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Source, Dispersal and Impacts of Airborne Pollutants: A Case Study of Mangalpur Industrial Complex, Raniganj

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ABSTRACT The consequences of Industrialization and its pollution are increasing day by day causing impact on human health. Particulate matter and gaseous emission from industries are responsible for rising discomfort, increasing airway diseases, decreasing productivity and causing deterioration of environment. The present study is carried out in Mangalpur industrial estate, Raniganj invaded by a number of sponge iron industries in recent years. Major pollutants from these industries include SPM, RPM (PM_{10}),So_2, NO_x and solid waste. Using remote sensing and GIS technique the pollution zone has been identified and health data has been collected accordingly. Wind direction and velocity are also taken into consideration to understand the dispersal pattern of the pollutants. The results depict a clear correlation between health problems and level of pollutants. Various health problems like intestinal, skin, respiratory have been categorised. Eventually, spatial distribution of pollutants and the worse affected villages have also been identified, considering that some remedial measure had been suggested.

INTRODUCTION

Pollution implies increase or even decrease of any atmospheric constituent from the value that would have existed without human activities (Elsom 1983). Weber's concept (1982) on pollution lies on 'the presence of substances in the ambient atmosphere, resulting from the activities of man, causing adverse effect to man and the environment'. In an industrial city, exposure to air pollution seems to be an inescapable part of our life. It not only puts burden on our society but adversely affect soil, water, crop, vegetation, animal, wildlife, weather, climate and manmade structure and finally reducing economic value, personal comfort and well being (Dix 1983). A pollutant is a substance or effect which adversely alters the environment by changing the growth rate of species, interferes with the food chain, is toxic, or interferes with the health, comfort, amenities or property value of people (Dix 1983).

The growing paces of industrial activities are considered to be major responsible factor for air pollution. Besides burning of fossil fuel in power production and motor vehicle emission are other sources. Widespread and indiscriminate set up of sponge iron plant worsen the situation in most of the cases. Sponge iron is a generic term of metallic product obtained through direct reduction of iron oxide in solid state usually with some kind of carbon at temperature below melting point (Raja , Pal 2006). India has emerged as a leading sponge iron producer in the world. The price of sponge iron is 1/3rd of the price of coke but the production process involves release huge amount of pollutants (solid and gaseous), which have adverse health impacts and biological consequences like respiratory, intestinal and skin related problems and even some are related to carcinogens. When a factory discharges waste into the atmosphere; it is presumably adopting the cheapest way of disposing of its unwanted materials to keeps the price of the product low (Elsom 1983). In fact industrialist finds it suitable and cheaper to set a polluting sponge iron industry in the less developed areas where people are not so much conscious about the problem focusing on economic development comparing with the developed areas where aware population will claim pollution abetment measure.

There is now an exhaustive literature on the health effects of the major air pollutants, including epidemiological and toxicological studies. Saha et al. (1985) while studying the problem of air pollution in South Bengal found higher level of SPM, So_2 and NO_x and other pollutant on the industrial area and also reported their seasonal variability. They surveyed industrial and non industrial workers throughout the region and found respiratory problem is two to three times higher in Durgapur which is close to Mangalpur than rest part of the south Bengal. Jayanthi and Krishnamoorthy (2006) studied the health impact from air pollution in Manali area of Chennai and analyzed the increasing pattern of pollution

and morbidity. Their study indicates that the impact of SPM and PM10 levels gives rise to increased hospitalization for respiratory, asthma and gradual increase in mortality cases. Cases of premature death due to heart attack are on the increase in male under the age group 40–59. The risk appraisal study (2006) of Sponge iron plants in Raigarh District, Chattisgarh by Jan Chetana, and National Centre for Advocacy Studies reported that there is a prima facie toxic risk, particularly cancer risk, to those living around the sponge iron plants due their air emissions. Being a part of mining area the region also faces problem from coal dust and its consequent pollution that was studied by Khosal (2007) in Raniganj and Asansol, West Bengal

The present study is carried out to examine, on a micro level, the health impact of pollutants coming out from industries in such a region that is already polluted by mining activities. Besides the sources and dispersal pattern of pollutants are of special interest.

