, USING GEOGRAPHIC INFORMATION SYSTEM

Jonah, S.A., Dania, R., Ezemonye, C.V., Fanisi, O., Ejiga, U., Benu, I.S., Banjo, G. Pius, A., Akpan, E. U., Bakara, I. U., Tanimowo, B., Abdullahi, B., Nwachukwu, E. I., Maishanu, I. H.,*Okunola, I.A., *Jimoh, M.O., *Amadi, A.N. and *Ejepu, J.S.
Department of Physics, Federal University of Technology, Minna, Nigeria
* Department of Geology, Federal University of Technology, Minna, Nigeria
E-mail:
Phone No:

Abstract
The key concept of this study is the presentation of the CO_2 emission signature at Central Kubwa as an interactive Geographic Information System (GIS) layer. Such an interactive GIS layer would serve as an environmental audit mechanism tool to monitor compliance with regulations designed to limit greenhouse gas emissions; furthermore, such a layer should be interfaced with the existing Abuja Geographic Information System (AGIS). Over 1200 stations of interest (i.e. locations with active sources of CO_2 over any 24-hour period) were appropriately geo-referenced and marked in the conventional way, in terms of street identifiers. The stations were re-visited with the CO_2 level meter whence information about the outdoor levels of CO_2 was logged progressively from one point to the next. Majority of the locations visited for this survey indicated ambient CO_2 levels above the 450 parts per million (ppm) threshold selected for this study. Of the different sources of CO_2 identified for this survey, the petrol-powered internal combustion engines predominate. The GIS emission layer maps for this study show that the western segment of Central Kubwa is characterized by heavy red clusters, indicating a high CO_2 emission zone, whereas the red clusters are dispersed on the eastern sector, indicating a low CO_2 emission zone. This novelty GIS-enabled, Windows-compatible, interactive CO_2 map of Central Kubwa is now a veritable planning tool in the hands of environmental monitoring auditors devoted to the issue of global warming and climate change.

Keywords: Carbon dioxide, GIS, Mapping, Interactive, Layer

Introduction
Large-scale emission of anthropogenic greenhouse gases resulting in the global warming trend is the focus of attention at the moment. The main greenhouse gases are water vapour, carbon dioxide (CO_2), methane, nitrous oxide and ozone, but CO_2 is easily the rogue gas implicated in the global warming episode because it is not easily cleaned from the upper atmosphere once it released. Presently, there is no database of any greenhouse gas for any town or city of Nigeria. Since Nigeria is a signatory to several international protocols on environmental protection best practices, it is just proper that there exist a means by which information on environmental issues can be collated and disseminated. Thus, this project was designed as a follow-up to the pioneering effort specifically targeted towards creating a protocol for greenhouse gases emission studies. Such studies would necessarily be incorporated into the global warming and climate change discussion. The stations of interest selected for this study were locations with active sources of carbon dioxide over any 24-hour period.

The published literature states that mean atmospheric carbon dioxide concentration has increased from a preindustrial value of 280 parts per million (ppm) to 366 ppm in 1998 and was projected to increase at a rate of 1.5 ppm per year (Keeling and Whorf, 1999). Experimental studies growing trees in open-top chambers indicates that a 300 ppm increase in atmospheric carbon dioxide concentration stimulates photosynthesis by 60%, the growth of young trees by 73% and wood growth per unit leaf area by 27% (Norby, 1999). Furthermore, it was pointed out that it seems probable that there will be a similar response in natural forest ecosystems. Because of their intrinsic high productivity, tropical forests are a prime candidate for such a C fertilisation response, and the crucial question has been to what extent such a response might be limited by low nutrient availability, in particular by low nitrogen or low phosphorus (Lloyd, 1999).

Aim and Objectives of Study: The aim and objectives of this study are the following:

(i) To create a GIS database on carbon dioxide at Greater Kubwa with a view to showing the spatial spread.

(ii) To contribute towards the preparation of a possible futuristic framework for a greenhouse gas emission database for Central Kubwa using the Geographic Information System (GIS).

(iii) As a result of (ii) above, the eventual inauguration of a public enlightenement programme involving environmental monitoring auditors on the prevalence of CO_2 emissions at Central Kubwa, with a view to adopting possible mitigating measures in this regard.

Area of Study: Kubwa town is a province of the Bwari Area Council of Abuja administrative territory. The area of study is about 4.64 km^2 and lies within longitudes $7^0$19.430′ and $7^0$21.199′ and latitudes $9^0$08.455′ and $9^0$09.238′ respectively. Kubwa lies in the savanna belt of central Nigeria, characterized by grassland to thick shrub vegetations and undulating topography due to proliferation of rocky outcrops. The area usually experiences an annual two-season spell, with moderate to sufficient rains from April to October and a dry clime from November through March. The soil around Kubwa area has a high coefficient of natural fertility as evidenced by the intense subsistence agriculture in the locality. For this study, satellite imagery maps of Kubwa principality have been used. Fig.1 is the QuickBird satellite map of the whole of Kubwa town showing the extent of Central Kubwa. The grid positioning of Kubwa province is shown as Fig.2.

