CHAPTER-VIII

EPIDEMIOLOGICAL STUDY
8.1. INTRODUCTION

Clean environment is one of the indicators of quality of life is a clean environment. A degraded environment leads to a lower quality of life, loss of productivity and higher health care costs. According to a recent report by the WHO, environmental quality is an important direct and indirect determinant of human health. Poor quality of life is directly responsible for about 25% of all preventable diseases like diarrhea and respiratory infections. The impoverished populations living in rural and semi-urban and sub urban areas are the most affected by the poor environmental quality.

Among several pollutants the airborne substances can endanger human health (a) by altering the physical properties of the atmosphere, as they can screen out ultra-violet radiation (uv-B), (b) by their direct effect when taken into the body through respiratory systems, and (c) when they fallout contaminate food and water.

Air pollution causes many health problems. Total suspended particulates and particulate matter of the size of less than 10 micron (PM$_{10}$) have been associated with both pre-mature mortality (death from respiratory illness and cardiovascular diseases) and increased morbidity prevalence of chronic obstructive lung disease, especially bronchitis and incidence of upper and lower respiratory tract infections (Ostro, 1994).

As per a World Bank study report, ambient air pollution level (PM$_{10}$, SO$_2$, lead, NO$_2$) exceeding WHO standards in 36 major Indian cities/towns account for 40,350 pre-mature deaths, 19,805 million hospital admissions and sickness requiring medical treatment and 1,201 million incidence of minor sickness annually.

8.2. CEMENT INDUSTRY AND AIR QUALITY

Industrial activities have adversely affected their surrounding environment including air, water, land, soil or biota. Among many industries, cement industries are known to cost potential effect on air pollution (Purdom and Anderson, 1983). They
discharge all kinds of particulate dust and gases. This also includes respirable dust, which is of health significance. About 0.07 kg of dust is being generated during the manufacture of 1 kg of cement (Hindy and Attia, 1988) in other words, production of 1 tonne of cement involves combination of about 2.5 to 2.8 tonnes of raw material which generates 5-10% of dust and gases, right from raw material-into finished good i.e. dust comes out at all stages of operations and along with dust, gases like N₂, CO, CO₂, water vapour, SO₂, NO, NO₂, H₂S, sulphur compounds (Agarwal, 1986) are also associated. Cement dust composed of major concentration of oxides of calcium, silicon, magnesium, aluminium, iron, alkalies and traces of others. These contaminants enter into the atmospheric air and deteriorate the air-quality.

The presence of these chemical elements / compounds in breathable air are injurious to health or life over short or long periods. This quality of air is measured in terms of the total loss to the society due to the functional variations of harmful side effects.

8.3. DUST AND HEALTH

Environmental pollution is an ever increasing problem to mankind causing the health problems on account of contamination of air, water and sound. Amongst various health problems of the surrounding people, inhalation of the dust presents a serious menace. Dust is produced during various industrial operations like cement making, quarrying, blasting, grinding, drilling and crushing. As material undergoes progressive disintegration, it acquires certain properties which have a special significance with regard to the health of those exposed to its action, because of its minute size (0.2 to 10.0 microns). Respirable dust is the fraction of air-borne dust that once inhaled is not expelled from the lungs by sneezing or coughing (Vincent, 1993). The pathological effect of the dust depends on the toxicity and the nature of the material being inhaled. The effect may be anything from a minor respiratory complaint to one of the many disabling diseases, ending with reduced ventilatory capacity.
The parental material becomes chemically and biologically highly reactive and hence it is more toxic. The chemical composition of particles and of associated organics may vary from region to region and is important to the understanding of potential toxicity. By virtue of its microscopic size, the material occupies greater space. The zone of danger of a toxic material is thus far greater when it exists in the form of respirable dust.

8.3.1 Symptoms of Exposure

Exposure to contaminants can occur through three major pathways: ingestion, inhalation and dermal contact. Nausea, vomiting, irritation of eyes, nose and throat, pains and constriction in the chest with coughing, laboured breathing and severe headaches, cardio-vascular, chronic pulmonary diseases, respiratory problems, diseases related to lungs. The diseases are aggravated by high contamination of SPM, SO2, Oxides of N2, photochemical smog etc. in the atmosphere (Ravikumar et al, 2000). Under these circumstances the incidence of asthma and bronchitis can reach epidemic proportions. Additionally, increases in air pollution are associated with exacerbation of asthma as measured by decreased lung function values and respiratory symptoms (Koenig et al, 1993, Romieu et al, 1996; Peters et al, 1997) shortness of breath (Ostro et al, 1995). Among older persons, those more than 65 years of age, there is an increase in mortality, particularly those who already suffer from chest or heart diseases.

