Chapter II
CHAPTER: TWO

REVIEW OF LITERATURE

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REVIEW OF LITERATURE

2.1. INTRODUCTION

In this chapter an attempt has been made to review the related empirical investigations of pollution impact, cost and control policy issues. Though the number of studies on economic impact of pollution is limited, available studies facilitate an insight as to how pollution economically affect the human health, vegetation, animal and material structures.

To get better exposition, the chapter is being discussed here on the following heads

1. Air pollution studies
2. Water pollution studies
3. Tannery industry pollution studies and
4. Pollution control policy studies.

It is to say in simple, any adverse change in the environment caused directly or indirectly by man in the process of his living is pollution. With the increasing accent on industrialisation, man becomes both the cause and victim of pollution.

There are many sides to the pollution problem. Air is obviously the first and most susceptible component of our environment to pollution. Air pollution means, in the atmosphere presence of substances, gases or radiations.
render the air injurious to humans, animals, crops and property. The following studies gives a clear picture about air pollution impact and cost aspects.

2.2. AIR POLLUTION STUDIES

An earliest and often cited study of economic importance of pollution was conducted by the Mellon Institute during 1913. Primarily the costs of soiling and wasted fuels (from incompletely combusted) were considered in such studies. It was found that the average annual percapita costs due to such effects in the Pittsburg area were about $20.

An early study attempted to find the relationship between US air quality and its damage cost on human health is done by Ridker (1967). The disease due to general air pollution he studied were lung cancer, chronic bronchitis, acute bronchitis, emphysema, asthma, pneumonia. He estimated 18-20 per cent of costs attributed to air pollution.

Crocker's (1967) work regarding economic aspects of air pollution on beefcattle and pasturelands reported the solution for reducing the pollution effects. That is, either the air pollution caused by the phosphate companies must be brought down to the minimum technologically feasible level of the industry or the companies should buy up these sites subject to severe pollution.
Ridker R.G. and Henning John A. (1967) studied the determinants of residential property values specifically due to air pollution. They found that other things being equal property values are significantly and inversely related to sulfur levels of the atmosphere. The estimated benefits they calculated was $10-15 million per year in St. Louis for shift to low sulfur levels.

It has been said that air pollution will have a detrimental effect on residential property values. Nourse H.O. (1967) mentioned two estimates for the St. Louis metropolitan area, USA. One estimate indicated that there is a decrease of $245 in property value for every increase of 0.5 milligram in the level of sulphite per 100 square centimeters per day. On the other hand there is an estimate of a decrease of $1000 in house values due to a specific nuisance. The impact of pollution will depend on the total array of houses available in a particular city, as well as the income distribution and tastes of the households. According to him therefore it is illegitimate to use the data (estimations) of one place to indicate the impact of pollution on house values in another place.

Lave L.B. and Seskin E.P. (1970) concluded that the measures of air pollution (Sulphates and suspended particulates) were significant factors in explaining
variations in the total death rate across areas of the United States of America.

8 Anderson A.J. and Crockers T.D. (1971) study estimated a 10 per cent rise in air pollution implies 1-2 per cent drop in property value. But Weiand observed no statistically significant effects on median value of housing due to air pollution.

9 Justus C.G., Williams J.R. and Clement J.D. (1973) studied the cost aspects due to respiratory diseases in USA, using data from Ridker's study (1967).

10 According to Stanford Research Institute (1973) the annual value of damage to vegetation due to air pollution in the US is $134 million. But Heck W.W. and Brandt C.S. (1977) calculated it as over $1 billion and in their calculation, they considered the indirect damages on vegetation also.

11 Millecan A. (1976) estimated the crop damage from air pollution in California. The crop damage represents less than 1 per cent of the total value of California crops and less than 0.25 per cent of the total value of US crops.

12 Lave L.B. and Seskin E.P. (1977) revealed the justification for pollution abatement programme on the basis of benefits to human health alone. According to them, the
most conservative estimate of the effect of 58 per cent reduction in particulates and 88 per cent reduction in Sulfur Oxides would lead to 70 per cent decrease in total mortality. Thereby they expected a national annual benefit of $6.1 billion in 1979.

