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Preliminary Assessment of Air and Sound Quality in Ariaria Market, Aba, Southeastern Nigeria

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ABSTRACT
This study aims at assessing the air and sound quality of the Ariaria International Market, Aba, in South-Eastern Nigeria. As a first step, the study involved going to the market, studying the layout and mapping out different sections according to type of human activity, vehicular movement and expected type of pollutant. The busiest days of the market were chosen to carry out the field work. Hand-held tools (Cole-Parmer Extec sound level meter, Aerosol Mass Monitor and IBRID MX6 Multi-Gas monitor) were used to measure pre-determined pollutants. Results revealed that SO_2 ranged from 0.00 ppm to 0.4ppm which is above the required limits of 0.1ppm and CO went up to about 32ppm, above the required limits of 20ppm. The noise level was up to 94.4 DbA which was above the FEPA standards. Pollution patterns and levels are linked to the type and levels of human activity. It is recommended that an agency be set up to monitor the quality of the environment around areas of dense human activities such as markets and enforce environmentally friendly practices by traders and buyers within the market and surrounding regions. In addition, vehicular traffic be managed efficiently to reduce emissions.

Keywords: Air quality, Noise, sound, pollutants, Aba, Nigeria

INTRODUCTION

This study focuses on determining the air and sound quality in Ariaria International Market, Aba in Abia State, Nigeria. Ariaria International Market, Aba, with coordinates: Lat. 5°7'5"N and Long. 7°19'57"E. It is located in a very densely populated part of the city. In addition to the high human activities, the presence of several small-scale manufacturing companies and heavy motorized traffic serves to make the market one large point source of pollution in the city.

Pollution can be attributed to intangible sources such as noise. The traditional definition of noise is "unwanted or disturbing sound". Sound becomes unwanted when it either interferes with normal activities such as sleeping, conversation, or disrupts or diminishes one's quality of life. This type of pollution is more predominant in urban and highly populated areas due to the greater numbers of vehicles, machinery and human activities. According to Birgitta & Lindvall (1995), and Mahbood & Athar (2007), (Singh & Davar, 2004), road traffic, jet planes, garbage trucks, construction equipment, manufacturing processes, and lawn mowers are some of the major sources of this unwanted sounds that are routinely broadcasted into the air.

For a place that is very busy for most parts of the day like the Ariaria market, grinding, generator and transport related noise pollution elevate the general noise levels with possible severe health consequences. Noise pollution affects humans and may result, if exposed over a long period of time, in loss of hearing, insomnia, high blood pressure, etc. However, it is one of the least combated sources of pollution as its effects are usually considered transient or eliminated once people move away from the sources and permanent damage to living organisms may not be obviously traceable to it.

Several authors have studied the indicators such as air, sound, water, etc., used to specify environmental qualities. Mage *et al* (1996) have studied the air quality in twenty megacities (Tokyo, Seoul, New York, etc). Vardoulakis *et al* (2003) have also studied the air quality in street canyons and the levels of volatile organic compounds (VOC) in South America (Caracas, Quito, Santiago, Sao Paulo and Bangkok) and Asia (Bangkok and Manila). This study will add to this body of knowledge by looking at the air and sound quality in Aba, Southeastern Nigeria. Geologically, the study area lies in the South eastern part of the Cenozoic Niger Delta Basin of Nigeria (Fig. 1). Cenozoic Niger Delta sedimentary basin was formed from the interplay between subsidence and deposition arising from a succession of sea transgressions and regressions (Short & Stauble, 1965) which gave rise to the deposition of three lithostratigraphic units in the Niger Delta. These units are Marine Akata Formation, Paralic Agbada Formation, and the Continental Benin Formation (Table 1). The Akata and Agbada Formations are the source and reservoir rocks respectively for petroleum in the Niger Delta while the Benin Formation serves as the aquifer for all the groundwater supplies. The overall thickness of these Cenozoic sediments is about 10,000 meters.

