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Research Article

STUDENT OPINIONS AND SOLUTIONS TO CITY AIR QUALITY: A CASE STUDY

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ABSTRACT
Presently the air pollution is a burning issue due to globalization and motorization in various countries. Air pollution related problems resulted in an increased public awareness about surrounding air quality in both developing and developed countries. There are many pollutants adversely affecting human health such as CO, RSPM, SO_2, NO_2, SPM and O_3 etc. The high concentration of these pollutants can be life threatening, causing breathing difficulty, headache and dizziness. A survey of engineering students has been conducted in the campus of Delhi Technological University (DTU). An attempt has been made to analyze student's reactions to city air pollution problem and kind of remedial actions suggested by them.

Keywords: *Air Pollution, DTU, Human Health, Pollution Awareness*

INTRODUCTION
The rapid industrialization leading to urbanization, unplanned and excessive exploitation of natural resources have been causing pollution problems in cities and towns of developing countries. Manmade and natural sources of emissions polluted the air with toxic substances. A recent study in middle-income homes of Delhi found that PM10 levels to be as high as 170–810 $\mu g/m^3$ even in homes where there was no cooking or smoking activity (Kumar, 2001). It is well known that mitigating outdoor air pollution remains a major challenge in most developing countries. Annually, outdoor air pollution contributed to 3.2 million deaths and 76 million life years lost worldwide in 2010, two-thirds of which occurred in Asian Countries (Lim *et al.,* 2012). The knowledge about environment to students is very essential to apply the concept of engineering and ecology to mitigate pollution problems. It is the responsibility of the young generation to save and protect the environment and try to evade such kind of behaviors which deteriorate the natural ecosystem. Presently the environmental knowledge is such kind of weapon which can help to young generations in this regard. Positive attitudes and values towards the environment are developed with the help of good education (Kahyaoğlu, 2009). The purpose behind the environmental education is to raise awareness among people to gain skill, knowledge, attitude as well as positive approach to protect and save the environment. The most effective way of developing the responsibility of individuals towards environment can be thought as education (Mishra and Shukla, 2013). The Langkawi Declaration on Environment (1989) recommended the need to protect environment be viewed in a balanced perspective and emphasis accorded to promoting economic growth and sustainable development (Hassan *et al.,* 2010). Lack of insufficient awareness among individuals on the societal level is an important problem about coping with environmental issues for many counties (Yurttaú *et al.,* 2010 and Özdemir *et al.,* 2004). Hassan *et al.,* (2010) evaluated the environmental awareness about the concept of sustainable development among secondary school students. The survey was conducted on 340 respondents of fourth and fifth class students from urban and suburban area in the district of Hulu Langat, Selangor (Bandar Baru Bangi and Mukim Hulu Langat). Secondary school students were found with high level of environmental awareness in the concept of sustainable development. The study indicated higher level of environmental awareness among female students in comparison to male students. Science students are found more aware than arts stream students. In addition to this, the urban school students were observed more aware than the suburban background students.

Yurttaú and Sülün (2010) resolute the perceptions of eighth grade primary school students about the most important environmental problems in city where they live. After the analysis of questionnaire based survey, environmental education was recommended as a mandatory course for the primary school going

age children. Likewise Ercan (2011) studied about the awareness of environmental problems among the student. The total 111 students (63 females and 48 males) were surveyed to investigate about environmental problems and proposed solutions. The majority of students thought of visual pollution and air pollution. The students brought various solutions to the problems by suggesting awareness raising campaigns, providing educational seminars by the government, broadcasting TV programs related to the matter and increasing criminal sanctions towards environmental crimes. It was also assessed that students were aware of the majority of the environmental problems and they expect more sensitivity from adults (parents, administrators etc) who are supposed to be more aware and sensitive to the issues than the children. Karatekin (2013) observed the mindset of elementary students about perceptions of environmental problems through mind mapping technique. He surveyed 88 students of 5th, 6th, 7th, and 8th grades at an elementary school in Ankara. The research study showed that the most worrisome environmental problems for 5th, 6th, and 7th grade students are air pollution and waste, and the most worrisome environmental problems for 8th grade students are global warming and drought. It was also found that the elementary students were most concerned about environmental issues such as air pollution, water pollution, problem of waste and global warming.

