Measurement of Vehicular Emission in Karu Metropolis, North Central Nigeria

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Abstract: **The level of gaseous emissions (CO, NO_2, SO_2, H_2S, and PM) was measured at four selected locations (Masaka, Ado, Aso and Mararaba Sharp-Corner) in Karu metropolitan area of Nasarawa State using handheld croncon gasman gas meter/detector and particulate monitor from morning to evening for 30minutes and readings were recorded for time zero (0) and then after each 2 minutes interval at each location for a period of three days. The level of emission recorded at the major road junctions are within the range of 20-30PPM, 5-6PPM, 0.1-0.3PP, 0.0-0.1PPM for PM, CO, NO_2, SO_2 and H_2S in that order. This showed a concentration pattern for all the four sampling sites. The result established that the emissions levels of CO and PM in the metropolis especially morning and evening at Masaka and Mararaba sharp-Corner were higher than the permissive Nigeria air quality standard of 10ppm for atmospheric CO, 006ppm for NO_2, 0.1 for SO_2, 0.1 for H_2S and 006ugm^{-3} for PM. These will have adverse health effect and may contribute to climatic change in the long term if unmitigated. To this effect, it is recommended that vehicle owners should stop using poor quality petrol and more roads should be constructed within the metropolis**

Key words: **toxic gases, metropolis, urban areas-karu, measurement and vehicular emission**

I. INTRODUCTION

The atmosphere is made up of mixed gases covering the earth crust excluding water; the atmosphere air we breathe is made up of 78.1% nitrogen, 21% Oxygen, 0.09% argon, 0.03% carbon-dioxide and trace amount of other gases at level below 0.002%, Manaham and Stanley (2000). Human averagely take 24,000 breathes each day and air is the oxygen that we breathe. The source for CO_2 for plants photosynthesis is a cover for living organism thus, protects it from harsh environment (Barker, *et al.*, 1995). However, the entrance of harmful gases or particles into the ecosystem changes the quality of air; causing several harm to the ecosystem. Pollutants are called toxic waste, Uguayi *et al* (2003). Air pollutants are classified as primary and secondary pollutants. The main sources of air pollutants are from anthropogenic, it could be stationery or mobile (industrious and transportation activities), Rao and Rao (2001). In all the sources of air pollution, transportation is considered to be the major one (USDT/USEPA, 1993, seviyny 1998).

After the industrial age, transportation has become vital concept of lives. In view, cars and heavy duty trucks releases lots of fossil fuels to the environment. Study shows that emissions from engines contain both primary and secondary pollutants. This is the major cause of air pollution and is very difficult to manage, orubu *et al* (2001).

50% of the Total air pollutants are from transportation, saneca *et al* (1984), Jack F.A. (1982). Urban centres in Nigeria (Karu inclusive) have witness increase in population, human activities and increase per capital vehicle ownership. This implies that the per capital ownership of vehicle has been on the upward increasing leading to traffic congestion of roads, FOS (2016). This has generally increased the concentration of toxic gases, particulates and hydrocarbons. In Nigeria, significant attention has been focused on the studies of industrial pollution in the oil industry while in other studies only references are made to the gravity of pollution problem from population increase because of its proximity to Abuja. The mentioned towns have a major network link to the northern and southern part of the country.

Aim and Objectives

The aim of this study is to measure and compare the concentration of vehicular emission of Karu metropolis with the following objectives:

1. To assess the existing air quality
2. To assess the extent of air pollution due to transport activities
3. To compare the effect of air pollution from morning to evening at different location of Karu Local Government.
4. To make recommendation based on existing practices.

Significance of the Study

1. Policy makers: This will assist policy makers in transportation and environmental sectors to identify the level at which transport emission have affected the environment and the level of these toxic gases in the different study area.
2. Health sector: Some of these toxic gases like CO which is generated from the incomplete combustion of organic matter due to insufficient oxygen supply to enable complete oxidation to CO_2 and as a poison which could be very harmful to human health. Some of the symptoms of CO poison includes convulsion, headaches. It can also lead to cardiovascular disease and severe effect on the fetus of a pregnant woman.

CO poison is very fatal in essence, it can lead to death.

3. Agricultural sector: In the presence of oxygen CO burns a blue flame to produce CO_2 which could be of negative effects to crops directly or indirectly through changes in the climatic condition and changes in soil pH. It can also cause acidification which lead to poor crop yield and livestock production.
4. This research work will not only help in the above mentioned areas but with also contribute positively to the entire ecosystem.

Method of Operation

Karu is located in Nasarawa state, North Central of Nigeria which stretches into the boundaries of the Federal Capital Territory (FCT). Karu is said to be predominantly a civil servant and a commercial city as different business activities are carried out and the populace spend their time outdoors.

Through careful observations, the sampling sites in the metropolis were identified before the date of the data collection. Four sampling sites were considered because of high traffic volumes always noticed along the road. The sampling sites are: Masaka, Ado, Aso and Mararaba Sharp-Corner.

II. MATERIALS AND METHODS

Instruments used for this research work were digital.

1. Haz-Dust TM 10um particulate monitor
2. Handheld crowncon gas meter for CO, NO_2, SO_2, and H_2S
3. Digital stopwatch
4. Nose mask

Operational Principle

Digital Haz-Dust TM 10un: before measuring the particulate matter concentration, the power switch is turned to "on" and allowed to warm- up for a few minutes, then the Range switch is then set to its position and zeroed. A clear environment with the area of study should be used for the zeroing using a provided time to turn the adjustment screw until the display reads 0.00+/- 0.02mg/m^3 Gasman Gas Meter: Measurement here is done by turning all the metres to TEST position. Red LED with flash, sounder will operate; display will indicate battery condition (100% i.e. fully charged).

III. METHOD OF DATA COLLECTION AND ANALYSIS

The raw data, carefully obtained at each sampled site were recorded for morning, afternoon and evening at time (t)= 0 and subsequently at two (2) minutes interval for three consecutive days. Mean concentration of CO, NO_2, SO_2, H_2S and PM were calculated and graphs were plotted.