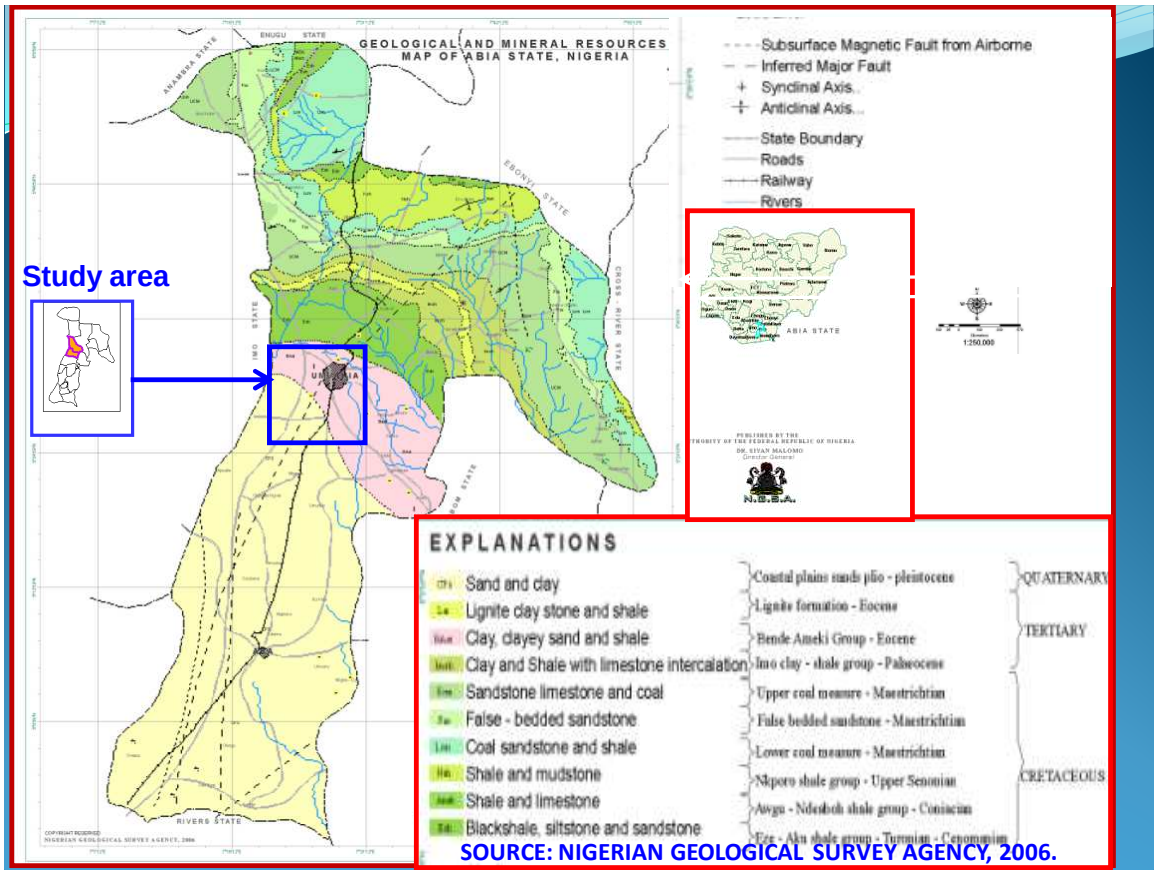

Fig. 1: Geologic Map of the Study Area

MATERIALS AND METHODS

Methods of Study

Sampling

This involved choosing a total of twenty six (26) air quality locations (Table 1) within Ariaria area in Aba, Southeastern Nigeria which were considered representative of the entire market environment and spectrum of activities. The locations covered areas of dense to sparse vehicular movement, manufacturing/fabrication (with high fumes generation), chemicals trading, foods, etc. Other areas covered include dump sites, timber sheds and generator lines. Two out of the total twenty six test locations were chosen as control locations and assumed to be similar to the baseline environment in the market area. The control locations are Uratta Junction by Express and Fly-Over Junction by Express at a distance of about 5km and 10km, respectively, away from the Ariaria Market). The predominant wind direction was also considered significant in choosing the orientation of the multi-parameter monitor. Positioning downstream of the air direction ensured that detectable levels of pollutants were captured by the monitor.

