

Urban Growth Air Pollution, CO, NO₂ and SO₂ Emission and COVID-19 in Kano Metropolis Nigeria

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Abstract- The study employed three primary pollutants CO, NO₂ and SO₂ within kano metropolis, Nigeria and volumetric traffic count conducted with the aid of gas sensing device by Crown Cone and GIS and RS used. CO sensed during covid-19 cut downs by 60.31.%, this is because of reduction in wood-fuel usage for domestic and light industrial purposes. Taludu Sulfur Dioxides (SO₂) emission record is 0.72 Ppm, Sharada junction depicts Nitrogen Dioxide (NO₂) record as 0.82 Ppm, while Taludu junction shows 19.0 Ppm carbon dioxide (CO). Taludu Junction is more likely to have air pollution effects in the future because, it is located between very densely ancient Kano city and densely industrial land uses. In addition, the primary pollutant emissions are shown to be very high within 2:00PM and 4:00PM. It is the volumetric traffic movement and it is the closing period for offices and some businesses and industries. It is also the period of shopping for domestic purposes. Covid-19 in Kano metropolis is more connected to housing and population densities, overcrowding, insufficient ventilations and lighting in highly overcrowded areas which affects environmental quality. There is strong need for urban growth framework development in KNMA to guide in mitigating environmental challenges.

Keywords –Urban Growth, Air Pollution, Covid-19, Primary Pollutants, Kano Metropolis

I. INTRODUCTION

[1], the infectious and communicable disease (COVID-19) which originated from the city of Wuhan has presently become global issue. [2], coronavirus originated from Wuhan and the communicable disease Covid-19 spread across the globe. [3], covid-19 takes its origin from Wuhan China in the early December, 2019. [4], Covid-19 has generated uneasy globally, this is because of its spontaneous rate of spreading. [5], coronaviruses are non-segmented envelop positive -sense RNA viruses and it falls in coronaviridea. [6], SARS-CoV-2 is closely and structurally very

close and like SARS-CoV. It damages and destroys nervous system. [7], the pandemic was first called as novel coronavirus (2019-nCoV) by world health organization (WHO), while it was named as SARS-CoV-2 by coronavirus study group international. [8], covid-19 outbreak in China attracted global attentions. [9], there is global covid-19 outbreak currently going on across the world. [10], covid-19 rapidly grows in South Korea [11], covid-19 is now a global phenomenon that spread across the countries. Rampal and Seng (2020), Malaysia reports its first covid-19 case on the 25th January, 2020.

II. COVID-19 and Urban Growth Challenges

2.1 Preventives and Mitigating Covid-19 Strategies

[1], lockdown as a preventive measure was employed by most nations of the world. Although, lockdown strategies has significant impacts on socioeconomics of man. [12], the rapid spread of covid-19, Spanish government introduced social distances a fortnight after then epidemic started. The measures decrease daily cases by 3.059% and later to 5.11%. Scholars concentrate and focus on covid-19 with references to its mitigating measures, proactive treatments [13]. [14], social distances will play significant roles as mitigating strategy of covid-19. [15], government of the Chinese stipulated guidelines spelt-out that, discharge patients also required two additional weeks of isolations at the at their designated domain. This is to follow further chest CT and nucleic acid testing examinations. [16], Republic of Ireland employed these technologies as sterilization, smart communication, bespoke of production of PPE. [6], its immune mechanism medicinal plant may possibly be efficient and effective together with potential drugs in India. [17], lower and middle-income nations desired financial and technical supports to response to covid-19 sufficiently.

[18], the lockdown strategies cut down China's carbon emission by 25% and NO₂ emission by 30%. [19], serostatus could aid in tackling covid-19 and its related negative implications on the economics sector especially, in large population, it could be very effective serological testing. [20], control and preventive measures within hospital premises are essentially integral for mitigating spreads of covid-19. [21], it is highly essential an integral for African nations particularly Nigeria to proactively utilizes the available and preventive but mitigating measures to tackles covid-19. [22], satellite observation globally indicates that, lockdown result to significant cut down in air pollution. [2], Chinese government closed transportation sector in and out of Wuhan City. [23], geographical information system (GIS) could be used in Pakistan in Covid-19 evaluations, this is because it could conveniently locate geographical locations. [24], covid-19 lockdown strategy improves water bodies quality especially for the lakes employed for this study. [25], lock down as covid-19 preventive strategies and quarantine could be model precisely. Quarantine period required kin and careful attentions as it could equally results to the spreads of the covid-19.

2.2. Covid-19 and Air Pollutions

Positive environmental effect of the lockdown is that, it significantly cuts down environmental pollution of Wuhan, Spain, USA together with Italy as the epicenter pollution by approximately 30% [1]. [26], temperature average and minimum together with air quality significantly are correlated with covid-19. [18], air pollution contributed greatly in covid-19. [27], the study uncovers that, there is negative correlation directly with daily death count of coronavirus with regards of absolute humidity in Wuhan. [28] comment that BC and NO₂ significantly dropped and reduced by 50% in its concentration, while the study unveils that O₃ significantly rose by precisely 50%. Urban air quality substantially improved the first two weeks of the lockdown, thereby air pollution significantly decreased. Temperature in the city and the contamination of isolation increases the concentration of O₃. [29], humidity and temperature indicate no connection with covid-19 negatively. Regional countries with humidity and temperature very low are to take proactive measures and careful attention. [29], the study focuses on evaluation and correlation of an average temperature (AT), humidity (ARH) with daily cases of covid-19 pandemic report within thirty selected Chinese province. Sahin(2020), there is strong correlation between population and weather with the epidemic covid-19. [1], Reduction in transportation and energy consumptions in these countries are tabulated as stated in table 1 below.