Results For Level Of Emission Collected At Each Point

Day One (Masaka Junction)

Table 1.0 Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	008	00.1	00.0	006	32.3
04	006	00.1	00.1	006	31.5
06	007	00.1	00.1	006	31.2
08	009	00.1	00.0	006	31.9
10	008	00.1	00.0	006	30.8
12	009	00.1	00.1	006	30.9
14	012	00.1	00.1	006	30.5
16	009	00.1	00.1	006	30.5
18	003	00.1	00.0	006	30.5
20	007	00.1	00.0	006	30.3
22	011	00.1	00.1	006	30.3
24	009	00.1	00.1	006	30.2
26	010	00.1	00.0	006	30.2
28	012	00.1	00.0	006	30.1
30	009	00.1	00.0	006	30.2

Table 1.1 Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	006	00.1	00.0	006	23.6
04	009	00.1	00.4	006	27.6
06	007	00.1	00.1	006	23.5
08	005	00.1	00.1	006	23.4
10	008	00.1	00.1	006	22.4
12	008	00.1	00.1	006	23.5
14	009	00.1	00.1	006	22.4
16	005	00.1	00.1	006	22.3
18	007	00.1	00.1	006	22.8
20	005	00.1	00.1	006	22.7
22	006	00.1	00.1	006	22.5
24	005	00.1	00.1	006	22.7
26	009	00.1	00.1	006	22.9
28	008	00.1	00.1	006	23.5
30	007	00.1	00.1	006	23.6

Table 1.2 Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	007	00.1	00.1	006	23.5
04	014	00.1	00.1	006	26.5
06	015	00.1	00.1	006	26.4
08	023	00.1	00.1	006	26.4

10	017	00.1	00.1	006	26.4
12	014	00.1	00.1	006	26.6
14	010	00.1	00.1	006	26.4
16	009	00.1	00.1	006	26.6
18	014	00.1	00.1	006	26.6
20	008	00.1	00.1	006	26.6
22	018	00.1	00.1	006	26.4
24	022	00.1	00.1	006	26.4
26	017	00.1	00.1	006	26.4
28	019	00.1	00.1	006	26.6
30	022	00.1	00.1	006	26.4

Day Two (Masaka Junction)

Table 1.3 Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	007	00.1	00.0	006	31.5
04	006	00.0	00.0	006	31.2
06	005	00.1	00.1	006	31.2
08	010	00.1	00.0	006	30.9
10	009	00.1	00.0	006	30.8
12	007	00.1	00.1	006	30.5
14	005	00.1	00.1	006	30.5
16	004	00.1	00.1	006	30.5
18	012	00.1	00.0	006	30.3
20	011	00.1	00.0	006	30.3
22	007	00.1	00.1	006	30.5
24	008	00.1	00.1	006	30.3
26	009	00.1	00.0	006	30.5
28	003	00.1	00.0	006	30.9
30	012	00.1	00.0	006	31.5

Table 1.4: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	009	00.1	00.0	00.1	24.1
04	009	00.0	00.0	00.4	23.9
06	007	00.1	00.1	00.1	23.8
08	005	00.1	00.0	00.1	23.5
10	008	00.1	00.0	00.1	22.3
12	007	00.1	00.1	00.1	23.9
14	009	00.1	00.1	00.0	22.8
16	005	00.1	00.1	00.0	22.5
18	007	00.1	00.0	00.0	22.3
20	003	00.1	00.0	00.1	22.7
22	005	00.1	00.1	00.1	22.5
24	007	00.0	00.1	00.1	22.5
26	009	00.0	00.0	00.1	22.7
28	008	00.1	00.0	00.1	23.5
30	003	00.1	00.0	00.1	23.4

Table 1.5: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	006	00.1	00.1	006	26.3
04	007	00.1	00.0	006	26.3
06	006	00.1	00.0	006	26.3
08	012	00.1	00.1	006	26.6
10	022	00.0	00.1	006	26.6
12	023	00.1	00.0	006	26.6
14	012	00.1	00.0	006	26.6
16	010	00.1	00.1	006	26.4
18	010	00.1	00.1	006	26.4
20	005	00.1	00.1	006	26.4
22	003	00.1	00.0	006	26.4
24	014	00.1	00.0	006	26.4
26	012	00.1	00.0	006	26.6
28	016	00.1	00.0	006	26.4
30	023	00.1	00.1	006	26.4

Day Three (Masaka Junction)

Table 1.6: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	007	00.1	00.0	006	30.9
04	005	00.0	00.0	006	30.8
06	012	00.1	00.1	006	30.7
08	016	00.1	00.1	006	30.7
10	022	00.1	00.1	006	30.5
12	018	00.1	00.1	006	30.5
14	014	00.1	00.0	006	30.3
16	010	00.1	00.0	006	30.3
18	012	00.1	00.0	006	30.3
20	020	00.1	00.0	006	30.3
22	019	00.1	00.0	006	30.1
24	017	00.1	00.1	006	30.7
26	009	00.1	00.1	006	31.3
28	007	00.1	00.1	006	31.5
30	005	00.1	00.1	006	31.7

Table 1.7: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	006	00.1	0.00	005	23.9
04	007	00.0	0.00	005	23.7
06	005	00.1	0.00	006	23.5
08	008	00.1	0.00	005	23.3
10	012	00.1	00.1	006	23.4
12	010	00.1	00.1	006	23.7
14	009	00.1	00.1	006	23.7
16	007	00.1	00.1	006	23.9
18	011	00.1	00.0	006	23.6
20	007	00.1	00.0	006	23.6
22	005	00.1	00.1	006	23.6
24	003	00.0	00.0	006	23.6
26	007	00.0	00.0	006	23.6
28	005	00.1	00.0	006	23.6
30	009	00.1	00.1	006	23.4