15 Ostro B.D. (1983) made a study by using the data of Health Interview Survey (HIS) conducted by the National Centre for Health Statistics, USA to examine the relationship between air pollution and various measures of morbidity.

16 Furtado J. (1984) stated there was a direct link between the sulphur dioxide from industrial smokestacks and the deaths of aquatic life in lakes and streams of the USA and Canada.

17 Peckam B.W. (1986) accepted the relationship between air pollution and health damage. He listed many of the ecological and economic effects of visibility reduction due to air pollution. Peckam and his co-workers of the Division of Economic Effects Research of the National Air Pollution Control Association, compiled literature survey on the effects of various forms of pollution and the socio-economic implication arised out of it.

18 Padmanabhan V.T. (1986) studied occupational health hazard at the Indian Rare Earth Plant. The issues analyzed
were health status of workers, quantity of pollution load, work enforcement and health, and safety apparatus available, including the internal safety organisation and compensation structure. The main findings were that radiation at higher levels induced sterility. The biological process was a massive cell death beyond the replacement potential of the organism. It was found that the radiation also caused heart diseases. Pollutants from these plants would also give rise to many cancerous and genetic disorders among the workers.

19 Gunter Mann K.L. (1981) estimated the cost of air pollution abatement for the secondary aluminium industry for several alternative emission standards. A damage function is developed and analyzed in connection with the problem of selecting economically efficient standards.

2.3. WATER POLLUTION STUDIES

Water is the source of all life, but if the quality of water gets degraded, health and life of living things is bound to get degraded. Studies on impact, cost aspects of water pollution follows:

20 Bragdon J.H. and Marlins (1972) study of 17 companies operating 120 plants in the American pulp and paper industry reveals that there was a strong correlation between a good record of pollution control and a good profit record. A positive and significant correlation between profitability
and pollution control efficiency, showed that pollution control need not affect profitability adversely.

In a study of water borne diseases in Baroda district in Gujarat by Raichur K.C. and Kantawala D.C. (1972) it was revealed that, of the 15000 annual deaths in the district, 30 per cent were due to water borne diseases. Interestingly such deaths are as low as 6 per cent in places having both protected water supply and underground drainage system. It is estimated by this study that Rs. 72 crore will be required to provide piped water supply (Rs. 40 cr) and underground drainage system (Rs. 32 crores) to the whole of Baroda district in 1972 prices.

Singley J.E. et al (1974) studied the damage effects of bacteria in drinking water. He calculated dollar cost to each case. For e.g. it amounts $ 184 for one case of Salmonellosis.

Abel F.H., Tihansky D.P and Walsh R.G. (1975) analysed the damage effects of various diseases due to water pollution. Due to the effects observed the estimated cost for USA is $ 644 million per year.

Freeman A. M. (1979) has estimated the annual benefits of water pollution control in USA for the year 1985. He estimated in 1979, the amount will be some where between $ 6.6 billion and $ 24.8 billion with a most likely
estimate of $12.3 billion. His estimates indicated that over half of the benefits were attributable to the enhanced value of better quality water for recreation.

Kannan K.P. and Sebastian Mathew (1982) studied the problem of marine pollution caused by a titanium factory and its impact on the livelihood of fisher men in three villages in Kerala, India. They attempted to show how the people affected by it perceived and reacted to the situation and how it was tackled by the company management. The study analyzed the impact of marine pollution in fishing, health and plant life.

It has been found that, the fish catch landed for the year 1980-81 indicates that the average for the three 'unaffected' fishing villages is 2410 tonnes, but the catch in Vettukad (pollution affected village) is only about 220 tonnes which is less than 10 per cent of the former. On the basis of the annual average price of Rs.3500 per tonne, the annual loss incurred for Vettukad alone comes to Rs.7.67 million. Study has not given any quantitative conclusions for other pollution problems such as health hazards, adverse impact on plants etc. However, respondents reported that problems such as cough, and respiratory disease appeared in the study area. But the researchers felt it would be quite naive to attribute all of them are due to the air pollution created by the public sector factory.
Sutherland R.J.\textsuperscript{26} (1985) estimated the recreation benefits of improved water quality in three states, viz. Washington, Idaho and Oregon by using Travel cost method. He found with respect to the three states when improved water quality through various measures carried, the largest potential benefits exist near the pollution centres.

