Chapter 2
Review of Literature
CHAPTER II

REVIEW OF LITERATURE

One of the essential preliminary tasks in a research study is to go through the existing literature in order to acquaint with the available body of knowledge in the area of interest to bring clarity and focus to the research problem and to improve the methodology and broaden the knowledge base in the research area. This chapter attempts to review some available empirical studies regarding different aspects of pollution; it’s health effects and costs. Review of related literature has been classified on the basis of following indicators.

2.1) Epidemiological Studies

The massive number of deaths attributed to an acute episode of smog in London in December 1952 stimulated the study of the relation between mortality and air pollution. There followed studies of the acute effects of daily changes of pollution in London and in other cities from which the WHO Expert Group and Task Group concluded that increases in deaths were evident when 24-hour average concentrations of smoke exceeded 500 mg/m$^3$ together with sulphur dioxide above the same value. More recent analysis of past data from London have suggested that variations in daily mortality may be related to variations in daily levels of both pollutants at rather lower levels but problems with confounding factors and disagreement as to which mathematical model is most suitable for describing the data prevent definitive statements about the precise levels at which smoke and sulphur dioxide are associated with acute increase of mortality.

The most often quoted analysis of the long-term effects of air pollution on mortality is that by Lave and Seskin. The results of this study were used
by the Organisation for Economic Co-operation and Development (OECD) to estimate the costs of ill health due to sulphur oxides and in particular sulphates. Estimates were made of the number of deaths to be expected for each mg/m$^3$ increase of sulphate in the air and from this was extrapolated the cost of morbidity due to sulphate with some limitations of the basic data and the statistical analysis.

The series of studies by Ferris and Co-workers on a sample of the population in Berlin; New Hampshire (United States) showed that the prevalence of respiratory symptoms declined between 1961 and 1966/67 when Total Suspended Particulates (TSP) declined. There was no change in the prevalence of respiratory symptoms between the years 1966-67 and 1973. While there were changes in the concentration of Sulphur dioxide there were few measurements of this component. The sulphation index as determined from lead dioxide candle measurements was the principal measure of sulphur compounds used in this study. Although the data seemed to indicate a relation between morbidity and Total Suspended Particulates (TSP), no relation was found with sulphur oxides. This study was carried out with great care and attention to epidemiological detail. The major criticism has been the limited quality of the aerometric data over the 12-year period of the study.

A study was carried out on primary school children in Sheffield (United Kingdom) by Lunn and Co-workers. Smoke and sulphur dioxide were measured by samplers close to the children’s schools. A group of five year olds was studied living in four different areas with annual mean pollutant levels. At the first examination of the study in 1963/65 the children in the cleaner area for three or more colds per year, persistent or frequent coughs and colds going to the chest. When 68 percent of these children were reexamined four years later in the period 1967-69 at age 9 years, no significant differences in lung function or symptom prevalence were found between the children in the clean area and the three dirty areas combined. During the intervening period, smoke abatement controls had been introduced. Although there was some reduction in sulphur dioxide levels,
they were still high in comparison with contemporary levels. Quantitative conclusion drawn from this study was that no effect on symptoms and illness could be detected below an annual average of 140 mg/m³ of smoke (the average levels of the pollutants for the three dirty areas in 1967/69) but that at annual average levels above 200 mg/m³ for both pollutants together an effect was evident.

**Studies In Indian Scenario**

Indian studies though limited, cover both effects of outdoor pollution as well as indoor pollution.

Smith (2000) did the estimation of annual health effects of indoor air pollution exposure in India in 2000. He estimated ill health from indoor air pollution to be as large as 4.2-6.1% of the national total, and 6.3-9.21 for women and children under five. The most serious hazard is Acute Respiratory Infection (ARI), the single largest disease category in India (1/9th of the natural burden). Smith estimates that children below 5 years account for 85% of ARI in India. For TB in women, a study near Lucknow found that male and female householders using wood or dung cakes are 3 times more likely to have someone reporting TB.

Shally et al. (2000) studied the association between ambient air pollution and respiratory symptoms in nearly 700 under-five children in slums in a longitudinal follow-up for 6 months. Ambient air SO₂, NOx, and SPM, and exposure to burning were monitored. The pollutants co-varied with each other. Increases in SO₂ and SPM were associated with increased incidence of respiratory symptoms, increased duration of symptoms, or both.