Table 1.8: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	007	00.1	0.01	006	26.4
04	006	00.1	0.01	006	26.4
06	007	00.1	0.00	006	26.4
08	014	00.1	0.00	006	26.4
10	011	00.0	0.00	006	26.4
12	016	00.1	0.00	006	26.4
14	020	00.1	0.00	006	26.4
16	019	00.0	0.00	006	26.6
18	017	00.1	0.00	006	26.6
20	022	00.1	0.00	006	26.6
22	024	00.1	0.00	006	26.4
24	019	00.1	00.1	006	26.9
26	026	00.1	00.1	006	26.4
28	019	00.1	00.0	006	26.6
30	021	00.1	00.1	006	26.6

Day One (Ado Junction)

Table 1.9: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	013	00.1	0.01	006	30.5
04	011	00.1	0.01	006	30.1
06	011	00.1	0.00	006	29.7
08	008	00.1	0.00	006	29.7
10	007	00.1	0.00	006	30.1
12	005	00.1	0.00	006	28.8
14	026	00.1	0.00	005	28.9
16	006	00.1	0.00	005	28.9
18	010	00.1	0.00	006	28.9
20	022	00.1	0.00	006	28.7
22	020	00.1	0.00	006	28.7
24	015	00.1	00.1	006	28.5
26	018	00.1	00.1	006	28.9
28	024	00.1	00.0	006	28.9
30	011	00.1	00.1	006	28.9

Table 2.0: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	012	00.0	0.01	006	23.3
04	008	00.1	0.01	006	23.6
06	009	00.0	0.01	006	24.7
08	019	00.0	0.01	006	24.7
10	014	00.0	0.01	006	24.7
12	008	00.1	0.01	006	24.6
14	007	00.1	0.02	005	24.6
16	012	00.0	0.01	005	24.6
18	007	00.0	0.01	006	24.5
20	008	00.0	0.00	006	24.6
22	011	00.1	0.01	006	24.6
24	010	00.1	00.0	006	24.6
26	006	00.1	00.0	006	24.6
28	016	00.0	00.0	006	24.3
30	009	00.0	00.1	006	24.0

Table 2.1: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	024	00.1	0.00	006	27.1
04	009	00.1	0.00	006	27.1
06	010	00.1	0.00	006	27.2
08	011	00.1	0.00	006	27.3
10	012	00.1	0.00	006	27.4
12	015	00.1	0.00	006	27.6
14	010	00.1	0.00	005	27.8
16	019	00.1	0.00	005	27.4
18	026	00.1	0.00	006	27.4

20	015	00.1	0.00	006	28.4
22	017	00.1	0.00	006	28.4
24	022	00.1	0.00	006	28.3
26	028	00.1	0.00	006	27.9
28	021	00.1	0.00	006	27.7
30	024	00.1	0.00	006	27.9

Day Two (Ado Junction)

Table 2.2: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02 04	011 011	00.1 00.1	00.1 00.1	006 006	30.9 30.7
06	007	00.1	00.1	006	30.5
08	008	00.1	00.1	006	30.3
10	008	00.1	00.1	006	30.1
12	010	00.1	00.1	006	29.9
14	011	00.1	00.1	006	29.7
16	014	00.1	00.1	005	29.5
18	016	00.1	00.1	005	29.5
20	018	00.1	00.1	006	29.5
22	024	00.1	00.1	006	29.7
24	020	00.1	00.1	006	29.7
26	019	00.1	00.1	006	29.7
28	017	00.1	00.1	005	30.1
30	019	00.1	00.1	006	30.5

Table 2.3: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	009	00.1	00.0	006	23.9
04	009	00.1	00.0	006	23.7
06	007	00.1	00.0	006	245.
08	008	00.0	00.1	006	23.3
10	010	00.1	00.1	006	23.7
12	009	00.1	00.1	006	23.9
14	005	00.1	00.1	006	24.0
16	003	00.1	00.1	005	24.0
18	008	00.1	00.1	006	24.1
20	009	00.1	00.1	006	24.3
22	014	00.1	00.1	006	24.6
24	009	00.1	00.0	005	24.6
26	005	00.1	00.0	006	24.6
28	004	00.1	00.1	006	24.6
30	003	00.1	00.1	006	24.6

Table 2.4: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	026	00.1	00.0	006	27.4
04	027	00.1	00.0	006	27.4
06	019	00.1	00.0	006	27.3
08	019	00.1	00.1	006	27.3
10	017	00.1	00.1	006	27.3
12	017	00.1	00.0	006	27.4
14	011	00.1	00.0	006	27.4
16	009	00.1	00.0	005	27.4
18	009	00.1	00.0	005	27.7
20	010	00.1	00.0	006	27.7
22	011	00.1	00.0	006	27.9
24	021	00.1	00.0	006	27.4
26	020	00.1	00.0	006	28.4
28	024	00.1	00.0	005	28.6
30	026	00.1	00.0	006	28.6

Day Three (Ado Junction)

Table 2.5: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	016	00.1	00.0	006	30.9
04	014	00.1	00.0	006	30.7
06	009	00.1	00.0	006	30.5
08	012	00.1	00.1	006	30.3
10	009	00.1	00.1	006	30.1
12	007	00.1	00.1	006	29.9
14	007	00.1	00.1	006	29.8
16	010	00.1	00.1	005	29.7
18	007	00.1	00.1	005	29.7
20	019	00.1	00.1	006	29.5
22	017	00.1	00.1	006	30.1
24	026	00.1	00.1	006	30.1
26	028	00.1	00.0	006	30.3
28	009	00.1	00.0	006	29.7
30	012	00.1	00.0	006	29.7

Table 2.6: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	010	00.0	00.1	006	24.0
04	011	00.0	00.1	006	23.9