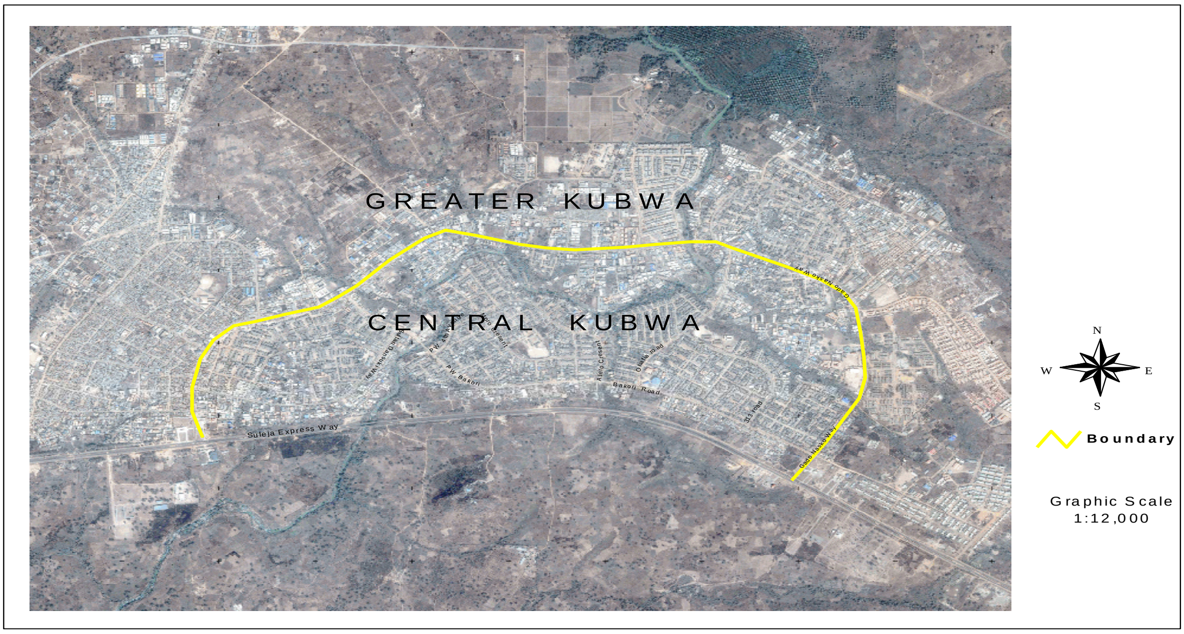


Fig.1: QuickBird satellite imagery of Central Kubwa

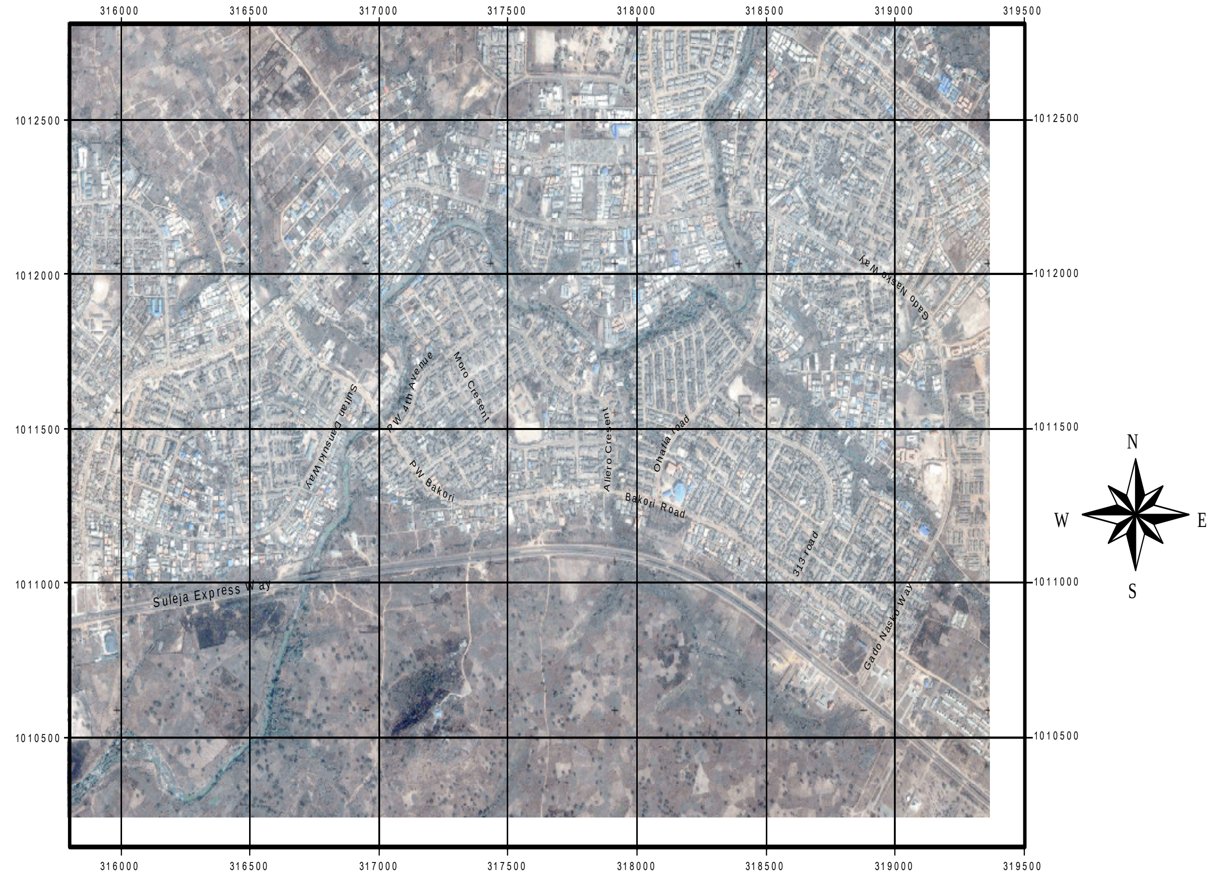


Fig. 2: Grid positioning of Kubwa province

Scope and Limitation of Study: The areal extent of Central Kubwa was covered for this project exercise. Carbon dioxide emission values were taken at 1,264 georeferenced locations and these constituted the stations of interest for this project work (see Appendix). Each of these georeferenced stations was either a household or a business premises that was defined to be an "active" emitter of carbon dioxide. "Active", as specified by the field workers, referred to any location that emitted carbon dioxide above the 450ppm value within any 24-hour period.

As is usual with studies of this nature, time and cost constraints are always impediments to full-scale coverage of any designated study area. For this study, cost implication was the most vexing issue encountered; hence Kubwa town was segmented into Greater Kubwa and Central Kubwa. Central Kubwa was covered for this exercise.

Justification: This study was carried out in order to fill the knowledge gap that is integral to understanding an aspect of the climate change issue.

Literature Review: A carbon dioxide study with a local significance was carried out by Ndoke et al (2006). They pointed out that since the beginning of the industrial revolution, atmospheric concentration of carbon dioxide has increased considerably, as well as those of other greenhouse gases. The authors noted that this increase in concentration was likely to accelerate the rate of climate change i.e. an indirect implication of global warming. The authors pointed out also that global average temperature will rise by about 2^0C (3.6^0F) by the year 2100 if current emission trend continues. CO_2 is being generated in ever increasing amount in part due to increase in the population of the earth, in part due to clearing of forests and in part to increased combustion of fossil fuels. If this increase becomes severe, it could enhance greenhouse effect, leading to global warming trend. This warming might be enough to melt part of the polar ice caps and raise the level of the oceans.

Elsewhere, Robinson et al (1998) studied the effect of increased amount of carbon dioxide and other greenhouse gases. They postulated that the greenhouse effect amplifies solar warming of the earth. Greenhouse gases such as H_2O, CO_2, CH_4 and others in the earth's atmosphere, through combined convective readjustments and the radiative blanketing effect essentially decrease the net escape of terrestrial thermal infrared radiation. They proposed that increasing CO_2, therefore, effectively increases radiative energy input to the Earth's atmosphere. The path of this radiative input is complex. They also asserted that an increase in the atmospheric carbon dioxide leads to increased plant life.

Jacobson (2009) explained that climate-warming carbon dioxide spewed by coal-fired power plants and fossil-fuelled vehicles has been causing hundreds of premature US deaths each year over the several decades. The deaths were due to lung and heart ailments linked to ozone and polluting particles in the air, which are spurred by carbon dioxide that comes from human activities. As the planet warms due to carbon dioxide emissions, the annual death rate is forecast to climb, with premature deaths in the United States from human-generated carbon dioxide is expected to hit 1000 a year when the global temperature has risen by 1C.

Enger and Smith (2006) posited that urbanised, industrialised civilisation has dense concentration of people that use large qualities of fossil feels for manufacturing, transportation and domestic purpose. These activities release large qualities of polluting by-products (including carbon dioxide) into our environment. The authors pointed out that thousands of deaths have been directly related to poor air quality in cities and many of the megacities of the developing world have extremely poor air quality.

Tanz et al. (1990) reported that observed atmospheric concentrations of carbon dioxide and data on the partial pressures of carbon dioxide in surface ocean waters were combined to identify globally significant sources and sinks of carbon dioxide. The atmospheric data were compared with boundary layer concentrations calculated with the transport fields generated by a general circulation model (GCM) for specified source-sink distributions. The authors pointed out that, in their model, the observed north-south atmospheric concentration gradient can be maintained only if sinks for carbon dioxide were greater in the Northern than in the Southern Hemisphere. They concluded that the observed differences between the partial pressure of carbon dioxide in the surface waters of the Northern Hemisphere and the atmosphere were too small for the oceans to be the major sink of fossil fuel carbon dioxide, thus leading to the absorption of a large amount of carbon dioxide on the continents by terrestrial ecosystems.

Malhi and Grace (2000) mentioned that tropical forests play a major role in determining atmospheric concentrations of carbon dioxide, as both sources of carbon dioxide following deforestation and sinks of carbon dioxide resulting probably resulting from carbon dioxide stimulation of forest photosynthesis. They pointed out that, in trying to quantify the role of tropical forests, the results by researchers in this field suggested that both the carbon sources and sinks in tropical forests were significantly greater than had been assumed.

