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RESEARCH ARTICLE

INDUSTRIALIZATON IMPACT ON AIR QUALITY INDEX: ANHUI PROVINCE

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Abstract

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The industrializationtechnology allowed us to create everything from food and energy to hygiene and manufacturing technology. How will ecology affect the environment and how will the environmental impact be reduced in the future? In the last 20 years, fast economic growth and industrialization in China have resulted to great energy use and consumption and environmental degradation. As a result, the heavy and chemical industries, especially energy industries will grow increasingly at this stage of industrializationIntensive research has brought more attention to the eff ects of energy use on the health of the surrounding conditions, but there is little pollution from energy production. The maj or problem is air pollution, resulting from smoke and (things sent out or given off) from burning (coal, natural gas, oil, etc.). More than 80% different toxins can be observed from industrial pollution, from dioxin and asbestos to chromium and lead which are regulated by the United States EPA, Apart from all these regulations, industrial sector isamong the worst air pollution generatoron Earth. This study highlights on the impacts on air quality index caused by emissions from industrial enterprises between the years 2008 and 2017 in Anhui province. It has concluded that the main source of all major air pollutants are from industrial enterprises and they have a negative effect to the AQI in Anhui province.

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Introduction:-

Environmental degradation is a common result of industrialization. Reduction in life expectancy and negative effect people's health (Straf et al., 2013). As the Industrial Revolution came, people were capable of advancing in the 21st century. The technology was quickly formed, the science went through advancement and the production period came in view and then industrial pollution becomes an extra effect. In the beginning, industries were small and the exhausted fumes as the main pollutant. Any form or type of pollution that can be sourced back from industries as the immediate source is industrial pollution. Most of the pollution seen on Earth can be sourced back from industries of any kind. In fact, the problem of industrial pollution is a very important agenda for organizations trying to combat environmental degradation. Countries facing the sudden and rapid development of this sector consider this to be a serious matter that needs to be brought under control. China is no exception to this phenomenon of which industrialization has led to a significant increase in polluted air, In fact, along with the experience ofmany developed countries in the starting stages of industrialization and modernization, China's rapid economic development has led to a significant amount of pollutants emissions and environmental damage (Economy, 2004;Lin et al., 2010;Guan et al., 2012). The increase in pollution is due to the moving of factories from most places on the globe to China. Even

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though it is evidently clear, global production has contributed massively to China's economic growth. On the other hand, it seriously pollutes the local and regional environment. As a result, the nation is now experiencing some of the world's most polluted atmosphere and water sources (Vennemo et al. 2009).Since 1978, Anhui province in central China has been rapidly prosperous. The size of the city has grown significantly and a relatively healthy urban structure is designed to boost the economic growth of the state. However, many problems need to be addressed, as the level of industrialization across the city is uneven. Many cities in Anhui have also faced environmental problems, such as heavy fog in some cities in northern Anhui province in the winter of 2012. (Bingal etc. 2014).With a population of a little over 62 million, Anhui is the 8th most popular province in China. It is the 22nd largest province based on area, and the 12th most densely-populated of all 34 provincial regions.

The aim of this study is to clarify the extent to which industries negatively affect the air quality index in Anhui province and outline outcomes that are likely to be faced if measures are not taken to tackle this situation. As other provinces are also experiencing or will experience industrialization, Anhui experiences with air pollution can provide a valuable case study. This paper’s objective is to evaluate whether industrialization is the major cause of air pollution, summarize air pollution data from major pollutants in Anhui province and discuss future implications in an area with polluted air.

Materials and Methods:-

Analyzing publicly accessible information, we evaluated the long term trends of air pollution emissions and pollutant concentrations in Anhui Province, while focusing on industrial emissions (gaseous) and the major air quality pollutant. Industrial annual emission data ofnitrogen oxides (NO2) andsulfur dioxide (SO2) from 2008 to 2017 were derived from the Anhui province Statistical Yearbooks (tjj.ah.gov.cn). Data of emissions in the air quality in Anhui province are also from the Anhui province Statistical Yearbooks (tjj.ah.gov.cn).

Air quality is measured by air quality index or AQI. AQI acts as a thermometer that lasts from 0 to 500 degrees. However, instead of highlighting temperature changes, AQI is a way to prove air pollution. Air quality measures how clean or polluted the air is. Air quality control is important because contaminated air can be harmful to our health and our environment. AQI monitors five important air pollutants (1) ground-level ozone, (2) nitrogen dioxide, 3) sulphur dioxide, 4) carbon monoxide and 5) airborne particles or aerosols. The Chinese Ministry of Environmental Protection (EUROPEAN) is responsible for measuring air pollution in China. From 1 January 2013, MEPs will monitor daily pollution levels in their major cities. The AQI level is based on the level of six levels of air pollutants, such as sulphur dioxide (SO2), nitrogen dioxide (NO2), aerodynamic diameter (PM10), the highest air pollution index (API), with an expiry suspension of 2,5.