STUDY AREA

The geographical position of Mangalpur under the administrative control of Raniganj P.S., lies within the surrounding well known places, Asansol, in the west (at 86º56´ E & 23º42´ N) Durgapur in the east (87º17´ E & 23º33´ N), Jamuria in the north in the bank of river Ajoy (87º17´ E and 23º43´ N) and the Damodar in the South separating the Bankura district at Mejia of Bankura and Ballavpur of Burdwan.

Though the focal point of the study is Mangalpur but the area extends well into Jamuria P.S. in the north and Andal P.S. in the east. The villages those are falling in the study region are Mangalpur, Majipara, Baktarnagar, Harihspur, Babuisol, Palasbon, Ronai, Goalpara, Sonachora, Bandhdanga , Ratibandh , Dhandardihi, Bansra, Napur, Kunustoria etc. Villagers are regularly exposed to various kinds of pollutants that are coming out from the sponge iron industries.

Among the villages, the following villages

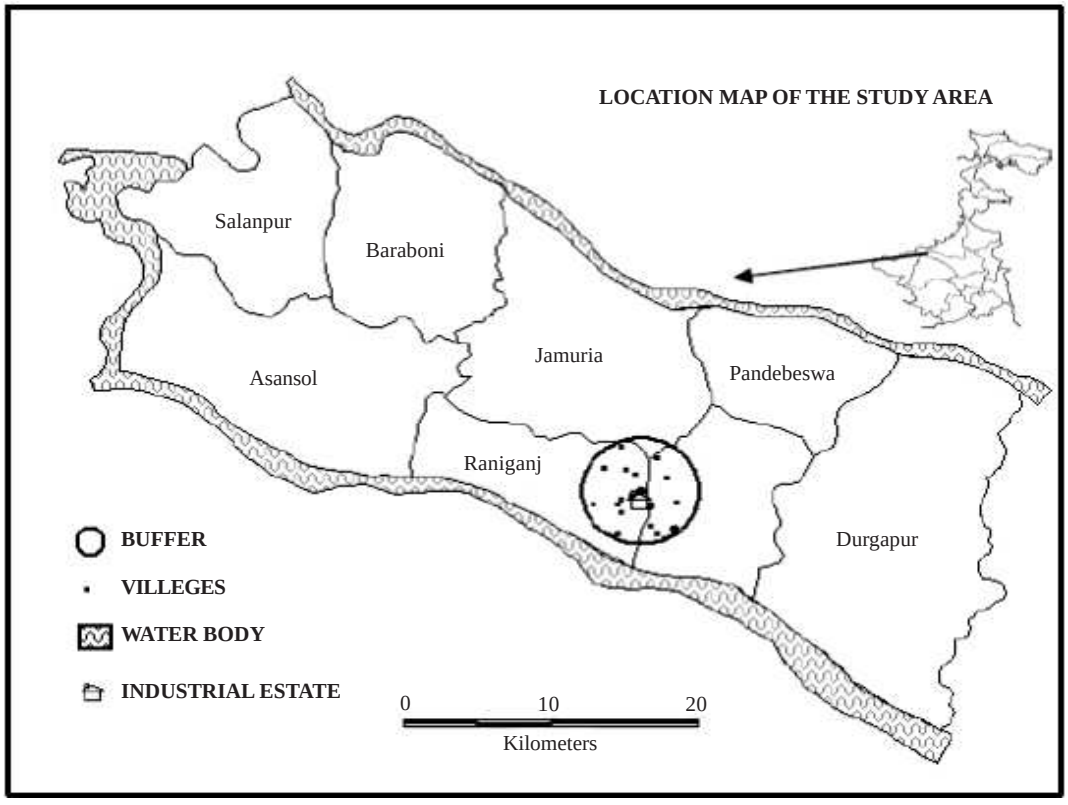

Fig. 1. Locatin map of the study area

Majipara, Mangalpur, Baktarnagar, harispur, Babuisol and Palashbon, have been selected for the present study based on their location, proximity and wind movement (Fig. 1).

MATERIAL AND METHOD

Location and the ambient air quality data off the sponge iron industries are collected from various sources. The West Bengal Pollution Control Board, Asansol provided the secondary data of industrial pollution. The data have been processed to get various charts.

Published IMD data of wind movement and velocity has been collected. Wind rose diagram has been prepared and wind movement pattern has been analysed to show the probable affected regions. Using GIS technology a buffer of 5 km from the industrial hub has been created to locate the villages facing suspended and gaseous pollutants.