Data Acquisition Procedures

Site Selection: This phase involved a preliminary reconnaissance of the area of study to identify locations where emissions of carbon dioxide were considered significant. The stations of interest thus identified were geo-referenced and marked in the conventional way in terms of their street identifiers. For this project work, 1264 locations in Central Kubwa were duly identified. Some of the well-known neighbourhoods visited were the following, viz: Federal

Housing Authority Estate, INEC Quarters, Kubwa Phase 2, Kubwa Phase 3, RCCG's Environs, Navy Quarters, PW Quarters, and Mr. Bigg's Quarters.

The choice of Central Kubwa for this study was primarily determined because of cost consideration as no grant was secured for this study. The heart of the Federal Capital Territory was the original target for this study, alas, this couldn't be followed through because the key participants in this survey could easily be quartered for days at Kubwa with no extra cost to the survey party because of well-established social and family ties at Central Kubwa. Quartering and transportation logistics would have been really difficult at the Garki-Wuse axis. As it were, a pioneering work of this nature has been carried out at Minna, Niger State.

The locations chosen for this survey were the household and business premises where it was determined that, in any twenty-four hour period, an active static source of carbon dioxide (i.e. petrol-powered generator, coal-powered hearth, etc.) would be "live." This means that, for certainty, carbon dioxide emission will occur. The duration of emission was not necessary for our purpose to create an emission pollution layer. What was important was if emission occurred at all. The identification of any such station of interest was facilitated by oral interviews of the householders or the merchants that the survey party encountered during their visits. Furthermore, the source of carbon dioxide emission must be visually identified and tested with the carbon dioxide meter.

Data Acquisition: The carbon dioxide (CO_2) meter (GC-2028 Model of the Lurton Instruments) was employed for the measurement of outdoor ambient values of carbon dioxide at the designated stations of interest. The carbon dioxide (CO_2) meter was leased from the Kaduna State Environmental Protection Agency (KSEPA) at the prevailing rate of ₦27, 000 per day (including KSEPA's technician per diem).

Dataset of Study Area: The abridged dataset for this study is shown in the Appendix section. The dataset is presented as a table showing designated station numbers (chosen arbitrarily), their latitude and longitude values, conventional locations (corresponding to street locations), sources of carbon dioxide emissions, power ratings of sources (where applicable), and the measured numerical CO_2 values.

RESULTS

The full-bodied dataset (i.e. 1264 stations of interest) of the study area, in Microsoft Excel, was exported to the Arcview 3.2 GIS platform. The multiple field creation enables the GIS application to function with better user interface co-ordination in terms of interactive abilities.

It is important to convert analogue maps, like scanned maps and satellite images, into digital formats accessible in the Geographic Information System (GIS) environment. The step or process involved in the conversion of these attribute data is known as "digitization." The digitized map of the study area on ArcView3.2 is shown as Fig.3 whilst the overlay of the digitized map on the QuickBird satellite map is shown as Fig.4.

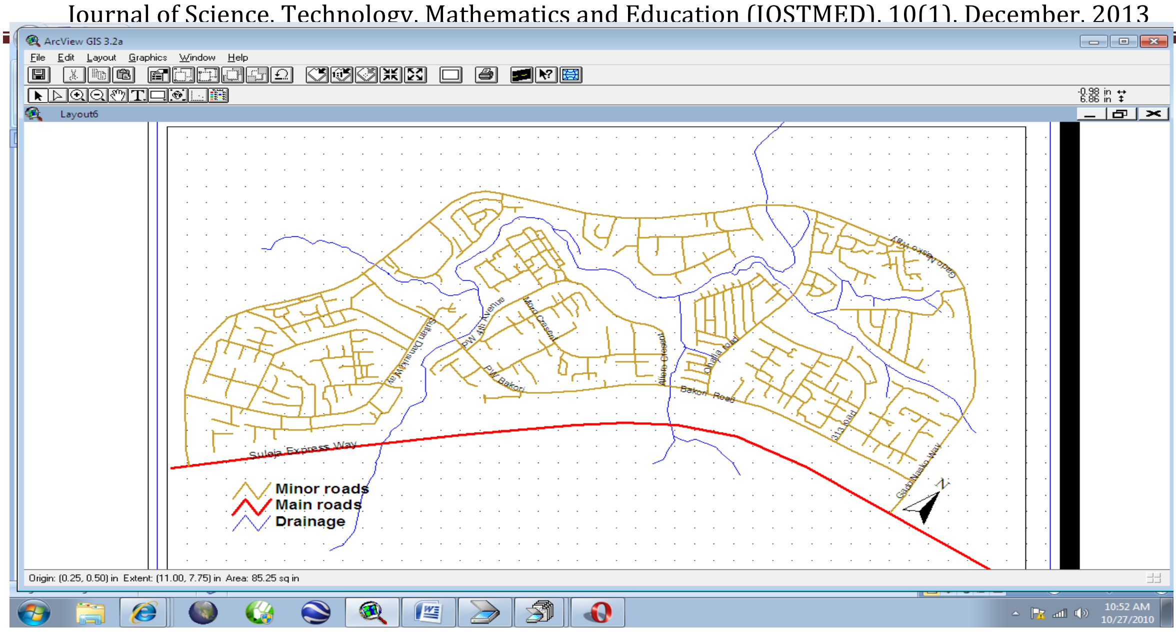


Fig. 3: Digitized map of the study area on ArcView3.2

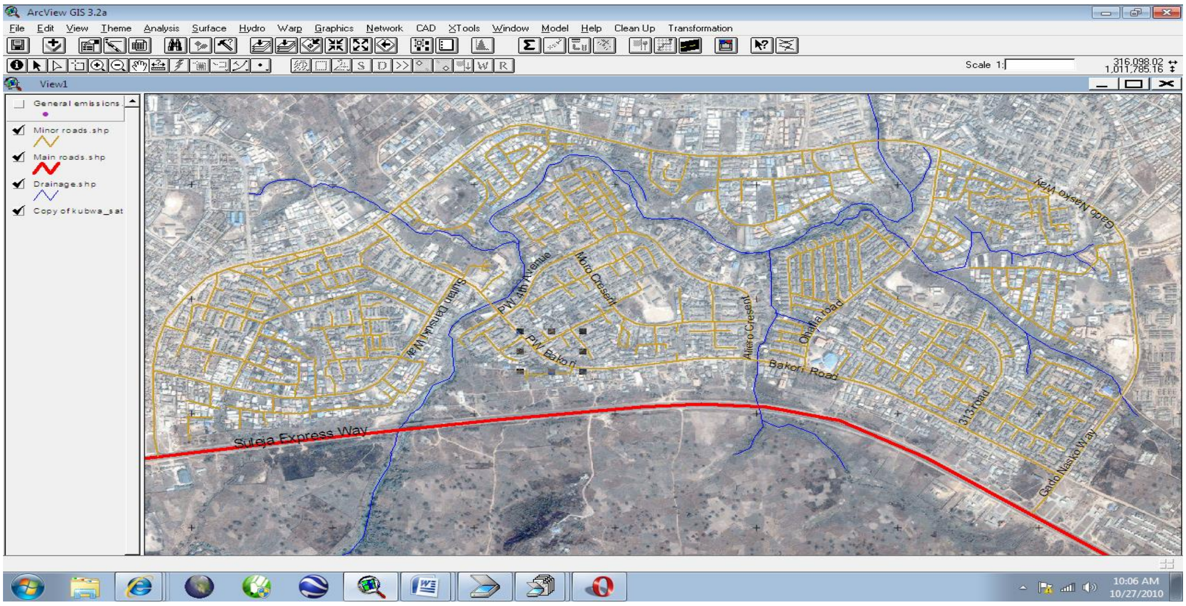


Fig. 4: Overlay of the digitized map on the QuickBird satellite map of study area

After the digitization of the map of the study area, points were identified on the map with respect to their conventional locations. Then the latitude and longitudes values were converted to the Universal Trasverse Mercator (UTM) system and inputted into the GIS platform. By this means, all of the points identified as stations of interest were "shifted" to their true position on the digitized map, as shown in Fig.5. Such a map is called a "vector map."