Vakil's\textsuperscript{27} (1984) explorative study mainly aim to ascertain the economics involved due to environmental pollution. His work attempted on various cost dynamics involved in pollution control as well as possible solution of contaminated environment. Indigenous, exogenous factors that affect the pollution problem are also closely examined. The case of U.S.A has been emphasized and referred often as the pollution and its related problems are assiduously examined and tackled. This could have been a model for Indian context, but for the limited scope in interpreting Indian data.

His study on economic aspects of pollution control was carried out in 1978 for 299 companies in Thane-Belapur region of Bombay. The response received was only from 26 companies, 7 of which declined existence of any pollutants emitted or effluent generated in their production process. The findings of the study reveals that water contamination is the major pollution problem caused by all companies surveyed.
A comprehensive industry document is prepared by Central board for the Prevention and Control of Water Pollution (1984) in India. The document includes strategy for pollution control suggesting types of treatment, Minimal National Effluent Standards (MINAS), nature of effluent-monitoring, periodicity of monitoring, parameters to be monitored.

The significant component of this document is development of Minimum National Effluent Standards (MINAS) based on Techno Economic Study. These standards are evolved through evaluating the costs of various levels of effluent treatment. The MINAS are evolved by correlating annual burden of pollution control to annual turnover of the industry, so that the cost of implementing MINAS is kept within reasonable limits. The annual cost of treatment including depreciation is maintained within 3 per cent of the annual turnover of the industry while deciding on the treatment systems.

Since there is general resistance and uninterest towards antipollution measures, Nadkarni M.V. and Ravichandran M. (1987) felt it is necessary to probe whether and how far the cost of pollution control is burdensome, in relation to overall investment, total annual costs, turnover and profits. They carried out a study in 15 industrial units in Karnataka, India (sample consists of 8
which have installed pollution abatement plants for treatment of water. From their calculations it has been found that, the annual burden on account of pollution abatement as a per cent of turnover is generally low being less than one per cent in as many as 8 units and more than 3 per cent in 4 units. Even as a per cent of total cost, it turned out to be significant only in 2 units. The level of profits or losses appear to have been determined independently of the level of costs incurred for pollution abatement.

Murthy M.N. (1988) indicated that the paper and pulp industry in India contributes significant environmental pollution which requires additional resources to abate it. In his economic analysis of water pollution control in paper industry, costs of water pollution abatement for big and small paper mills show that the comparative capital and operation costs per tonne of paper for the small paper mill is more than double that for the big mill. Estimates show that as the capacity of a mill increase from 10 tonnes per day to 115 tonnes per day, the cost of pollution abatement per tonne of paper produced reduces from Rs.72.79 to Rs.18.58 at 1970-71 prices. His study also mentioned abatement costs for big and small paper mills at shadow prices which are higher than those at market prices.
Karia V.K.\textsuperscript{31} (1990) through his study in Gujarat Narmada Valley Fertilizers Co. Ltd, a public limited company, concluded that the pollution control in industries is prolific. Because within first two years of commencing production, GNFC could find uses of most of its liquid, solid and gaseous pollutants. According to him total quantity of fresh water used by the company was 39,550 cubic meter and liquid effluent generated was 25,665 cubic meter every day. He found that nearly 71 per cent of this effluent was used profitably within company's premises by making minor modifications mainly in effluent piping network. According to him, if this concept is popularised, it can give the required thrust to reduce pollution caused by industries.

In another study made by Karia V.K.\textsuperscript{32} (1990) the company GNFC has adopted the productivity oriented approach in managing the effluents, from which it has been able to save nearly Rs.25 Lakhs per annum. According to him the company has been able to recycle and reuse 73 per cent of its liquid effluent. So 33 percent of companies freshwater requirement is met with by using recovered treated effluent.