Table 1 indicating NO₂ Reduction During Covid-19

S/N	Countries	Percentages of Reduction of NO ₂
1	Spain	20-30
2	France	20-30
3	China	20-30
4	Italy	20-30
5	USA	20-30

Sources: Muhammad, Long, and Salman

[30], covid-19 is highly communicable diseases speed up by weather conditions. [23], the research reveals approximately air pollution in China related cases cause 4,000 death daily but the lockdown strategies employed cuts this down its daily death toll of air pollution. [31], atmospheric pollution influences the spreads rates and mortality rate in the outbreak of covid-19. [32], the study uncover rapid decline in NO₂ as shown by satellite data in the environment and significant reduction in energy consumptions and NO₂ emission as a result of economic activities. This therefore improvement in the global air quality is directly connected with short term of global reduction in emission. [33], outdoor air pollution caused adverse respiratory infectious disease in man. [34], PM_{2.5} cut downs in its concentrations by 21%, CO₂ by 49%, while 35% is for NO₂, O₃ increase by 15%. [35], increase in solid generations, and reduction at the rate of recycling processes and decrease in GHGs emission supports clean environment during covid-19. [36], temperature with AQI between 10-20°C promotes more cases of covid-19 while humidity in relation to covid-19 spreads is relatively higher. AOI therefore influences Covid-19 in cities. [37], humidity has opposing correlation with covid-19 rate of spreading outbreaks. Solar radiation on the other hand affects the survival rate of covid-19 viruses [40], the study indicates cut down in CO concentrations by 64.8% within central business district (CBD), while NO along roads, its concentrations drops by 77.3% but O₃ significantly increase by 30%.

2.3. Aims of the Covid-19 Related Scholarly Works

[12], the work focuses on the appraisal of Spanish government control measures for control and mitigation of covid-19. The study uses algorithm base information from patients, geographical location and climate condition affects specifically, the variability of covid-19 across the globe [4]. [39], the papers focuses on the application of data-driven estimation methods such as (ISTM) long short -Term memory for the intelligent guessing and predicting cases of covid-19 in India. [12] the two major parameters employed are new and discharge cases. The paper dwells on relationship between covid-19 and weather conditions focusing on nine selected cities of Turkey. Three applicable parameters employed are wind speeds in (mph), dew point in (°C) and temperature in (°C) and humidity in (%). [26], the study concentrates on the climate impacts with reference to its indicators on covid-19 epidemic in New York city of USA. [40], there is strong correlation of covid-19 with very densely populated urban area in relation to very dense population connection with air population. [41], the paper dwells on the online mental health services perspective in China. [42], the work focuses on the relevant literature globally on covid-19, ranging from academic journals, related organizations, and companies. [43], the study dwells in data generated from European countries and China and it employed simulation with the aids of cumulative distribution functions (CDF) in evaluating SAR-CoV-2. [44], the study focuses on Covid-19 air born disease transmission and air sample of SARS-CoV₂ in Iran samples were taken in the biggest hospital for the study. [29], the paper dwells on finding connection between weather conditions and covid-19.

[45], the research concentrates on the covid-19 children infections in Malaysia specifically four cases of pediatrics. [03], paper focuses on within the scope of infodemic predicaments of happening in China within December 2019 through February 2020. [46], the paper dwells on the antibiotics prescriptions conditions and its rate of effectiveness specifically used by patients in Japan. [47], the paper aims at covid- outbreak growth rate within scope of its rapid communicable. Daily case report was the solid foundation of the study. [48], the study deals with the evaluation of reproduction numbers in relation to real time effectiveness. [49], the research aims at evaluating in Japan direct influence of temperature on covid-19. [50], the article dwells directly on covid-19 control and mitigation preparedness, its responses as well its transmissibility within the management institutions in Kenya. [31], the research handles and assesses the wide gaps for future academic studies. [51], the study focuses on the mitigation measures employed by Senegal, South Africa, Democratic Republic of Congo and Egypt. [52], the paper dwells on the statistical mortality of covid-19 rates within the African Nations.

2.4. Covid-19 and Human Sociology and Environment

[39], covid-19 has indeed generated high level of risk to man. [13], covid-19 has great global effects and implications. [15], government of the Chinese stipulated guidelines spelt-out that, discharge patients also required two additional weeks of isolations at the at their designated domain. This is to follow further chest CT and nucleic acid testing examinations. [53], there are insufficient testing diagnostics equipment for covid-19. [16], covid-19 personnel and protective equipment (PPE) is highly essential in mitigating and working for its solution. Present and most of the sterilization available technologies are not in conformity with and are not very suitable for the processing PPE. Covid-19 severely affect the respiratory track as an infectious disease [16]. [54], the study shows secondary communicable of covid-19 within a household with infected patient account to 30%. While 38% for specific house with 1 patient, 50% for specific house with 2 patients, 31% for specific house with 3 patient contacts. [55], the economic cost of covid-19 to the world economy is approximately \$ 1 trillion in the year 2020. [56], covid-19 brought these environment consequences and huge clinical solid waste generation, and water and air quality improvement.

