CHAPTER - I

Introduction
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INTRODUCTION

The first chapter outlines the basic information on environment and set of objectives of the study, and reviews the related and allied studies on Environment Impact Assessment (EIA). The industrial revolution has consumed non-renewable earth resources as raw materials in big way. It has made human life more comfortable and side by side has posed threat to environment. The laws to protect environment have been flexible and has loopholes. Its degradation alters ecology. The background knowledge on basic issues of Ecology, Environment, Pollution and its identification are essential to realize the problems of waste. In this context the tanneries have some geographical significance. The pollution problems can be viewed through spatial, ecological, system and behavioural approaches. The science of geography was used by several authors to assert the environmental impact.

The economic importance of tannery in India, and its characteristics, policies framed by government, tanners forum (to protect its own members) technical support from institutions are linked with the prosperity of leather industry. In this study the elements of tanning process, its position in India, and the prominent processes are narrated. The menace of tannery pollution from macro to micro level has also been studied.

The various procedures and methodologies to appraise the dimension of the tannery pollution and the objectives of study are set out. The unprecedented increase in the number and activities of human beings since industrial revolution and, particularly in this century, has caused deterioration of the environment and depletion of natural resources that threatens the future of the earth. It is ironic that these impacts have occurred largely as a result of processes that have
produced such unparalleled levels of wealth and prosperity in the industrialised world. There is now a recognition that environmental impacts arise as a result of economic behaviour and they can be addressed effectively by social, economic, political and policy changes. The concept of growth at any cost was there in the eighties all over the world until it was being replaced in the nineties with the solemn idea of sustainable development.

The largest ever summit meeting held was in Rio de Janeiro, Brazil in June 1992, where the U.N Conference on Environment and Development - the Earth Summit, aimed at identifying environmental and economic link and producing worldwide consciousness on a sustainable use of global resources.

The cob-web of environmental problems in India calls for innovative approaches and solutions. In order to combat the pollution, India should integrate all developmental planning with environmental concern. This alone is not however, enough and it is also argued that the only effective way of implementing environmental programmes was to involve people in the decision-making process. Several models of environmental planning do exist, on a small scale, in different parts of the country. However, in the main decision-making process such an approach has rarely been accepted.

In the areas of environmental laws, weakness arises mostly out of a top-down approach. Despite environmental laws covering all aspects from air and water pollution to waste disposal, only a few offenders have been brought to book.

Such provisions of law exist, in statute book, but for the initiative of some public spirited individuals who had moved the courts to direct the government to implement laws rather than vigilance on the part of implementing agencies, like the State Pollution Control Board.
1.1 CONCEPTS OF POLLUTION

It is essential to define and describe the relevant concepts like environment, ecology, pollution and pollutants before dealing with the conceptual paradigm of environmental pollution research in geography.

1.1.1 Concept of Ecology

The concept of ecology has become very important in the study of environmental pollution. "Ecology is the scientific study of the relationship between living organisms with each other and their environment" (Charles, 1976). Christman (1973) defined ecology as the "interactions of organisms with their chemical and physical environment or the interaction of the biotic and abiotic environment".

Within each ecosystem, there are many important components: for instance, the plants provide food and energy to human kind and animals to survive. Bacteria and fungi decompose the dead organisms and return the chemical materials for reuse to the system. If these chemicals contaminate excessively, the whole ecological system of the area can be disastrously disturbed. The concept of ecology is also infused into the geographical concept of spatial relationship between man and his surrounding environment. Each ecosystem has a basic structure, consisting of producers, consumers and decomposers. Such an ecosystem is characterised by its own capability for self-maintenance. The limit to tolerance is also a principle of ecology. Therefore, for a better perspective approach, the concept of ecology has been used here in the study.

1.1.2 Concept of Environment

Environment means a set of surrounding which influence organisms. According to Daubenmine (1974) "in fact any external force, substance or condition that affects organisms in any way becomes a factor of their environment
and the sum of all these factors constitutes an environment. Fitting (1972) has defined environment as the totality of milieu factors of an organism. Environment is the sum total of all the external conditions and it influences the developmental cycle of biotic elements.