Since most of the meat processing units in the country have not installed any pollution control facilities, National Productivity Council \textsuperscript{33} (1991) conducted a study to
evaluate the techno economic feasibility of implementing appropriate pollution control measures. In a meat processing unit the cut losses, green and spoil meat contribute substantial solid waste as well as BOD (Biological Oxygen Demand) load. Hence the council found, if pollution abatement measures are adopted, it will reduce the total load by around 20 per cent.

2.4. TANNERY INDUSTRY POLLUTION STUDIES

Environmental pollution problem arising from the discharge of untreated tannery effluents has become a matter of increasing concern to the public. Because tannery industry's foul smell and salt, chemical contained effluents create so much havoc to the surrounding people. It is fair to attempt, hence an appraisal of the impact of tannery industry pollution on the vegetation and health of the people.

34 Thabaraj G.J. et al (1964) reported stunted growth of tomato plants when they irrigated with tannery effluents. Germination of seeds was retarded and inhibited to some extent. They also supported that, by the continuous irrigation with the effluents there was an accumulation of sodium and chlorides in the soil.

35 Rajagopalan R. et.al. (1967) found that the productivity of the soil decreased when tannery wastes are applied.
on fields and some part of the land become completely infertile and germination of paddy seeds was not satisfactory.

According to Hariharan A.S. (1968) ground water has been found to be affected where the waste water from tanneries are ponded or lagooned or spread out on land or discharged into drybeds. The survey showed that the background concentration of total dissolved solids increased from about 640-4000 mg/lit and chlorides from 88 to 1000 mg/lit. The effect of contamination is observed upto a distance of about 8 km from the tannery effluent outfalls.

Department of Industrial Development (1979) in its report on leather industry revealed that the chlorides in the wastewater from the tannery industry cause chlorosis in the plant i.e. destruction of plant tissues particularly the leaves. High sodium content in the wastewater increases the sodium absorption ratio and thus affects the soil structure and plant growth. It is also reported that the productivity of the soil decreases when tannery wastewater were applied on fields and some parts of the land become completely infertile.

Guruprasada Rao M. and Nandakumar N.V. (1981) in their work found that an irrigation reservoir was contaminated by the untreated effluents discharged from
forty five tanneries in Ranipet, North Arcot district, Tamil Nadu, India. There were reports from the farmers that the yield was much less due to water contamination.

Sreenivasan M. et.al. (1984) reported that the effluents discharged from the tanneries located in North Arcot district have caused serious deterioration in the quality of ground water. The effect of various pollutants manifested on the crops as stunted growth, poor germination, staining, leaf burn, poor quality of grains, fruits etc. The fact that most of the farmers have stopped cultivating crops like paddy and sugarcane, and have taken to raising moderately resistant crops like maize and ragi.

Nani (1984) in his work on the environmental situation in North Arcot district during 1984 revealed that more than 5000 acres of fertile lands and 600 drinking water wells in about 200 villages around Ambur area have been severely polluted. The drinking water used by the people of Ambur was certified as unfit for human consumption by the Directorate of Health and Preventive Medicine, Madras. Regarding health impact of tannery industry pollution, he mentioned a rare syndrome, "Milk diarrhoea". It has been found that infants are victims of diarrhoea because the mothers milk is contaminated.
Nandakumar M.V. et al\textsuperscript{41} (1986) reported that the following diseases occur to workers working in the leather industries. Dermatitis, Bronchitis, Respiratory Diseases, Acute Pharyngitis, Acid burns, Asthma, Allergic Disorders, Tuberculosis, Injuries Leprosy etc.

Bakyavathy D.M. et al\textsuperscript{42} (1986) in their work stressed the fact that the heavy concentration of tanneries in the Ambur zone is a serious health problem. According to them the local doctors in Ambur and Vaniyambadi reported that the tannery workers had terrible skin related ailments and ulcer. They are all chronic patients. The ESI hospital alone treated 1510 skin infection cases in 1984. Lower respiratory tract infections are very common in children. This leads to primary complex and TB. It has been found that women working in the tanneries get Dermatitis while the women engaged in sorting wool are chronic victims of fever, skin irritations and respiratory problems.