Table 1: Study locations and their coordinates

Station	Location	Coordinates
AQC1 (Control)	Uranta Junction by Express Way	N 050 05’ 03.5” E0070 19’ 44.9”
AQ 1	Ariaria Market Gate 2)	N 050 06’ 56.7” E0070 19’ 55.7”
AQ2	Victory Lane by Line B	N 050 06’ 53.7” E0070 19’ 57.8”
AQ3	Free Zone	N 050 06’ 51.8” E0070 19’ 52.2”
AQ4	B Line	N 050 06’ 51.8” E0070 19’ 59.2”
AQ5	Ure Line	N 050 06’ 56.4” E0070 20’ 05.5”
AQ 6	Omosisi by AT1	N 050 06’ 58.9” E0070 20’ 08.4”
AQ7	ATE Extension	N 050 07’ 00.2” E0070 20’ 09.4”
AQ8	Grinding Section	N 050 07’ 02.1” E0070 20’ 06.5”
AQ9		N 050 07’ 03.5” E0070 20’ 04.3”
AQ10	AKTC Park	N 050 06’ 56.7” E0070 20’ 10.5”
AQ11	Bakasi Park	N 050 06’ 50.2” E0070 20’ 14.7”
AQ12	C Line near Bakasi Park	N 050 06’ 47.8” E0070 20’ 11.7”
AQ13	A Line	N 050 06’ 43.6” E0070 20’ 06.4”
AQ 14	A Line	N 050 06’ 38.2”

		E0070 20’ 09.8”
AQ 15	A Line (Generator Sets)	N 050 06’ 43.9” E0070 20’ 05.9”
AQ 16	WWLS /B line Weavon Section	N 050 06’ 42.8” E0070 20’ 04.7”
AQ 17	WWLS / B Line	N 050 06’ 37.2” E0070 20’ 09.1”
AQ 18	A Line	N 050 06’ 57.6” E0070 19’ 57.8”
AQ 19		N 050 06’ 58.5” E0070 19’ 58.2”
AQ20	AME	N 050 07’ 01.1” E0070 20’ 01.1”
AQ21		N 050 07’ 02.0” E0070 20’ 02.6”
AQ22	Enyimba by Express	N 050 06’ 56.2” E0070 19’ 46.7”
AQ23	Bakasi by Express	N 050 07’ 06.1” E0070 19’ 49.6”
AQ24	Omode by Express	N 050 07’ 23.2” E0070 19’ 52.1”
AQ C2 Control	Aba Fly Over (Traffic Holdup)	N 050 03’ 54.7” E0070 19’ 41.4”

Equipment/Field Measurements

Sound Determination

A series of hand held air quality monitoring equipment such as the IBRID MX6 Multi-Gas monitor, Aerosol Mass Monitor Model GT – 531 and Cole- Parmer Extec Model 407736 Sound Level Meter were used for monitoring air quality of the proposed project area. Sampling in each case was for a period of eight hours per day with readings of all the parameters determined every two hours. The eight hours monitoring period was varied from day to day in order to take readings from early morning to late night over the monitoring period. Three readings were taken for each sample location and the average determined for the sample location. The measurements were done by holding the sensors of the various air qualities monitoring equipment at a height of about two meters in the direction of the prevailing wind and readings were recorded at stability. During the field work campaign the following air quality and meteorological parameters were monitored. Namely carbon monoxide, nitrogen dioxide, sulphur dioxide, hydrogen sulphide, volatile organic compounds, ammonia, methane and total suspended particulate. Others were relative humidity, ambient temperature, wind direction and noise. Measurements were done using different instrument modes to generate the most useful results.