Acute respiratory infection (ARI), which has now attained national importance are regarded as the most important cause of morbidity and mortality in developing and developed countries alike (Bulla & Hitze, 1978). However, the magnitude of the problem is higher in the developing countries on account of poor health services and several other socio-economic factors (Silhar and Maru, 1963). The highrisk groups are under fives (Biswas et al, 1999) and ageold people. Acute respiratory infection is responsible for 15-35% of deaths during childhood in India of which almost 75% are victims of pneumonia (Narin, 1988).
8.4. EPIDEMIOLOGICAL SURVEY

Epidemiological studies estimate the effect on the health of entire populations rather than individuals in experimental settings. It may deal with either short-term health effects resulting from long-term average exposure. Epidemiological studies are useful because they reflect real life exposure conditions. Therefore, potential adverse effects of pollutants may be relevant for broader population.

Environmentally provoked diseases include those communicable and non-communicable diseases. Latter are caused by air pollution. Rapid demographic changes causing significant epidemiological transition, unplanned urbanisation and rapid industrialization and consequent environmental pollutions are serious factors behind the menacing rise of the non-communicable diseases and changes in sozio-cultural practice. Life styles are equally responsible for this increases in non-communicable diseases. A ambient air pollution and indoor and workplace environment are responsible for increasing respiratory episodes, asthma and acute respiratory infections (Nath, 1999).

Human epidemiological studies of acute health effects have found decreased lung function (Dassen et al, 1986), increased respiratory systems and illness (Graham, 1990). It also demonstrates significant associations of ambient air pollutants with hospital admissions for respiratory and cardio-vascular diseases (Liao, 1999).

8.4.1. Opinion Survey

As per the public response, there is a definite and clear cut relation between the prevalence of diseases and the dust pollutants. It includes the factors such as concurrent disease, diet, living conditions, occupational exposures, life styles and cultural factors. The existence of an association between the dust pollution and health effect does not necessarily prove causal relationship. Opinion survey has been the tool for community studies. But as the consistent and coherent findings in evaluating the evidence on the
effects of air pollution play an important role in establishing the causal pathway in mortality and air pollution. However, these studies do provide some clues based on the people’s response over the present issue of health hazard due to dust.

8.4.2. Collection of Data

The data is collected to get a feed back from the public, the doctors, pharmacists and hospital records, by conducting an opinion survey to evaluate the general status of health and living conditions of people in Bagalkot, Kaladagi, Lokapur and Yadwad, who have been exposed to dust from cement factories over a long period. The questionnaire was prepared incorporating the considerations presented by health impact assessment process guidelines (A.D.B., 1992), generic health-impact prediction and assessment methodology (Arquiaga, 1991) and health impact assessment tasks (Canter, 1996). Opinion survey questionnaire (Anon, 1988) the standard questionnaires circulated to the public, doctors, pharmacists of medical shops, are given in Annexure I, II, III & IV.

8.4.3. Opinion from the Public

Information from the public is collected in the entire study area location wise in the residential areas. It includes age, sex, occupation, number of years of stay (residency status), family history of illness, general health condition, specific health condition, family data, socio-economic category, feeling about dust / discomfort / soiling of clothes, articles, house etc. (Table 8.1).

Information given by the public is that, most of the members are affected by common respiratory diseases (Plate : 11). About 26% 15%, 13% and 16% of the people have suffered by various respiratory diseases in Bagalkot, Kaladgi, Lokapur and Yadwad respectively. Children especially infants (under 5 years of age) and old age persons are affected more as compared to adults.
8.4.4. Opinion from the Doctors

Doctors have the knowledge of cross-section of the people regarding their health condition and diseases by regular consultancy, incidence, hospitalization etc. In this account, their field of specialization, prevailing respiratory diseases, general morbidity and percentage, crude death rate and percentage, leading causes of death, probable reasons for disease, remark on effect of cement dust on the health profile of local community. To what extent can this prevalence be attributed to the cement factory.

