

# People Knowledge and Perceptions about Carbon Dioxide (CO<sub>2</sub>) Air Pollution in Malang Caused by Motor Vehicles

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**Abstract:-** The increase of the use of transportation results in the increase of the level of air pollution caused by the combustion of fossil fuels. A deep study of people's perception of environmental problems is vital because a sustainable world requires the participation of everyone to provide knowledge, make decisions and change people daily routines. This research was aimed to analyze the knowledge and perceptions of people in Malang city about air pollution, the impact of CO<sub>2</sub> emissions for the community, and the efforts to reduce the level of air pollution. The descriptive qualitative-quantitative design was used to obtain data by direct observations in four different areas of pollution including Soekarno-Hatta, Ahmad Yani, Merdeka Timur, and Villa Puncak Tidar areas and questionnaires from a sample of 200 respondents with different gender, education, economy background, occupation, and origin. The gathered data were analyzed with ANOVA statistics and excel formula "countif". The research results show that most respondents have high knowledge about air pollution and how to reduce air pollution. Moreover, they agree that government and local citizens should encourage tree planting program to reduce air pollution in Malang city, Indonesia.

**Keywords:-** air pollution, knowledge, perceptions, effort

## I. INTRODUCTION

Air is a collection of some gases consisting of 78% nitrogen, 21% oxygen, 0.93% argon, 0.032% carbon dioxide, and some other elements (CTE, 2012). Air is very important for living things, especially for humans, because people need oxygen, as one of the essential gases in the air, for respiration processes. However, the air is not pure anymore. Recently, air is polluted everywhere. Air pollution is an entry/inclusion of various substances into the air that can cause degradation in the air quality. It is caused by several factors, both nature and human activities (Gorham, 2002). Pollution from automobile emissions is a serious problem facing society because certain products of the combustion of gasoline can have undesirable consequences for the environment with carbon dioxide and water vapor as the major products (White 1982).

The population density in Malang city rises every year which impacts to the increase of the use of transportation in Malang city. As a result, the number of vehicles also increases every year. In fact, carbon dioxide is released into the atmosphere when carbon-containing fossil fuels such as oil, natural gas, and coal are burned in air. As a result of the tremendous world-wide consumption of such fossil fuels, the amount of CO<sub>2</sub> in the atmosphere has increased over the past century, now rising at a rate of about 1 ppm per year (Shakhashiri, 2008). The increasing number of transportation in Malang city also causes enhancement levels of traffic jam in this region. Consequently, density volume of transportation, especially in the intersection, causes CO<sub>2</sub> emissions accumulated into an inconvenience level impacting on the surrounding areas, especially people who do activities in it (IGES, 2007). The degree to which people may be exposed to the primary or secondary pollutants depends on what kinds of activities they engage in, and where the highest concentrations of pollutants tend to be in a metropolitan area. (Gorham, 2002).

According to Robertson (2006), it cannot be denied that CO<sub>2</sub> is dangerous for human health both contacted in short and long times. Although the safe working level of carbon dioxide is presently set at 5000 ppm for an 8 h day 40 h working week, no human ever endures such a level of carbon dioxide in the atmosphere for 24 h a day. In addition, Rice (2004) says that the CO<sub>2</sub> has a continuum of effects that range from physiologic to toxic, anesthetic, and lethal. The effects of CO<sub>2</sub> in a specific individual depend on the concentration and duration of exposure as well as individual factors, such as age, health, physiologic make-up, physical activity, occupation, and lifestyle. With high-level CO<sub>2</sub> exposure, the displacement of O<sub>2</sub> by CO<sub>2</sub> significantly contributes to toxicity. In this respect, urban air pollution represents a thoroughly social problem, so an intrinsic

knowledge of people's perception of environmental problems, and in this instance urban air pollution, is therefore vital (Bickerstaff & Walker, 2001).

Due to the complex problems air pollution has caused, alternative solutions must be applied. According to Schwela, D & Zali, O (1999), advances in automotive technologies have made it possible to lower emissions from motor vehicles dramatically because frequently strategies designed to increase average by improving traffic flow actually enable a given roadway network to carry more vehicles per hour.

Saksena (2007) stated that the earliest studies about people perception were aimed to measure the level of awareness of air pollution among people. The results showed that pressure representing the social, economic, ecological, and institutional forces cause the emissions. Therefore, this research was aimed to analyze the knowledge and perceptions of people in Malang about air pollution, the impact of CO<sub>2</sub> emissions for the community, and the efforts to reduce the level of air pollution.

## **II. RESEACH METHOD**

This study was held from January to March 2013. The researcher observed the crowded areas, especially those with high traffic congestion. Those places were chosen because almost every day these places were always crowded with vehicles, even particularly with traffic jams during rush hours. The research took place in Malang city, especially in the crossroad areas in Soekarno-Hatta street, Ahmad Yani street, Merdeka Timur street, and Villa Puncak Tidar area, Malang regency, East Java, Indonesia.