06	009	00.0	00.1	006	23.9
08	009	00.1	00.1	006	23.7
10	012	00.1	00.0	006	23.5
12	007	00.1	00.0	006	23.9
14	006	00.1	00.0	006	23.9
16	003	00.1	00.0	005	24.1
18	009	00.1	00.1	006	24.1
20	007	00.1	00.1	006	24.6
22	011	00.1	00.1	006	24.6
24	009	00.1	00.0	005	24.4
26	005	00.1	00.1	006	24.4
28	009	00.1	00.1	006	24.4
30	011	00.1	00.1	006	24.6

Table 2.7: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	024	00.1	00.0	006	27.7
04	022	00.1	00.0	006	27.7
06	026	00.1	00.0	006	27.7
08	021	00.1	00.0	006	27.9
10	009	00.1	00.0	006	27.9
12	019	00.1	00.0	006	28.1
14	020	00.1	00.0	006	27.4
16	024	00.1	00.0	006	27.4
18	019	00.1	00.0	006	28.4
20	022	00.1	00.0	006	28.4
22	024	00.1	00.0	006	28.4
24	019	00.1	00.0	006	28.4
26	029	00.1	00.0	006	28.4
28	019	00.1	00.0	006	27.9
30	030	00.1	00.0	006	27.9

Day One (Aso Junction)

TABLE 2.8: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	010	00.1	00.1	006	28.6
04	012	00.1	00.1	006	28.6
06	015	00.1	00.1	006	28.6
08	019	00.1	00.1	006	28.3
10	012	00.1	00.1	006	28.3
12	021	00.1	00.1	006	28.1
14	024	00.1	00.1	006	28.1
16	028	00.1	00.1	006	28.3
18	018	00.1	00.1	006	28.3
20	014	00.1	00.1	006	28.3
22	019	00.1	00.1	006	28.1
24	020	00.1	00.1	006	27.9
26	019	00.1	00.1	006	27.6
28	024	00.1	00.1	006	27.6
30	022	00.1	00.1	006	27.3

Table 2.9: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	007	0.00	00.1	005	23.4
04	013	0.00	00.1	006	23.7
06	014	0.00	00.1	006	23.9
08	018	0.00	00.1	006	23.8
10	018	0.00	00.1	006	23.9
12	006	0.00	00.1	006	23.8
14	011	0.00	00.1	006	23.9
16	019	0.01	00.1	005	23.8
18	017	0.01	00.1	006	23.9
20	015	0.01	00.1	006	23.8
22	017	0.01	00.1	006	23.9
24	019	0.01	00.1	005	24.0
26	016	0.01	00.1	006	24.0
28	010	0.01	00.1	006	24.0
30	009	0.01	00.1	006	24.0

Table 3.0: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	021	00.1	0.00	006	27.4
04	015	00.1	0.00	006	27.4
06	011	00.1	0.00	006	27.4
08	020	00.1	0.00	006	27.4
10	018	00.1	0.00	006	27.6
12	009	00.1	0.00	006	27.7
14	010	00.1	0.00	006	27.8
16	012	00.1	0.00	006	27.7
18	014	00.1	0.00	006	28.7
20	020	00.1	0.00	006	28.8
22	022	00.1	0.00	006	28.7
24	024	00.1	0.00	006	28.7

26	028	00.1	0.00	006	27.7
28	019	00.1	0.00	006	27.7
30	029	00.1	0.00	006	27.8

Day Two (Aso Junction)

TABLE 3.1: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	019	00.1	00.1	006	27.9
04	012	00.1	00.1	006	27.9
06	010	00.1	00.1	006	28.4
08	012	00.1	00.1	006	28.4
10	019	00.1	00.1	006	28.4
12	015	00.1	00.1	006	28.4
14	020	00.1	00.1	006	28.7
16	021	00.1	00.1	006	28.7
18	024	00.1	00.1	006	27.7
20	027	00.1	00.1	006	27.9
22	022	00.1	00.1	006	27.8
24	029	00.1	00.1	006	28.9
26	027	00.1	00.1	006	28.4
28	019	00.1	00.1	006	28.4
30	021	00.1	00.1	006	28.4

Table 3.2: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	007	00.1	00.1	006	24.0
04	009	00.1	00.0	006	24.0
06	010	00.1	00.1	006	24.0
08	012	00.0	00.1	006	24.4
10	017	00.1	00.1	006	24.4
12	009	00.1	00.1	006	24.7
14	006	00.1	00.1	006	24.0
16	005	00.1	00.1	005	23.9
18	009	00.1	00.1	006	23.4
20	010	00.1	00.1	006	23.4
22	011	00.1	00.1	006	23.4
24	013	00.1	00.1	005	23.7
26	006	00.1	00.1	006	23.4
28	003	00.1	00.1	006	23.4
30	00	00.1	00.1	006	23.4

Table 3.3: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	015	00.1	00.0	006	28.4
04	020	00.1	00.0	006	28.4
06	018	00.1	00.0	006	28.4
08	010	00.1	00.0	006	28.4
10	011	00.1	00.0	006	28.4
12	014	00.1	00.0	006	28.7
14	021	00.1	00.0	006	28.8
16	026	00.1	00.0	005	28.7
18	019	00.1	00.0	005	28.7
20	021	00.1	00.0	006	28.7
22	028	00.1	00.0	006	28.7
24	030	00.1	00.0	006	28.4
26	029	00.1	00.0	006	28.8
28	031	00.1	00.0	005	28.8
30	026	00.1	00.0	006	28.8

Day Three (Aso Junction)

Table 3.4: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	012	00.1	00.0	006	28.6
04	010	00.1	00.0	006	28.3
06	011	00.1	00.0	006	28.3
08	009	00.1	00.0	006	28.6
10	014	00.0	00.1	006	28.3
12	016	00.0	00.0	006	28.1
14	020	00.0	00.0	006	28.1
16	021	00.1	00.0	005	28.3
18	026	00.1	00.1	005	28.1
20	024	00.1	00.1	006	27.9
22	022	00.1	00.0	006	27.8
24	019	00.1	00.1	006	27.6
26	018	00.1	00.1	006	27.3
28	022	00.1	00.0	006	27.4
30	027	00.1	00.0	006	27.3