Kamat (2000) carried out studies on the health effects of SPM, SO₂ and NOx, in the seventies. Serial studies of randomly selected matched communities revealed children below 5 years and elderly above 60 years to suffer more. The morbidity for cough, dyspnoea, common colds, eye irritation, headache and dermatitis strongly correlated with the three pollutants. Lung functions were lower with greater pollution. Mortality due to cardio respiratory causes varied according to SPM levels.
Pande et al. (2000) carried out a study in Delhi between January 1997 to December 1998 to study the relationship between outdoor air pollution and emergency room visits. Daily counts for visits by patients suffering from acute asthma, acute exacerbation of chronic obstructive pulmonary disease and acute coronary events were obtained. Ambient air SPM, SO₂ and NOₓ, were measured along with temperature and humidity. Data was analyzed using one-day time lag for events of interest. It was observed that emergency room visits due to acute asthma, acute exacerbation of chronic obstructive pulmonary disease and acute coronary events increased by 21.3%, 24.9% and 24.3% respectively on account of higher than acceptable levels of pollutants.

Chhabra et al. (2001) carried out a cross-sectional study among the residents of Delhi to determine the role of ambient air pollution in chronic respiratory morbidity in Delhi. A random stratified sample (n = 4171) was selected from among the permanent residents, for at least 10 years, around each of the nine permanent air quality-monitoring stations in the city. Air quality data for the last ten years was obtained and based on the differences Total-Suspended-Particulates (TSP) the study areas were categorized into lower and higher pollution zones. Lung function of symptomatic non-smokers, however, was consistently and significantly better among residents of lower pollution zones, both in males and females.

Case Control-Studies

Liver:
A case-control study in New Jersey of 265 patients with liver cancer and matched controls found an increased risk in males working in gasoline service stations: RR = 2.88, 95% CL = 1.2-6.9 (Stemhagen et al., 1983)
Pancreas:

To follow-up the descriptive suggestion of an excess of pancreatic cancer in Louisiana (Blot, Fraumeni and Stone, 1978) deaths from pancreatic cancer were matched with deaths from other causes by age, sex, race, year of death, and locality for 876 pairs of deaths in 1960-75. The occupation recorded at death registration was examined (Pickle and Gottlieb, 1980). There was a two-fold risk for workers in oil refineries: 95% CL = 0.9-5.2, whilst residents near oil refineries had a slight elevation in risk. A multi-hospital multisided case control study was used to probe the occupational associations of pancreas cancer in and there was a significantly raised risk for exposure to solvents and gasoline.

Lung:

Tsuchiya (1965) obtained numbers of deaths and numbers of employees in Japan by questionnaire from 200 large organizations in 1957-79. He reported an excess of lung cancer in those exposed to kerosene and petroleum products, but no expected figure was provided.

Gottlieb (1980) compared the occupation recorded on the death certificate for persons dying from lung cancer and non-cancer control deaths matched for age, sex, race, residence, year of death in Louisiana in 1960-75. There was an increased risk of lung cancer in refinery process workers, craftsmen, and oilfield workers.

Testis:

A case - control study of 347 patients with germ-cell tumours of the testis in Texas in (1977-80) showed an excess with reported work in the petroleum and natural gas industry: RR = 2.29, 95% CL = 1.0-5.1 (Mills, Newell and Johnson, 1984).

Brain:

A conference held by the New York Academy of Sciences reviewed the topic (Selikoff and Hammond, 1982). There appeared to be fairly consistent findings from the general mortality studies, seven of the nine studies showed an excess of deaths from CNS tumours and the pooled
results a significant excess (O = 179, E = 153.6, O/E = 1.16, 95% CL = 1.0 - 1.3). A retrospective study of over 7000 men employed in a petrochemical plant in Texas in 1941-77 showed an excess of brain tumours (Waxweiler et al., 1983).

Gottlieb et al., 1982. Residential proximity to petroleum industry for more than 10 years has been reported to increase the risk of lung cancer, as noted in a case-control study in Louisiana comparing those residentially exposed (living within 0.99 mile of industry) with those not residentially exposed (living 1.0 to 3.0 mile of industry) (RR = 1.47 - 1.65).