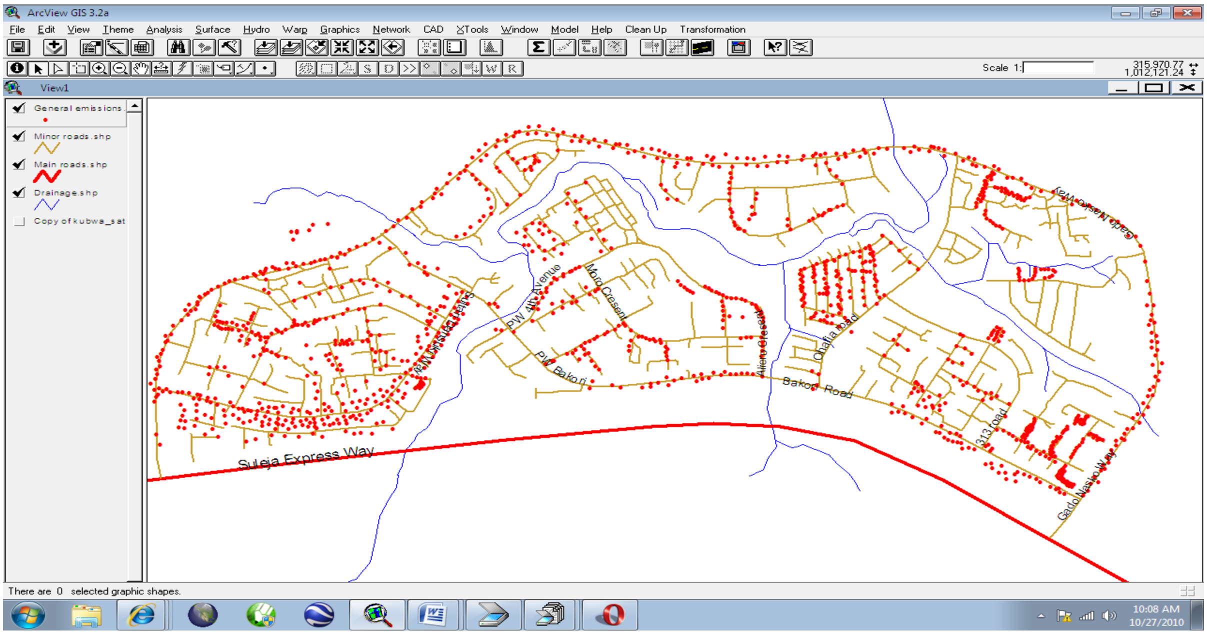
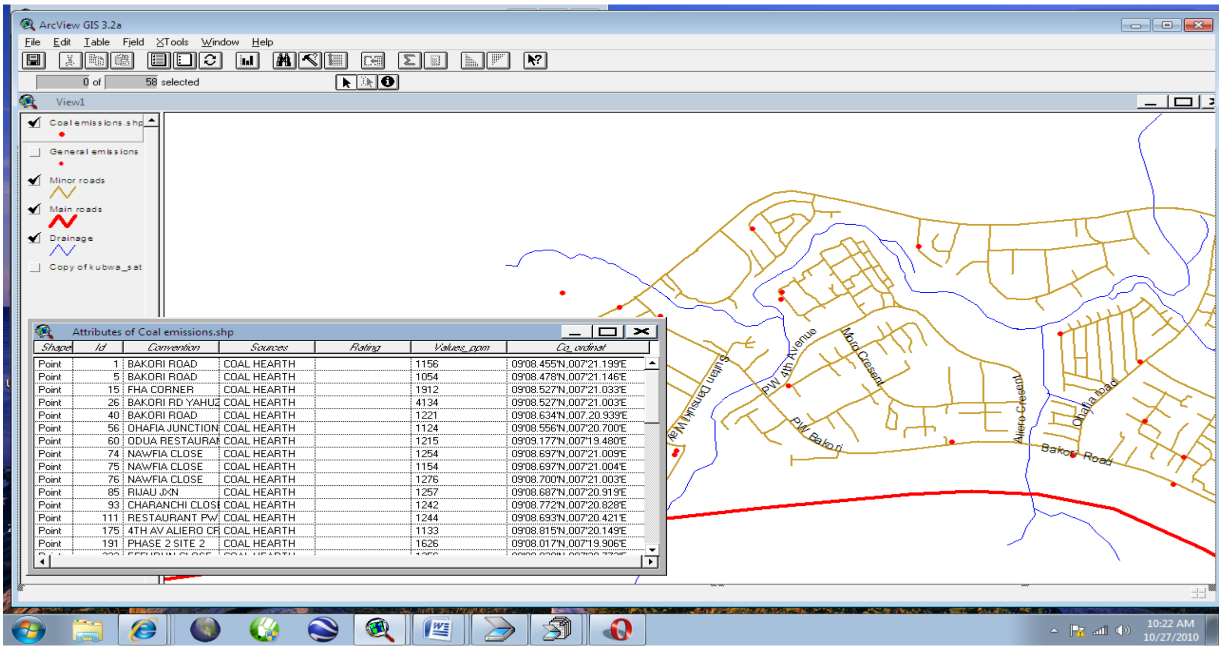


Fig. 5: Vector CO_2 emission map of study area

(Note that each of the red dots on this figure corresponds to an "active" source of carbon dioxide emission, representing the 1264 stations visited).

Several layer maps were also created for the different sources of carbon dioxide emissions for Central Kubwa, and these maps are shown as Fig.6 for coal-powered hearths, Fig.7 for diesel-powered generators, Fig.8 for kerosene-powered stoves, Fig.9 for petrol-powered generators, Fig.10 for stalling traffic points, and Fig.11 for wood-powered hearths. These layer maps show the distribution of the different sources of CO_2 emissions at Central Kubwa.

These sources of CO_2 were visually identified (the sources of atmospheric CO_2 are already known to most every science person). The CO_2 meter was employed to confirm if the sources truly emit CO_2 and by how much (please refer to the Appendix). The CO_2 were not necessarily "isolated" but their concentrations in the ambient environment in parts per million with respect to each source was what was measured.



Shape	Id	Convention	Sources	Rating	Values_ppm	Co_ordinat
Point	1	BAKORI ROAD	COAL HEARTH		1156	09'08.455'N,007'21.199'E
Point	5	BAKORI ROAD	COAL HEARTH		1054	09'08.478'N,007'21.146'E
Point	15	FHA CORNER	COAL HEARTH		1912	09'08.527'N,007'21.033'E
Point	26	BAKORI RD YAHUZ	COAL HEARTH		4134	09'08.527'N,007'21.003'E
Point	40	BAKORI ROAD	COAL HEARTH		1221	09'08.634'N,007.20.939'E
Point	56	OHAFIA JUNCTION	COAL HEARTH		1124	09'08.556'N,007'20.700'E
Point	60	ODUA RESTAURAN	COAL HEARTH		1215	09'09.177'N,007'19.480'E
Point	74	NAWFIA CLOSE	COAL HEARTH		1254	09'08.697'N,007'21.009'E
Point	75	NAWFIA CLOSE	COAL HEARTH		1154	09'08.697'N,007'21.004'E
Point	76	NAWFIA CLOSE	COAL HEARTH		1276	09'08.700'N,007'21.003'E
Point	85	RIJAU JXN	COAL HEARTH		1257	09'08.687'N,007'20.919'E
Point	93	CHARANCHI CLOSE	COAL HEARTH		1242	09'08.772'N,007'20.828'E
Point	111	RESTAURANT PW	COAL HEARTH		1244	09'08.693'N,007'20.421'E
Point	175	4TH AV ALIERO CR	COAL HEARTH		1133	09'08.815'N,007'20.149'E
Point	191	PHASE 2 SITE 2	COAL HEARTH		1626	09'08.017'N,007'19.906'E