Table 3.5: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00

02	007	00.1	00.0	006	23.4
04	007	00.1	00.0	006	23.4
06	009	00.1	00.0	006	23.7
08	011	00.1	00.0	006	23.1
10	015	00.1	00.0	006	23.9
12	008	00.1	00.0	006	23.7
14	010	00.1	00.1	006	23.9
16	007	00.1	00.1	006	24.2
18	012	00.1	00.0	006	24.4
20	017	00.1	00.0	006	24.4
22	019	00.1	00.0	006	24.4
24	010	00.1	00.0	006	24.4
26	018	00.1	00.0	006	24.7
28	019	00.1	00.0	006	24.7
30	017	00.1	00.1	006	24.7

Table 3.6: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	021	00.1	00.0	006	28.
04	020	00.1	00.0	006	28.
06	015	00.1	00.0	006	28.
08	011	00.1	00.0	006	28.
10	020	00.1	00.0	006	28.
12	018	00.1	00.0	006	28.
14	009	00.1	00.0	006	28.
16	010	00.1	00.0	006	28.
18	019	00.1	00.0	006	28.
20	026	00.1	00.0	006	28.
22	024	00.1	00.0	006	28.
24	028	00.1	00.0	006	28.
26	030	00.1	00.0	006	28.
28	029	00.1	00.0	006	28.
30	026	00.1	00.0	006	28.

Day One (Mararaba Sharp Corner)

Table 3.7: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	016	00.1	00.1	005	27.8
04	027	00.1	00.1	005	27.3
06	014	00.1	00.1	005	26.6
08	010	00.1	00.1	006	26.3
10	020	00.1	00.1	006	26.8
12	020	00.1	00.1	006	26.8
14	016	00.0	00.1	006	26.6
16	016	00.1	00.1	006	26.8
18	016	00.1	00.1	006	26.8
20	018	00.0	00.1	006	25.8
22	020	00.0	00.1	005	25.8
24	020	00.1	00.1	005	25.3
26	022	00.1	00.1	006	25.5
28	024	00.1	00.1	006	25.0
30	026	00.1	00.1	006	24.7

Table 3.8: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	006	00.0	00.1	005	25.2
04	011	00.1	00.1	006	25.2
06	012	00.0	00.1	005	25.1
08	010	00.0	00.1	005	25.1
10	016	00.0	00.1	005	24.7
12	009	00.1	00.1	006	24.7
14	018	00.1	00.1	005	24.3
16	016	00.0	00.1	005	23.3
18	016	00.1	00.1	006	24.0
20	014	00.1	00.1	006	23.7
22	014	00.1	00.1	005	23.7
24	011	00.0	00.1	005	24.7
26	012	00.1	00.1	005	24.5
28	019	00.1	00.1	005	24.7
30	008	00.1	00.1	005	24.7

Table 3.9: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	021	00.1	00.0	006	29.1
04	017	00.1	00.1	006	29.6
06	015	00.1	00.1	006	29.1
08	025	00.1	00.1	006	29.2
10	019	00.1	00.1	006	29.3
12	016	00.1	00.1	006	29.3
14	025	00.1	00.0	006	29.4
16	033	00.1	00.1	006	29.4
18	028	00.1	00.0	006	29.6
20	031	00.1	00.1	006	29.6

22	019	00.1	00.1	006	29.4
24	016	00.1	00.0	006	29.4
26	030	00.1	00.0	006	29.4
28	028	00.1	00.0	006	29.4
30	031	00.1	00.0	006	29.6

Day Two (Mararaba Sharp Corner)

Table 4.0: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	010	00.1	00.1	006	27.3
04	016	00.1	00.1	006	27.6
06	014	00.1	00.1	005	27.6
08	026	00.1	00.1	006	27.6
10	011	00.1	00.1	006	27.3
12	020	00.1	00.1	005	27.6
14	019	00.1	00.1	005	27.6
16	017	00.1	00.1	005	27.3
18	020	00.1	00.1	006	26.3
20	021	00.1	00.1	006	26.4
22	021	00.1	00.1	005	26.4
24	023	00.1	00.1	005	26.7
26	023	00.1	00.1	006	26.8
28	022	00.1	00.1	006	26.5
30	021	00.1	00.1	006	25.9

Table 4.1: Afternoon Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	007	00.0	00.1	005	25.1
04	006	00.0	00.1	005	25.0
06	012	00.1	00.1	005	25.2
08	010	00.0	00.1	005	25.2
10	009	00.0	00.1	005	25.2
12	009	00.0	00.1	005	25.1
14	018	00.0	00.1	005	24.7
16	011	00.0	00.1	005	24.7
18	008	00.1	00.1	005	24.8
20	017	00.1	00.1	005	24.5
22	012	00.1	00.1	005	24.4
24	014	00.0	00.1	005	24.2
26	017	00.1	00.1	005	23.0
28	019	00.1	00.1	005	23.3
30	019	00.1	00.1	005	23.6

Table 4.2: Evening Session

TIME (min)	CO	NO_2	SO_2	H2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	021	00.1	00.0	006	29.1
04	021	00.1	00.0	006	29.1
06	017	00.1	00.1	006	29.6
08	015	00.1	00.1	006	29.3
10	014	00.1	00.0	006	29.3
12	020	00.1	00.0	006	29.3
14	022	00.1	00.0	006	29.4
16	026	00.1	00.0	006	29.4
18	030	00.1	00.1	006	29.6
20	031	00.1	00.1	006	29.4
22	029	00.1	00.0	006	29.4
24	034	00.1	00.0	006	29.4
26	030	00.1	00.0	006	29.4
28	027	00.1	00.1	006	29.4
30	024	00.1	00.1	006	29.4

Day Three (Mararaba Sharp Corner)