Over the last two decades, motor vehicles are emerged as a critical source of urban air pollution in much of the developing world. The incidence of various transport related pollutants like CO, NO_x, SO_2, O_3 and PM in developing countries exceeds international and national limits. The associated human health and welfare costs run into hundreds of millions of dollars and far exceed the prevention costs in terms of the control measures. The air pollution problem is particularly serious in the rapidly urbanizing cities of South and East Asia (especially in mega cities such as Bombay, Calcutta, Delhi, Dhaka and Karachi in South Asia and Bangkok, Beijing, Shanghai, Jakarta and Manila in East Asia). Growing number of urban dwellers are exposed to unacceptable levels of atmospheric pollutants from a variety of sources. In terms of human exposure to harmful emissions, motor vehicle has become a major problem in large cities. Megacities are very large urban sprawls confronted with a multitude of environmental challenges including soaring air pollution emissions. Thus megacities tend to be global risk areas and their inhabitants are vulnerable to air pollution induced adverse health impacts, such risks need to be estimated to help initiate national and international efforts to improve the sustainability of megacity life worldwide (Gurjar *et al.*, 2010).

MATERIALS AND METHODS

Brief Description about University

Delhi Technological University is a leading world class technology university playing its key role in national and global knowledge. DTU is a significant milestone to create an academic and research environment to foster scientism and engineering excellence together. This is strongly identified with engineering education in India. Since its inception and foundation, DTU has constantly lead the way in reform movements, and in the latter era of the Republic of India, DTU has assumed pivotal roles in the reconstruction, modernization, and administration of the society. The efforts and expertise of DTU graduates have been major contributors in the planning and construction of India's infrastructure.

Selection of Sampling Site

DTU has a lush green sprawling campus of 164 acres. Most of the part of University is covered with green vegetation. The site selection has been done on basis of movement of people, parking of vehicles and the cooking of food stuffs. Three prime locations were selected in the university campus to monitor the ambient concentration of NOx, SO_2, CO and O_3. The selected locations are depicted in figure 1.

Monitoring Instrument and Survey

High volume sampler is used in this study to monitor the concentration of different pollutants. The sampler uses a continuous duty blower to suck in an air stream. The high volume sampler was installed at selected locations in university campus. The monitoring has been performed for 12 hours at each location to collect the data of various pollutants. To assess the concentration of the pollutant, laboratory analysis was done by using absorbents. The different absorbents are used for the assessment of different types of

pollutants like 0.1 N Sodium tetra-chloromercurate for sulfur dioxide, solution of sodium hydroxide and sodium arsenite for oxides of nitrogen. In addition to this carbon monoxide as well as ozone is measured with the help of non-dispersive infra-red absorption method and ozone analyzer respectively. In addition to this questionnaire survey has also been performed among students to take their opinion about the various issues related to city air pollution and its remedial measures.

Figure1: Google earth view of sampling locations in DTU campus

RESULTS AND DISCUSSION

Analysis through Monitoring

On the basis of analysis of collected sample, all the monitored pollutants are found within permissible limit, prescribed by Central Pollution Control Board (CPCB). The basic reason behind this may be the presence of green vegetation in the campus. The average concentrations of all the locations in university campus are presented in table 1.

Table 1: Average concentration of air pollutants in university campus

Air Pollutants	Measured Concentration	Permissible Standards
NOx	40 µg/m^3	80 µg/m^3
SO_2	5 µg/m^3	80 µg/m^3
O_3	21 µg/m^3	180 µg/m^3
CO	1 mg/m^3	4 mg/m^3

Analysis through the Reactions of Students

A survey was also conducted to determine the behavior and the attitude of students to various issues related to city air quality. The opinion about air pollution's seriousness has been classified in four modules i.e. very serious, not very serious, somewhat serious and not serious at all. From the opinion analysis take through student's survey, 47% of the male and 27% of the female students are observed in favor of very serious option whereas only 7% male as well as female students are found with very casual approach towards air pollution and think that it is not serious at all (Figure 2).