[57], covid-19 poses global challenges with regards to its unclear treatment therapy with dramatic increase of its patients. [58], covid-19 affected major urban centers in China and it spreads from Wuhan. [59], spelt out that world health organization (WHO) comment that about 87% of African countries face annual epidemic once annually, while 45% of the African continent countries face and experience epidemic twice annually. [60], covid-19 outbreak is now a global issue affecting all regions of the world. [61], Kingdom of Saudi Arabia announces the suspension temporarily of Umrah together with visitation of the holy Prophet Mosques. While Tokyo Olympic games is scheduled from 24th of July, 2020. [62], covid-19 is seen and declared by world health organization (WHO) as a global issue. [63], restriction in travelling significantly affects labor force across the globe. Thereby workforce effects together with huge loss of jobs across the sector of the economics. [64], covid-19 consists both global health and severe socio-economic global impacts. [23], covid -19 epidemic results to international public health issues concerned. [37], types of population densities has direct connections with covid-19 rate of spreads. [65], covid-19 epidemic like may likely results from wildlife market that operate illegally in India, although, this may not be the only prime cause for the epidemic. [66], covid-19 spread is directly affected by socio-economic factor. Each mega city has specific major influencing factor affecting the spreads of covid-19.

2.5. Urbanization and Environmental Pollution and Covid-19

[67], the study utilizes bicycle as an instrument in the assessment of black carbon (BC) and PM_{2.5} accumulation and concentration in moderate city of southern Brazil. [68], the study focuses and utilizes the usage of bicycles air pollution accumulations was evaluated with a lane with specification of carbon black (BC). It uses a parameter indicator of combustion of fossil fuels. [69] scholars comment that world health organization WHO stated that there are over 4M recorded and confirmed cases of covid-19 within 215 nations. [70], the study makes intelligent comparison of in-cabin air pollution of technologies of different buses in the city of Curitiba Brazil. [71], the study dwells on the persistence toxic substance (PTS) in relation to its emission in south America. [72], the study employed dynamic land ecosystem model (DLEM) depicts very weak of China grass land in sinking carbon between 1961-2000 integrated four parameters land uses, ozone, climate and carbon dioxides. [73], the study employed two methods to evaluates direct effects of mixture of pollutants on plants. [74], global rapid urbanization process has direct effects on carbon dynamic in relation to the terrestrial effects on the atmosphere CO accumulation on the climate. [75], the study dwells on air pollution, air quality and environmental protection to mention few. [76], the study unveils that carbon accumulation and its sequestration rate declines over period with ecosystem in urban areas. [77], the immune system of marine wildlife is affected by pollutants effects. [78], the study covers low concentration in biota in most cases. [79], impact of contaminants on both human and the environment could be bio-monitor with the aid of raptors as sentinels. [80], persistence organic pollutants (POPS) and mercury (Hg) have great health effects. [81], the study indicates ground-level ozone (CO₃) levels in rural areas are far above in the urban centers nearby. [82], the study reveals very high accumulation and concentration of ozone (O₃) reduces carbon fixation the indigenous plants. The study focuses on the CO and NO₂ emission in Kano metropolitan area Nigeria [83]. This offset CO₂ and N deposition in its elevations. [84], ground level ozone layer (O₃) is considered as the major air pollutant in the southern Europe, this is because of its concentration reduction of SO₂ and climate reason. [85], solar radiation and very high temperature at Mediterranean basin region and result to air pollution particulate of very high level ozone. [86], the study focuses on tree reactions to climate variation and pollutions within O₃ interaction, draught, and nitrogen deposition among other. [87], the study dwells on the roles of green infrastructure

in the removal of air pollution in the urban forest of Florence. [87], urban forest provides essential services to the urban processes through regulation of temperature, purification of pollution of air, inter-capping noise, water runoff control and provides recreational opportunities.

2.6. Covid-19 African Countries

[88], world health organization states that covid-19 covers 46 out of the total 47 nations of Africa with total 2, 475 cases across the countries as on 25th March 2020. Chad, [89], African continent faces insufficient health facilities and the social distance implementation. [52], world health organization (WHO) declares covid-19 as a pandemic on the 11th March 2020. When the declaration was made, African countries reported very few cases. [52], strong business and air traffic for tourists between Africa and Europe results to the early cases of covid-19 on transmission to African nations. First case was reported and recorded in Egypt on the 14th February 2020. Nine South Africans came back from Italy and all were later confirmed covid-19 positive. [90], the technologies, skills and expertise used in African for Malaria, HIV and tuberculosis could be employed for covid-19. Forty-three African countries had the capabilities and capacities of testing and diagnosing covid-19 by the mid of March 2020. [91], covid-19 infections started from interactions of Nigerian with infected Italian. [88], states the starting dates cases reports across Africa.

Table 2 demonstrating African Countries with Covid-19 first Report Days

S/N	Countries	Dates of First Cases	S/N	Countries	Dates of First Cases
1	Nigeria	27 th February,2020	10	Ethiopia	13 th March, 2020
2	Senegal	1 st March,2020	11	Gabon	13 th March, 2020
3	Morocco	2 nd March,2020	12	Guinea	13 th March, 2020
4	Tunisia	2 nd March,2020	13	Kenya	13 th March, 2020
5	South Africa	5 th March,2020	14	Mauritania	13 th March, 2020
6	Burkina Faso	6 th March,2020	15	Namibia	13 th March, 2020
7	Congo	1 ^{0th} March,2020	16	Rwanda	13 th March, 2020
8	Ivory Coast	11 th March,2020	17	Sudan	13 th March, 2020
9	Ghana	12 th March,2020			

Source: AbdulAzeez, 2020.

