



Investigation of the Concentration of Market Particulate Due to Traffic and Milling Activities in Bodija Market.: A Silent Air Quality Threat to Human Health.

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Abstract: The impact of particulate pollution in the market due to traffic and milling activities was investigated. Samples were obtained and measured for both vehicular and milling activities within Bodija market, Ibadan, Oyo state, southwestern Nigeria. The concentration for milling varied from $10.7\mu\text{g}/\text{m}^3$ - $24.3\mu\text{g}/\text{m}^3$ in the morning of monitoring and $18.4\mu\text{g}/\text{m}^3$ - $50.9\mu\text{g}/\text{m}^3$ in the afternoon of monitoring while the concentration for vehicles varied from $12.8\mu\text{g}/\text{m}^3$ - $17.8\mu\text{g}/\text{m}^3$ in the morning of monitoring and $22.0\mu\text{g}/\text{m}^3$ - $37.3\mu\text{g}/\text{m}^3$ in the afternoon of monitoring. Milling activities at the Bodijamarket harboured the significantly highest concentration of particulate pollution due to some unhygienic practices observed during milling and this has implications on the air quality and safety of the people within the market. Sensitizing millers and people within the market on particulate pollution and its health effects on man and the environment is highly recommended.

Keywords: Particulate pollution, milling activities, unhygienic practices.

1. Introduction

Pollution is the release of contaminants that cause adverse change into the natural environment. Pollution occurs in different forms namely water, air, noise, and land but this study focuses on particulate pollution which according to Wikipedia is "the mixture of solids and liquid droplets floating in the air". Some particles are released directly from a specific source, while others form in complicated chemical reactions in the atmosphere. This is the case of Bodija market which accommodates loads of people given its enormosity thereby having pollution as one of the problems facing the market users and its environment. Particulate matter can cause serious problems in the environment among which are the change in the radiation, change in cloud formation, contribution to global warming, and reduced visibility.

The study intends to achieve the following:

- Identification of all forms of extant pollutants within the marketplace, the sources of pollution and analyzing the generation process in order to identify wrong process approaches.

- Quantification of particulates generated within Bodija market due to traffic.
- Determination of the adverse health effects of the particulate pollutants on the people and the environment with a view to providing mitigating measures to them.

Air Pollution

Air pollution is the introduction of particulates, biological molecules, or other harmful materials into earth's atmosphere, causing diseases, death to humans, damages to other living

organisms such as animals and food crops, or the natural or built environment. Air pollution may come from anthropogenic or natural sources. According to Friedl (2014), air pollutants can be described as gases and particles in the atmosphere that harm organisms and affect climate and also as the release of these particles and gases into the air. According to the 2014 WHO report, air pollution in 2012 caused the deaths of around 7 million people worldwide and Randesh

(2015) in his article titled "Conserve Energy Future" referred to air quality as "the condition of the air within our surrounding". He stressed further that the good quality of air can be degraded by the day to day emissions from different air pollution sources. Among these pollutants are sulfur dioxide (SO₂), particulate matter, hydrocarbons (HC) and volatile organic compounds (VOC), lead, carbon dioxide (CO₂), carbon monoxide (CO), nitrogen oxides (NO_x), and smog.

Sources of Air Pollution

Mitchell (2014) in his article classified the sources of air pollution based on mobility and these are stationary and mobile sources. According to him, "A stationary source of air pollution refers to an emission source that does not move, also known as a point source". Point stationary sources include factories, power plants, dry cleaners and degreasing operations. The term area source is used to describe many small sources of air pollution located together whose individual emissions may be below thresholds of concern, but whose collective emissions can be significant. Residential wood burners are a good example of a small source, but when combined with many other small sources, they can contribute to local and regional air pollution levels.