Table 4.3: Morning Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	017	00.1	00.1	005	27.8
04	027	00.1	00.1	005	27.4
06	016	00.1	00.1	006	27.4
08	014	00.1	00.1	006	27.3
10	012	00.0	00.1	006	27.3
12	010	00.0	00.1	006	27.6
14	010	00.0	00.1	006	27.6
16	011	00.1	00.1	005	27.3
18	015	00.1	00.1	005	26.3
20	018	00.1	00.1	006	26.8
22	020	00.1	00.1	006	26.6
24	022	00.1	00.1	006	26.7
26	024	00.1	00.1	006	26.6
28	028	00.1	00.1	006	26.6
30	024	00.1	00.1	006	25.6

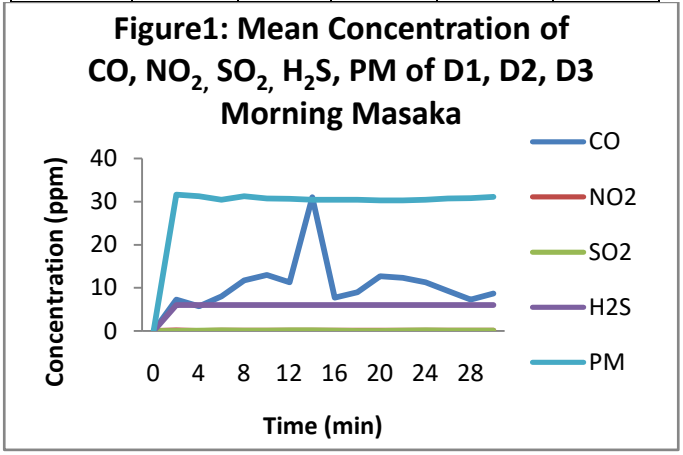
Table 4.4: Afternoon Session

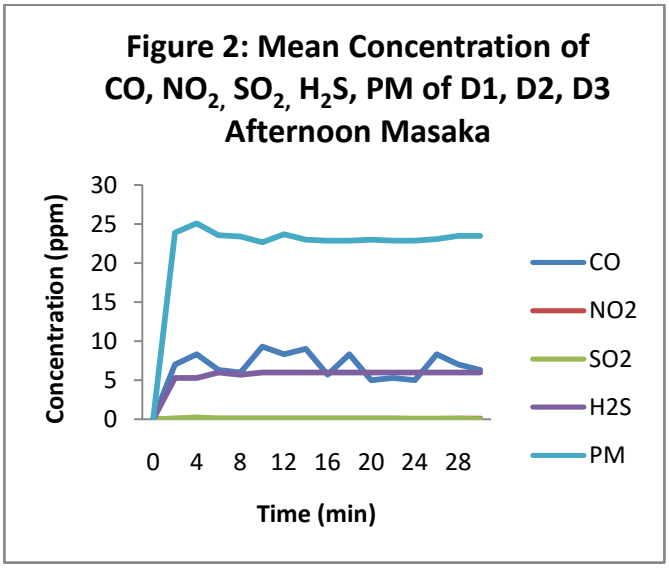
TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	00.1	0.00	0.00
02	005	00.0	00.1	005	25.1

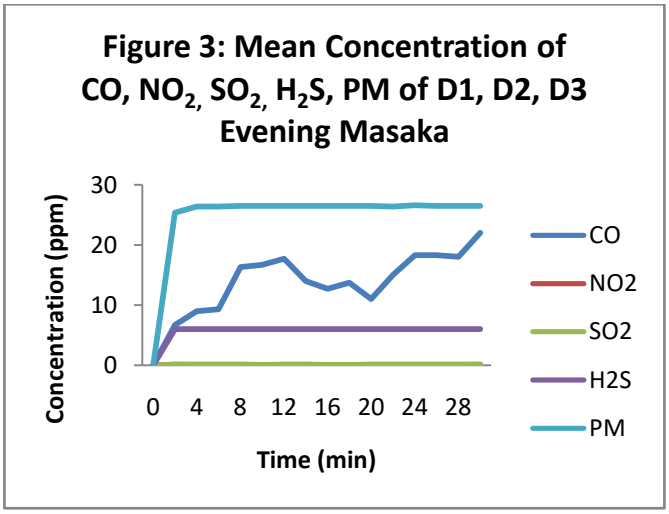
04	004	00.1	00.1	005	24.9
06	007	00.0	00.1	005	24.7
08	006	00.0	00.1	005	24.7
10	009	00.1	00.1	005	24.7
12	014	00.1	00.1	006	24.5
14	012	00.0	00.1	006	24.4
16	010	00.0	00.1	005	24.4
18	008	00.0	00.1	006	24.4
20	008	00.0	00.1	005	24.4
22	017	00.1	00.1	006	24.3
24	020	00.0	00.1	006	23.9
26	019	00.1	00.1	006	23.7
28	012	00.1	00.1	005	23.5
30	020	00.1	00.1	006	23.7

Table 4.5: Evening Session

TIME (min)	CO	NO_2	SO_2	H_2S	PM
00	0.00	0.00	0.00	0.00	0.00
02	021	00.1	00.1	006	28.7
04	020	00.1	00.0	006	28.9
06	021	00.1	00.0	006	29.1
08	022	00.1	00.0	006	29.2
10	017	00.1	00.0	006	29.2
12	019	00.1	00.1	006	29.2
14	022	00.1	00.1	006	29.4
16	028	00.1	00.1	006	29.4
18	026	00.1	00.1	006	29.4
20	034	00.1	00.1	006	29.4
22	030	00.1	00.1	006	29.4
24	029	00.1	00.0	006	29.4
26	036	00.1	00.1	006	29.6
28	019	00.1	00.1	006	29.4
30	032	00.1	00.1	006	29.6