Table 1:- Characteristics of related indicators to Air Quality Index.

Air Quality Index (AQI)	Levels of AQI	Categories of AQI
0–50	level 1	Excellent
51–100	level 2	Good
101–150	level 3	Slight pollution
151–200	level 4	Moderate pollution
201–300	level 5	Heavy pollution
>300	level 6	Serious pollution

Evaluated data in this study was all acquired form the Anhui province Statistical Yearbooks then sorted and analyzed using graphical methods to show relationship between two or more variables so that the relationship between AQI in Anhui province and the impact of industrialization can be clearly noted.

Results:-

Responsible pollutants in Anhui province AQI are SO_2, NO_2 and PM_{10}, referring this three as the major indicators of AQI in the province. To show and visualize the vivid role of industrialization in air pollution this study will compare trends of emissions from industry and the amount of responsible pollutants available in the environment.

Sulphur dioxide:
As China's main air pollutant deposit, SO_2 has been the target of the air pollution control strategies for a long time. The number of these substances is between 2 and 12 from the 1980s, but SO_2has always been one of the focuses (Xue et al. 2014).

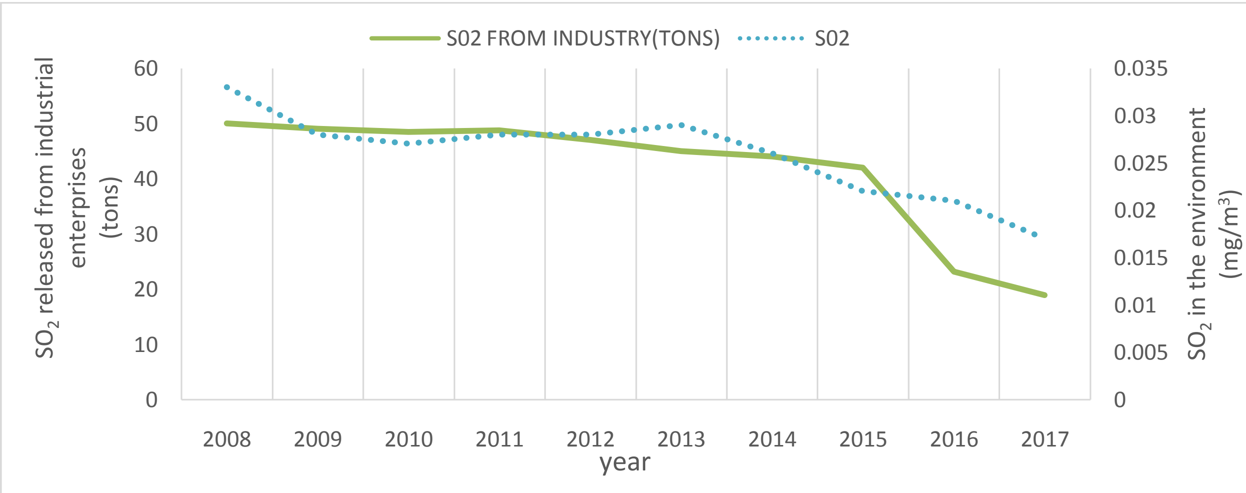

Fig. 1:- S02 discharged from Industrial enterprises and $S0_2$quantity in the atmosphere (2008-2017).

Anhui province like any another province in China is not an exception to the danger of acid deposition in the atmosphere due to SO_2 deposition. From the 2008 to 2017, discharged from Industrial enterprises and $S0_2$ quantity in the atmosphere have been having a synchronized downward trend with SO_2 quantity in the atmosphere lagging behind due to other sources that slightly contribute to the presence of SO_2 in the atmosphere (fig. 1). There are two main factors that led to the reduction of SO_2 emissions from industrial enterprises, which are decline in number of industries and the increased effort in exhaust gas treatment before they were released to the environment.

Nitrogen dioxide:
Most commonly, NO_2Comes with trucks, wood plants, emission tools and road sources such as construction, gardens and industrial horticulture and all sources that set fossil fuels on fire. The improvement of development and activities has continued since the industrial revolution was rejected by the release of various pollutants into the global environment (Bilos et al., 2001, Kim and Kim, 2002). As stated previously that NO_2 is among the major air pollutants in Anhui province fig. 2 shows how total gases emissions from industries varies linearly with the amount of NO_2 in the atmosphere. They are not exactly synched because we have other sources of NO_2 like vehicles and off road sources.