The figure 3 depicts the perception of students about air quality in capital city. From the figure 3, 67% male and 61% female students are accepted the worsening of air quality in Delhi city whereas 27% male and 19% female students are found in support of the improvement in city air quality.

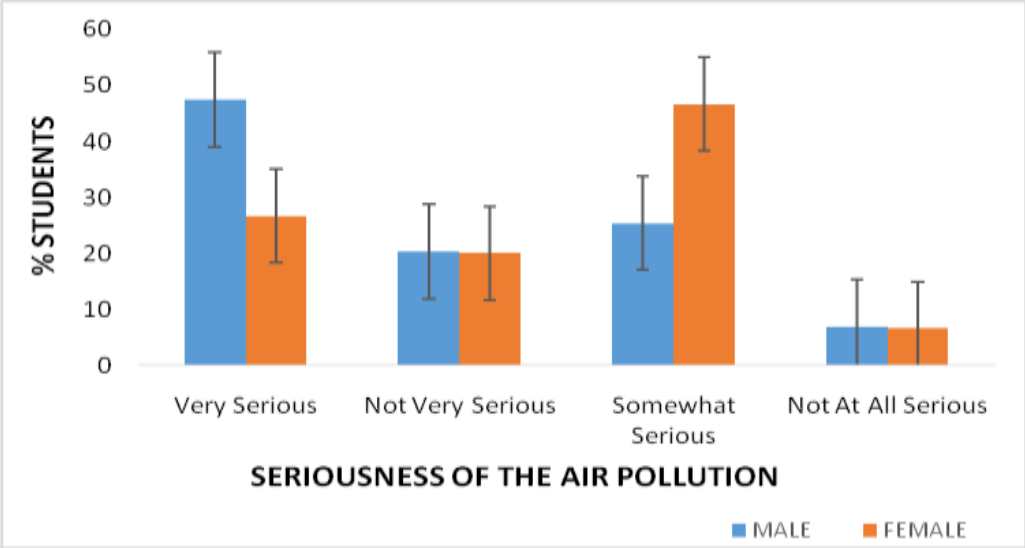

Figure2: **Student's perception to seriousness of the air pollution**

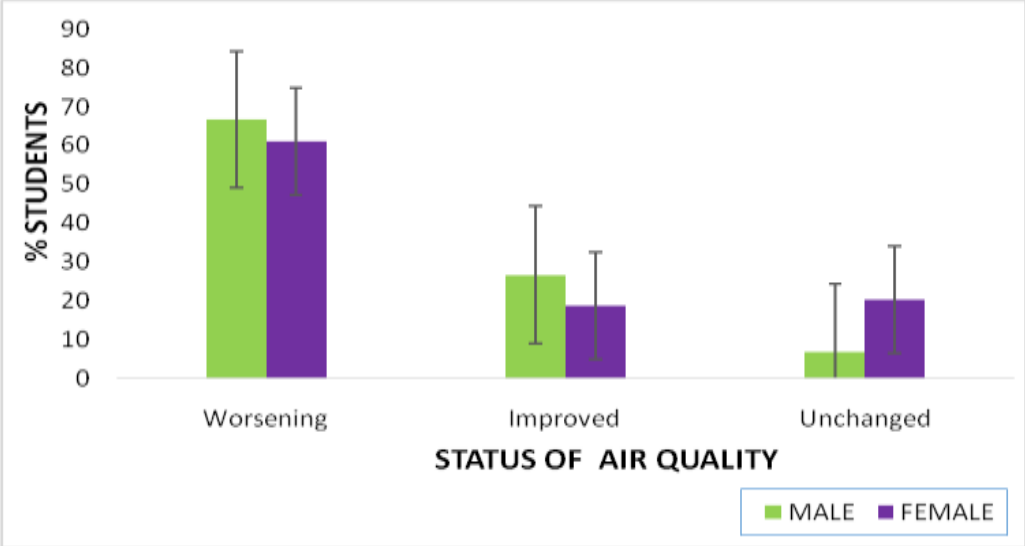

Figure 3: Student perception about surrounding air quality of Delhi

Since the vehicular traffic plays a significant role in the worsening of air quality. By keeping this view in mind, the mode of travel based analysis has also been conducted. Figure 4 presents the perception of male and female students towards the different mode of travelling. It is found that 37% of male students use car as their primary mode to travel from their residence to university campus. On the other hand, for the same purpose the female students use metro as a primary mode. From the analysis, it is also found that female students believe more in public transport system to move from one place to another place in comparison to male students.