Venkataramani S.H. \textsuperscript{43} (1987) stated how effluents from tanneries in North Arcot district, Tamilnadu ruin land and people. Two decades ago Vaniyambadi was one of the Tamilnadu's richest agricultural areas but due to tannery pollution major land area has converted into a vast barren tract. The number of families dependent on agriculture was 24,000 two decades ago but now it reduced to 8000. Cultivable lands in the Taluk has declined from 68000
hectares to 22,000 hectares. Besides an estimated 2,000 drinking water wells in the taluk have turned repugnant brackish (only 30 wells produce tolerably potable water). The tanneries negligence led to respiratory disease, gastroenteritis and even menstrual problems for women.

Singram P. and Pothiraj P. (1989) carried out a study on soil health care in tannery polluted areas of North Arcot District. They found that the location of 75 per cent of tanneries in North Arcot district had caused severe damage to soil fertility and quality of irrigation water. Accumulation of harmful salts caused deflocculation of clay particles and affects physical properties of soil which impaired the drainage aceration and microflora of the soil. They confirmed a fact of earlier study that is, the dynamics of harmful salts movement found in tannery effluent travelled a distance of 8 km from the source and caused pollution of under ground water sources. Among the field crops, CO1 Maize, CO 43 Paddy, CO 771 Sugarcane, CO 13 Ragi, and BN Grass were found suitable for the tannery affected soil. Reduction in land value due to degradation of soil fertility was also observed.

In a study, the Department of Chemistry, Gandhigram Rural Institute, the only University functioning in Dindigul Anna District, analysed the ground water and soil pollution in villages around Dindigul. Samples of soil and...
water were collected from Chinnapallapatti, T.Puthur, Nallendrapuram, Ponnimandurai and from near Kudavanar which were analysed as per the standard methods published jointly by American Public Health Association, American Water Works Association and Water Pollution Control Federation. It is evident from the results that all parameters analysed are far greater than the tolerable limits for drinking water in case of seven sources. The total solids, chlorides and hardness present in these samples are extremely higher for these water samples. Results of analysis of soil samples from the same villages and also samples beside effluent stream on the way to Senkulam pond reveals that certain areas of Chinnapallapatti and Ponnimandurai have become highly saline with high chloride contents.

From this study it is inferred that nothing can be grown in many of the lands of these villages. This is mainly because, the several water sources in these villages have become polluted even in the areas where soil is not much polluted. But in some areas soil salinity is an additional contributing factor to this problem.

Peace Trust, a voluntary organisation in the study area district carried out a physio-chemical analysis of effluent water, irrigation well water, drinking water, river water and coconut water samples which were taken from in and
around Dindigul area. In their study, the parameters analysed were PH, Chloride, Sulphide, Chloride and Chromium. Except coconut water, in all the samples they found these substances are higher than the tolerable limits. Their study gives the following implication, i.e., the effluent water, irrigation well water, drinking water sources, and river water are polluted significantly immediately after the effluent discharge.

Apart from these two studies, an another important study was carried out in the study area by Department of Physics, University of Bremen, Federal Republic of Germany. Analysis of samples from river water, irrigation water, effluents from tanneries reveal that chromium content in these media were higher than the tolerable limit. The study team, from its analysis conclude that the chromium from tannery wastes spread into the whole environment. The results of the analysis showed that the chromium contents in drinking water was 12 ppb. But the study team cautioned that though the value is below the limit value presumably the pollution of the water will increase in longterm if the practice of discharging untreated effluents is continued and that more wells will be polluted irrevocably.

The above mentioned three studies carried out in the study area discussed mainly about nature of water and soil or land pollution. Considering the nature of pollution from
the results of these three studies, present work discuss the economic loss incurred in the pollution affected area.