In general, in the field of environmental geographical studies, mainly two types of environment are dealt with: the physical environment consisting of non-living elements within the biosphere (geographical location, climate, soil, surface water, groundwater), bio-geographical regions or habitat (flora and fauna) and cultural environment in which human beings establish relationship with the natural environment which includes economic activity, living conditions, political factors and settlement. All elements of physical and cultural environment interact with each other.

To study the relationship between various aspects of environment, a model has been developed by Kumra (1982). It deals with the geographical scheme of environmental arrangement which concerns itself with the range of physical, physio-human and human environments. The latter two have been segmented into four groups (a) environmental, (b) biotic, (c) behavioural and (d) socio-economic, of sub-system forms the total system of human environment. Danserean (1977) declares that geographical perspectives are interpreted through four approaches: analytical, theoretical, spatial and applied. All the environments are merged with the human dimension at the core and with the temporal dimensions around that. If any disturbance takes place at any level in any period of time, it will create a pollution hazard in human environment and may cause disturbance in the life cycle of human environment. In this study, emphasis is given to the physical environment since the problem of pollution is mainly concerned with natural environment including air, water and land pollution. Human and cultural environments are also taken into account (Fig. 1.1).
GEO-SPATIAL ENVIRONMENTAL SYSTEM

(Kumra 1982)

Fig 1.1
1.1.3 Concept of Pollution

Due to human-induced environmental changes, harmful products originate, causing unwanted contamination through toxic substances in the natural environment, which often give rise to problems of pollution. Dixon (1972) defines pollution as "all those activities conscious or unconscious of man and his domestic animals and the result thereof, which detract in any way, directly or indirectly, in the long term or short term, from enjoyment of his environment and his ability to derive full benefit therefrom".

Pollution causes undesirable changes in the physical, chemical and biological characteristics of air, water and land that may have harmful effects on human life, living conditions and cultural aspects. Pollution could be evaluated in terms of four factors. They are (a) nature and property of the pollutant (b) space-time context of their emission (c) specific environment affected by it, effect on human life in the industrial city for example (d) impact on ecosystem. The concept of pollution should be dealt with through source, distribution and pattern of emission of pollutants in the environment since, the term 'pollution' is difficult to develop a concrete idea and magnitude of pollution and the degree of environmental consequences.

The United Nations Environmental Programme (UNEP) argues that pollution from industry crosses national boundaries and has international repercussions, that it pollutes water, soil and air and affects people's health. It adds that the discharge of industrial residues are costly wastes and claims that the treatment is much more expensive than prevention of pollution.

1.1.4 Pollutants and their Identification

Sir Fredrick Watner says "a substance is normally considered to be a pollutant if it adversely alters the environment by changing the growth rate of species, and by its toxicity interferes with the food chain health
comfort, amenities or property values. The pollutant may be a solid, subsolid, liquid or gaseous or submolecular particles.

In general, there are two types of pollutants in the environment namely, visible and invisible. Visible pollutants include effluents, wastewater and solid waste and invisible pollutants are of many types including trace elements. There are four major types of pollution in the environment, namely, air, water, land and noise. Air pollution occurs due to the emission of gases from vehicles and industries. Land and Water pollution takes place due to the discharge of industrial effluents, while noise pollution is generally found in some industries and in areas of heavy traffic.

1.1.5 Land Pollution/Soil Pollution

A pollutant is something which adversely interferes with health, comfort, amenities, property and environment of the people. Generally, most pollutants are introduced in the environment as sewage, waste and accidental discharges are the by-products or residues from the production centres. Pollutants come from all types of human activities. Particularly, industries produce residues and waste products. Considerable work has been done on the study of air and water pollution. Being of equal importance, land pollution should also be considered as a serious and dangerous problem of today and can hardly be neglected.