Since this survey research studied the populations in Malang by selecting and studying samples, this study applied descriptive qualitative-quantitative design. In this research, the technique of choosing the samples was random sampling to have the same composition and characteristics as the universe. Therefore, the random sample was represented by 200 subjects with each 50 subjects were located on each chosen locations of pollution. In selecting the sample, the researcher considered the age, gender, occupation, expense, education background, locations of living, origin, and length of exposure to air pollution of the sample to obtain reliable data.

There were two types of data used in this study including primary and secondary data. Primary data consist of public knowledge and perception about air pollution, impact of air pollution caused by CO<sub>2</sub> emissions from motor vehicles, and efforts to reduce air pollution that were obtained from the direct observation in the field and questionnaires. There were closed questionnaires used in this study. However, the secondary data resources in this research consisted of the profiles of research areas, a map of the study site, numbers of population, and statistical numbers of motor vehicles in Malang city. To obtain data from the local people and local government, the researcher was assisted by a guide.

Moreover, this study follows the process of data analysis as described by Kothari (2004), that there were three steps in analyzing the data. Firstly, the raw data of questionnaire results and field notes were completed and corrected. Secondly, the data were classified based on the locations of polluted areas, age, gender, occupation, education, expense, location of living, origin and length of exposure to air pollution. Furthermore, the data were analyzed used ANOVA statistics to find the possibility of classified data. When the possibility was found, the classified data then were analyzed using excel formula "countif" to find the number of majority responses. After that, the analyzed results were displayed in complete tables and graphs and described in the findings.

## **III. FINDINGS AND DISCUSSIONS**

The findings of knowledge and perceptions of people about air pollution, the impacts of air pollution on human health, and the efforts to reduce air pollution in Malang city are illustrated in the following graphs and tables.

### **1. Knowledge and Perceptions about Air Pollution**

The first finding answers the question about people knowledge about whether: people know what air pollution is, polluted air contains dangerous gases for the human health, they know that the longer they are exposed to air pollution, the greater the risk they will suffer from air pollution related diseases, they know that clear air is better for human health, they know how to reduce air pollution, and they know that trees can reduce air pollution in Malang city.

According to the analysis, it is clearly found that from the four locations (Soekarno-Hatta, Ahmad Yani, and Merdeka Timur streets and Villa Puncak Tidar) most people know about what is meant by air pollution in Malang city and even have very good knowledge about air pollution in Malang city. For answers "know" about air pollution, people who answered for Villa Puncak Tidar represent 17% of all respondents saying that they know about air pollution in Malang city. This number was the highest response for the choice "know". Moreover, the percentages of responses for the choice "know" for Merdeka Timur placed the second higher responses with the percentage of 12%, followed by Soekarno-Hatta and Ahmad Yani responses, by 11.5% and 11% respectively.

Thus, by answering “know” for the majority of the people, it indicates that most of the people for the four locations have the same knowledge about air pollution and they quite understand what air pollution is and know that air pollution is dangerous for human health. The results of the questionnaires also describe people knowledge about some strategies to reduce air pollutions. These responses reveal that people knowledge about air pollution in Malang city was clearly high.

Moreover, the analysis on people attitude toward air pollution reveals that such a great number of respondents have an attitude that they tended to agree with some questions like wearing mask for those who work near air pollution, trying to keep in distance from air pollution, using environmental based motorized vehicles, checking health every six months periodically, tree planting programs along the sides of the roads, some diseases as the impacts of air pollution by as many as 17% (Soekarno-Hatta), 15.5% (Ahmad Yani), 12.5% (Merdeka Timur) and 13.5% (Villa Puncak Tidar).

The next finding discusses about people feeling and perceptions including such ideas as comfortable season to live in Malang, comfortable time, feeling when exposed to air pollution, and most people who get impacts from air pollution. For the first idea, people mostly chose dry season as the most comfortable time to live in Malang. Moreover, from the four locations, respondents for Soekarno-Hatta street said they usually feel comfortable with 13.5%, reaching the highest position for choosing option “usually” followed by those answering for Merdeka Timur street by 11% and those answering for Ahmad Yani street by 10.5%. However, the most response for Villa Puncak Tidar was “sometimes” with 10% of the total respondents.

For the second question about the most comfortable time to live in Malang, most respondents chose early morning as the most comfortable time. From those who responded early morning, most respondents said they usually felt comfortable with the same percentages for each location such as Soekarno-Hatta, Ahmad Yani, and Merdeka Timur streets by 11.5%. Only Villa Puncak Tidar had 11% for the most answers of this area for the choice “usually”. For all four locations, the option “usually” was the highest compared to other options.