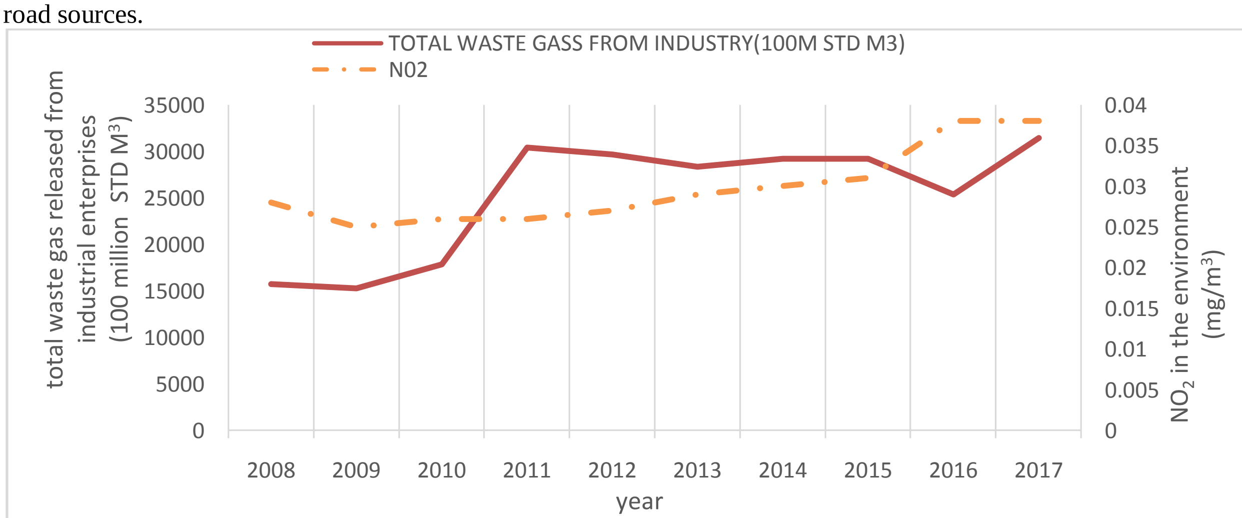

Fig. 2:- Total waste gas discharged from Industrial enterprises and $N0_2$ quantity in the atmosphere (2008-2017).

Particulate matter (PM_{10}):
Up to 10 micrometer diametersmall particles can enter the lungs, which can cause them serious health problems. Ten micrometers is quite smaller than the width of one person's hair. Coarse dust particles (PM10) are between 2.5 and 10 micrometers in diameter. Currently, the WHO measures the safety concentration of pm10 at less than 10 micrometers and detects it at less than 20 micrograms per cubic meter. This is much lower than the EU safe particle count of 40 micrograms per cubic meter. In Anhui province between the years of 2008 and 2017 the amount of particulate matter in the atmosphere has been ranging between0.099 mg/m^3 in 2013 and 0.075 mg/m^3 in 2008 (fig. 3).

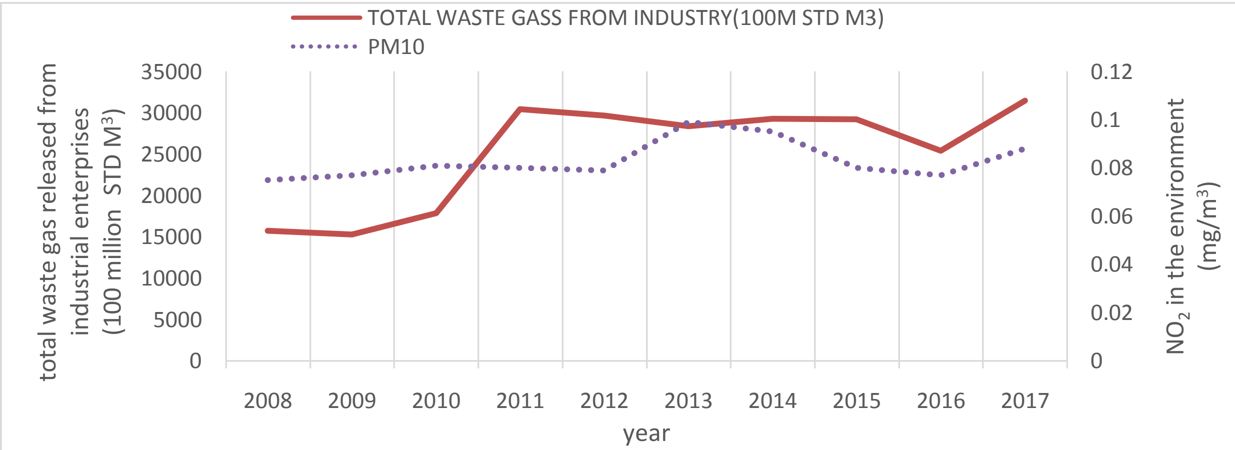

Fig. 3:- Total waste gas discharged from Industrial enterprises and PM_{10} quantity in the atmosphere (2008-2017).