In a preponderantly agricultural country like India, land accounts for the basic needs of the people. There are a number of competing demands on land like agriculture, forestry, grasslands, urban and industrial development and transport. All such activities, either directly or indirectly, result in harmful effects on land. About 90 per cent of solid waste in India finds its way to dumps and landfills. Most of the remaining 10 per cent is incinerated. Dumping or burying trash on land is obviously a method of disposal with serious drawbacks. It is highly limited by the amount of suitable land that is available, for disposal. Unless
rigidly supervised and inspected, it presents a public health hazard. Even after the use of most modern devices, incineration also has its own limitation. At best, incineration reduces the amount of refuse by only 80 per cent. This process also promotes air pollution. The remaining 20 per cent ultimately disposed of in dumps and landfills, is readily accepted as injurious to public health and also to agricultural crops.

1.1.7 Definition of Water Pollution

Pollution is an injury to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to human life, health of animals, plants and aquatic organisms. Water pollution may be defined as the addition to water or an excess of material (heat), that is harmful to human beings, animals or desirable aquatic life, or otherwise cause significant departures from the normal activities of various living communities in or near bodies of water.

1.2 GEOGRAPHICAL CONCEPT OF ENVIRONMENTAL POLLUTION

Environmental Pollution is a serious topic all over the world. Population explosion and mushroom growth of industries has, caused concern to human well being and an aftermath ecological balance has developed among natural and social sciences. With the increase in industrialisation, various pollutants contaminate the natural environment. Industrialisation promotes the prosperity and position of any country but unfortunately it also brings some undesirable effects on local, national and global environment.

As man has been the prime concern of ecological force on the earth's surface for more than 10,000 years, man-environment relationship becomes very important, in pollution research. According to Charles (1976) "Man is faced with ecological crisis. The crisis has developed as a consequence of increasing mismanagement of the world environment and unrestrained growth of human
population." He adds that the "environment Pollution which carries mankind's problem into the very structure of nations itself, is the major part of a general social crisis which must be overcome if civilisation is not to relapse into barbarism". Pfaffin et al (1976) proclaims that "man is a critical member of the ecosystem. His interaction with the environment is an integral part of the processes of change and development of any place". "Man is not only influenced by environment, his behaviour may also profoundly affect the environment". Hence, for the well-being of human environment, it is important to study the causes of pollution and its mitigation measures.

1.2.1 Place of Environmental Pollution in Geographical Analysis

Geographers' contribution in environmental pollution studies is rarely seen. Since the innovation of a new sophisticated technology which causes the environment deterioration, the geographers now bestow attention to the environmental studies. Environmental concern has also been finding its way into physical geography and the man-environment theme also includes the study of environmental pollution in the field of geography.

Singh (1977) developed a set theory to place geography in environmental studies. He considered four subsets of factor groups which also contain various elements among them. The sets are: (A1) Ecological, (A2) Biotic, (A3) Socio-economic and (A4) Behavioural. The combination of these factors/groups jointly form the core concern of 'Environmental Geography'. The interdisciplinary subjects have been developed by overlapping the subsets in different ways (Fig. 1.2).

The role of geography in environmental studies is "the orderly description and interpretation of causes, processes, patterning of parameters essential for pollution study and inter-relationship and spatial organisation of human environment with varying distribution over the earth surface within the framework of ecological and behavioural perspectives" (Kumra, 1982). From the figure we
PLACING GEOGRAPHY IN ENVIRONMENTAL STUDIES

FOUR PERSPECTIVES
A₁ ECOLOGICAL
A₂ BIOTIC
A₃ SOCIO-ECONOMIC
A₄ BEHAVIOURAL
A = A₁ UA₂ UA₃ UA₄

E = GEOGRAPHY
E = A₁ ∩ A₂ ∩ A₃ ∩ A₄

i=1

A = Technosystem of the set UA
i=1

IMPORTANT ELEMENTS
11 AIR
12 SOIL
21 TISSUE
22 GENES
23 SOCIAL WORKS
32 ECONOMIC NORMS
41 MENTAL ATTITUDE
42 CULTURAL VALUES

INTEGRATED FIELDS
a PLANT ECOLOGY
b BIOSOCIOLOGY
c CULTURAL ECOLOGY
d BEHAVIOURAL SOCIOLOGY

Fig. 12

(Kumra 1982)
know that environmental geography is a function and rationalization of various disciplines which also include environmental pollution.