Other countries with report cases in Africa include Angola, Chad, Benin, Congo, Cape Verde, Côte d'Ivoire, Liberia, Central A/Republic, Seychelles, and Somalia. The study indicates as back as 14th March,2020. Libya is the only African country without covid-19 report of cases.

2.7. COVID- 19 in Kano Metropolis Nigeria

Nigeria as at 29th May is the third countries with total confirmed cases 9302, with total discharged of 2697 with total death 261 [92]. While the Kano state confirmed cases of 942, with total discharged recovered patients of 192. Kano State records 41 death. Kano State is the second in Nigeria with regards to Covid-19 cases in Nigeria after Lagos state (NCDC, 22nd May 2020). The state hierarchy according to [93]. This study considered the first top ten most recorded cases states in Nigeria as uncovers by the [93] to support the study, Kano state therefore is the second largest with records cases of covid-19 and it is the second with Covid-19 cases in Nigeria.

Table 3 showing States in Nigeria with Covid-19 Cases

S/N	Sates	Confirmed Cases	S/N	States	Confirmed Cases
1	Lagos	3224	6	Jigawa	241
2	Kano	883	7	Bauchi	230
3	FCT	447	8	Oyo	199
4	Katsina	308	9	Ogun	196
5	Borno	247	10	Kaduna	179

Source: NCDC, 22nd May 2020.

Kano state, Covid-19 cases is paramount in the Kano metropolitan area (KNMA) where the metropolis accommodate more than five million dwellers. The interaction between Kano metropolitan dwellers with the

physical environment with references to air pollution and covid-19 is the focus of the study. The study therefore aims at evaluating the effect of primary pollutants SO₂, NO₂, and CO with on- going covid-19 cases in the metropolis.

III. METHODOLOGY AND STUDY AREA

The study employed three primary pollutants assessment within kano metropolis, Kano State Nigeria. The primary Pollutant are sensed and recorded carbon dioxide (CO), Nitrogen Dioxide (NO₂) and Sulfur Dioxides (SO₂) with the aid of gas sensor by Crown Cone. Volumetric traffic count was also conducted within the metropolis. Volumetric traffic count was conducted along seven (7) major junction across the entire metropolis and Covid-19 cases were obtained from NCDC Nigeria and relevant literatures. Kano Metropolis is geographically located within Latitudes 12 ° 25¹ N to 12 ° 40¹ N and Longitude 8° 35¹ E to 8° 45¹ E. It is the most developing and urbanizing cities and commercial centre of the Northern Nigeria. Kano metropolis population is projected to reach 5,724,000 people by 2025. Major cities of Kano and Lagos together with other major cities has an annual urbanization of 3.61% within 2015 and 2018. It is highly crowded with 1000 people per Square kilometre (KM²) and its climate is wet and dry base on Koppen's classifications [94], [95], [96], [97], and [98]. GIS and RS are employed for the study for the locational map of the Kano metropolis indicating the selected junctions used for the air pollutant sensing and recording.