2.5. POLLUTION CONTROL POLICY STUDIES

To control pollution, government intervention is necessary. There are several alternative strategies available to the government for controlling the pollution and other environmental problems. These alternatives include (i) regulation and prohibition; (ii) economic incentive measures including various kinds of taxes and subsidies and (iii) governments direct investment for providing environmental services. Economists believe that market instruments constitute the only viable alternative to pollution control when they compared with other instruments, such as moral suasion and direct controls. Some major and important works carried out in the economic incentive measures or economic instruments are: A.V. Kneese, B.T.Bower (1968), W.J.Baumol and W.E. Oates (1975), A.V. Kneese and C.L.Schultz (1975), W.J. Baumol and W.E. Oates (1975), A.V. Kneese and C.L.Schultz (1975), White (1976), T.R. Anderson et.al. (1977), R.A. Liroff (1980), OECD (1980), B.T. 55 56

Tietenberg T.H. (1978) discussed economic and legal issues of pollution charges. He concluded his discussion with two aspects viz., (i) nationally uniform emission charges appear inferior to spatially differentiated emission charges.
charges and (ii) Spatially differentiated emission charges appear to offer the nation a realistic opportunity to achieve its air pollution goals at significantly lower cost.

59
Sims W.A. (1979) applied a translog cost function for the estimation of pollution abatement responsiveness of firms, to pollution charges in the brewing industry. The empirical results demonstrated considerable abatement responsiveness to pollution charges by firms existed in the industry.

60
Pittman R.W. (1981) studied the relative efficiencies of different institutional arrangements (quotas, tax, charge etc.,) for pollution control through the estimation of a production function for a sample of 30 pulp and paper mills in Wisconsin and Michigan of USA. It has been found that the systematic differences in marginal treatment cost for different mills appeared which is the evidence of serious inefficiencies resulting from the current system of pollution control regulation. Hence it is suggested using more market oriented control measures like effluent charges or transferable discharges are suitable one as they lead to a more efficient pattern of resource allocation.

Sulphur dioxide is a major air pollutant. It is generated in the burning of crude fuels, especially coal and residuals of fuel refinement process. Falk. I. and Shechter
M. (1981) in their work, computed pollution charge for sulphur dioxide on the basis of Pigovian tax scheme which imposes a price for the damage caused by the use of the air as a sink for production wastes (Sulpur Oxide). Morbidity and pollution data for Haifa, an industrial town in Northern Israel with more than 50 factories located at, are used to illustrate and calculate the proposed tax scheme. Though these factories emitted sulphur dioxide in the region, the authors focussed their attention on the dominant pollution source, the Haifa electricity power plant which is the source of about 70 per cent of all sulphur dioxide emission in the region. Hence with the method described in this paper, the tax is imposed only on electricity generation.

Pollution can be remedied in either of two ways. (i) by polluters and or pollutees changing their production technology or (ii) by any one of the two parties act in such a way that technology changes become less costly for e.g., a polluter could move to an area where there are fewer smoke sensitive neighbours for pollutees can move away from smoke producing factories. Considering the second remedy, White .J. and Donald Wittman (1982) analyzed efficiency properties of pollution tax particularly single and double pollution taxes. They found that single pollution taxes do not lead to incentives for long-run efficient pollution
abatement i.e. they do not give polluters and pollutees incentives to locate industries in an efficient spatial pattern. Hence they suggested double pollution taxes.

During 1981-82 in evaluating environmental policy in USA economists often mentioned that regulations are more costly than necessary to meet environmental quality standards. Hence in a study, Seskin E.P. et al (1983) assessed some of the potential savings associated with implementing economic strategies to abate air pollution.

Griffin R.G. (1987) also supported the price guided (subsidy, tax, charges) policies for pollution abatement. Because the superiority attributed to price guided measures depends on their reduced information requirements.

Kohn R.E. (1989) used general equilibrium analysis to demonstrate that the Pigovian tax on pollution promotes an efficient allocation of inputs, including an efficient number of firms in each industry.

Majority of the pollution impact studies under review are related to effect of pollution in a particular country or region in maintaining air, water quality standards of that nation. Empirical studies are very few in measuring the impact of pollution from a particular industry. Present study aims to measure the impact of tannery pollution on human health, vegetation, animals and property values.
2.1.5 REFERENCES


47. Scheer, J., Burkhard Bechhot et al. (1989), "Report on Environmental Pollution Due to Tannery Effluents in Tamil Nadu, India", Department of Physics, University of Bremen, Bremen.