Detail and elaborative questioner has been prepared and surveyed to evaluate the extent and effect of industrial pollution, especially off the sponge iron industries. The survey was based on personal interviews of people located in 6 villages during December 2007 to March 2008. Hundred respondents, both adults and children living in surrounding villages were asked about the recent trends in air quality in their areas, contributing sources, and activities that had improved or worsened air quality in recent years. They were also asked about the adverse health effects, such as asthma, eye problems, chronic respiratory and skin related problems. Total 352 samples has been surveyed randomly; 62 from Babuisol, 100 from Baktarnagar, 50 from Palashban, 60 from Harishpur, 30 and 50 from Majhipara and Mangalpur villages respectively.

Finally suggestions have been formulated for combating the pollution and to sustain the impacts of industrial growth

MAJOR POLLUTANTS OF THE STUDY AREA

The region is characterised by at least 10 sponge iron industries along with jute mill, aluminium and cement grinding industry which are releasing huge amount of pollutants to the water, air and soil. The residents of the region are exposed to the pollutants. As a result, many adverse impacts of the pollution are visible and will be surfaced in near future (Table 1).

Major pollutants found in the area are of three types: gaseous pollutants (Sox, Nox), Particulate matter (SPM, RPM) and solid waste metal (chromium, lead etc.). Gaseous pollutants, particularly the oxides of nitrogen, sulphur-di-oxide and the particulate matter include the RPM (PM10) the amounts of which in the study region are shown in Figure 2.

Among the solid waste the amount of copper in the ESP dust of Jai Balaji Sponge iron is 3.35 mg/kg and 3.46 mg/kg in Shyam Sel Sponge industry. Other toxic metal released from above two industries are Lead 10.2 mg/kg and 7.47mg/kg, Nickel 17.9 mg/kg and 9.9 mg/kg, cobalt 6.44mg/kg and 4.15 mg/kg respectively. The industrial pollutants, specially the airborne pollutants are affecting the people of distant places. The possible intensity of pollution depends on the air movement that has also been considered in the following section.

Wind Movement in the Study Region

Wind velocity and direction play a major role to carry the pollutants from the source of pollution to the distant places (Gadzelman 1980).

Table 1: Major industrial pollutants and their probable effects on human health

Industry	*Pollutants*	*Effects*
Sponge Iron	• Heavy metals, e.g., cadmium, lead, zinc, mercury, manganese, nickel and chromium • Suspended particulate matter (SPM), respirable particulate matter (RPM), • Oxides of sulphur and nitrogen and hydrocarbons	• Increase cancer risk • Bronchitis, asthma, breathing problem. pneumoconisis, kidney failure & other respiratory tract disease • Cough chronic bronchitis and also exacerbate asthmatic conditions.
Cement Grinding	• Asbestos fine particle • SPM,RPM,So2,CO	• Asbestosisrespiratory tract disease
Jute Industry	• Gaseous emissions	• Respiratory tract disease • Water borne disease

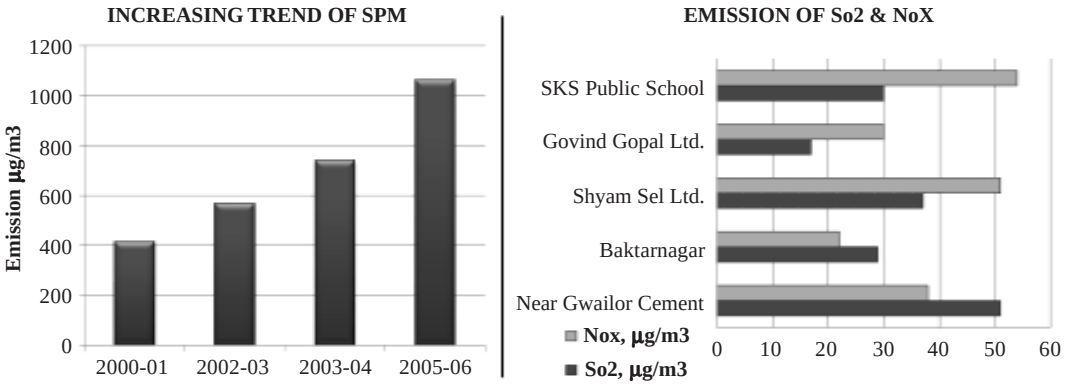

Fig. 2. Ambient air quality
Source: Central Pollution Control Board

Throughout the year winds do not move in a particular direction rather it flow in different directions with different velocities. So the chances of the exposure of such pollutants to the public health also vary significantly.