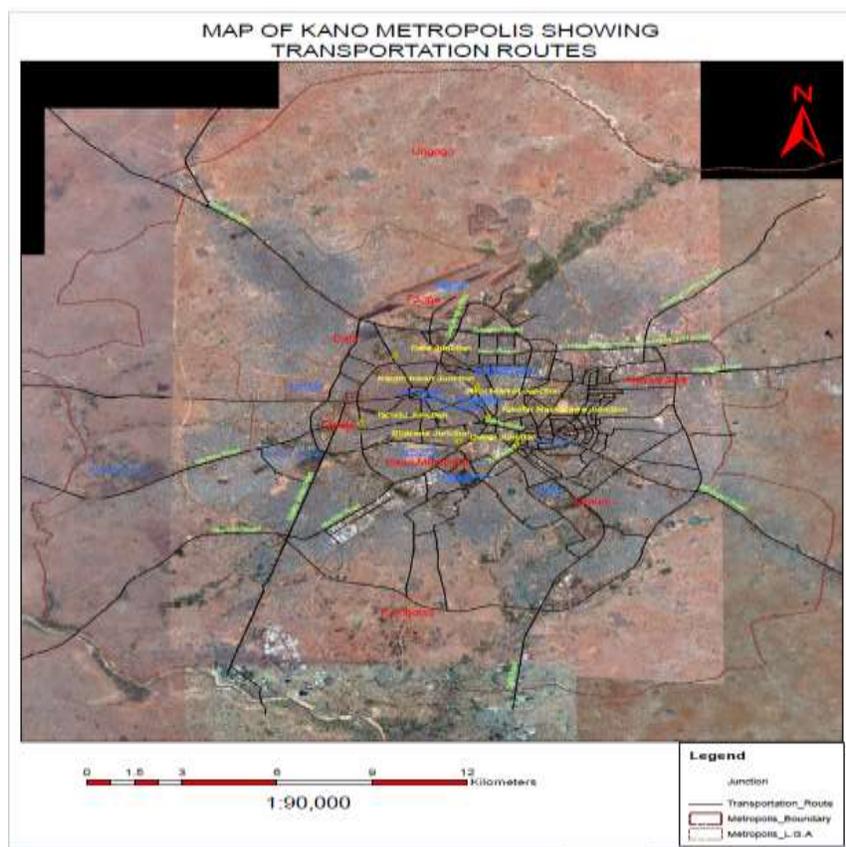


Figure 1 Indicating Selected Junction in the Metropolis

III. DATA ANALYSIS

Table 4 depicting Sulfur Dioxide (SO₂) Sensed Records in Kano Metropolis

Time	K/Market Junction	K/Nasarwa Junction	Tal'udu Junction	Sharada Junction	Dangi Junction	Rimi Market Junction	Gidan Malam Junction	Averages
	SO ₂	SO ₂	SO ₂	SO ₂	SO ₂	SO ₂	SO ₂	
8:00AM	00.2	00.2	00.5	00.3	00.2	00.2	00.3	0.27
12:00AM	00.3	00.5	00.6	00.5	00.4	00.5	00.5	0.47
2:00PM	00.4	00.6	00.9	00.6	00.6	00.6	00.6	0.61
4:00PM	00.7	00.7	00.9	00.7	00.8	00.7	01.0	0.79
6:00PM	00.4	00.5	00.7	00.6	00.6	00.5	00.6	0.56
Averages	0.40	0.50	0.72	0.54	0.52	0.50	0.60	

Looking at the table 4 carefully, it could be seen that Taludu Junction records is the highest across the junctions with precisely an average daily record of 0.72 Ppm. The result indicates Gidan Malam Junctions is the second with average daily records of 0.60 Ppm. Additionally, Kwanan Nassarawa, Sharad and Dangi Junction demonstrate average daily records above 0.50 Ppm. The study indicates only Rimi Market Junction shows exactly 0.50 Ppm. Additionally, the average of daily Sulfur Dioxide across the sampled junction based on the time of sensing and recording depicts slightly different trends. Records of 4.00PM is the most significant with 0.79 Ppm. This is because, it is the most traffic volumetric movement. It is the closing period for offices and some businesses especially services industries like Banks. It is the period of shopping for domestic purposes and it is the period for inter-local governments and intern-state goods conveyance as Kano metropolis the most commercially active metropolis in African continent. 6:00 PM is the most indoor pollution emission through cultural daily heating and cooling. The indoor air pollution therefore affects the outdoor especially in high densely polluted areas in the metropolis.

Table 5 revealing Nitrogen Dioxide (NO₂) Sensed Records in Kano Metropolis

Time	K/ Market Junction	K/Nasarawa Junction	Tal'udu Junction	Sharada Junction	Dangi Junction	Rimi Market Junction	Gidan Malam Junction	Averages
	NO ₂	NO ₂	NO ₂	NO ₂	NO ₂	NO ₂	NO ₂	
8:00AM	00.3	00.3	00.3	00.4	00.4	00.4	00.4	0.31
12:00AM	00.5	00.5	00.5	00.7	00.5	00.6	00.5	0.54
2:00PM	00.6	00.6	00.7	00.9	00.7	00.7	00.6	0.69
4:00PM	00.7	00.7	00.9	01.5	00.8	00.9	00.8	0.90
6:00PM	00.5	00.5	00.6	00.6	00.6	00.6	00.6	0.57
Averages	0.37	0.52	0.60	0.82	0.60	0.64	0.56	

Looking at the table 5 carefully, it could be seen that Sharada Junction records is the highest across the junctions with precisely an average daily records of 0.82 Ppm Nitrogen Dioxide (NO₂). The study also shows Rimi Market maintain its second position on the daily averages Nitrogen dioxides emissions with 0.64 Ppm. The result indicates Taludu Junction and Dangi Junctions are the thirds with average daily records of 0.60 Ppm Nitrogen oxides sensed records. Looking at the table again, it could be seen that Kwari market Junctions maintain the least also across junctions because (0.37 Ppm), it is located in the ancient Kano City with the most densely populated area with insufficient parking spaces and connectivity with other major points within the metropolis. Long lasting traffic hold up prevent motorist patronizing the area thereby affecting its nitrogen oxides emission. Looking at the Nitrogen sensing periods, 4:00PM maintain the same trend with the exactly 0.90 Ppm. This is because of the stated influencing factors above. Figure 2 shows SO₂ and NO₂ emission comparison in the study area.

