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Research Article

ASSESSMENT OF THE CURRENT AIR STATUS OF ADDIS ABABA (FROM SEPTEMBER TO JANUARY, 2016), ETHIOPIA

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Abstract

Air pollution is occurring on a vast and unprecedented scale around the globe. In Africa, the healthy air environments are polluted by by-products of some useful activity, such as industrial gaseous and vacuolar emission. . In many urban areas exposure to air pollution is the main environmental threat to human health. Emissions of carbon monoxide and all nitrogen oxides can be leads to the climate change and ozone depletion. In the previous study there was no studied about the evaluation of concentration of air pollutants in Addis Ababa. The main of aim this study is evaluate the concentration of Carbon monoxide (CO), Nitrogen Oxides compounds (NOx), Nitrogen monoxide (NO) and Ozone (O3), and humidity which released from vehicles and industries emission to ambient air pollution of Addis Ababa, Ethiopia from September to January, 2016. A cross-sectional study was design carried out during October to July 2017 at selected areas of Addis Ababa. Air pollutants were sampled from 12 sampling sites which is a reference of all area of Addis Ababa by instruments of handheld 4-Gas, Model HM5000 analyzer. Microsoft office Excel software was used to test the comparison of average concentration of air pollutants with humidity within six months. From all types of air pollutants the highest concentrations of air pollutants NO and NOx were recorded 385% and 384% from September to January 2016 with the same values (53%) of humidity. This result recorded due to in the high temperatures of vehicle engines; nitrogen and oxygen react to form nitrogen oxides. According to these indicated that the air status of Addis Ababa will changed time to time.

Keywords: Air pollution, Carbon monoxide (CO), Nitrogen Oxides compounds (NOx), Nitrogen monoxide (NO) and Ozone (O_3)

Introduction

Back ground of the study

Today, pollution is occurring on a vast and unprecedented scale around the globe (Speth, 2015). In the world wide the environmental aspects were affected by various point and non point source of pollution. More than 50% of the global population heavily relies on biomass fuel as a source of household energy(Kumie, 2009). The potential for serious consequences of exposure to high levels of ambient air pollution was made clear in the mid-20th century(Cohen *et al*., 2004). One of the most problems especially in countries is that rapid urbanization and industrialization which results to rapid deterioration of ambient air quality (Health, 2008). As different scientists were said that; this problem is coming from; as a trends of, toward large and growing releases of certain chemicals principally from burning fossil fuels that are now significantly altering the natural systems on a global scale; and of, toward steady increases in the use and release to the environment of innumerable biological products and toxic substances (Speth, 2015).

In Africa, the healthy environments are polluted by releasing of pollutants to the environment are most often the casual by-product of some useful activity, such as industrial gaseous, vacuolar emission, waste disposal and so on (Federal Department of Economic Affairs, 2015). In Ethiopia, the environmental conditions are critically treated by climate change, industrial process, solid and liquid wastes ("UN," 1990). Increasing demand on transportation service and challenges of the prevailing poverty are basic problems in emerging cities of developing countries (Savell, 2010). The major cause of air pollution in urban area is generated from vehicles. Vehicular air emission is more specific to ambient air pollution. An increased level of traffic air pollution was observed in most urban settings in developing countries like Addis Ababa (Affairs, 2011). Addis Ababa is the capital city of Ethiopia which is located on the foothills of the Entoto mountain range. Entoto mountain peaks surround the city of Addis Ababa with the elevations around 300 meters. The city has since expanded east and west along the foot of mountain range, and more recently southwards out to the plains. The area of Addis Ababa is covering around 51,284 hectares almost 200 square miles of which about 24% is residential, 7% is used by government institution and urban services, 6% by light and heavy industry, with the remaining 63% covered by agricultural land, forestry land other open spaces. It has a population of 3,384,569 according to the 2007 population census, with annual growth rate of 3.8%. This number has been increased from the originally published 2,738,248 figure and appears to be still largely underestimated and causes of an increment for air pollution (Republic, 2007). Different researchers were evaluating the concentration of air pollutants of different countries focused on the emission of CO, NO, NO_2, NOx and Ozone(O_3) (Enge *et al*., 2002). In the previous study there was no studied about the evaluation of concentration of air pollutants in Addis Ababa. The impacts of pollutants are aggravated to different country like developed country, developing country and urban areas of Africa except in Ethiopia, Addis Ababa (Tefera, 2011 & Kumie, 2009). This situation is not yet studied in Addis Ababa, Ethiopia, where industries and vehicles are widely used. In this study find the concentration air pollutants like CO, Nitrogen monoxide (NO), Nitrogen dioxide (NO_2), Ozone and humidity in selected area of Addis Ababa. Therefore, in this research the concentration of the listed gases in the selected areas of Addis Ababa, Ethiopia will be assessed. The main objectives of this study is to evaluate the evaluation of amount of Carbon monoxide (CO), Nitrogen Oxides compounds(NOx), Nitrogen monoxide(NO) and Ozone(O3), and humidity which contribution of both vehicles industries emission to ambient air pollution for six months from September to January, 2016.