The movement of suspended pollutants, to some extent, linked with pollutants cycle (Gadzelman 1980).In the first phase the pollutants ejecting from chimneys being warmer than ambient air tries to ascend upward. In the second phase, when they reaches the equilibrium with the surrounding air it stretch out into a long plume; near the smoke stack the plume will be narrow and concentrated and gradually spreads up to disappears. Here the pollutants dispersed by means of turbulent diffusion. The final stage is involved with removal of pollutants from atmosphere by Brownian motion. Temperature inversion, sometime, make the situation more vulnerable.

To understand the spreading of the pollutants climatic data (IMD) have been collected and plotted to get wind rose map (Fig. 3). Being a part of monsoon system the area experiences reversal of wind direction in summer and winter as evident from the diagram .So the pollutants spread as a consequence in west and north-west and east and south-east direction. During winter climatic

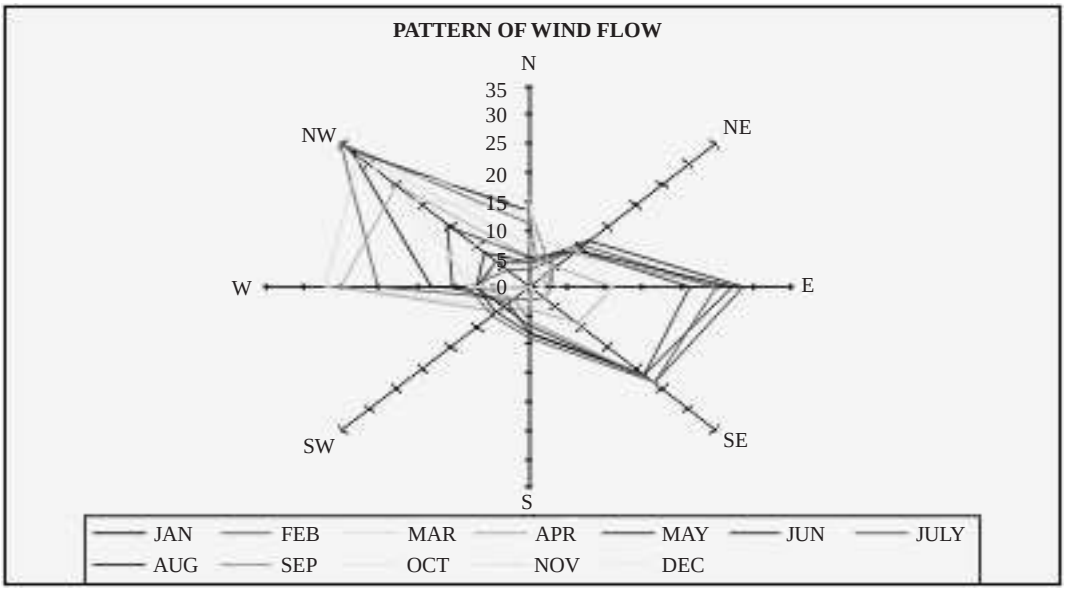

Fig. 3. Wind movement pattern (based on IMD data)

condition over the area remains stable as high pressure condition prevails so, the pollutant ejected by plants remains concentrate on the lower layer of the atmosphere. While during summer the pollutants spread away with the flowing air. The survey has been carried on during winter when pollutants concentrate on south-western part of the industries. Hence the villages situated in that part are studied

RESULT AND DISCUSSION

Sponge iron plant releases huge pollutants in the atmosphere. Heavy metals, for example, chromium, cadmium, nickel released from the industry, are very much deadly for the human health perspectives. Iron along with other carcinogenic heavy metals increases cancer risk. The toxic effects of heavy metals are varied and may often manifest after long periods, sometimes several years. Sponge iron plants also emit oxides of sulphur (SOx) and nitrogen (NOx) and hydrocarbons. These air pollutants are likely to increase the incidence of skin, respiratory tract ailments, e.g., cough, pain, chronic bronchitis and also exacerbate asthmatic conditions.