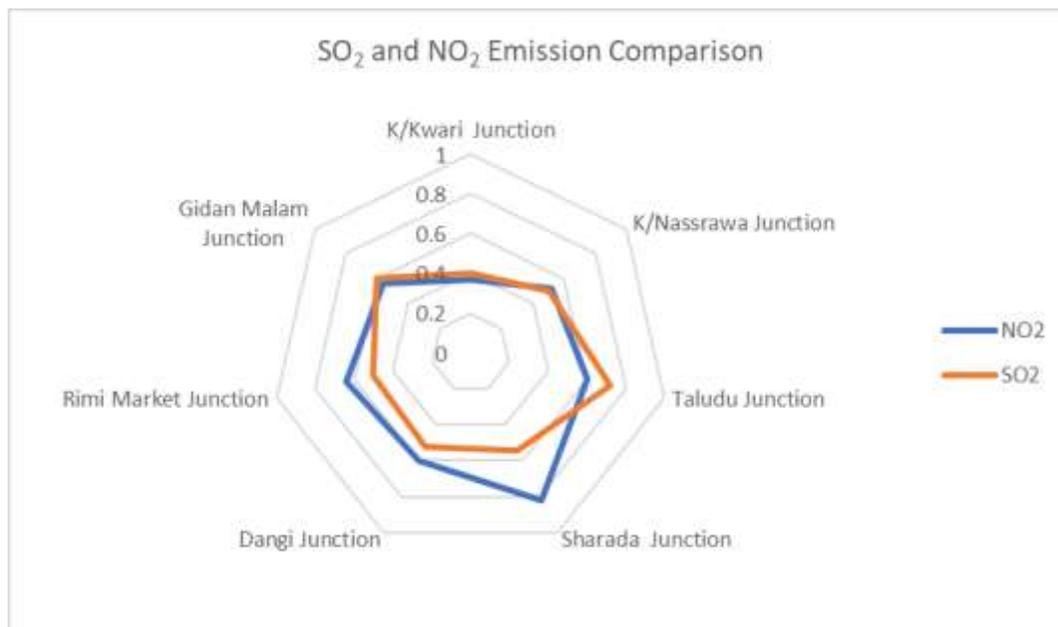


Figure 2 Demonstrating SO₂ and NO₂ Emission Comparison in the Metropolis

Table 6 portraying Carbon monoxides CO Sensed Records in Kano Metropolis

Time	K/Market Junction	K/Nasarawa Junction	Tal'udu Junction	Sharada Junction	Dangi Junction	Rimi Market Junction	Gidan Malam Junction	Averages
	CO	CO	CO	CO	CO	CO	CO	
8:00AM	009	009	008	009	010	007	009	8.7
12:00AM	010	010	010	012	012	012	013	11.6
2:00PM	018	017	028	021	016	021	020	20.1
4:00PM	018	019	030	029	019	024	025	23.4
6:00PM	014	014	019	018	014	015	017	15.9
Averages	13.8	13.8	19.0	17.8	14.2	15.8	16.6	

Considering the table 6 above, the average daily records of carbon monoxide, Taludu Junction records an average of 19.0Ppm as the most significant records, Gidan Malam Junction follows with exactly, 16.6Ppm. Kwari Market and Kwana Nasarawa Junctions are the least polluted. Looking at the timely average records, carbon monoxides (CO) also maintain the train like SO₂ and NO₂. 4:00PM is has the lease air pollution indicator (API), follow by 2:00PM with 20.1Ppm. 8:00 AM records the lease. Figure 3 Illustrates CO emissions per each of the sample junctions in the metropolis

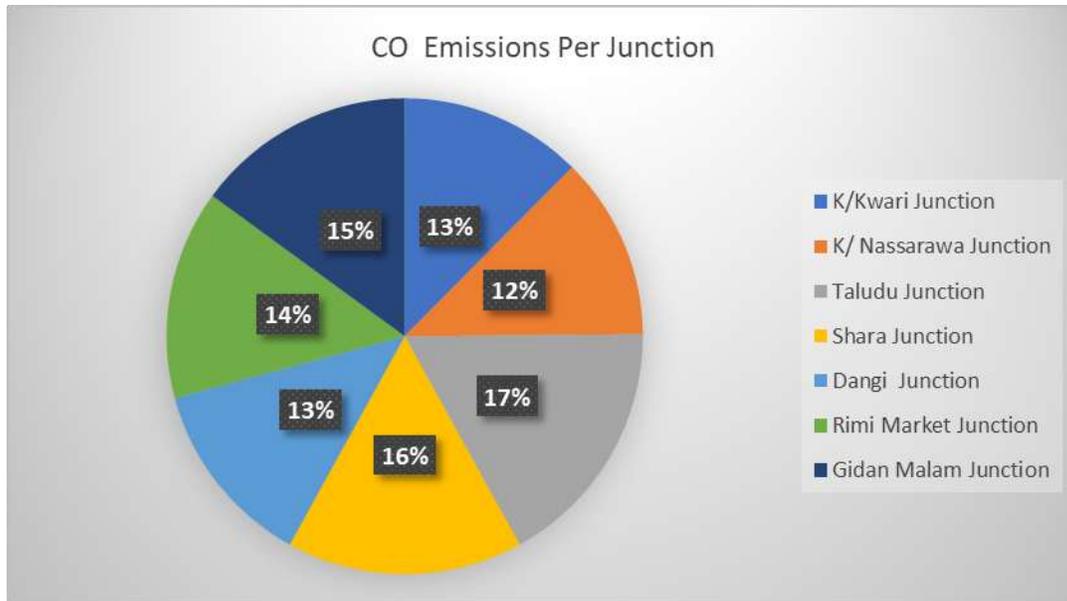


Figure 3 Illustrating CO Emissions Per Each of Selected Junction in the Study Area.

Table 7 indicating July Traffic Count Records

Table 7 provides the volumetric count conducted for the study. The first count was conducted, and the result indicates that tricycles is the most dominant and popular modes of transportation within the metropolis looking at the daily average records across the junctions employed for the study. This is because of it convenient and time saving is the most pivotal factor. It records 13,487 tricycles. Looking at the table 7 again, it could be seen that motorcycles maintains the second position 7443 motorcycles with relatively very close margin with car/lorries that records 7271 cars/lorries. Tarauni Dangi Junctions also indicates 1542 vehicles as the top records while Kombotso local government Sharada junction records the highest vehicular frequency of 1,533 also. The result demonstrates Kwari junction is the lease with 1227 vehicles. Figure 4 demonstrates tricycles records as the dominants within Kofar Wambai market in the metropolis.