Fig. 6: Layer map and corresponding table for coal-powered hearths

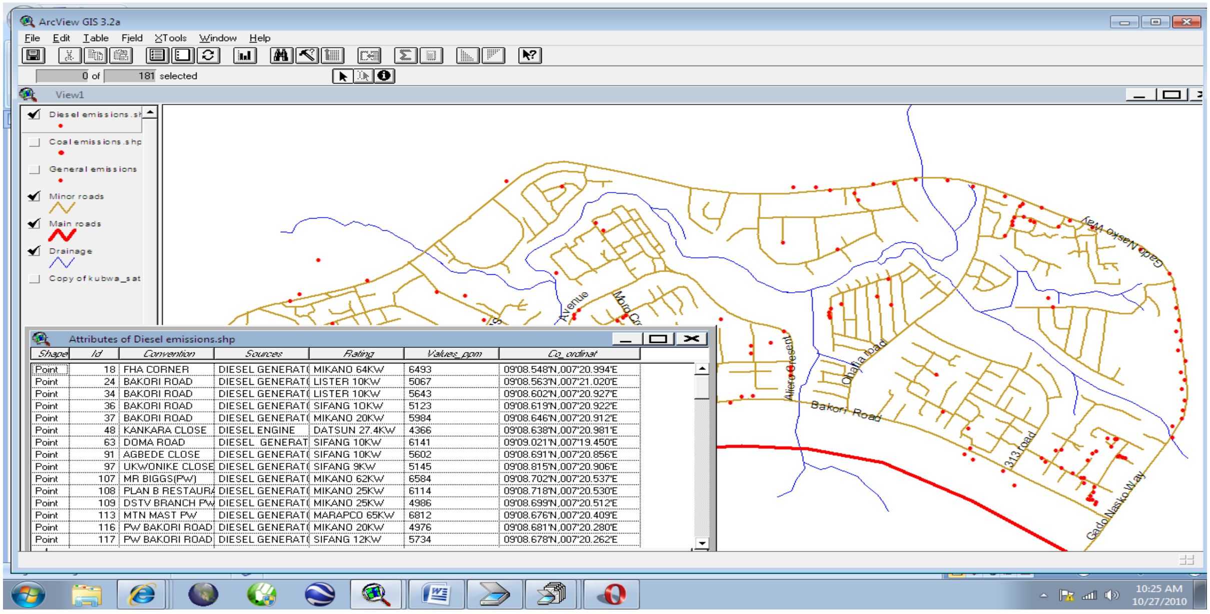


Fig. 7: Layer map and corresponding table for diesel-powered generators

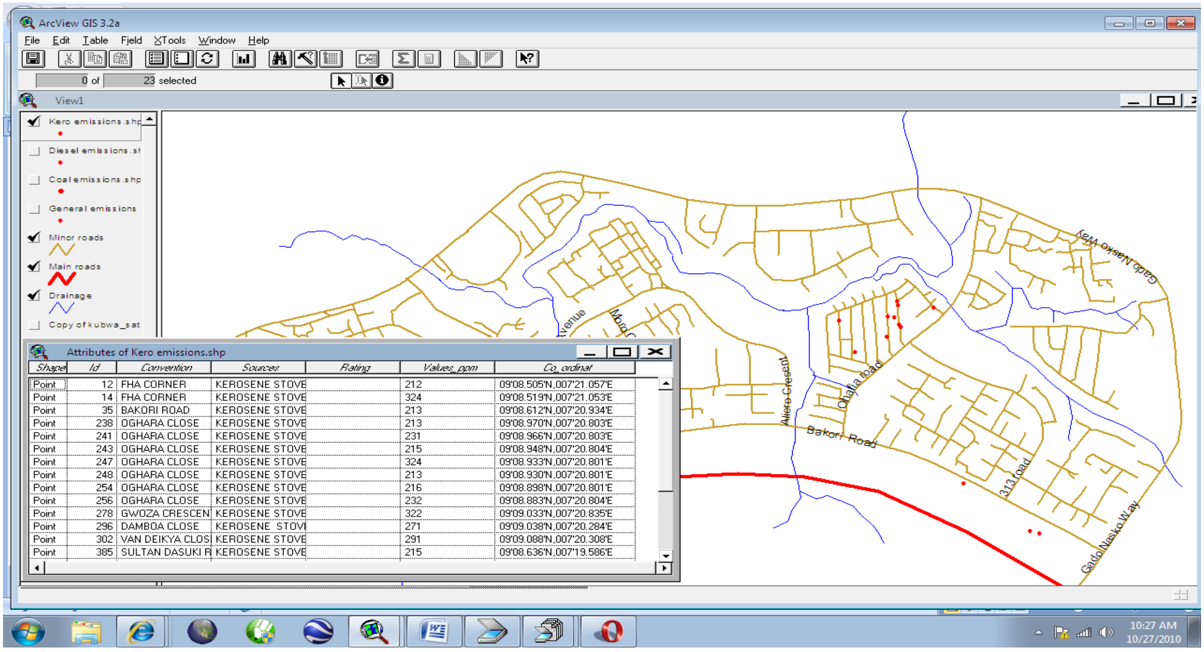


Fig. 8: Layer map and corresponding table for kerosene-powered stoves

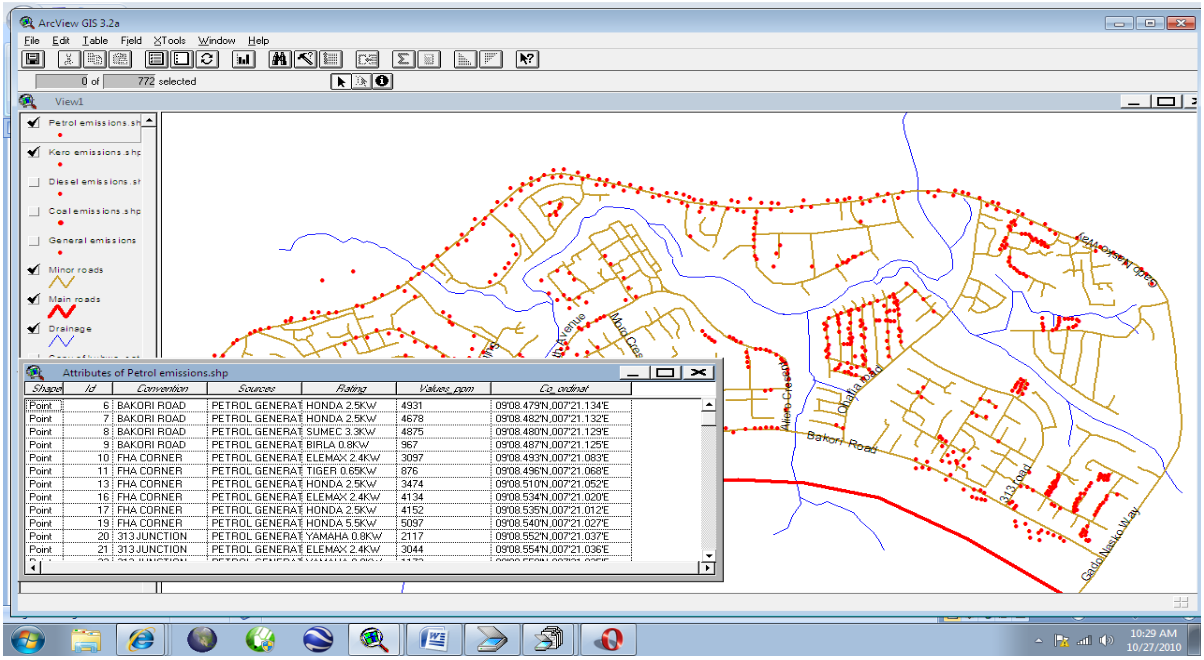


Fig. 9: Layer map and corresponding table for petrol-powered generators

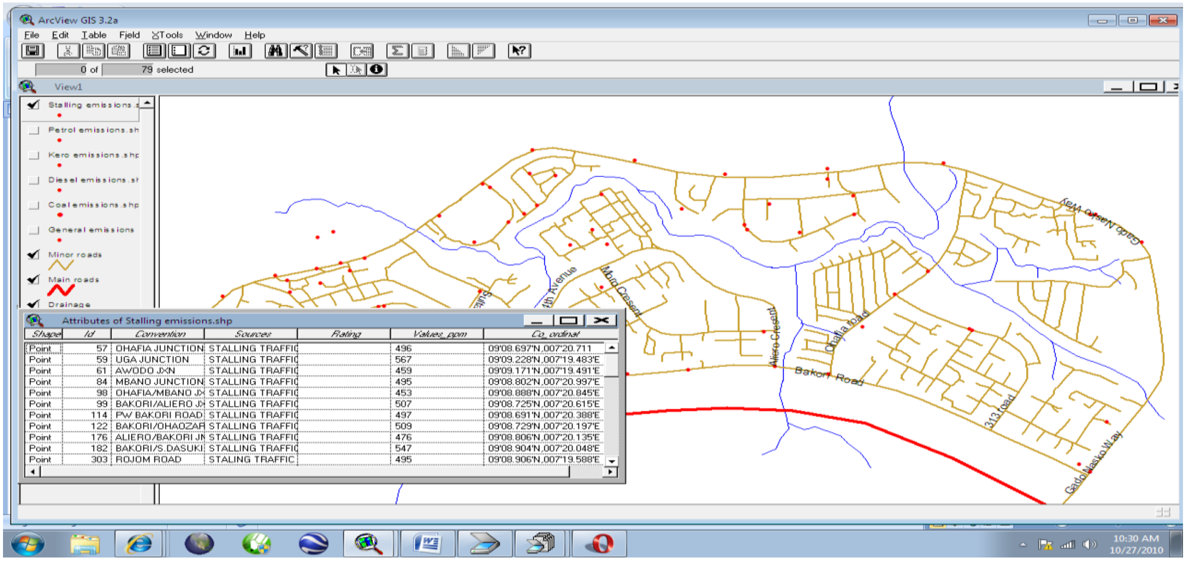


Fig. 10: Layer map and corresponding table for stalling traffic points

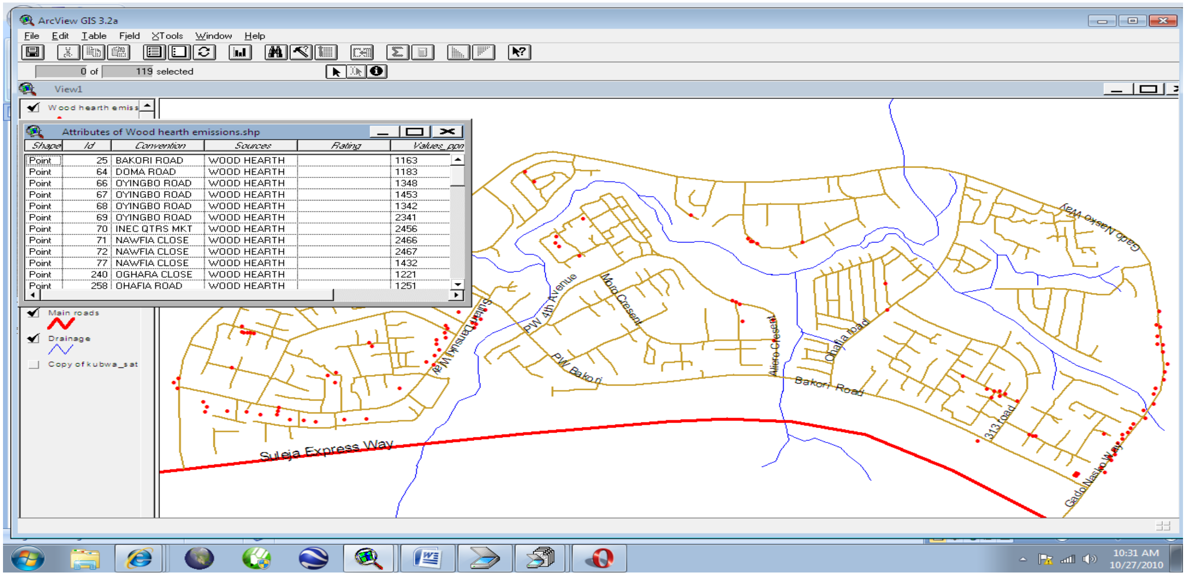


Fig. 11: Layer map and corresponding table for wood-powered hearths