Materials and Methods

Description of Study Area

The study was conducted in Addis Ababa on selected areas of crowded vehicular, industries in central Ethiopia (located latitude at $9^0$1'48''N and longitude $38^0$44''24''). Addis Ababa has a subtropical highland climate zones with temperature differences of up to 10^oC (18^0F) depending on elevation and prevailing wind patterns (Republic, 2007). The selected study areas of Addis Ababa were Aduwa square (Megenagna, N $09^0$00.145'; E 038^0 47.560'), Arada (Arada building, N$09^0$01. 977'; E 038^0 41.187'), Betel(N 09^0 00.225'; E038^0 41.515'), Bob Marley square(Imperial Hotel, N09^0 00.156; E038^0 48.005'), Bole Bridge(N 080 59.351';E038^0 47.550'), Entoto(St. Mary church), Kaliti Road Intersection (Trafic light), Bus station(Addis Ketema, N$09^0$02.038'; E038^0 43.947'), Lagare Traffic Light, Mexico Square, Teklehaimanot square and Ureal Traffic Light. These sampling sites were the reference of area of the all area of Addis Ababa.

Study design

Comparative cross-sectional study design was followed from October to July 2017 at selected areas of Addis Ababa. With *dependent variables*, Carbon monoxide (CO), Nitrogen Oxides (NOx), Nitrogen monoxide(NO), Ozone(O3), humidity and direction of wind.

Study sites selection

Study sites were selected based on the fulfillment of the inclusion criteria which means to compare the evaluation of present day of concentration of air pollutants from the previous between different sites which have similar status in concentration of air pollutants, vehicles emissions and industrial activities were selected.

Equipment

The handheld 4-Gas Analyzer, Model HM5000 were used to sample the ambient air at each of sampling sites.

Data collection

The 2016 (from September to January) the ambient level of NOx, NO, CO, Ozone and humidity was collected from national metrology as a secondary data. Data collections were collected in minute and hours for six months (September to January, 2016).

Data analysis

Sampling data were analyzed by the use of version of Microsoft office Excel software.

Results

Concentration of Nitrogen monoxide

Across the six months monitoring nitrogen monoxide by metrology examined, the highest concentration of nitrogen monoxide was recorded in January, 2016 with 60% of humidity (fig 1).

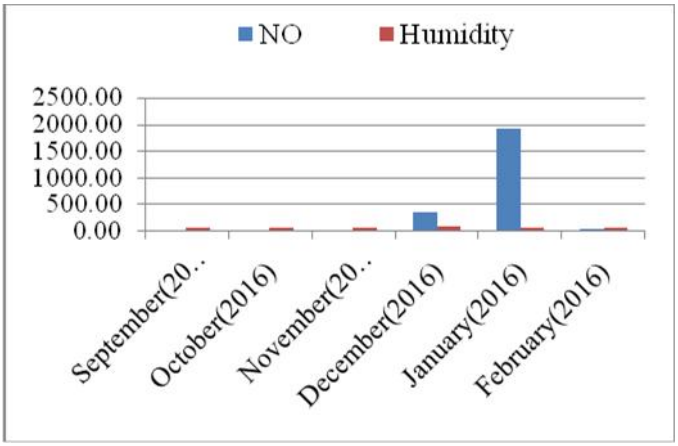

Fig 1: concentration of nitrogen monoxide with humidity.

Concentration of Nitrogen dioxide with humidity

Across the six months monitoring nitrogen dioxide by metrology examined, the highest concentration of nitrogen monoxide was recorded in December, 2016 with 20% of humidity (fig 2).

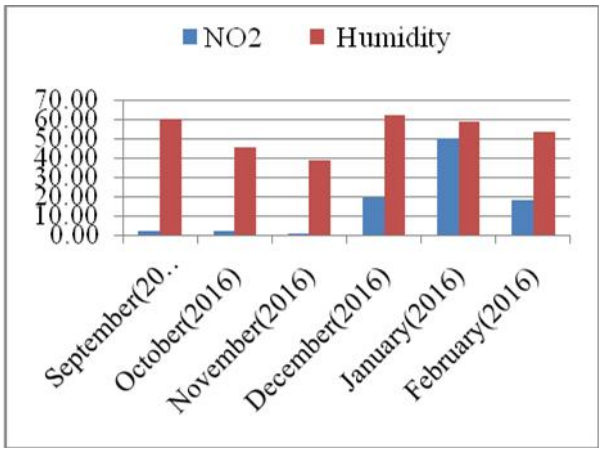

Fig 2: concentration of nitrogen dioxide with humidity.