As per the opinion all the doctors, bronchitis, asthma, upper respiratory infection, T.B., cough and pneumonia are prevailing diseases in the study area. About 90% of them is bronchitis which is the most prevailing respiratory disorder (Anon, 1988). According to doctors 30-35% of the residents of down wind direction suffer from respiratory ailments. The dust nuisance is generally irritant when the wind is directed towards the residential areas. This health hazard is due to dust emission in relation to wind speed and direction.

8.4.5. Opinion from the Pharmacists

Opinion of pharmacists of government hospitals and private medical shops is collected, as per the location of the shop, general transaction of medicine, doctors prescriptions, common prescriptions and percentage respiratory diseases, related medicine transaction and percentage, remarks.

All the pharmacists of the government hospitals and private medical shops opined that the respiratory disease related prescriptions are more and their medicine requirement, is high as compared to other medicines. The common medicine sold at most of the medical shops in the study are Asthalin, Salabetol, Wysolone, Derriphyline, Citrizen, Bromixin, Dexonin, Ciproprolin, Empicin, Omaxilin, Celestone, Visogin etc. This indirect evidence relates to direct incidence of respiratory diseases in the study area.
8.4.6. Information from the Hospitals

Information is also collected from District Hospital, Primary Health Centers, Primary Health Units, Lower Family Planning Divisions, Private Hospitals, Laboratories, X-Ray units etc. regarding their locations, number of admissions and visits, U.R.I., asthma (Plate : 12), bronchitis, T.B., cough, pneumonia, total number of OPD/IPD, sex, age group, etc.

As per the record of government hospitals in study area (table 8.2) reveals that, 9.4% of people are affected by cement dust in Bagalkot; 7.24% of people are affected in Kaladagi, out of which 4.74% are of URI, where as 7.97% is in Lokapur and are mostly of URI and bronchitis cases and 13.18% in Yadwad (11.18% of URI).
Plate 11: Respiratory infection affected family in the vicinity of cement factory.

Plate 12: Severely affected asthmatic patient by cement dust.
Table – 8.1 Medical Information – Suffering Age Group, Common Diseases and Medicine Transaction in Study Area

<table>
<thead>
<tr>
<th>Suffering Age Group</th>
<th>Most common ailments</th>
<th>Related Medicine Sale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children (0-20)</td>
<td>URI</td>
<td>M</td>
</tr>
<tr>
<td>Adult (20-40)</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Old Age (40 above)</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Old Age (40 above)</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Old Age (40 above)</td>
<td></td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bagalkot</th>
<th>Percentage of people affected M</th>
<th>F</th>
<th>Suffering Age Group</th>
<th>Most common ailments</th>
<th>Related Medicine Sale</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>10</td>
<td>26</td>
<td>Medium</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Kaladagi</td>
<td>08</td>
<td>07</td>
<td>15</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Lokapur</td>
<td>08</td>
<td>05</td>
<td>13</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Yadwad</td>
<td>09</td>
<td>06</td>
<td>16</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

URI = Upper Respiratory Infection
Br = Bronchitis
BrA = Bronchitis Asthma
ABr = Acute Branchitis
Table 8.2 Record from Hospitals