Figure 4 Depicts Tricycles as the Most Popular within Kofar Wambai Market in the Metropolis

Figure illustrates the popularity of tricycles in the metropolis. This is because of it convenience, economy. The sizes of the tricycle help transporting passengers, goods, and services from one geographical location to others. This creates large job opportunities to the youth especially and generates revenue to the authorities. The less fossil fuel consumption thereby reduces rate of pollutant emission.

Table 8 Showing August Traffic Count Records

Daily Volumetric Traffic Count 6:00 AM to 6:00 PM					
Local Government Areas	Junctions for the Study	Cars	Tricycles	Motorcycles	Averages
Tarauni	Dangi	1228	1299	1186	1238
Nasarawa	K/Nasarawa	1808	3,399	1989	2399
Fagge	kwari	524	1859	914	1099
Kano Municipal	Rimi Market	599	2004	588	1064
Dala	Gidan Malama	1065	1498	1099	1221
Gwale	Tal'udu	999	1439	878	1105
Kumbotso	Sharada	1462	1832	1377	1557
Total		7685	13330	8031	

Looking at the 8 table carefully, it could be tricycles records closely double the records 13,330 vehicles and 7685 vehicles. Motorcycles maintains its second position in records as in the first traffic volumetric count. Considering average vehicular records across the local governments selected junction, Kumbotso Sharada junction is the top in the records with 1557 vehicles. This because, the local government falls between ancient densely populated Kano state and densely commercial business district. Figure 5 illustrates the transportation in the metropolis.

Figure 5 Showing Transportation Network in the Metropolis



Figure 5 Showing Transportation Network in the Metropolis

4.1. CO Emission Before Covid-19 and During Covid-19 Comparison

Only carbon monoxide was sensed in the residential area during covid-19 lockdown in the Metropolis because of movement control order (M.C.O) imposed throughout Kano state. Justification of CO selection is that, it is directly connected with low income and high densities where over depended on wood-fuel is very high. This is conducted in three very high densely populated, the selected local government are Kano Municipal (Kantin Kwari Junction), Nassarwa Local government (Kwana Nassarawa Junctions), and Gwale local government (Tal'udu Junction).

Table 9 Showing Carbon Monoxides Record During COVID-19 in KNMA

Time	Kwari Market Junction		K/Nasarawa Junction		Tal'udu Junction	
	CO (B)	CO (D)	CO (B)	CO (D)	CO (B)	CO(D)
8:00AM	09	03	09	03	08	04
6:00PM	14	05	14	04	19	06
Averages	23	08	13	07	27	10

Looking at the figure, it could be inferred that, the CO sensed records before Covid-19 is far above the CO sense records during Covid-19 in the study area. Kwari Market junctions records an average of (23Ppm) and (08Ppm) for before and during Covid-19, Kwanan Nassarawa junction reveals and averages (13Ppm) and (07Ppm) of before and during Covid-19. Additionally, Tal'udu junction being the most polluted junction indicates records before and during Covid-19 as (27Ppm) and (10Ppm). It could be inferred CO emission in KNMA reduces by 60.31.% this is because of reduction in wood-fuel usage for domestic and light industrial purposes. This could be compare with , positive environmental effect of the lockdown is that, it significantly cuts down environmental pollution of Wuhan, Spain, USA together with Italy as the epicenter pollution by approximately 30%[1]. [38], the study indicates cut down in CO concentrations by 64.8% within central business district (CBD), while NO along roads, its concentrations drops by 77.3% but O₃ significantly increase by 30%. [34], PM_{2.5} cut downs in its concentrations by 21%, CO₂ by 49%, while 35% is for NO₂, O₃ increase by 15%. Figure 6 indicates comparison of CO emissions before and during Covid-19 in the metropolis.

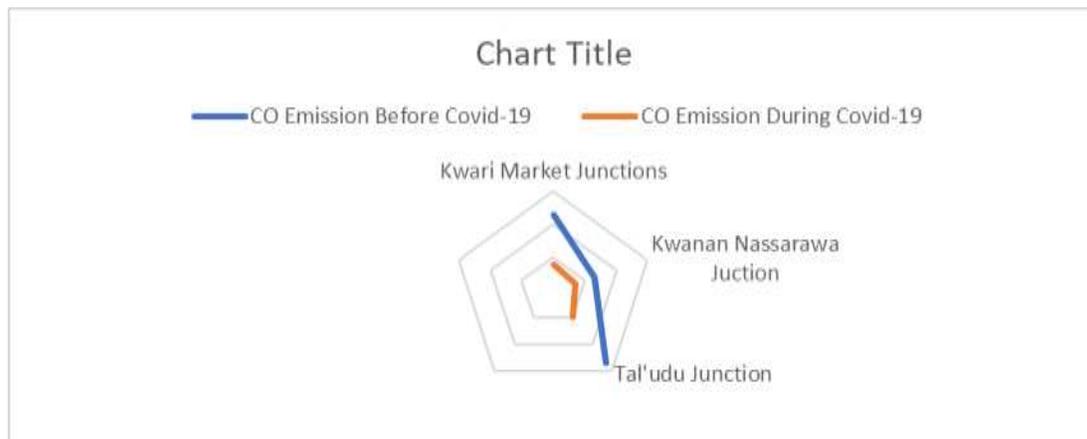


Figure 6 Indicating Comparison of CO Emission Before and During Covid-19

4.2. Air Pollutions and Income Categories and its Influence of Emission

The study also correlates between income categories and its direct connections with the pollutant's emissions. This provides bases for generalizing of the contributions of each income category with references to selected indicators for the generalization. The study categorizes the indicators into two sub-categories physical and social indicators. Table 10 demonstrates each indicator in relation to the high, medium, and low-income earners categories.