Concentration of Nitrogen oxide compounds with humidity

Across the six months monitoring nitrogen oxide compounds by metrology examined, the highest concentration of nitrogen oxide compounds was recorded in January, 2016 with 60% of humidity (fig 3).

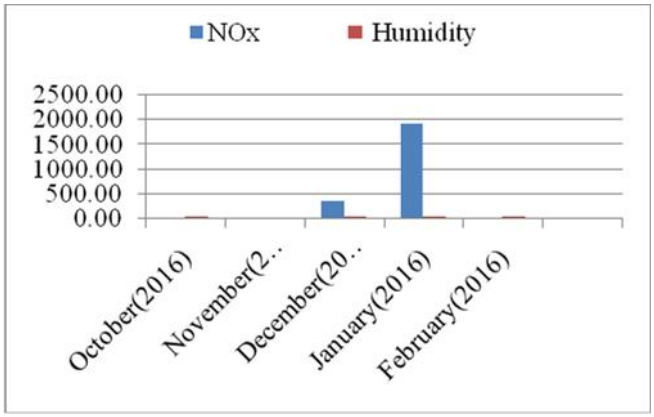

Fig 3: concentration of nitrogen oxide compounds with humidity.

Concentration of ozone with humidity

Across the six months monitoring ozone by metrology examined, the highest concentration of ozone was recorded in December, 2016 with 16% of humidity (fig 4).

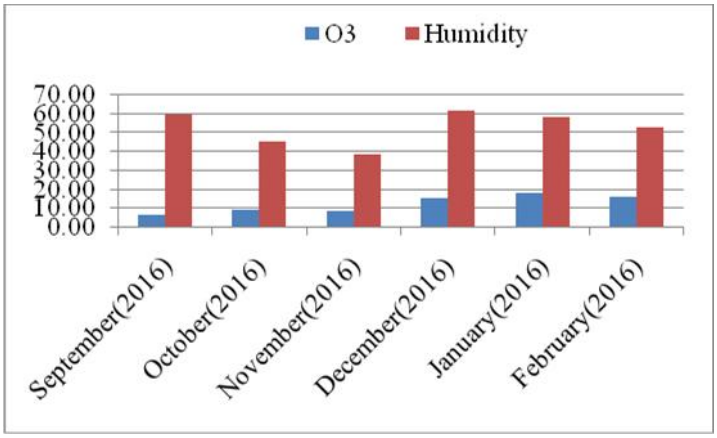

Fig 4: concentration of ozone with humidity.

Concentration of carbon monoxide with humidity

Across the six months monitoring carbon monoxide by metrology examined, the highest concentration of carbon monoxide was recorded in September, 2016 with 60% of humidity (fig 5).

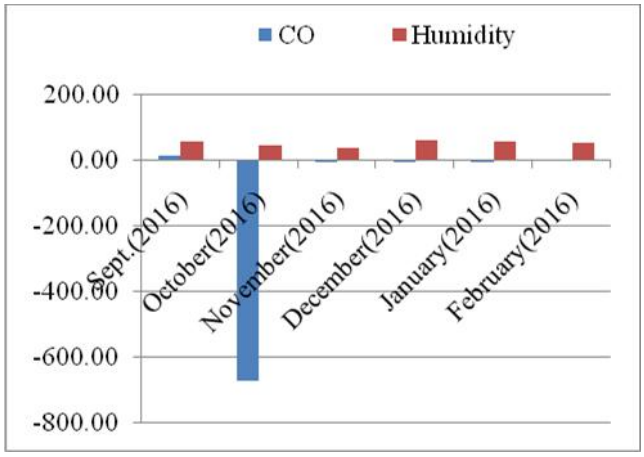

Fig 5: concentration of carbon monoxide compounds with humidity.

The average concentration of air pollutants with humidity

Across the six months monitoring air pollutants by metrology, the highest concentrations of air pollutants NO and NOx were recorded 385% and 384% from September to February 2016 with the same values (53%) of humidity (fig 6).