1.2.2 Present Approaches

In order to study the environmental impact, various geographical approaches have been used by Kumra (1982). He has highlighted four approaches namely: Spatial, Ecological, Systems and Behavioural.

1.2.3 Spatial Approach

Geography is the science which studies spatial relationships between various phenomena over the earth's surface. Spatial approach is useful for the study of pollution pattern. In areas where the density of industries is high, the magnitude of pollution is also equally high.

In the cause-effect analysis, it is important to examine the spatial relationship of pollution. Distribution of large tanneries in and around residential areas is the main cause for air, water, land and noise pollution which are responsible for various problems. It has been examined as to what traits control the patterns of distribution of pollutants and how these patterns can be modified to determine a more rational distribution.

1.2.4 Ecological Approach

Ecological approach to environmental geography is through ecological analysis, which interrelates human and environmental attributes and interprets their relationships. In this approach, geographers shift their emphasis from spatial variations between areas, to relationships within a single or bounded geographic space. Soil quality has been appraised to know the effect of tannery effluent which is disposed of in the fields, rivers, streams and lakes. The study of land use was to find the relationship between land use pattern and the magnitude of pollution.
In the understanding of the impact of pollution, plants, animals, human beings and microorganisms (phytoplankton) have been considered as critical species. Black gram seeds were germinated in various levels of chromium concentrations to observe the chromium impact on agricultural crops. Phytoplankton has been collected from the site of tannery pollution and also from pollution-free area to understand the species diversity. The impact of tannery pollution on human beings has been assessed from the ESI hospital health records. Secondary data have also been taken to find out the chromium impact on animals.

1.2.5 System Approach

It is an important tool for ecosystem research and environmental management. Ecological systems are dynamic and complex in nature which have interactions with many parameters and often display lag effects, thresholds and non-linear causal relationships (Watt, 1966). This approach is similar to scientific procedure which deals with description, classification and chemical analysis, experimentation and trial tests.

System analysis can be illustrated with the problem of improving water quality in a polluted river. For this purpose, chemical and physical characteristics of water have been analysed. System measurements would finally involve the identification of the major influences and their magnitude on the Palar river. The approach also deals with pollution and human interrelationships. For this purpose, field survey has been made to understand the effect of air pollutants especially dust (hairs, fleshes, and toxic chemicals) on those living in and around the tanneries and in residential areas.

1.2.6 Behavioural Approach

Behavioural approach as a tool in environmental pollution studies is now widely practiced by the geographers, sociologists and anthropologists. In the
present approach, use of social norms such as economic and occupational structure have been used to understand the behaviour of the population with respect to pollution. Perception of environmental pollution was studied with the help of behavioural approach through questionnaires. In the perception approach on man-environment, there are various elements and their interrelations perceived by various groups of people. For instance, in the perception survey conducted among the farmers, efforts were made to understand the type of pollution occuring in the study area, how it is disposed of into the environment and what are the consequences and steps taken by the farmers to overcome pollution.

1.3 ROLE OF GEOGRAPHY IN ENVIRONMENTAL IMPACT ASSESSMENT

In recent years, great concern has been universally raised regarding environmental pollution by various disciplines. In the field of geography, it has recently been recognised as an important area of research. Now-a-days, geographers have become concerned with 'Clean Environment' 'Ecological Balance' and 'Sustainable Development'.