For the present study total 352 samples were surveyed and data has been collected from Babuisol, Baktarnagar, Palashpur, Harishpur, Majhipara and Mangalpur villages and tabulated. They club together as respiratory, intestinal and skin problem to get the manageable picture in accordance with human health problem.

Respiratory Problem

Respiratory diseases are broadly linked with the morbidity and mortality of the region. As reported by American Cancer Society (ACS) by studing over 500 000 people living in 51 different US metropolitan areas from 1982 to 2000 confirmed the associations between annual average particle pollution levels (PM10 or PM2.5) and annual all cause mortality rates: an average increase of 10μ/m3 of PM10 or PM2.5 was associated with a 3%–4% increase in mortality.

Presences of 0.3 to 0.5 micron dust particles are harmful for lungs. Shortening of breathe, Pain during Breathing and Cough are directly related to SPM and RPM which in turn related to wind flow pattern. These symptoms find commonplace in Palashbon and the central location like Majipara and Mangalpur. Shortening of breathe and cough is reported high in Palashbon where 58% and 64% of respondent suffering from the problem. Pain during breathing is reported highest in Mangalpur (69%). Discomfort in Chest is highest in Majipara (40%). This was the case for a micro region now has a look of the total region where 10% peoples of Asansol & 6% peoples of Raniganj blocks are affected by respiratory disease known as pnumoneocosis (Khosal 2007).The propensity of suffering from asthma is increasing. It gets its highest value in Majipara (45%), though the picture is not alarming in the rest of the region. The tendency from suffering from asthma is high among the adult females (Jayanthi and Krishnamoorthy 2006).

Skin Related Problem

Incidents of skin related problem had been reported in the mining and industrial part of this region from long time for instance, Saha et al. 1985 found high skin related problem in this region compare to other part of Bengal. Skin related problem and allergy is not so serious and about 60% of villagers from two villages namely Majipara and Baktarnagar suffering from this problem, where the occurrence of allergy is highly reported. Mostly children are found to suffering from this type of problem. But in the rest of the villages the problem is manageable so far.

Intestinal Problem

Along with the above two problems people are suffering from various intestinal problems like indigestion, fever, body ace are mostly occurring in the outskirt region. Though their linkages with pollutants are not certain but increasing trend of this problem is a major concern. In Palashbon, 76% surveyed people suffering from fever and 74% from Body Ace respectively. That is the highest in the region. The problem of urination is cropping out in Majipara and Babuisol where the value is 35% and 37%.

It had been shown that skin problem in that area is not so much as it is in respiratory and intestinal problem. With an average 25% of the area suffering from skin related problem with highest in Majipara (48%), more than half of the population (52%) suffering from intestinal problem with highest in Majipara (65%) and little less than half of the population (48%) suffering