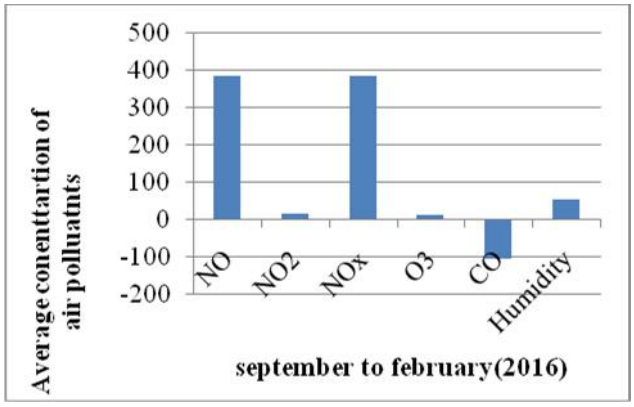

Fig 6: concentration of air pollutants with humidity.

Discussion

The study investigates that the status airs of Addis Ababa, the capital city of Ethiopia in 2016 of the first six months. Thoughtfully the healthy air is affected by different air pollutants emission from vehicles and industrial activities (Institution, 2015). In this study, the highest values of Nitrogen monoxide (NO) and nitrogen oxide compounds (NOx) (in fig 1 and 3) were recorded in January, 2016 with the same humidity. This value may be recorded due to the reason of higher emissions from industries and vehicles and wind direction (Gases, 2016). When fuels are burned in vehicle engines, high temperatures are reached. At these high temperatures nitrogen and oxygen from the air combine to produce nitrogen monoxide. As a result nitrogen monoxide is combines with oxygen in the air to form nitrogen dioxide or (NOx). As the value of NO (1993 $\mu g/m3$), NO_2 $\mu g/m3$ (49 $\mu g/m3$), and NOx (1993) indicates that, the air status of Addis Ababa in 2016 was alarmingly increase as compared to WHO standard (240$\mu g/m3$, 40 $\mu g/m3$ and 200 $\mu g/m3$.

This is difficult for air and rain because which increases and produces or forms climate change and acid rain.

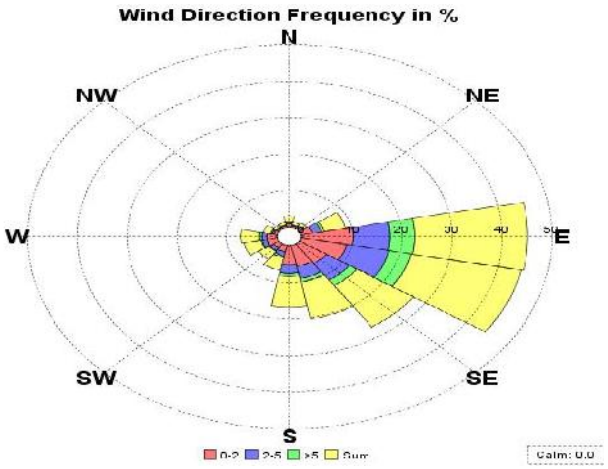

Fig 7: wind direction

The highest value of ozone (65 $\mu g/m3$), were recorded in December may be due to formation of a minimum amounts of air pollutants and direction of wind in one direction of east as showed fig 7. This value was smaller than that of WHO standard of O3 (100 $\mu g/m3$) due to the above reason (Joss et., 2017). However, the highest value of CO (18 $\mu g/m3$) were recorded in September with the same concentration of humidity of six months of 2016 ("WHO, Air quality guidelines, 2005). The value was smaller than that of WHO standard, may be carbon monoxide was produced from fuel is burned in sufficient supply of oxygen since the month is September which is runny and lot of plantation and due to good humidity. Plants remove some of secondary pollutants carbon dioxide which is formed from primary pollutants of carbon monoxide from atmosphere because they use it in photosynthesis (Anwar *et al.,* 2016).

In general, as Fig 6 showed that, from all types of air pollutants the highest concentrations of air pollutants NO and NOx were recorded 385% and 384% from September to February 2016 with the same values (53%) of humidity. This is due to in the high temperatures of vehicle engines; nitrogen and oxygen react to form nitrogen oxides. These gases irritate the lungs and cause acid rain (Anwar *et al.,* 2016). According to these result indicated that the air status of Addis Ababa will changed time to time, so we can protect our environment.

Conclusion

Air pollution can harm us when it accumulates in the air in high enough concentrations. Millions of Americans live in areas where urban smog, particle pollution, and toxic pollutants pose serious health concerns. People exposed to high enough levels of certain air pollutants may experience in irritation of the eyes, nose, and throat, wheezing, coughing, chest tightness, and breathing difficulties, worsening of existing lung and heart problems, such as asthma increased risk of heart attack. As the result showed that our air statuses also gonging to be affect human health and climate. From the major air pollutants NO and NOx were highly concentrated than that of the other pollutants in September to February, 2016.

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