Noise Determinations

A Cole- Parmer Extec Model 407736 Sound Level Meter was used to measure the noise level of the locations. The equipment measures noise via a microphone probe that generates signals approximately proportional to located sound waves. Measurements were done by directing the probe towards the direction of the prevailing wind and readings recorded at stability. The sound level measured were viewed from the reading on the meter’s LCD. An indication of ‘*over*’ means that the measurements were out of range and required selecting the other measurement ranges. The meter has two weightings – an 'A' and 'C' Weighting**.** 'A' or 'C' Weighting is selected via the

FUNCT switch. With weighting 'A', the meter responds as the human ear with regard to frequency response (the human ear boosts and cuts amplitude over the frequency spectrum therefore it is not 'flat' responding). Weighting 'A' which is used for environmental measurements, regulatory testing, law enforcement, and workplace design were used for noise measurements. Weighting 'C' is used for flat response measurements (no amplitude boost or cut across the frequency spectrum). Weighting 'C' is suitable for the sound level analysis of machines, engines, etc.

RESULT AND DISCUSSION

The results from the quantitative data gathered showed that the level of some of the parameters varied widely from place to place, while for others, the levels were relatively stable across the market or even undetectable at the resolution of the equipment used. The raw data was used to generate plots to aid analysis and determine if there is a relationship or trend across the sampled area. The results table is shown in Table 1 and the plots are shown in Figures 2 - 6 for each of the parameters.

Noise Pollution

The Analysis of the noise distribution shows that the noise levels are close to the Federal Ministry of Environment's 8-hour limit of 90dB for most parts of the market. In fact, the noise level is higher than the limit in the grinding area where metal-to-metal friction is very high. . Figure 1 shows the distribution of noise Pollution while Figure 2 is the histogram of the distribution of noise. Figure 3 is a typical distribution of CO while Figure 4 shows the distribution of CO. Figure 5 are Plots of air quality indices in Ariaria International Market.