Area sources can also be thought of as non-point sources, such as construction of housing developments, dry lake beds, and landfills. A mobile source of air pollution refers to a source that is capable of moving under its own power. In general, mobile sources imply "on-road" transportation, which includes vehicles such as cars, sport utility vehicles, and buses. In addition, there is also a "non-road" or "off-road" category that includes gas-powered lawn tools and mowers, farm and construction equipment, recreational vehicles, boats, planes, and trains Mitchell (2014) in his article also identified agricultural operations and some natural occurrences as the sources of air pollution. He attributed pollutions occurring from the misapplication of fertilizers, herbicides, and pesticides to agricultural operations which can potentially result in aerial drift of these materials and

harm may be caused while attributing pollutions from wild land fires, dust storms, and volcanic activity to natural occurrences also contribute gases and particulates to our atmosphere. Meanwhile, he also mentioned that industrialization and the use of motor vehicles are overwhelmingly the most significant contributors to air pollution.

Friedl (2014) had a different opinion from Mitchell's classification of the sources of air pollution. She classified sources of pollution based on the number of sources and varying effects.

On the basis of the number of sources, she identified and described point source pollution as an occurrence that involves air pollutants coming from a single source of origin, such as smokestacks at a single factory and Non-point source pollution as when the air pollutants come from many sources, such as all of the cars in a particular city. On the basis of effects, she identified and described primary pollutants as those that cause direct harm or that can react to form harmful substances in the atmosphere and Secondary pollutants as those harmful substances that are created from the reactions between primary pollutants and the components of the atmosphere.

Methodology

Study Area

Bodija market is located in Ibadan, Oyo State. Ibadan is a cosmopolitan city whose population continues to increase daily. The market is situated along secretariat U.I road, within the territory of Ibadan North Local Government, which is the most populated of the 11 local governments in Ibadan. The market is bordered in the North by Agbowo and Orogun, in the south by Bodija estate, while in the West and East are Sango and Bashorun/Ashi respectively.

Materials

The following materials were used for the project:

- a. Particulate meter was used to measure the amount of particulate generated by

- vehicles and pedestrian activities.
- b. CO₂ Meter was used to measure CO₂ emissions from vehicular activities within the market.

Methods

The research was carried out by following the methods below:

Sampling

Five (5) sample points were taken along the road that has more vehicular activities to represent the particulates generation points by vehicular activities while 8 sample points were taken along the roads and shops restricted to milling and sorting activities to represent particulate collection points generated by milling and sorting. These sample locations covers areas of dense to sparse vehicular movement, pedestrian activities, grinding stores, chemical trading, foods etc. These sample points were considered as a representative of the entire market environment and spectrum of activities. The control location is FoodCo supermarket, which is located 2km kilometers away from Bodija market.

Measurement of air quality parameters:

Air quality monitoring device; Thermo Scientific MIE pDR-1500 particulate meter was used to monitor the air quality of the study area. The particulate meter was used to measure the concentration of PM_{2.5} in the air. PM_{2.5} was chosen out of other particle size because of its recorded health effect, being the most dangerous respirable particles, causing different kind of lung diseases. The device used for monitoring is an easy to use equipment that provides fast and accurate measurement of particulate contamination in particles per cubic foot. The device was switched on and then calibrated. It was then placed on a stable platform in order to ensure accuracy of measurement. The measurement was recorded when the readings on the display screen were stable. Sampling in each case was done two times in a day which includes

morning and afternoon. Readings of the two intervals was taken at each sample point in the market. The monitoring was carried out for the duration of one (1) week.

Results

The following results were obtained from the field work

Vehicular and Milling Particulate Pollution

The daily concentrations of PM_{2.5} measured from both milling activities and vehicular traffic at the study area (Bodija market) for the duration of a week corresponding to morning and afternoon peak market activities.