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Location</th>
<th>Hospital</th>
<th>Population of PHC/DH</th>
<th>URI No.</th>
<th>URI %</th>
<th>Bronchitis No.</th>
<th>Bronchitis %</th>
<th>Br Asthma No.</th>
<th>Br Asthma %</th>
<th>T.B. No.</th>
<th>T.B. %</th>
<th>Pneumonia No.</th>
<th>Pneumonia %</th>
<th>Total No.</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bagalkot</td>
<td>D.H</td>
<td>76903</td>
<td>3464</td>
<td>4.5</td>
<td>2835</td>
<td>3.68</td>
<td>630</td>
<td>0.81</td>
<td>255</td>
<td>0.33</td>
<td>59</td>
<td>0.07</td>
<td>7243</td>
<td>9.4</td>
</tr>
<tr>
<td>2</td>
<td>Kaladagi</td>
<td>PHC</td>
<td>62302</td>
<td>2954</td>
<td>4.74</td>
<td>333</td>
<td>0.53</td>
<td>431</td>
<td>0.69</td>
<td>98</td>
<td>0.15</td>
<td>709</td>
<td>1.13</td>
<td>4525</td>
<td>7.26</td>
</tr>
<tr>
<td>3</td>
<td>Lokapur</td>
<td>PHC</td>
<td>32510</td>
<td>1247</td>
<td>3.83</td>
<td>1219</td>
<td>3.74</td>
<td>104</td>
<td>0.30</td>
<td>31</td>
<td>0.09</td>
<td>1</td>
<td>0.003</td>
<td>2602</td>
<td>8.00</td>
</tr>
<tr>
<td>4</td>
<td>Yadwad</td>
<td>PHC</td>
<td>24162</td>
<td>2702</td>
<td>11.18</td>
<td>326</td>
<td>1.34</td>
<td>139</td>
<td>0.57</td>
<td>07</td>
<td>0.02</td>
<td>19</td>
<td>0.07</td>
<td>3186</td>
<td>13.18</td>
</tr>
</tbody>
</table>

URI = Upper Respiratory Infection
Br = Bronchitis
BrA = Bronchitis Asthma

DS = District Hospital
PHC = Primary Health Center
Abr = Acute Branchitis
TB = Tuberculosis
CHAPTER-IX

CONCLUSIONS AND RECOMMENDATIONS
The environment is a mutually balanced system in which the very survival of the man is dependent. A congenial environment should constitute the pure air, water and atmosphere. But such a need is sensitively dependent upon the human interaction with the geo-environment which varies from rural-to-urban; industrialized rural to urban; the density of population and number and type of industries located in a given area. With a view to know the impact of natural resource based industries on human life, in area around Bagalkot, Kaladgi, Lokapur and Yadawad of Bagalkot and Belgaum districts were selected. The area lies between latitudes 15° 5′ – 15° 20′ north and longitudes 75° 5′ - 75° 45′ east and is covered in the Survey of India toposheets number 47 P/3, 4,7,8,11,12,15 and 16. Covers an area of 1089 km².

Geologically the area is a part of Kaladagi sub-group. Major portion is covered by dolomitic limestone and the rest by proterozoic sedimentary crystalline rocks like limestones, quartzites and quartzarenites. The greatest asset in terms of mineral potential of the Kaladagi super group is the limestone deposits which are distributed in larger portion of the study area.

The cement factories and associated quarrying, lime making and other activities are mainly concentrated in western, southwestern, central, and southeastern part of the region, to make use of the abundant limestone deposits. The cement and limemaking activities contribute particulate dust and gases to the ambient air and affect air quality, soil, plants, health, aesthetic and cultural aspects. At each stage of the manufacturing process of cement, the nature and intensity of dust particles vary depending on the raw materials and the capacity of the plant.

The area experiences hot summer, mild winter and scanty rainfall and as a result the region remains relatively hot throughout the year. The emitted pollutants are spread over the entire study region in the atmosphere by wind. The climatic conditions control the wind velocity pattern. The windrose diagrams (annual average) reveal the directions
of the winds and 18% are westerlies, 7% each are northerlies, west-north-westerlies and easterlies and 25% constitute calm condition. Winds seasonally change their directions such as easterly during winter; northerly and westerly during summer; westerly during monsoon and northerly and northeasterly during post-monsoon season. The gusty winds and precipitation during monsoon and convection currents and air turbulence during summer reduce the pollutant concentration. Low temperatures and calm conditions assist the dust concentration during winter and post-monsoon period.

Cement dust consisting of particulate dust and gases deteriorate ambient air. The amount of suspended particulate matter, oxides of nitrogen and sulphur dioxide around Bagalkot is 142.9; 51.0 and 12.7 mg/m³; Yadwad 13.5; 16.8 and 11.5 mg/m³; Kaladagi 83.0; 3.0 and 2.6 mg/m³ and Lokapur 57.6; 0.7 and 1.2 mg/m³ respectively. These values are lesser than the ambient air quality according to the National Ambient Air Quality Standards. The average concentration of settleable dust for cement factories at Bagalkot, Yadwad, Kaladagi and Lokapur is 30.5, 22.7, 13.9 and 4.6 tons/sq. km/30 days respectively. However, no standard quantity is fixed for settleable dust.