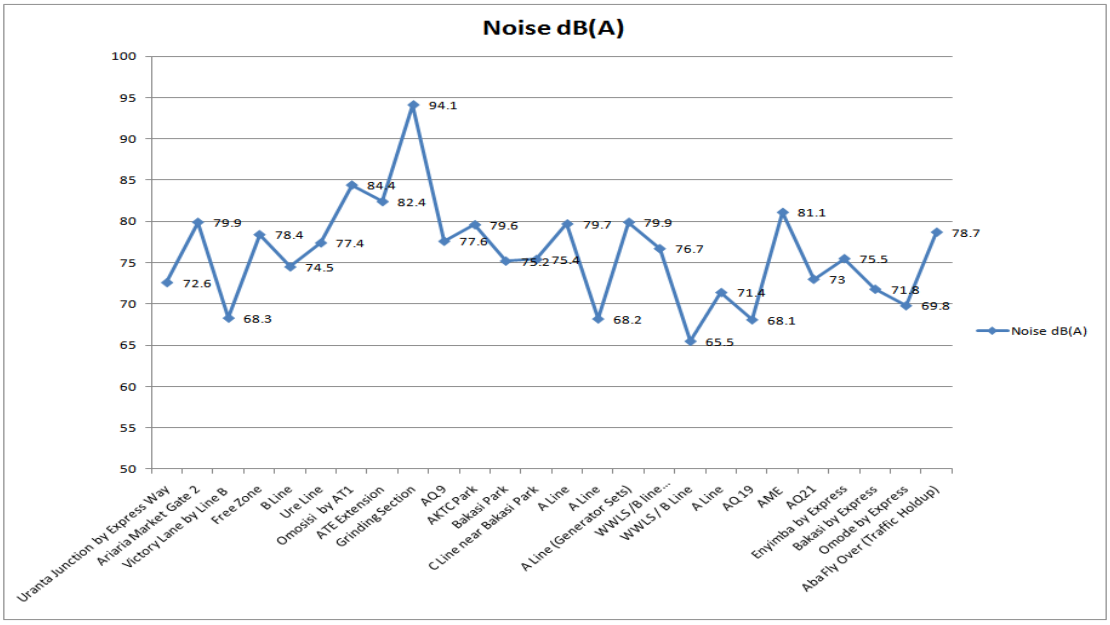

Figure 1: Distribution of Noise Pollution

Table 1: Measured parameters

Station	Location	Coordinate	VOC ppm	NH_3 ppm	NO_2 ppm	SO_2 ppm	H_2S ppm	CO ppm	CH_4 ppm	TSP mg/m3	Noise dB(A)	Rel. Hum %	Temp deg C
AQC1 Control	Uranta Junction by Express Way	N 05^{0}05' 03.5" E0070 19' 44.9"	0.3	1	0	0	0	4	0	0.367	72.6	43.2	36.3
AQ 1	Ariaria Market Gate 2	N 05^{0}06' 56.7" E0070 19' 55.7"	1.4	1	0	0.3	0	27	0	3.392	79.9	46.4	36.4
AQ2	Victory Lane by Line B	N 05^{0}06' 53.7" E0070 19' 57.8"	0.3	2	0	0	0	5	0	3.237	68.3	48.9	36.8
AQ3	Free Zone	N 05^{0}06' 51.8" E0070 19' 52.2"	0.3	1	0	0	0	0	0	3.795	78.4	37.7	36.7
AQ4	B Line	N 05^{0}06' 51.8" E0070 19' 59.2"	0.4	1	0	0	0	0	0	3.202	74.5	42.2	37.4
AQ5	Ure Line	N 05^{0}06' 56.4" E0070 20' 05.5"	0.4	1	0	0.4	0	20	0	2.357	77.4	39.8	37.8
AQ 6	Omosisi by AT1	N 05^{0}06' 58.9" E0070 20' 08.4"	0.4	1	0	0.3	0	10	0	2.244	84.4	41.8	38.1
AQ7	ATE Extension	N 05^{0}07' 00.2" E0070 20' 09.4"	0.4	1	0	0.2	0	6	0	0.724	82.4	47.7	38
AQ8	Grinding Section	N 05^{0}07' 02.1" E0070 20' 06.5"	0.5	1	0	0.3	0	32	0	0.625	94.1	47.6	36.5
AQ9	AQ 9	N 05^{0}07' 03.5" E0070 20' 04.3"	0.5	1	0	0	0	0	0	1.525	77.6	50.1	36.3
AQ10	AKTC Park	N 05^{0}06' 56.7" E0070 20' 10.5"	0.3	1	0	0	0	0	0	0.87	79.6	47.8	35.9
AQ11	Bakasi Park	N 05^{0}06' 50.2" E0070 20' 14.7"	0.5	1	0	0	0	4	0	2.39	75.2	51.9	35.7