The information about the most dominant source of air pollution has also been investigated through student's environmental knowledge and awareness (Figure 5). Majority of the male and female students support the continuous increasing number of vehicles as a most prominent source of air pollution followed by industrial expansion as well as open burning. Diesel generators set are found playing least role in air pollution as per student's perception.

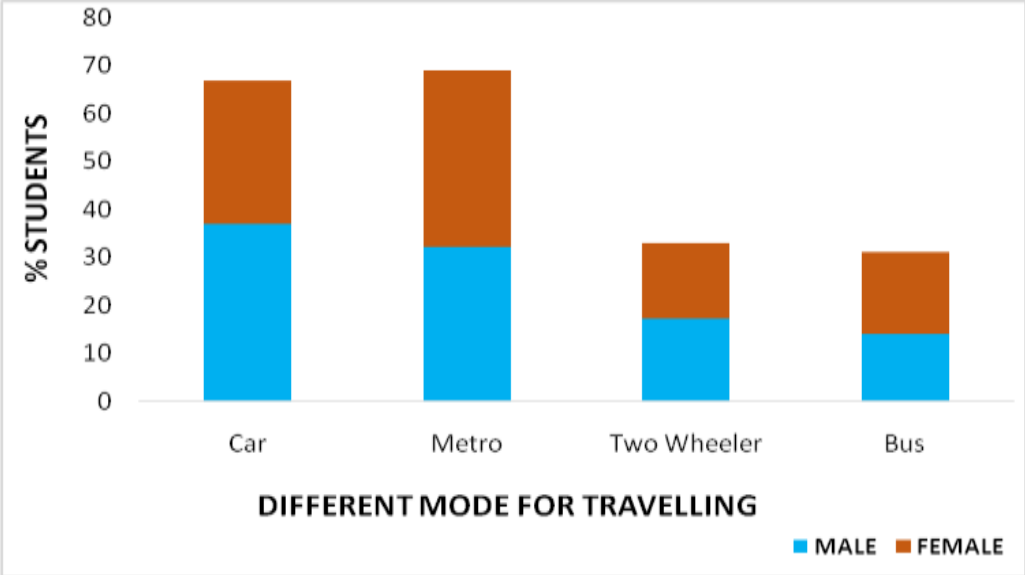

Figure 4: Different mode for travelling

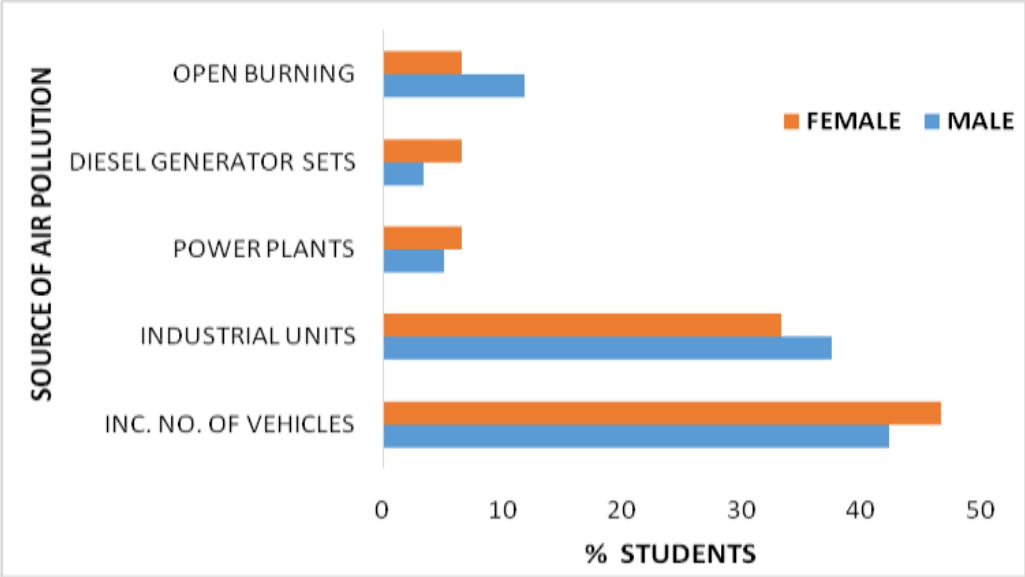

Figure 5: Different sources of air pollution

The most important environmental opinion which was collected through the survey was various remedial measures to control or reduce the air pollution in city. Seven mitigatory measures are put before the students and asked their perception about the best one (Figure 6). Those remedial options with their number code are mentioned below:

- Increase in number of buses (1)
- Integrate the bus routes with metro line and auto (2)
- Reduce number of cars (3)
- Impose penalty on polluting vehicles (4)
- Restrict diesel cars and bring clean diesel (5)
- Ban on open burning (6)
- Control on power plants (7)
- Improve electricity supply to eliminate diesel generators (8)