The average daily concentration of PM_{2.5} measured was calculated to give the daily variation of PM_{2.5} concentration for a week in the morning and afternoon including the control results

Discussion

Daily Variation of PM_{2.5} concentration at Bodija Market

The experimental data obtained from daily air monitoring of PM_{2.5} at Bodija market for one week shows that the concentration of PM_{2.5} with respect to milling activities is more on Fridays and Saturdays in the morning and afternoon at peak activities. This often happen because of the increase in market activities towards the weekend than other days of the week as large percentage of milling activities occurs in the market. However, it was also discovered that some of the days also have high concentration of PM_{2.5} due to the kind of activities done in and around the market place. Experiments and observation also shows high concentration of PM_{2.5} around the grinding mill and sorting section because of the direct release of yam or dry pepper particles into the atmosphere there by distorting the level of air quality within that area. Survey also shows that PM_{2.5} concentration with respect to vehicular traffic is higher on Mondays, Fridays, and Saturdays in morning and afternoon due to the offloading of goods in the market. Increase in

the number of pedestrians entering the study area will increase the number of vehicles in the market thereby causing increase in the concentration of particulates and gaseous emissions.

Variation of PM_{2.5} Concentration by Milling

The concentration varied from $10.7\mu\text{g}/\text{m}^3$ - $24.3\mu\text{g}/\text{m}^3$ in the morning of monitoring, and $18.4\mu\text{g}/\text{m}^3$ - $50.9\mu\text{g}/\text{m}^3$ in the afternoon of monitoring. World Health Organization (WHO) recommends $25\mu\text{g}/\text{m}^3$ while National Ambient Air Quality Standard (NAAQS) recommends $35\mu\text{g}/\text{m}^3$ as maximum permissible limit that ensures 95% safety from lung diseases. The elevated concentration of PM_{2.5} in the study area is due to the milling and sorting activities within the market which causes release of particulate into the atmosphere. Activities such as grinding of yam flour which release yam powdery particles and exhaust fumes coming out of the machine used in powering the grinding machine, release of particulates generated by food sellers especially when filtering beans and its dirt with other dust related goods and non-stop movement of pedestrians on untarred roads which also contributes to the release of particulate matter into the air.

Variation of PM_{2.5} Concentration by Vehicular Activities

The concentration varied from $12.8\mu\text{g}/\text{m}^3$ - $17.8\mu\text{g}/\text{m}^3$ in the morning of monitoring, and $22.0\mu\text{g}/\text{m}^3$ - $37.3\mu\text{g}/\text{m}^3$ in the afternoon of monitoring. World Health Organization (WHO) recommends $25\mu\text{g}/\text{m}^3$ while National Ambient Air Quality Standard (NAAQS) recommends $35\mu\text{g}/\text{m}^3$ as maximum permissible limit that ensures 95% safety from lung diseases. The elevated concentration of PM_{2.5} in the afternoon than morning is due to the increase in vehicular activities in the afternoon to and fro movement of vehicles both personal, commercial, trucks, are more in the afternoon than morning thereby releasing particulates and gaseous emission which deplete the air quality.

Conclusion

The following conclusions are drawn after the successful completion of the study.

- a. Particulate pollution plays an integral part in the increased mortality rate recently.
- b. People are still less sensitized than they should be as regards the detrimental effects of some pollutants on the body systems.
- c. Particulate pollution is one of the major problems menacing the society
- d. Diseases such as chronic asthma, pulmonary diseases etc. stemming from air pollution are as deadly as some dreadful diseases such as cancer and AIDS.

Recommendations

Based on the conclusions and discoveries, the following recommendations are made:

- People should be sensitized more on air pollution and its health effects on man and the Environment.
- Environmental regulation agency should look deep into this sector of the economy and make necessary law and enforcement.
- Grinding mill section contributes to a larger percentage of particulate generation in the market hence it should be cited is a more spacious environment and some kilometers away from the market where people converge every day. Enforcement should be made for the millers and any pedestrian visiting the area to use a particulate mask for their face.
- Government should offer supports to the people working in these sections in terms of provision of protective materials and also encouraging their usage.
- People within the market should make sure they use nose guard while in the market especially those at food stuff sections who dust out dust from beans, garri, melon etc.

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