Environmental pollution, in view of geography in the past, had limited work. The contributions of Humboldt, Ritter and Ratzel (1795-1840) regards environment as a landmark. According to them, the unity of nature presumed an inter-relation of all individual features in nature and the unity of nature includes organic, inorganic, human, animal and material substances. The problem of environmental pollution has started during industrial revolution and in those days environmental pollution did not capture the attention of the geographers and other scientists. Environmental pollution is now emerging as a special field in every discipline. It is clear that a comprehensive work has been done by the various scientists in various disciplines but in the field of geography, only a very limited study has been done.
Kayastha (1965) has stated that the study of pollution in India was triggered with the study of conservation of resources, disturbances in the delicate balance of nature and expansion of risk zones. He has related water pollution in different cities and proposed national water policy of India. Pollution is a consequence of effluents and population increase, and showed that there exist a relationship between natural increase in population and level of pollution (Dixon, 1972).

The pollution was considered as a problem of population by Jones et al (1972) and they analysed the cause of pollution and gave proper suggestions to solve it. Rothman (1972) also analysed the causes of pollution and gave suggestions to solve it. Rothman has however focussed attention on the sources of pollution, their spatial variation and measures to control it. The problem of every aspect of pollution and also the correlation of the level of pollution with its effect on human health has been done by Berry et al (1974).

Agarwal and Ghose (1974) monitored the level of pollution in Kanpur city and correlated it with the incidence of diseases and concluded that asthma, bronchitis and tuberculosis were related to various levels of pollution. Various pollution and their spatial variations were studied and suggestions were given for planning purposes (Wood et al. 1974). Wood and others also mapped the levels of air pollution. They used composite pollution index to infer the level of pollution which would be useful to other workers in the field of geology. Pandey (1976) worked on water pollution of the River Ganga and concluded that the main source was industries.

Environment had a core concept in geography and Strahler (1977) viewed that the environmental problems that were faced by the human beings existed in the absence of the sustained application of principles of science and technology. Bijlani (1978) and Karan (1978) suggested pollution control strategy consistent
with social, cultural institution and priorities of population could be rearranged through assessing the knowledge of perception of the environmental stress. Bharadwaj (1979) brought forth that population is the biggest factor for increasing levels of pollution. Michelson (1970) studied the side effects of land pollution on human mental health, among the residents of the surrounding areas of New York.

In this branch of applied science in India, only paltry work has been carried out by geographers, but the work of other scientists is quite satisfactory. In the field of environmental pollution the geographers contribution in India in recent years is considerable. In the present study, an attempt has been made to analyse both water and land pollution as crucial problems on account of tanneries in North Arcot-Ambedkar (N.A.A) district which has a spatial variation in pollution.

1.4 INDUSTRY AND ENVIRONMENT

Industrialisation patterns and their consequent environmental impacts have proven to be unbalanced. Today, in view of the severity of potential disruptions resulting from degradation of the global environment, concerted international action is required. Industry often brings, along with social and economic benefits, environmental destruction and health problems. Discharge of industrial pollutants into the air and water has potentially disastrous effects on health, but its negative effect on industry per se is not damaging. Moreover, lack of awareness, especially at the level of decision maker and the technologies of industrial countries are not always suited or easily adaptable to the socio-economic and environmental conditions of developing countries.

At present, the industrial structure in developing countries typically contains one or more of the three following elements:

* Industries utilize cheap labour and sell to export and domestic markets;
* Those industries which utilize local natural resources
* The countries are zealous on earning foreign exchange.

* A few environmental problems associated with the present industrial structure in developing countries are.

* The presence of heavy metals in the effluent chromium in the tanning industry.

* Contamination of both surface and groundwater due to industrial effluents, spoilage of surface landscape by disposal of solid waste.

1.4.1 Tanning/Leather Industry

Tanning is the art and process by which animal hides are converted into leather. The hides/skins, after removal of flesh and fat are treated with chemicals which cross-link the collagen fibres to form a stable and durable material called leather. The chemicals used in tanning may be derived from traditional vegetable products or chemicals. After tanning, the hides/skins (pelts) will usually be further processed according to its end use. It has a sequence of processes, namely, buffing, trimming, dyeing and surface coating.