Common sources of PM_{10} particles include sea salt, pollen and combustion activities such as motor vehicles engines and processes in industries. Dust from unsealed roads is a major source of PM_{10} particles. Just like fig. 2 infig.3, the relationship betweenTotal waste gases discharged from Industrial enterprises and PM_{10} quantity in the atmosphere is not completely dependent on each other. Their trend goes from 2008 to 2017, they are moving in the same direction as total waste gases increased from 15273 in 2009 to 31444 in 2017, the amount of PM_{10} also increased between the years of 2009 to 2017 with a maximum value of 0.099 mg/m^3 in 2013.

Discussion:-

The Chinese government has been publishing its day to day air quality index (AQI) from 2009. AQI calculates three criteria based on air pollutants and tracks algorithms developed by the U.S. Environmental Protection Agency (EPA). The highest pollutants in the index determine the air quality index for a given day. In China, the main source of air pollution is particulate matter, which measures harmful airborne particles less than 10 m (PM10) in diameter (one-seventh the width of human hair). Anhui province made no difference, between 2008 and 2017, the three main PM10 pollutants were with an annual concentration of between 0.075 mg/m3 and 0.099 mg/m3. China is still in the industrial phase. Fossil fuel consumption and carbon emissions will continue to increase over the next few years. The Chinese government is rational in finding the best way to balance economic development with carbon reduction. Therefore, it is more practical to analyze and measure the drivers of economic growth and to set the means and conditions to achieve China's economic development and carbon emissions targets.

As awareness of the particulate matter effects on health increases and the apparent problem of air pollution increases, PM2.5 pollution is currently a national concern, along with smog and smog from PM2.5, which are dominated by smog and smoke, a major public health problem. With the evidence of smog throughout the country, the increasing number of "blue sky" days in major cities has become a key criterion for assessing the efficiency of local governments, particularly during the putting into action of the Air Pollution Prevention and Control Action Plan in Beijing, Tianjin, Shanghai, the Yang Tze River Delta and the Pearl River Delta regions. As a result, national average levels of PM10 and PM2.5 dropped by 29% and 42% respectively between 2013 and 2016.

In the Ninth Five-Year Plan (1996-2000), the central government set other important air pollutant emission targets for key industrial sectors and regions and reorganized the economy to reduce emissions such as SO_2. As a result, SO_2's emissions standards were stricter than in 1996 to 2000. However, most local governments prioritize economic development over environmental protection, and the 10th Five-Year Plan (2001-2005) has broadly complied with the Emissions Control Standard (OECD, 2007) with a significant increase in SO_2 emissions. As a result, the central government will focus on the SO_2 emission reduction targets of the 11th Five-Year Plan (2006-2010), set difficult targets for 2005 levels, and reduce energy consumption (20% per unit of GDP) and SO_2 emissions (10%) by the year 2010.

Vehicle emissions are increasing compared to a significant reduction in CO_2 emissions from power plants. Roads and off-road vehicles have a noticeable effect on air pollution, and numerous studies have shown that air pollution in major Chinese cities is directly linked to increased traffic (Hao et al.2000; Chen and Yao, 2008; In addition, 2011; Cui et al., 2015). From 1998 to 2016, China's population increased 8.3 times. As of the end of 2016, car ownership had exceeded 300 million vehicles, including 217 million private owned cars (Chinese statistics in 2017), but major cities such as Beijing, Guangzhou, Hangzhou, Shanghai, Shenzhen and Tianjin have rules to reduce and limit the amount of private owned cars.