Dales et al., 1984. Residents (particularly children) living downwind of natural gas refineries have been shown to have statistically significant increase in respiratory system symptoms (cough, sputum production, wheezing) due to their exposures to sulphur dioxide and hydrogen sulfide emissions as based on health survey data from an exposed population (N=2157) and a demographically similar referent population (N = 834), for example, among 5-13 years of age, more respiratory symptoms were reported in the exposed than in the unexposed group (28% versus 18%: OR 1.18 - 1.31 -1 P< 0.02).

Hicks et al., 1984. Soft tissue cancers (rhabdomyosarcoma) were reported in the study, to occur significantly more often in children whose fathers were exposed to ionizing radiation in a petroleum refinery, suggesting the possibility of adverse consequence in children of parental exposure.

Olin et al., 1987. Chronic health effects in the general population may also be attributable to proximity to the petroleum industry. For example, an elevated risk of brain cancer has been suggested by the results of a study of people living near a petrochemical plant.

2.2) Costing Health Damage Studies

Any assessment of the economic costs of air pollution must rest on an estimated dose-response relationship which links pollution to health damage. Many estimates of this relationship, such as those
calculated by Lave and Seskin and the Wyoming Study are highly contentious.

The Organisation for Economic Co-operation and Development (OECD) has produced a set of estimates for health costs from air pollution. These use linear dose-response curves drawn from the work of and Lave and Seskin. To take some account of the uncertainty of empirical estimates of dose-response, the OECD analysis adopted maximum and minimum dose-response coefficients respectively five times larger and five times smaller than the calculated effect of pollution on health. British data for the early 1970s compiled by Black and Pole provide a convenient illustration of the variations in the contribution of different diseases to different measures of the sickness burden.

In 1972, Grossman developed a health production function that formed the basis of subsequent work in this field. Since his contribution, numerous models have been formulated to explore different aspects of the health production framework.

An empirical study conducted by Peterson (1977), dealt with estimating the social cost of Reserve Mining Corporation discharges of non-magnetic rock or tailings into Lake Superior. The tailings contaminated the lake’s water with asbestos form fibers - a known carcinogen. The incidence exposed the North Shore citizens to serious health risks since these communities draw their public water from the lake. It was estimated that contamination of the lake water would increase the average annual numbers of deaths in the North Shore region by 274 over the 25 years of remaining operation of the plant. It was also determined that the mean age at death of the North Shore victims would be 54 years of age, or 12.8 years less than the average life expectancy of a US male, which was 66.8 years. The social cost caused by each individual premature death was computed by estimating the annual present value of the lost productivity society suffers from each victim. This was estimated to be $38,849 (at 1975 prices) per victim. Then, given the projected death of 274 per year, the total social cost imposed by Reserve’s pollution to the North Shore community was
estimated to be $10,644,626. Finally the three economic studies of global warming that follow; the emission of greenhouse gases is viewed as a global externality.

Cropper (1981) explored the consequences of introducing explicit pollution variables in the health production function. Gerking and Stanley (1986) and Harrington and Portney (1987) have used this model to examine explicitly the relationships among willingness to pay for reduction in pollution, reduction in cost of illness, and changes in defensive expenditures.

Bresnahan et al. 1997 also studied health production function to establish the relation of exogenous variables (for example, air pollution) and certain choice variable (for example, treatment costs), to measure the health status of the individual.

The first study (Nordhaus 1991) was based on an analytical framework whose primary aim of the study was to find an “efficient” strategy for coping with greenhouse warming. In this study, the greenhouse damage function is defined as the cost to society due to climate change. The control cost function reflects the added expenditures to the economy for the purpose of reducing GHG emissions in order to slow the greenhouse effects. These costs include, but are not limited to, the changes required to switch from fossil to non-fossil fuels, the search for substitutes for CFCs, and the protection of coastal properties and structures. Additionally, this study assessed the impact of climate change assuming a doubling of pre-industrial (before 1860) carbon dioxide concentration. This benchmark level of CO₂ concentration is projected to increase the global mean temperatures by 3°C. If nothing is done, the full impact of this climate change will start to be realized by 2050. The results of this study depended on several factors, particularly the estimation of the damage function. Thus, three different levels of the damage costs were considered, and on the basis of the medium damage function, the optimal reduction was shown to be 11% of total GHG emissions. If this materialized, damage from the climate change would be
roughly 1% of the world's gross national product, and for this reason a modest program of international abatement is warranted.