For the third question about people feeling when the air is more polluted, the most answers was uncomfortable. Moreover, the answers were represented by as many as 12.5% for Merdeka Timur, 11% for Soekarno-Hatta, 10.5% for Ahmad Yani and 9% for Villa Puncak Tidar. All of these people always feel uncomfortable when the air is polluted.

Besides, for the question about people who get impacted by the air pollution in Malang city, most respondents said that people from Malang get more impact from air pollution than those who are from Surabaya and Jakarta. Comparing the answers, those who responded for Ahmad Yani and Villa Puncak Tidar, by 11.5% and by 10.5%, said that people from Malang always get impact from air pollution. However, respondents for Merdeka Timur and Soekarno-Hatta felt that people from Malang usually get impact from air pollution in Malang city, represented by as many as 12% and 10.5% of the total respondents.

Furthermore, the data were also analyzed using ANOVA statistic to find the possibility of significant categories. As a result, the possible categories to classify the data were based on the gender, education, expense, occupation, and origin. The results show that gender, expense, education and origin have a significant effect on the knowledge. In addition, gender, education and origin also have a significant effect on the attitude. Based on the analysis, gender, occupation, and origin show a significant effect on feeling and perception of people in Malang city about air pollution as well.

To explain, male respondents know more than females because most males experience outside houses more than females. Moreover, it also has been observed that local knowledge, as obtained through social interactions, play an important role in the shaping of perception (Howell, Moffat, Bush, et. al.,2003).

However, concerning both gender attitudes, feeling and perceptions towards air pollution, females extremely agree with some ideas proposed about air pollution and always feel that early morning is the comfortable time in Malang as well as uncomfortable when exposed to air pollution compared to males that usually feel the same way because females feel more sensitive with polluted air. It is due to their natural sense that they protect and care about their health more than males do. Whereas, commonly males less care about their health, therefore, they only agree about some ideas related to air pollution. Studies have suggested that lifestyles factors such as time spent outdoors can influence perceptions. In addition, Bickerstaff and Walker (2001) state that it has been shown that people form perception about the level of pollution from the density of presume sources (cluster of industries, congested road) or other observable effects of air pollution on the wider environment (color and growth of vegetation).

Similarly, people who spend more per month, indicating high economy, know very well about air pollution compared to those with lower expense/low economy background who only know about air pollution. In line with that, people with high education, tertiary level, know better than those who only study until primary or secondary levels of education, so do the attitudes. It is due to the information and knowledge they gain during the study compared to the less knowledge of the lower education. In addition, foreigners have better knowledge about air pollution and more attitudes as well as feeling and perceptions towards air pollution rather than Indonesian people because most of the foreigners have high education and most of them get polluted more in

Indonesia than in their home countries. In addition, Saksena (2007) agrees that factors such as ethnicity or race and income influenced perceptions in which air quality was less valued by those with more pressing problems. As Schusky (1966) said that similarly social status and ethnicity have been linked to concern for air pollution, with white suburbanites having expressed more concern than inner-city blacks. Bickerstaff and Walker (2001) add that where people are not strongly attached to their neighborhood their perceptions tend to be more negative about air quality and other attributes.

However, people from different occupations show the same perceptions about air pollution except for those working as parking man who responded that they never felt uncomfortable with air pollution and sometimes felt comfortable to live in Malang in the early morning during dry season since parking men always work outside which makes them used to with polluted air and they do not really feel the different impacts on their body. Not to mention, Saksena (2007) describes that people who are accustomed to relatively poor air quality may be less sensitive to further degradations of air quality. This is important to remember in the context of prevailing conditions in developing countries.

To summarize, the more people know about air pollution, the easier to take actions to decrease the level of pollution in Malang city because it will be less difficult to publicize the information and to give instructions to the people to simultaneously work together in reducing air pollution in. Alternatively, most respondents regardless their gender, occupation, education, expense, and origin feel uncomfortable with air pollution, furthermore, they perceive that early morning and dry season are the most comfortable times to live in Malang. They do not feel comfortable living in Malang since morning until evening because the air is more polluted due to the fact that the traffics are more crowded during these times.

## **2. Impact of Air Pollution (CO<sub>2</sub>) to the Level of Human Health**

The finding shows that air pollution impacts from the questionnaires like the diseases like asthma, lung cancer, heart attack, headache, bronchitis, and unconsciousness are the same as the impacts of air pollution mentioned in the EPA (2012). According to EPA (2012), over 2% CO<sub>2</sub> concentration in the air can cause those diseases with the exposure time ranging from within 1 minute until several hours.