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From the student's opinion analysis, maximum percentage of male (46%) students choose increasing the number of buses as a most viable solution to this problem whereas 31% male students preferred the integration option as key remedial measure. On the other hand, female students desired to pick both option equally i.e. increase the number of buses and integration of bus route to metro and auto services to resolve the air pollution problem in the capital city.

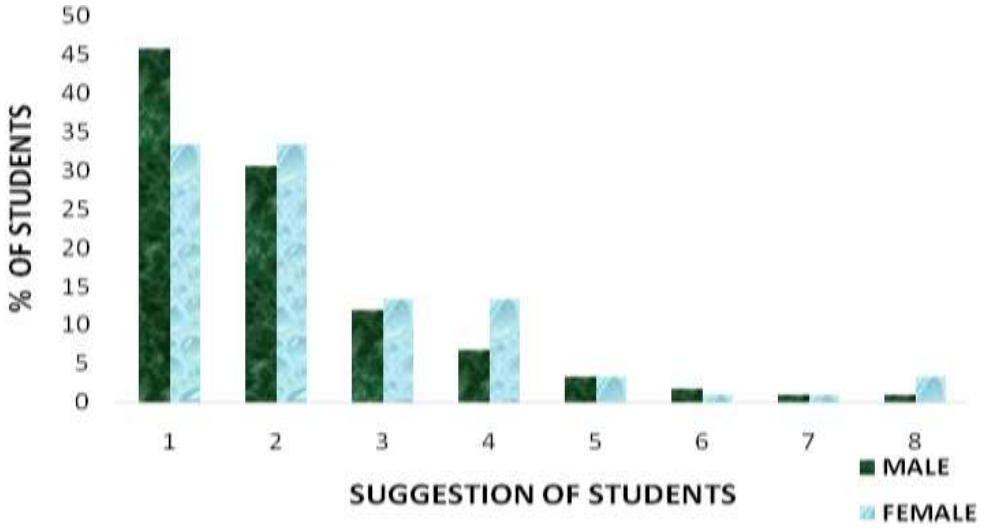

Figure 6: Student's suggestion to reduce vehicular pollution

Conclusion

As it is observed from the above parameters, university campus provides a glimpse of the larger picture that could encompass the larger area that is the whole area around it or may be even the state of Delhi. As it has been surveyed, the air quality, according to the majority of students is worsening and the problem of air pollution is going to be serious day by day. According to them the most dominant sources of air pollution are increasing number of vehicles, industrial units and open burning. Their major suggestions in controlling this problem are increase number of buses. Improve reliability and frequency of buses, integrate bus routes to metro, reduce the number of cars and remove and impose high penalty on vehicles with high pollution or smoke emission.

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