Table 10 Indicating Income Sulphur Dioxides (SO₂), Nitrogen Dioxides (NO₂) and Carbon Monoxide (CO) Emission and Income Categories in KNMA

S/N	High Income	Medium Income	Low Income
Social Facilities (Cars)	Pollution is acute because of Trip generation is very high,	Pollution level is low because light industrial activities is low and trip generation also is relatively low	Pollution is acute because of intensive light industrial activities that uses fossil fuel power uses and Trip generation is very high due to high population
Lay-out and Vegetations	Lay-out plot sizes and vegetation cover to some extent reduces air pollution movement between points	Population of a neighborhood and the vegetation cover intensity are the major determinant factors of air pollution in the medium income neighborhoods in KNMA	Lay-out plot sizes highly promoted the air pollution rate. Absence of vegetation cover plays a key role in the air pollution
Industries	High incomes residence close to industries land use is polluted more compared with those away	Medium incomes living very close to industries land use is more polluted compared with others away	Low incomes neighborhood close to industries land use has more polluted tendencies compared with those away
Nature of Buildings	High raise buildings and complex structure that required high energy and pollutant emission	Moderate energy buildings and there by moderate energy consumption and pollutants emission	Detached, bungalow and duplex buildings that required less energy and pollutant emission.
Residence Attitudes	Air pollution is acute because of the rates of burning fossil fuel.	Moderate pollution is noticed because of less burning rates of fossil fuels	Pollution rates varies with situations

The study indicates that income categories (high, medium, and low) play significant roles in the pollutant emission. The parameters employed for this assessment are physio-social. The physical factors affecting Sulphur Dioxides (SO₂), Nitrogen Dioxides (NO₂) and Carbon Monoxide (CO) Emission are; plot sizes and its vegetal covers within it, nature of buildings and complex and high rise buildings are occupied by high income earners and its characterized by high energy consumptions and pollutant emission. Proximity of neighbourhoods to the industrial land use is a physical factor that indicates the closer a neighbourhood is to the industrial area the higher its pollutions. On the other hand, the social factor affecting the sampled pollutants employed for the study are; residence attitudes towards fossil fuel burning, and availability of social facilities such as cars, air conditions and other electric gadgets. Both factors as reveals by the study are and directly connected with income Categories in KNMA. Income categories therefore are the major determinants of the pollutant emission in the study area.

IV.CONCLUSION

The study indicates CO sensed during covid-19 cut downs by 60.31.%, this is because of reduction in wood-fuel usage for domestic and light industrial purposes. This result could be compared with This could be compare with , Nakada and Urban (2020), the study indicates cut down in CO concentrations by 64.8% within central business district (CBD), while NO along roads, its concentrations drops by 77.3% but O₃ significantly increase by 30%. Muhammad, Long, and Salman, (2020), positive environmental effect of the lockdown is that, it significantly cuts

down environmental pollution of Wuhan, Spain, USA together with Italy as the epicenter pollution by approximately 30%. The study indicates that income level significantly influenced the pollutants in the study and this directly connected with physical and social factors attached to the income category. It also unveils that air quality indicator (AQI) in Kano metropolis is relatively within human consumptions but with possibilities of future increase. Looking at the primary pollutants considered for the study Sulfur Dioxide (SO₂) Sensed Records in Kano Metropolis, Nitrogen Dioxide (NO₂) Sensed Records in Kano Metropolis and Carbon monoxides CO₂ Sensed Records in Kano metropolis together with traffic volumetric count conducted during the study all indicate air quality indicator (AQI) is still within the human consumption level but there is great possibility of air pollution in the nearby future unless of proactive measures are taken. This is because, Kano metropolis is characterized with rapid urban growth as a result of these factors; (a) Roads Infrastructural Development from 1998 -2019, (b) May fly-overs, pass through and roads upgrading within Central Business Districts (c) Intensity of commercial activities within neighbouring states (d) Influx of immigrants from insurgent zones (e) Rapid population growth (f) Lay out development by the state governments (g) States creations and economic development (h) Inter-states linkages (I) Effectives inter-states Transport services (Kano Line) that travel across the country (J) Cities lay-out development (K) Land values appreciations (L) Carved out lay-outs from residential to commercial land uses (M) Conversion of residential land use to commercial. Covid-19 in Kano metropolis is more connected to densities in relation to overcrowding, insufficient ventilations and lighting in highly overcrowded areas which affects environmental quality.

V. RECOMMENDATIONS

There is strong need for urban growth framework development in KNMA to guide in mitigating environment challenges among which air pollution is among. Emphasis should be given to land use densities control and space standard regulation and implementation together with air pollution. This is because the on-going COVID-19 pandemic in the metropolis is link with densities and poor space standard implementation. Zoning regulations should be strengthened in the metropolis. This could serve as quality control document by Kano State Urban development board (KANUPDA) and other urban and regional planning and related ministries of environmental authorities. The urban growth framework could provide working documents to trajectory of rapid urban growth environmental issues with reference to air pollution in terms of theoretical and practical knowledge application within policies formation, strategies, techniques, and models development. This will also aid in achieving sustainable development with the metropolis and similar metropolis in Africa and in the world.

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