The constituents of tannery effluent vary according to the processes employed. If some toxic chemicals are used, they find their way into the effluents. These toxicants affect soil, water and air. Wastes of animal origin are powerful pollutants and are highly odourous when they decompose.

Tanning and its associated operations have considerable environmental impact. Widespread awful odours, poisoning from toxic gases and unsafe disposal of wastes are common in the industry. The use of chemicals in various processes leads to occupational hazards, creation of deleterious wastes and their safe disposal. Many of these impacts are on the health and safety of workers. The deterioration of natural resources, resulting from pollution, can have a negative effect on the long term growth potential of a country, though immediate economic benefits may be gained. In any case, excessive generation of pollution and waste is often a sign of inefficient manufacturing and a drain on scarce resources.
1.4.2 Leather Industry-World

According to the United Nations Industrial Development Organisation (UNIDO), 50 per cent of the cattle hides originate in four countries (USSR, USA, Argentina and Brazil) and 50 per cent of the sheep skins in five countries (USSR, Australia, New Zealand, China, Turkey). The USA, the former USSR and India account for 30 per cent of the world available hides (calves, sheep and goats). It is noteworthy that in 1980, 30 per cent of the world’s leather was tanned in only four countries, namely the US, USSR, Argentina and Italy. Due to the strict environmental legislation and labour problems, the production has however declined in these western countries.

1.4.3 Tannery Problems in the World

The leather, shoe and other industries in high labour cost countries could survive without some sort of protection. Due to the high labour cost and environmental problems, the developed countries import semi-finished leather, finished leather, leather garments and shoes, from developing countries, mainly India. In the developed world, the environmental Acts are stringent. Labour costs on the other hand are prohibitive. Paradoxically, their leather consumption has however been increasing. To keep their country and people safe, they export raw skins and hides to developing countries like India which are perpetually in dearth of foreign exchange. In developing countries, the presence of cheap labour, least awareness of environment, tax legislation, loopholes in the legislative Acts are convenient to the rich countries to force the economically weak to set up these banned industries in their native soil.

1.4.4 Generation of Pollution by Tanneries - A Global Perspective

From the tanneries in different countries of the world the processing of $4.7 \times 10^6$ tonnes of cattle hides per year involves a discharge of about $300 \times 10^6 m^3$ of waste water (on the basis of $65 m^3$ per tonne of hides). In the same
way, small skin processing, on the basis of 500 million skins per year and 200 litres per skin, discharges about 100 million m$^3$ per year. So the total effluents of the leather industry worldwide amount to some 400 million m$^3$ per year.

With respect to pollution load of these effluents prior to treatment, as measured by the parameters, oxidizable pollution, suspended pollution and toxic pollution, the impact of the leather industry worldwide on the basis of the processing of 25,000 tons of leather can be reckoned at 40 million population equivalent (cattle hides, sheep skins and goat skins) and at 1,600 population equivalent per ton of hides. This amounts to less than 1 per cent of the world's domestic pollution prior to treatment (based on a world population of 5.6 billion) and it is less than 0.5 per cent of the world's total domestic and industrial pollution. As the installed capacity has been increased to gargantuan sizes of 50-100 tonnes and the use of advanced technologies in the place of natural products in the processing have made the effluent more complex. The operations transform the hides into leather and generate both liquid (effluent) and solid (sludge) wastes.

1.4.5 Pollution Loads Associated with Leather Manufacture

All excess chemicals in processing and skin residues and pollution load are schematically shown below:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemical Oxygen Demand (BOD)</td>
<td>75 - 90</td>
</tr>
<tr>
<td>Chemical Oxygen Demand (COD)</td>
<td>200 - 260</td>
</tr>
<tr>
<td>Suspended Solids</td>
<td>140</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>12.6</td>
</tr>
<tr>
<td>Toxicity Ondaphnia (equotox)</td>
<td>2.5</td>
</tr>
<tr>
<td>Sulphides</td>
<td>9</td>
</tr>
<tr>
<td>Chromium ($\text{Cr}^{3+}$)</td>
<td>5</td>
</tr>
<tr>
<td>Effluent Volume</td>
<td>55m$^3$</td>
</tr>
</tbody>
</table>