It is clear from the studies that the ambient air quality is more deteriorated near the cement factory within a distance of 0 - 0.5 km and amount of deterioration decreases with increasing distance upto 10 Kms. The concentration of SPM, NOx, SO₂ and settleable dust is higher on the eastern side of the factory. The intensity of air pollution is higher around Bagalkot followed by Yadwad, Kaladagi and lower around Lokapur and it varies from place to place and season to season.

The dust pollutants are dispersed in the air and settle near the cement plant depending on size and movement of the dust particles. These pollutants affect the chemical composition and mineral matter of the soil. As a result, there is a considerable variation in the available nutrients and components of soil. The quantum of pollutants are increase significantly in 0 – 0.25 km as compared to 2.0 kms away from cement factory. The soil on the eastern side is more affected than on the other sides of the
factories. The soil pH, EC, bulk density, available nitrogen, phosphorus, potassium, calcium and magnesium values are influenced by the dust fall. Chemically the soil is composed mainly of CaO, SiO₂, Al₂O₃, Fe₂O₃ and MgO together with little amounts of Na₂O, K₂O, P₂O₅ and SO₃. Nevertheless the soil contains higher amount of available nutrients. The calcium oxide present in the soil ultimately results in crustation and compaction. The fertility status of the soil is medium.

The growth and yield of sorghum, which is one of the major crops of the study area is affected by cement dust. The height of the plant, leaf area, total dry matter production and grain yield decrease significantly with increasing distance from cement factory. The effect is also significant on western side of the factory as compared to the other directions. This trend is higher around Bagalkot, followed by Yadwad, Kaladagi, and Lokapur. The constituents of dust accumulated on the plant surface and hinder the growth, total dry matter production and ultimately reduce the grain yield.

Besides this, the air pollution has also caused significant health hazards in the people who live in and around the areas of cement factories, quarries and other spots like storage of lime, lime grinding, transportation etc. The main symptoms related to lung and respiratory canal are the nausea, vomiting, irritation of eyes, nose, throat pains, constriction in the chest with coughing, laboured breathing and severe head aches. The common diseases in the study area are the bronchitis, asthma, upper respiratory infection, pneumonia, etc. The diseases are found among the people around Bagalkot, Yadwad, Kaladagi and Lokapur. Among the majority affected ones are infants and old age people. There is close relationship between prevalence of disease and the air pollution but it does not show causal relationship due to their living condition and socio-economic factors.
RECOMMENDATIONS:

The following recommendations are being suggested based on the results of the research work.

1. A green belt with tall trees around the cement factory and the residential areas should be developed. The species recommended *Eucalyptus tereticornis* and *Acacia auriculiformis* and avenue trees (cassia species and peltaforum) be developed along the road side throughout the residential area. Cement dust resistant plants / crops with finer leaf surface and erect leaf angled acute leaf are to be grown around the cement factories. This vegetation act as an interceptor or shelter belt.

2. Critical areas such as hospitals etc should as for as possible, be located on the western side of the cement factory where dust pollution is minimal.

3. Multi storeyed buildings are to be avoided around cement factory, as such buildings may trap the dust. (depends on design)

4. The level of pollution will increase due to increasing number of cement factories and also increasing capacity of existing cement plants. Hence, continuous monitoring and liasoning by pollution control authority is needed.

5. The modernization / expansion programmes of cement industry should include conversion of manufacturing process, energy conservation measures, adaptation of latest technologies such as pre-heaters and pre-calcinators, installation of pollution control devices setting up of captive power units etc.

6. Application of organic matter / gypsum are recommended for fields around the cement factory to reduce impact of cement dust.

7. Legumes are to be grown in fields having high calcium content since it is a heavy calcium feeder.

8. Appropriate medical facilities be extended at free of cost in the people residing in the such a polluted zones and continuous monitoring of the health of the moffusil areas be conducted at regular intervals of time.
9. If in future, new cement factories are permitted there the location of the cement factory should be based on meteorological factors of the area. The residential area should be located at least 2 kms away from the cement factory. This is also in agreement with the recommendation made by the WHO for locating residential areas near cement industries.