The GIS application is characterised by a built-in user-interface coordination that gives it its interactive ability. The interactive nature of the application makes it possible for the points on the digitized map to be hot-linked to the full-bodied dataset of the study area. Each layer created has its own unique signature database. For instance, Fig.12 shows the result of the query procedure for Station 62 of the full-bodied dataset. All the pertinent infromation on that location can be viewed on the drop-down box.

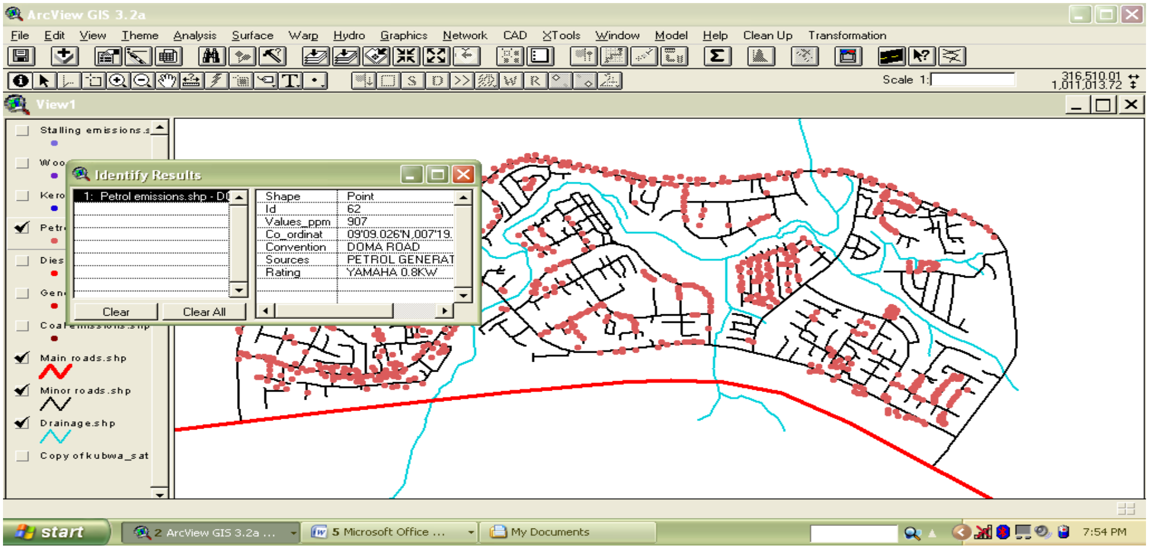


Fig. 12: Query procedure for station 62 of the dataset of study area

The carbon dioxide emission layer map of Central Kubwa is shown as Fig.13.