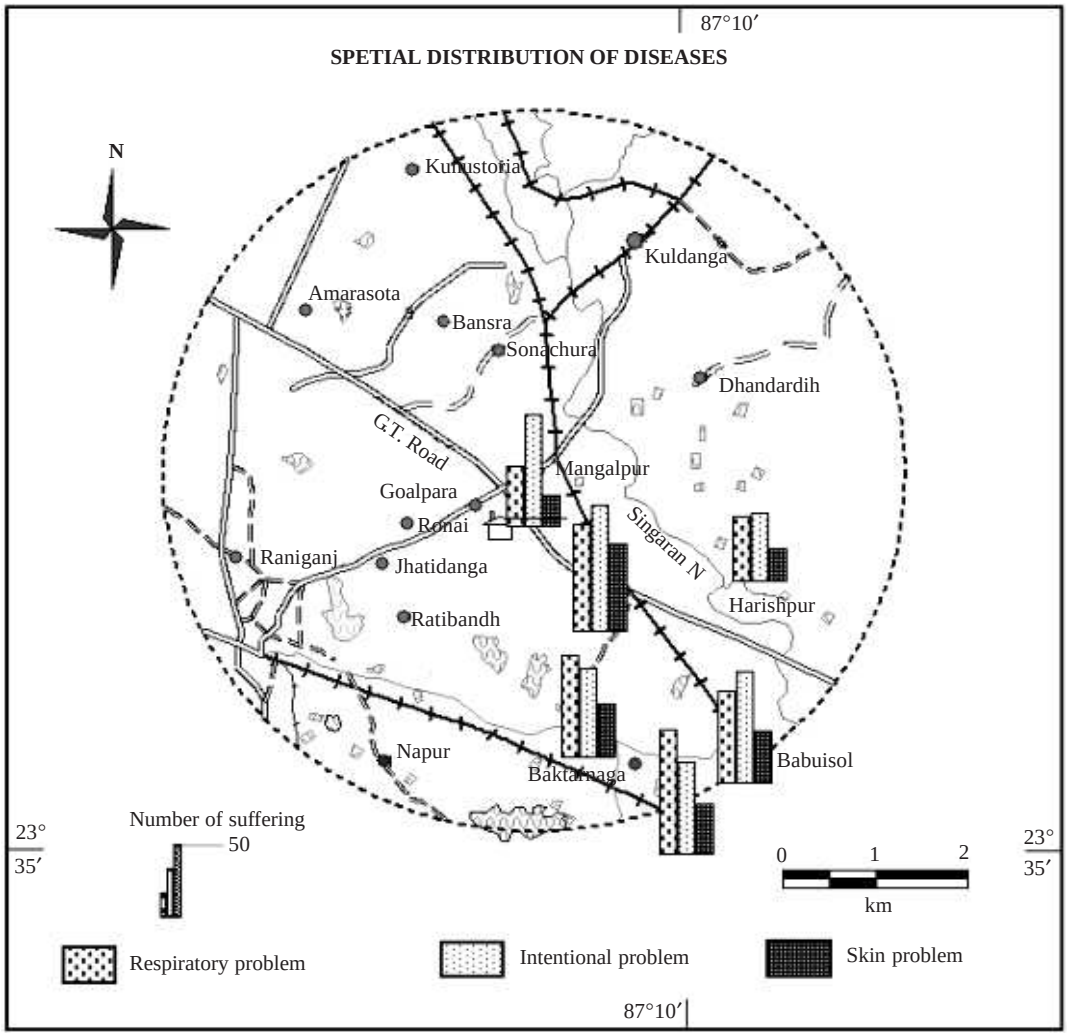

Fig. 4. Spatial distribution of disease

from respiratory problem with highest in Palashbon (64%) (Fig. 4).

A standard score with reference to total population of the village and the percentage of people suffering from diseases were calculated to understand which village is worst affected. Surprising enough that Majipara situated in the centre of the buffer and Palashbon situated the outskirt of the buffer are the worst affected village with score 540 and 542 respectively. In Mangalpur Baktarnagar and Babuisol the condition is more or less same. Whereas, Harishpur comparatively facing fewer pollutants. Wind direction may have played the significant role in this connection.

CONCLUSION

We all are aware today that pollution is a problem. It has been stated that pollution is caused by the deliberate or accidental contamination of the environment with man's created waste, and the continuation of this practice will eventually appear to be a Frankenstein Threatening. So the effect and extent of the pollution, both now and future are matter of concern for many people.

In the study area concerned the flourishing of sponge iron industry and increasing health hazards are positively related and the problem is

becoming acute day by day. Given that the reduction of pollution is itself costly, it is necessary for the society to decide how much of its limited resource allocate for pollution control. However, in practice, the assessment of cost and benefit is very difficult as short term and long term cost benefit question are there involving Geographical space and technology with fluctuating resource base (Dix 1983). Ultimately, pollution control measure is a social and political decision.

RECOMENDATIONS

Greater emphasis should be given on the technological development coupled with good waste disposal means. Even so, in the long term, the only way to reduce pollution is to minimize waste which includes better land use management policies and practice and to give much greater consideration to anticipating and preventing pollution problem. Proper health care system and facilities for those who are suffering from various health hazards need to be properly arranged.

To conclude, producer and consumers should be aware about the industrial pollutants and their hazardous impacts and their participation in the pollution control venture is important. A proper blending of environmental excise duty and environmental charge along with direct controls are necessary. Constant monitoring of the activity of hazardous plants is important to minimize the emission. Set up of green belt acting as absorbent of pollution may control the situation to some extent. In academic and policy circle, efforts are to be made to devise a suitable market based strategy for protection of industry emissions. The source of industry pollutants must be taken into account in setting air quality standard.

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