The analysis result for people attitudes towards impacts of air pollution figures out that of the five parameters, most respondents chose “agree” option. From the bar, 12.5% of the total respondents agree with the idea, showing response from Merdeka Timur. Moreover, 11% of the total respondents coming from Ahmad Yani responses also agree with those impacts. On the other hand, responses from Villa Puncak Tidar which was 11.5% of the total respondents extremely agree and so do 9.5% of total respondents for Soekarno-Hatta. Therefore, it can be concluded that people believe that those diseases are the impacts for the level of human health because of getting too much exposure to air pollution. EPA (2002) suggests that air pollution can make asthma symptoms worse and trigger attacks. Air pollution can make it harder to breathe. Even, carbon dioxide acts as both a stimulant and depressant on the central nervous system.

Thus, it can be concluded that people who agree or got these diseases are already exposed to the polluted air with high concentration of CO<sub>2</sub> 2%, more than the normal concentration of 0.033%. Being analyzed by gender, females extremely agree more than males who only agree with the idea that the mentioned diseases are the impacts of air pollution. It is accepted as women generally read more media than men; therefore, they obtain more information about the effects of air pollution from the media. Moreover, the fact that foreigners mostly have higher education than local people and experience cross cultural understanding from their country to another one gives a chance that they know the impacts of air pollution on human health more than local people. Thus, foreigners extremely agree with the idea compared to Indonesians who agree.

Classified based on the education, people who have higher education extremely agree about this idea compared to people whose educations are only primary and secondary levels. Most people who enjoy high education come from middle upper social status who usually is wealthier ones. Consequently, there is an access for them to obtain more education and much knowledge about the impacts of air pollution in human health. According to Byrd, VanDerslie, and Peterson (1997), people across all socio-economic strata felt that air pollution pose a greater risk to the community as a whole than to the self and family. Therefore, most do not deny the risks, but deny its personal effects, possibly to avoid anxiety.

## **3. Efforts to Reduce Air Pollution in Malang city**

After the data were analyzed, the findings show the most answers for some ways to reduce air pollution in Malang city both by government and by the community of people. From the first question about government effort to reduce air pollution, most people agree that government should encourage tree planting program along the main streets. The finding shows that respondents extremely agree that the government should make the program. This means that people really support the government effort that to reduce air pollution the best way is by planting more trees along the sides of the roads because it can produce more oxygen. In return, the level of CO<sub>2</sub> in the air can be minimized.

In line with that, Smith (1990) states that urban trees offer the ability to remove significant amounts of air pollutants and consequently improve environmental quality and human health. Trees remove gaseous air pollution primarily by uptake via leaf stomata. He concluded that management of an urban tree canopy cover could be a viable strategy to improve air quality and help meet clean air standards.

Seemingly, planting trees is the most effective way to reduce air pollution based on the people opinion as when people were asked about the way to reduce air pollution, most of them said that planting more trees around their houses can decrease the level of air pollution in Malang city. According to the table, respondents extremely agree to plant more trees around their houses. The fact of extremely agreeing demonstrates that people eagerly will plant more trees to reduce air pollution which is increasing every time. However, Nowak et al (2006) mention that pollution removal values for each pollutant will vary among cities based on the amount of tree cover, pollution concentration, length of in-leaf season, amount of precipitation, and other meteorological variables that affect tree transpiration and deposition velocities.

Furthermore, it is found that people preferred near plantation as the most favorable place to live based on their view. However, instead of extremely agreeing the option, most people only agree with the option. It indicates that people still have some consideration to live in the other areas. In addition, according to the economy background, people with less than 1 million expense per month only agree and are neutral with the proposed efforts that should be done by both government and the citizens, as well as about the area they preferred to live and action when the air is more polluted.

Alternatively, the researcher suggests some other ways to reduce air pollution that can be taken by the government such as installing other transportations like Light Rail Transit (LRT) or city buses in the central streets. Given an example, according to Lehmbruck, Spott, and Beckmann (2007), in the early 1990s the city of Strasboug began a comprehensive project to improve the city transport system with a long-planned new tram line. The aim of the building tramlines was seen as a means of reducing the negative impact of traffic. In 1995 the city of Strasboug has succeeded to change the city transport system and to improve the quality of the city residential life as well as to reduce car traffic entering the city.

However, it is proposed that people will use an alternative of bicycling to travel in short distances to reduce emission and traffic congestions. Lehmbruck, Spott, and Beckmann (2007) mention that London uses a congestion charge to reduce traffic congestions in this city by encouraging people to use public transport, clean fuel vehicles, bicycles, or walk instead of drive into central London.

#### **IV. CONCLUSION**

People from different gender, education, economy, occupation, and origin backgrounds know and have the same perceptions about air pollution as well as feel uncomfortable with the polluted area. They agree that people in Malang together with the government should take some measures to reduce the level of pollution in Malang city by planting trees.

#### **V. RECOMMENDATION**

For future research, it is suggested to focus more on analyzing the impacts of the air pollution on the human health. The government also must limit the permission for the old motor vehicles to operate on the streets.

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