AQ12	C Line near Bakasi Park	N 05^{0}06' 47.8" E0070 20' 11.7"	0.4	1	0	0	0	6	0	1.359	75.4	51.8	35.2
AQ13	A Line	N 05^{0}06' 43.6" E0070 20' 06.4"	0.3	1	0	0	0	5	0	2.525	79.7	57.6	35.2
AQ 14	A Line	N 05^{0}06' 38.2" E0070 20' 09.8"	0.4	1	0	0	0	7	0	0.225	68.2	56.3	35.1
AQ 15	A Line (Generator Sets)	N 05^{0}06' 43.9" E0070 20' 05.9"	0.9	1	0	0.3	0	21	0	3.961	79.9	52.9	34.5
AQ 16	WWLS /B line Weavon Section	N 05^{0}06' 42.8" E0070 20' 04.7"	0.4	0	0	0	0	1	0	0.401	76.7	57.7	34.4
AQ 17	WWLS / B Line	N 05^{0}06' 37.2" E0070 20' 09.1"	0.4	0	0	0	0	0	0	0.154	65.5	64.2	34
AQ 18	A Line	N 05^{0}06' 57.6" E0070 19' 57.8"	0.3	1	0	0.2	0	6	0	0.852	71.4	64	34
AQ 19	AQ 19	N 05^{0}06' 58.5" E0070 19' 58.2"	0.4	1	0	0	0	4	0	1.238	68.1	65.8	33.6
AQ20	AME	N 05^{0}07' 01.1" E0070 20' 01.1"	0.3	1	0	0	0	2	0	1.175	81.1	66.4	33.4
AQ21	AQ21	N 05^{0}07' 02.0" E0070 20' 02.6"	0.3	1	0	0	0	0	0	2.58	73	66.7	32.9
AQ22	Enyimba by Express	N 05^{0}06' 56.2" E0070 19' 46.7"	0.3	1	0	0	0	2	0	0.778	75.5	68.4	32.9
AQ23	Bakasi by Express	N 05^{0}07' 06.1" E0070 19' 49.6"	0.3	1	0	0	0	4	0	0.682	71.8	68.2	32.8
AQ24	Omode by Express	N 05^{0}07' 23.2" E0070 19' 52.1"	0.3	1	0	0	0	6	0	0.484	69.8	68.2	32.5
AQ C2 Control	Aba Fly Over (Traffic Holdup)	N 05^{0}03' 54.7" E0070 19' 41.4"	0.2	1	0	0.3	0	28	0	0.449	78.7	68.1	32