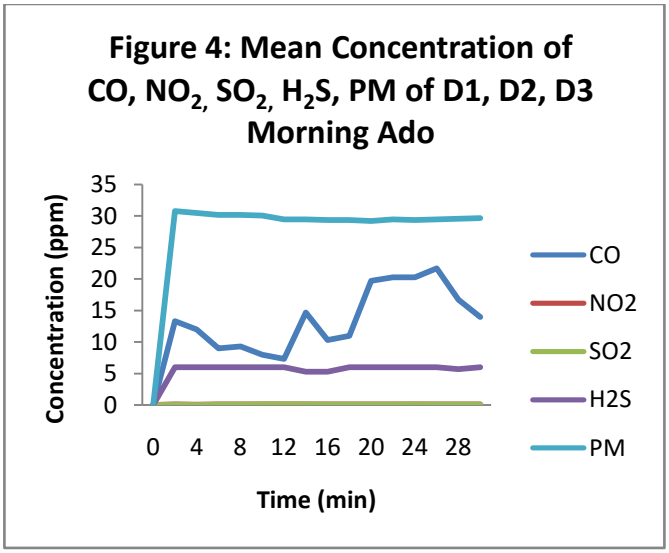


Figure 5: Mean Concentration of CO, NO_2, SO_2, H_2S, PM of D1, D2, D3 Afternoon Ado

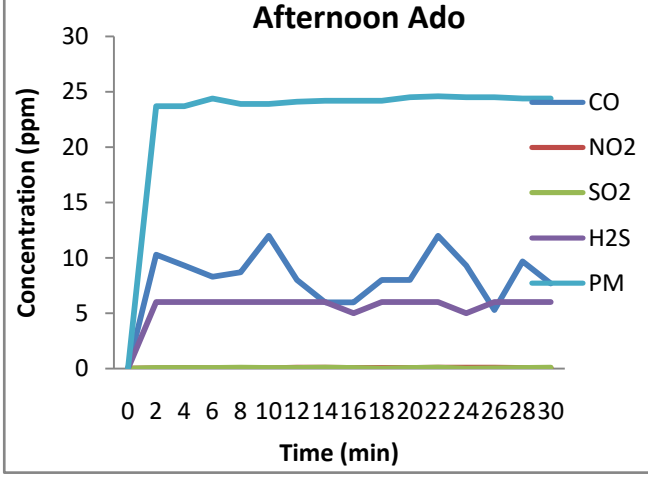


Figure 8: Mean Concentration of CO, NO_2, SO_2, H_2S, PM of D1, D2, D3 Afternoon Aso

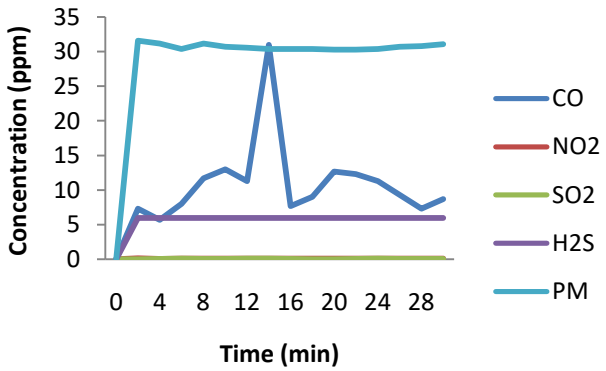
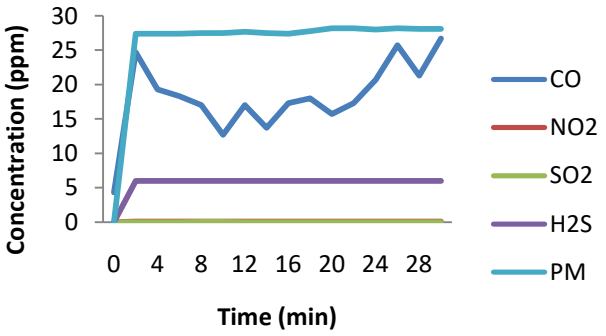


Figure 6: Mean Concentration of CO, NO_2, SO_2, H_2S, PM of D1, D2, D3 Evening Ado



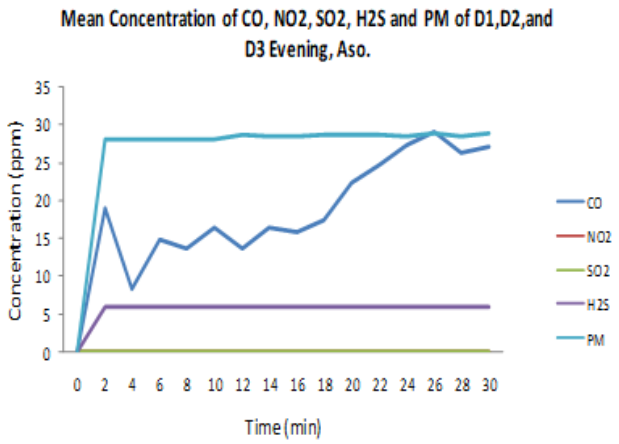


Figure 7: Mean Concentration of CO, NO_2, SO_2, H_2S, PM of D1, D2, D3 Morning Aso