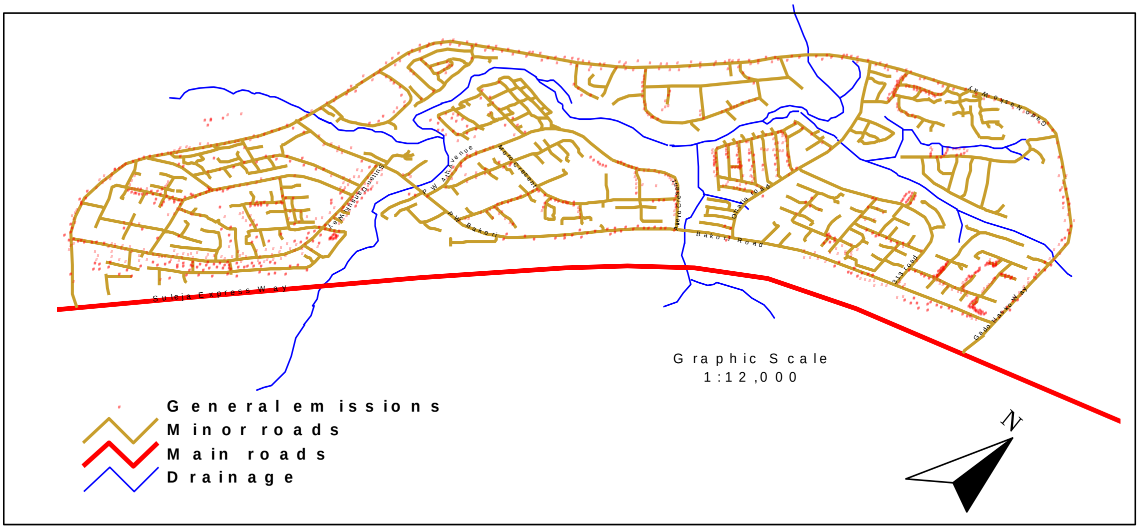


Fig. 13: Carbon dioxide emission layer map of Central Kubwa

The carbon dioxide emission overlay layer map of Central Kubwa is shown in Fig.14.

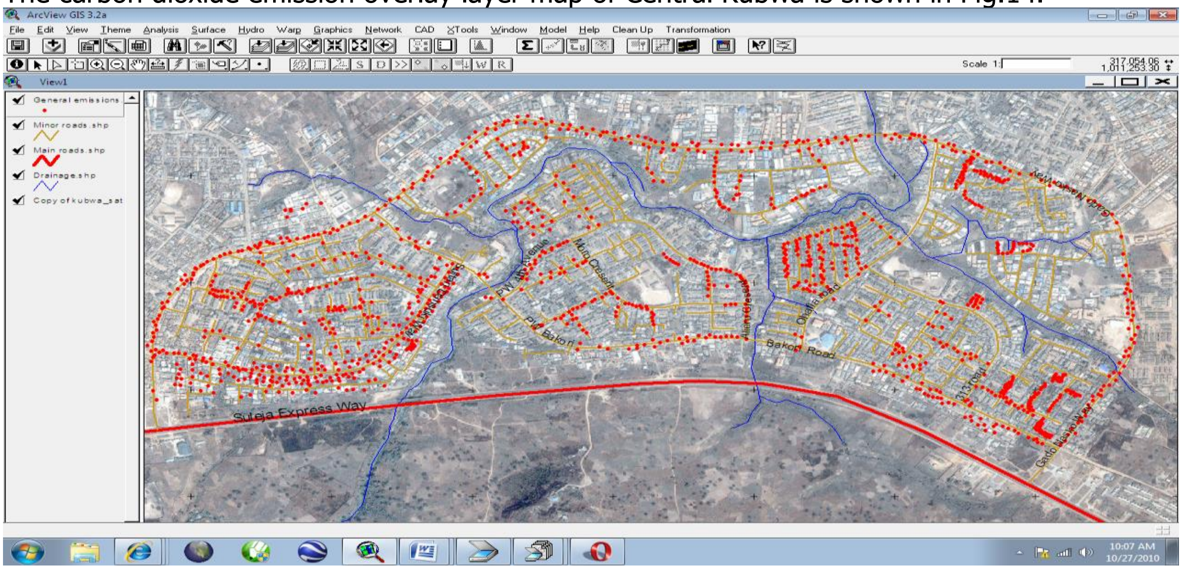


Fig. 14: Carbon dioxide emission overlay layer map of Central Kubwa

Discussion

Majority of the locations visited for this survey indicated ambient CO_2 levels above the 450 parts per million (ppm) threshold selected for this study (usually, "significant" CO_2 emission implies a range of values between 350ppm to 450ppm). Of the different sources of CO_2 identified for this survey, the petrol-powered internal combustion engines predominate. The GIS emission layer maps for this study show that the western segment of Central Kubwa is characterized by heavy red clusters, indicating a high CO_2 emission zone, whereas the red clusters are dispersed on the eastern sector, indicating a low CO_2 emission zone. The red colour scheme was used here because only stations with "significant" CO_2 emissions are presented

This novelty GIS-enabled, Windows-compatible, interactive CO_2 map of Central Kubwa is now a veritable planning tool in the hands of environmental monitoring auditors devoted to the issue of CO_2 emission. Appropriate intervention measures to reduce overall CO_2 emissions can now be inaugurated for the Central Kubwa province of Abuja, Nigeria.

Conclusion

Access to business premises was less restricted than access to private residential quarters, and this state of affairs can be observed in the emission layer maps. The western sector of Central Kubwa is obviously the business district while the eastern sector is mainly devoted to private residences. The CO_2 emission profile along the outer envelope of Central Kubwa (i.e. Gado Nasko Way) is prominent because, by necessity, businesses are clustered along this major road. Locations where diesel-powered generators are installed are the main culprit locations for CO_2 emissions. It can be deduced from this study that electricity supply to Kubwa province is not reliable, thus encouraging householders and businesses to depend on heavy CO_2 belchers for their electricity needs.

Acknowledgements

The authors wish to acknowledge the support of the Vice-Chancellor, Federal University of Technology, Minna, Nigeria, for making transportation available on the first day of the site selection and co-ordinate identification trip from Minna to Kubwa, a round trip of slightly over 300km.

References

Enger, E. & Smith, S. (2006). *Environmental science: A study of interrelationships (10ed.),* McGraw-Hill, New York (USA).

Jacobson, J. (2009). *Climate Warming Carbon Dioxide*, Stanford University, California (USA).

Keeling, C. D. & Whorf, T. P. (1999). *Atmospheric CO_2 records from sites in the SIO air sampling network.* In Trends: A compendium of data on global change, carbon dioxide information analysis centre, Oak Ridge National Laboratory, U.S.A.

Lloyd, J. 1999. The carbon dioxide dependence of photosynthesis, plant growth responses to elevated CO_2 concentrations and their interaction with soil nutrient status. II Temperate and boreal forest productivity and the combined effects of increasing carbon dioxide concentrations and increased nitrogen deposition at a global scale. *Funct. Ecol., 13, 439 – 459.*

Malhi, Y. & Grace, J. (2000). Tropical forests and atmospheric carbon dioxide. *TREE*, *15, 332 – 337.*

Ndoke, P., N., Uduak, G.A. & Kato, M. E. (2009). Contributions of vehicular traffic to carbon dioxide emissions in Kaduna and Abuja, Northern Nigeria. *Leonardo Electronic Journal of Practices and Technologies*, 9, 81-90.