The study by Cline (1992) considered the above assessment to be too modest. This study also used a cost-benefit framework for determining the efficient control of GHG emissions. He was quite deliberate in considering the uncertainty associated with the damage cost. He considered society to be risk averse and computed his final result after accounting for this risk factor. As a whole, the Cline study was based on a framework consistent with the precautionary principle. It recommends an aggressive program of global reduction in GHG emissions.

Alberini and Krupnick (1998) studied models considering mitigation activities along with averting activities and pollution as inputs where as in the year (2000) they studied models considering only pollution and averting activities as inputs in the household health production function.

2.3) Researches on Pollution Control Cost

Bidwells (1975) in his thesis attempts to assess the costs of pollution control in the Brewing Industry. After discussing five possible ways in which pollution may be abated. He proceeds to assess what effect improved standards of pollution control might have on future production costs. It was concluded that only with the very highest level of pollution control would total production costs per barrel rise-and then only slightly. Less severe pollution control measures could possibly lead to a fall in total production costs on a per barrel basis as a result of the reduced water consumption consequent upon more efficient utilization of resources.

Muller (1978) estimated a fixed coefficient production model using annual time series data for the pulp and paper industry in Canada to simulate the reaction of the industry to those changes, which might be expected from mandatory pollution control. Muller found that the increase in average total production costs resulting from secondary treatment of all
water-borne wastes varied from less than 3 percent for sulphate pulp mills to around 9 percent for sulfite pulp mills. Moreover, the results indicated that overall output in the industry does not decline by more than about 2 percent if cost increases averaged about 6 percent.

Conrad and Morrison (1989) examine the impact of pollution control on productivity in the U.S., Canada, and Germany. They construct a nonparametric model that explicitly recognizes the difference between pollution abatement and productive capital and then use a framework that purges the impact of abatement capital on total factor productivity growth. In the empirical application the bias, which is found to be modest, resulting from abatement capital is computed for the aggregate manufacturing sectors of the U.S., Canada, and Germany.

2.4) Empirical Evidences Of Regulation Of Pollution

Lanoie and Lapante (1994) and Lanoie, et al., (1998) have tried to identify the capital market response to environmental accidents. These studies have found that, in general, the announcement of adverse environmental news leads to a decline in the market value of the firms.

Hartman, et al., (1997) used survey data on 26 pulp and paper plants of four countries, namely, Bangladesh, India, Indonesia and Thailand. The survey covered four Indian states. The study finds that both formal and informal regulatory pressures positively affect abatement effort.

Murty and Prasad (1999) undertook analysis using cross-section data from 100 factories belonging to 11 highly water polluting industries in 13 states. They, however, find evidence of significant informal pressure (as represented by district development index and the rate of participation in the previous parliamentary elections.

Goldar and Banerjee (2002) analyses ambient water quality, not the industrial discharge of effluents as such, using annual water quality data
for 106 monitoring stations on 10 important rivers for five years. The study attempts to see how secondary education and pollut percentage affect pollution levels. The study finds a significant positive relationship between pollut percentage and water quality on the one hand and between the proportion of people who have completed school and water quality on the other.

2.5) CONCLUSION

Although the researcher has made an effort to make a systematic review of literature related to Industrial Pollution even then there are chances of omission of few studies due to scarcity of available resources in this regard. An important constraint in such an analysis has been the limited number of studies that evaluate the actual impact of Industrial Pollution on human beings. Most of the available studies narrowly focus on the effect of pollution on human beings biologically where the principal variable disease outcome is studied among others but the economic aspect is lacking. Hence in the present study researcher has tried to fill up the gap.
REFERENCES


• UNEP, The Asian Brown Cloud: Climate and Other Environmental Impacts (3), Centre for Clouds, Chemistry and Climate, Nairobi, 2002.