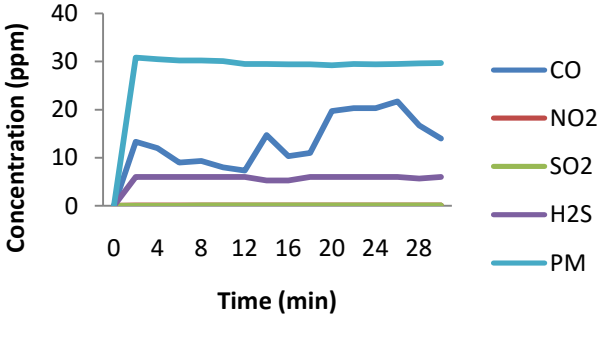
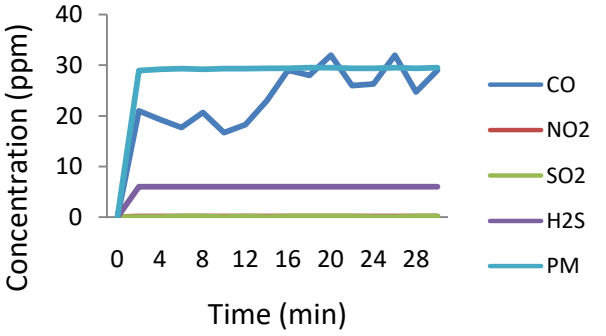
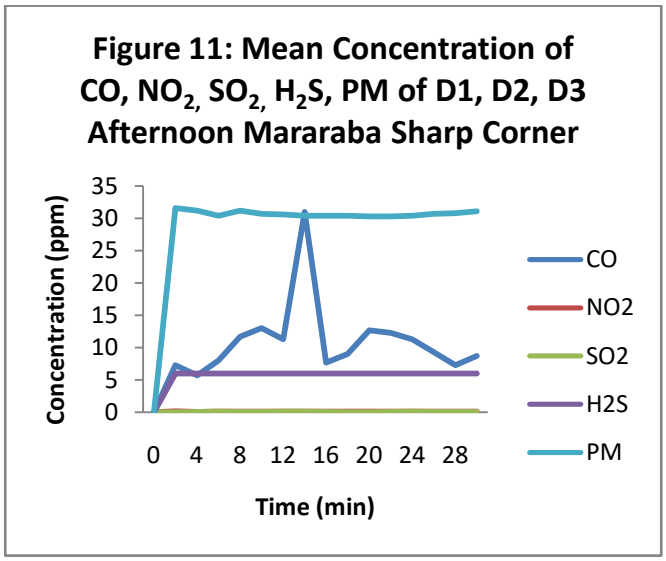
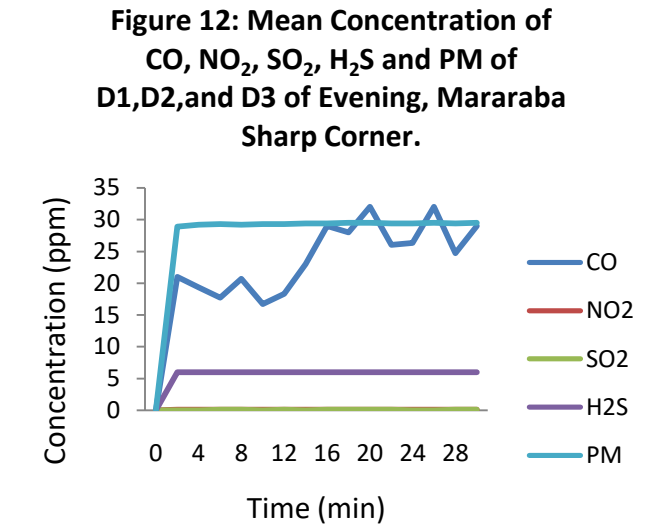


Figure 10: Mean Concentration of CO, NO_2, SO_2, H_2S and PM of D1, D2, and D3 of morning, Mararaba Sharp Corner







IV. DISCUSSION

Graphs were used to analyse the data obtained in this research work. As earlier stated in the methodology, the data were obtained for morning, afternoon and evening from four sites. Masaka, Ado, Aso and Mararaba Sharp-corner at times (t) = 0 and after 2 minutes interval. The mean concentration of CO, NO_2, SO_2, H_2S and PM were calculated and plotted into graphs for various sampling time (morning, afternoon and evening) respectively. Figure 1-12 presented the graphical results of data obtained from tables 1.0-4.5. The graph has y axis for concentration (ppm) and x axis for time (mins). Results revealed that PM has highest concentration within the range of (20-30 ug/m^3), followed by CO with a consistent result within the range of (5.0-29.0ppm). Consequently, H_2S, NO_2 and SO_2 also revealed a consisted result concentrations ranging from 5.0-6.0ppm, 0.1-0.3ppm and 0.1-0.0ppm respectively.

The results for the four sites shows that the CO and PM emitted in the evening were higher followed by the morning while that of afternoon was lower. This is as a result of traffic congestion. The low toxic gases recorded in the afternoon were because the toxic gases may not accumulate and disperse into the atmosphere during the afternoon session (period). The high concentration of toxic gases (CO and PM) during morning and evening periods were caused by people rushing to work in the morning and returning back in the evening. Also, the higher concentration of PM could be attributed to the fact that the research work was done during winter while the high concentration of CO was due to incomplete combustion of fossil fuel consumed by automobiles. Ugwanyi, *et al* 2003. Result for NO_2, SO_2, and H_2S shows low concentration because most of the automobiles in the study areas are petrol users.

As seen in the graphs, concentration of NO_2, SO_2 and H_2S for the four sampling sites was below the minimum standard of 10ppm recommended value by National Environmental Standard and Regulation Enforcement Agency (NESREA); 5ppm and 25mgm^{-3} for NO_2, SO_2 and H_2S respectively. This may be due to photochemical reaction taking place at the time of the day, Garba *et al* 2016.

V. CONCLUSION

During the research CO, NO_2, SO_2, H_2S, and PM from the exhaust of some vehicles and motor cycles were detected by the use of a gas man detector. The results obtained from the detected gases (pollutants) (i.e. CO, NO_2, SO_2, H_2S and PM) were analyzed using statistical and graphical methods for better comprehension. The revealed results showed that CO, H_2S and PM are highly group of pollutants emitted by automobiles. To this effect, their damages and harmfulness can be controlled by law enforcement agency, chemical methods and natural control measures.

VI. RECOMMENDATION

The work has revealed the economic and also health implications of this traffic emission on human health and the environment at large. Therefore it is recommended that:

1. Nasarawa State Environmental Protection Agency should thus recognize air quality management as a priority and work to prevent further environmental pollution by adopting effective policy, such as inspecting commercial vehicles in the metropolis.
2. Karu Local Government is a link between the north central and by extension to southern region of Nigeria. The local government has only one major road with few minor roads. This accounts for high traffic congestion noticed in the four sampling areas. Hence, government should construct more roads within the metropolis to reduce traffic congestion.
3. Traffic wardens should be protected against emission from traffic.

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