In order to reduce the production of vehicles, the central government has established a Emission control linked policy since 1990, including the introduction of new car production standards, controlling the production of vehicle, quality of vehicles, improving the quality of fuel, promoting sustainable transportation, renewable energy and high vehicles, as well as the traffic management arrangements (wu et al., 2011, WU et al. , 2016). The Council of State has set itself the aim of replenishing all the vehicles with the yellow label (e.g. gasoline vehicles that emit more than the example of China I, diesel cars on China III levels) and aging cars that are fuel efficient. In recent years, Beijing, Tianjin, Hubei, Shanxi, Liaoning and other regions and towns have exceeded their objectives. Phasing out of the huge pollution of vehicles also has a complete impact in improving air quality in urban areas and reducing carbon dioxide and black carbon production (handful from et al., 2014). In 2016, their 4,040,000 were banned, 106.5 percent more than the annual goal set in 2015 (MEE, 2017a). Recently, China has provided new motor and engine standards according to EU standards. At the national level, the phase III (similar to the three levels of Europe) (MEE, 2011b) entered the power in July 2007. Production levels are also established for the stage of IV fuel Vehicles (2011) and diesel cars (equivalent to Euro-IV). Studies have shown that the increase in extreme car delivery levels can reduce the production of waste gases from carsby around 39%, 57%, 59% and 79% compared to the 2013 levels (WU et al., 2016).

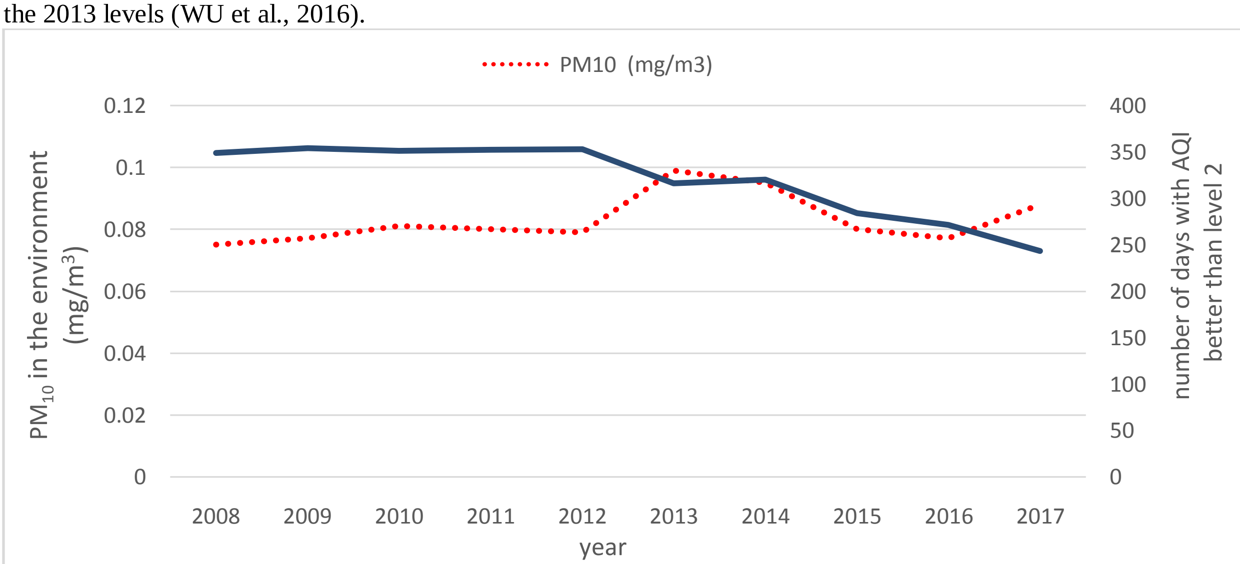

Fig. 4:- Number of days with AQI better than level 2and $N0_2$ quantity in the atmosphere (2008-2017) PM10 being the responsible pollutant in Anhui with the highest impact in the AQI. fig.4 illustrates with the increasing amount of PM10 in the atmosphere AQI drops and when the amount of PM10 reduces in the atmosphere the AQI rises.

Conclusion:-

Industrial gaseous emissions have a significant Impact on the AQI of an Area (Anhui Province). In order to control air pollution in China, the Chinese government has kept in to action a large number of national levels of pollution and control measures over the past three decades. According to China's management system, air pollution control through government officials has led to a significant reduction in pollution in several major environments in a short period of time, offering to use this method. However, these environmental control policies and the impact of severe pollution reduction in China have been largely implemented in the future, taking into account economic costs that cannot be sustainable. China has had the same air pollution and air control process as many developed countries have experienced before. This study has shown the contribution of industrial emissions to the depriving air quality index in Anhui, with its major pollutants being $S0_2$, PM_{10} and NO_2, and Having PM_{10} as the responsible pollutant.

However, this study still has some limitations. The research assumptions implies that all other sources of gaseous waste have been emitting constant amount of gaseous wastes throughout the years 2008-2017 thus seeing the general effects of industrial waste to the environment. Further studies on economical and efficient filtering technology of waste gases before being emitted to the environment from industries, all this to ensure efficient sustainability.

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