Norby, R. J. (1999). Tree responses to rising carbon dioxide in field experiments: Implications for the future forest. *Plant Cell Environ*, *22, 683 – 714.*

Robinson, A. B., Baliunas, S. L., Soon, W., & Robinson, Z. W. (1998). Environmental effects of increased atmospheric carbon dioxide. *Journal of American Physicians and Surgeons,* 3, *171-178.*

Tanz, P. P., Fung, I. Y. & Takahashi, T. (1990). Observational constraints on the global atmospheric CO_2 budget. *Science, 247, 1431 – 1438.*

APPENDIX: Abridged Dataset of Study Area (57 of the 1264 stations of interest)

S/N	NORTH	EAST	CONVENTIONAL LOCATION	SOURCE	RATING AND MAKE (WHERE APPLICABLE)	CO_2 VALUE (ppm)
1	09°08.455'	007°21.199	FHA JUNCTION	COAL HEARTH		1156
2	09°08.461'	007°21.176	BAKORI ROAD	WOOD HEARTH		1096
3	09°08.465'	007°21.170'	BAKORI ROAD	GENERATOR (PETROL)	Yamaha 0.8KW	1198
4	09°08.473'	007°21.157'	BAKORI ROAD	GENERATOR (PETROL)	Yamaha 0.8KW	1198
5	09°08.478'	007°21.146'	BAKORI ROAD	COAL HEARTH		1054
6	09°08.479'	007°21.134'	BAKORI ROAD	GENERATOR (PETROL)	Honda 2.5KW	4931
7	09°08.482'	007°21.132'	BAKORI ROAD	GENERATOR (PETROL)	Honda 2.5KW	4678
8	09°08.480'	007°21.129'	SULTAN DASUKI RD	GENERATOR (PETROL)	Sumec 3.3KW	4975
9	09°08.487'	007°21.125'	SULTAN DASUKI RD	GENERATOR (PETROL)	Birla 0.8KW	967
10	09°08.493'	007°21.083'	FHA CORNER	GENERATOR (PETROL)	Elemax 2.4KW	3097
11	09°08.496'	007°21.068'	FHA CORNER	GENERATOR (PETROL)	Tiger 0.65KW	876
12	09°08.505'	007°21.057'	FHA CORNER	KEROSENE STOVE		212
13	09°08.510'	007°21.052'	FHA CORNER	PETROL	Honda 2.5KW	3474
14	09°08.519'	007°21.'053	FHA CORNER	KEROSENE STOVE		324
15	09°08.527'	007°21.033'	FHA CORNER	COAL HEARTH		1912
16	09°08.534'	007°21.020'	FHA CORNER	GENERATOR (PETROL)	Elemax 2.4KW	4134
17	09°08.535'	007°21.012'	FHA CORNER	GENERATOR (PETROL)	Honda 2.4KW	4152
18	09°08.548'	007°20.994'	FHA CORNER	DIESEL ENGINE	64KW	6493
19	09°08.540'	007°21.027'	FHA CORNER	GENERATOR (PETROL)	Honda 5.5KW	5097
20	09°08.552'	007°21.037'	313 JUNCTION	GENERATOR (PETROL)	Yamaha 0.8KW	2017
21	09°08.554'	007°21.036'	313.JUNCTION	GENERATOR (PETROL)	Elemax 2.4KW	3044
22	09°08.558'	007°21.035'	313.JUNCTION	GENERATOR (PETROL)	Yamaha 0.8KW	1172
23	09°08.561'	007°21.023'	313.JUNCTION	GENERATOR (PETROL)	Tiger 0.65KW	980
24	09°08.563'	007°21.'020	SULTAN DASUKI RD	DIESEL (GENERATOR)	10KW	5067
25	09°08.561'	007°21.020'	SULTAN DASUKI RD	WOOD HEARTH		1163
26	09°08.556'	007°21.005'	SULTAN DASUKI RD YAHUZA SPT	COAL HEARTH		4134
27	09°08.553'	007°21.008'	SULTAN DASUKI RD	GENERATOR (PETROL)	6KW	4563
28	09°08.568'	007°20.991'	SULTAN DASUKI RD	GENERATOR (PETROL)	5KW	3427
29	09°08.571'	007°20.985'	SULTAN DASUKI RD	GENERATOR (PETROL)	3.3KW	3433
30	09°08.579'	007°20.950'	SULTAN DASUKI RD	GENERATOR (PETROL)	Tiger 0.65KW	1023
31	09°08.591'	007°20.945'	SULTAN DASUKI RD	GENERATOR (PETROL)	Elemax 2.4KW	4533
32	09°08.595'	007°20.944'	SULTAN DASUKI RD	GENERATOR (PETROL)	Honda 5KW	5024
33	09°08.618'	007°20.924'	SULTAN DASUKI RD	GENERATOR (PETROL)	TEC 5.5KW	3306
34	09°08.602'	007°20.927'	SULTAN DASUKI RD	DIESEL(GENERATOR)	10KW	5643
35	09°08.612'	007°20.934'	SULTAN DASUKI RD	KEROSENE STOVE		213
36	09°08.619'	007°20.922'	SULTAN DASUKI RD	DIESEL(GENERATOR)	10KW	5123
37	09°08.646'	007°20.912'	SULTAN DASUKI RD	MIKANO DIESEL	20KW	5984
38	09°08.637'	007°20.914'	SULTAN DASUKI RD	GENERATOR (PETROL)	Sumec 3.3KW	3421
39	09°08.'621	007°20.927'	SULTAN DASUKI RD	GENERATOR (PETROL)	Elemax 2.4KW	3218
40	09°08.'634	007°20.939'	SULTAN DASUKI RD	COAL HEARTH		1221
41	09°08.659'	007°20.954'	KANKARA CLOSE	GENERATOR (PETROL)	Tiger 0.65KW	1032
42	09°08.663'	007°20.943'	KANKARA CLOSE	GENERATOR (PETROL)	Elemax 2.4KW	5087

43	09°08.664'	007°20.939'	KANKARA CLOSE	GENERATOR (PETROL)	5KW	3097
44	09°08.667'	007°20.936'	KANKARA CLOSE	GENERATOR (PETROL)	Elemax 2.4KW	3129
45	09°08.669'	007°20.931'	KANKARA CLOSE	GENERATOR (PETROL)	2.7KW	2494
46	09°08.675'	007°20.945'	KANKARA CLOSE	GENERATOR (PETROL)	Honda 2.5KW	2245
47	09°08.669'	007°20.956'	KANKARA CLOSE	GENERATOR (PETROL)	Tiger 0.65KW	1051
48	09°08.638'	007°20.981'	KANKARA CLOSE	DIESEL(GENERATOR)	Datsun 27.4KW	4366
49	09°08.645'	007°20.999'	KANKARA CLOSE	GENERATOR (PETROL)	TEC 6KW	3122
50	09°08.677'	007°20.998'	KANKARA CLOSE	GENERATOR (PETROL)	TEC 6.5KW	4543
51	09°08.650'	007°20.861'	WELDER BUS STOP	GENERATOR (PETROL)	Elemax 2.0KW	2196
52	09°08.651'	007°20.860'	WELDER BUS STOP	GENERATOR (PETROL)	Honda 2.5KW	2119
53	09°08.654'	007°20.859'	WELDER BUS STOP	GENERATOR (PETROL)	Sumec 6.5KW	3218
54	09°08.642'	007°20.847'	WELDER BUS STOP	GENERATOR (PETROL)	Elemax 5KW	4507
55	09°08.652'	007°20.812'	WELDER BUS STOP	GENERATOR (PETROL)	yamaha 0.4KW	786
56	09°08.687'	007°20.700'	OHAFIA JUNCTION	COAL HEARTH		1124
57	09°08.697'	007°20.711'	OHAFIA JUNCTION	STALLING TRAFFIC		496