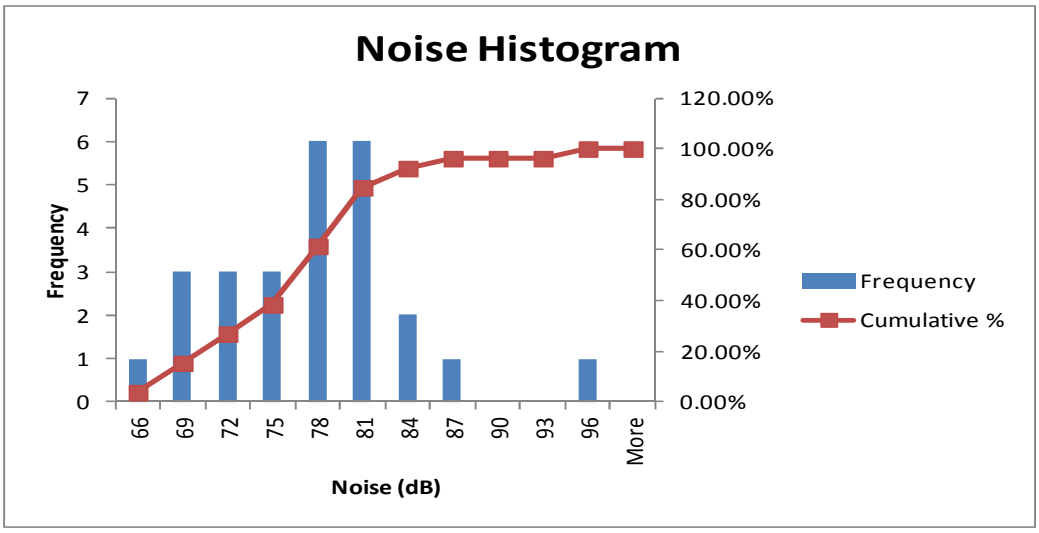

Figure 2: Histogram of the distribution of Noise

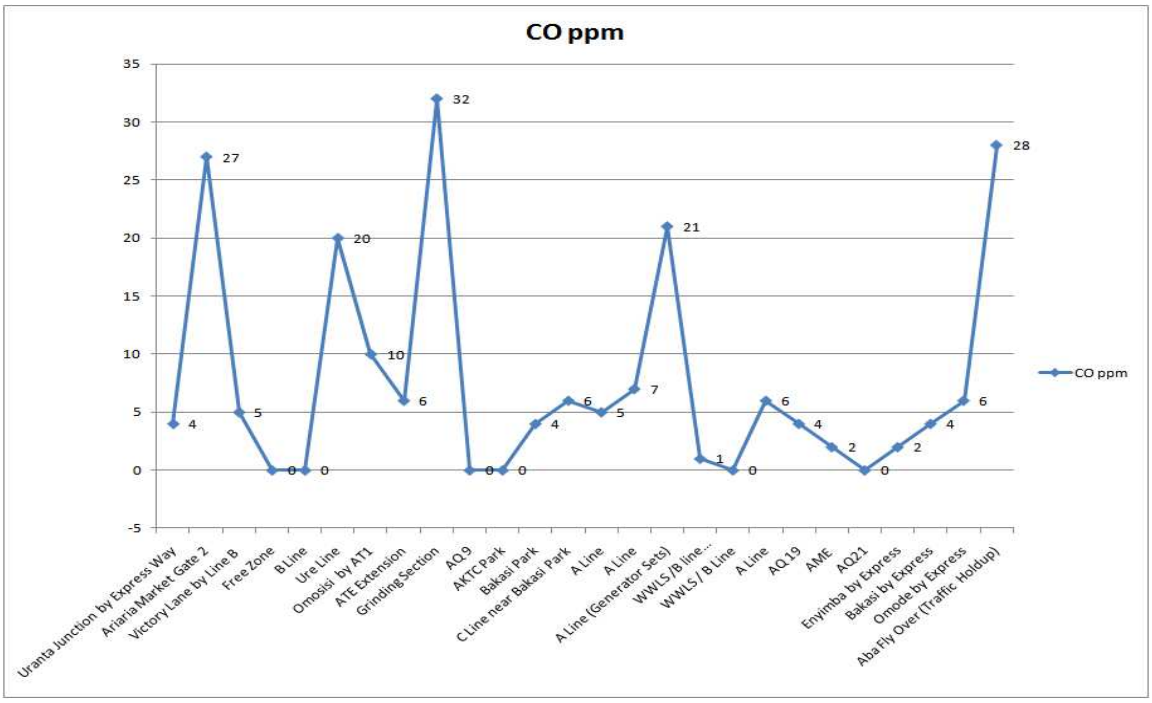

Figure 3: Typical Distribution of CO

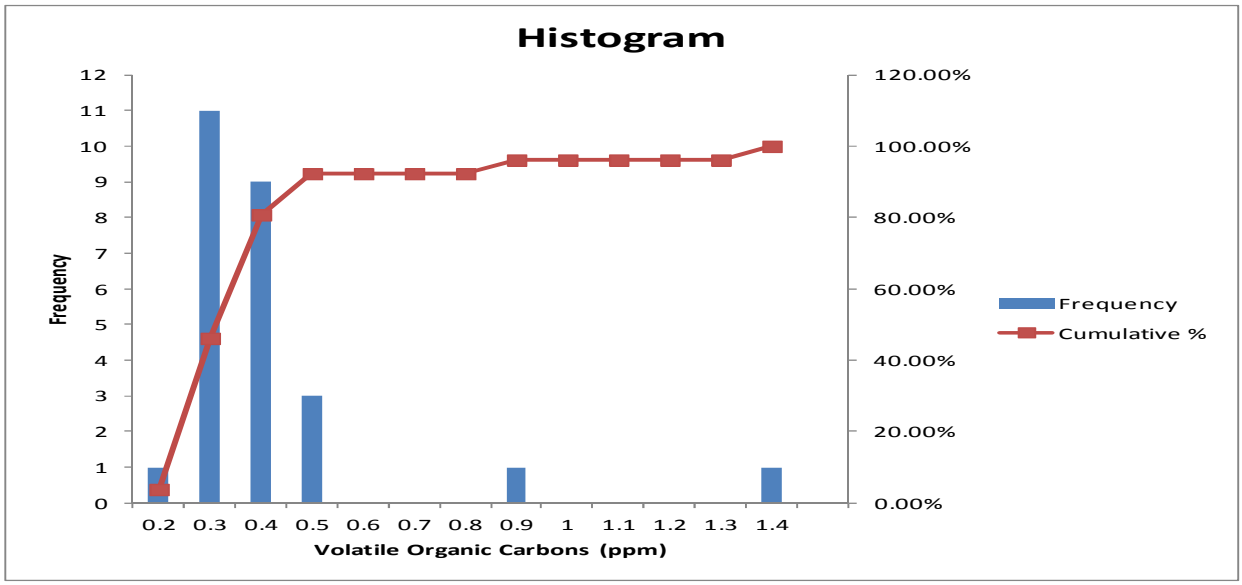

Figure 4: Histogram Showing the Distribution of CO

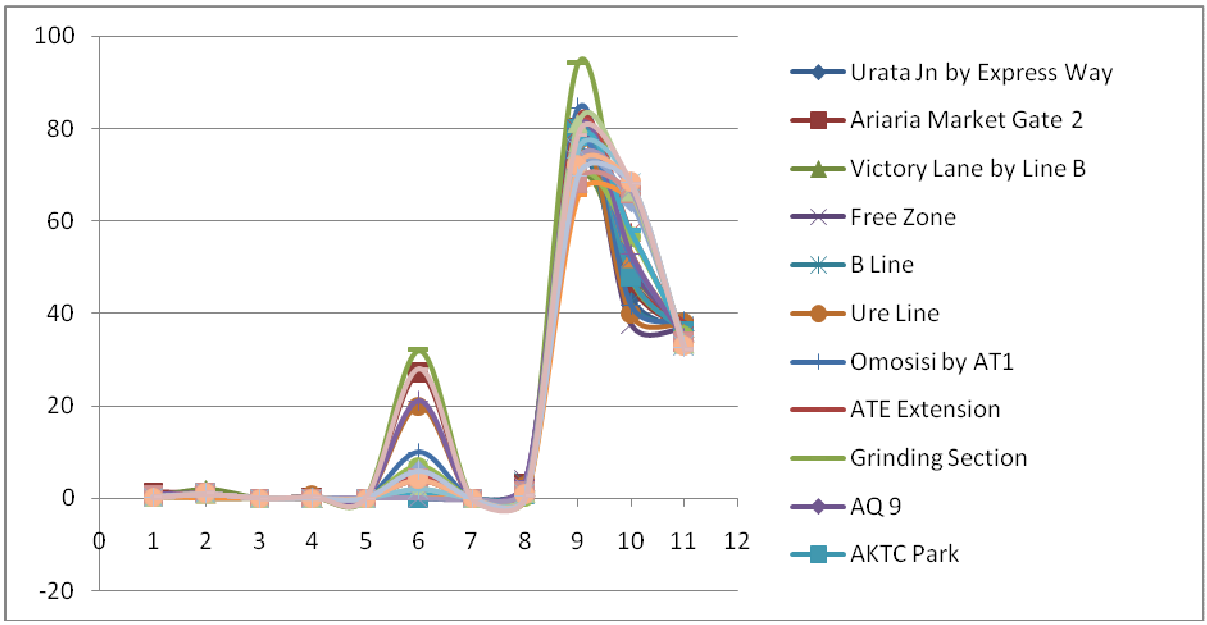

Figure 5: Plots of air quality indices in Ariaria International Market

CONCLUSION

This study has evaluated the issue of pollution, specifically air and sound pollution, with regards to the Ariaria International Market, Aba. It is evident from the results that sections of the market have poor air quality. Poor sound quality have also been observed in other sections of the market, and sometimes, in the same sections where the air quality is bad. This affects the geomorphology of the areas within and outside the market with negative impacts on the human health in the area.

As a result, some remedial measures have been proposed as seen to reduce the effects of pollution in the market and contribute in a small way to the efforts around the world at combating pollution. The remedial measures proposed include:

- The establishment of an Environmental Quality Monitoring agency that would be actively involved in promoting environmental friendly practices in industrial and business districts of cities. This would reduce practices such as indiscriminate burning of waste materials within the Ariaria International Market. The agency can be a Local or State Government Agency to ensure that environmental issues affecting the market are given priority.
- Improved transport infrastructure such as good roads and road networks, efficient traffic management to reduce vehicle idling time and flyovers. This can be achieved in the short term by filling potholes while planning for more permanent construction works in the long term.
- An orientation campaign to promote environmentally friendly practices by everyone within the market vicinity. For example, drivers can be encouraged to avoid blaring their horns indiscriminately at junctions.

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