Source: Chambolle, 1983
The processing mechanism reveals that every operation has its own characteristic pollution load-solution / suspension / organic / inorganic / toxic / bacterial and it emphasizes that each operation is to be studied and assessed individually for better understanding. The impact of tanning waste can be better studied by analysing

* Toxic Chemical and Ecotoxicity
* Impact of Tanning Effluents on Environment
* Recycling of Wastes in Agriculture and in Other Allied Industries.

Leather making is a universal industry. Availability of raw materials (hides/skins) and dye only do not ensure starting of tannery units in a place usually concentrated on river banks where copious amounts of sweet water are available for different processes. River course is also misused for waste disposal.

1.4.6 Quality of Effluents Discharged

In the beginning of this century, the problem was not alarming as the tannery units were small and geographically distributed. The approximate quantities of effluents let out during the different stages of the tanning process, have been arrived at, for both the processes. In both types of tanning, the quantity of effluent will vary from about 30 to 35 litres per kg of leather produced. In the case of leather finishing units, the process involves the use of organic dyes and this process will discharge extra of 2 to 5 litres per kilogram of finished leather.

1.4.7 Disposal of Tannery Effluents

The present condition of the lagoons, the storage facilities and method of disposal of effluents in the different tanneries, reveal that an unsatisfactory condition prevails in most tanneries. Though all the tanneries are expected to treat effluents and let out only the treated wastes, this practice is
seldom followed in N.A.A district. Most lagoons within the premises are of earthen construction and only few are built of concrete. The effluents are let into the lagoons and allowed to vapourise from solar evaporation ponds. The number and capacity of the lagoons, in most of the cases are not commensurate with the quantity of effluents available for disposal. Hence, it is a common sight to see overflowing lagoons and the waste getting drained into the nearby fields. There are large scale breaches in the lagoons and the effluents stagnated latter in the fields. A large number of tanneries in Pernambut, Valathur, Vaniyambadi, Ranipet, Walajah, Arcot and Gudiyatham zones dispose of the effluents directly into the lakes and surrounding ponds.

A few tanneries in Pernambut, Vaniyambadi and Vellore let the effluents directly into the Palar river, contaminating the potable water also. Apart from this, the washes like used lime, hair and leather bits heaped both inside and outside the tannery premises get slowly washed by the rain water and contaminate the adjacent areas. The sludges are dumped along the road side, which are prone to air pollution and its offensive odour causing mixture of ailments like headache. So, the present storage facilities are woefully inadequate and the condition of the tanks, channels are far from satisfactory. Among the 836 storage tanks, 67 or about 8 per cent was found to be satisfactory and the remaining 92 percent needs urgent corrective measures.

1.4.8 Influence of Tannery Effluents on Soil

In general, the soil in affected areas contains highly soluble salts. Electrical conductivity is more than 3.0 and the pH is also high. Appreciable deterioration in physical or chemical characteristics of the soils in the tannery zones, had already taken place. The soil in these areas have a moderate to rapid permeability and because of this contain low soluble salts.
1.4.9 Economic Importance of Tanneries in India

Raw skins, hides of cows, oxen, buffaloes, goats and sheep from various parts of the country are brought to the tannery for processing before exported to foreign countries through Madras port after meeting the requirements of local market for manufacture of footwear, belts, purses, suitcases, gloves and clothing. The by-products such as wool and hairs are also exported. Nearly 75 per cent of the products exported through Madras port are products processed from various tanneries in North Arcot Ambedkar district. It is estimated that more than 50 per cent of the leather and leather exported from India are processed and manufactured in N.A.A. district and account for more than 3000 million of rupees of foreign exchange.

While the contribution of tannery industry to the economic development of the district is substantial, the industry has also been responsible for creating adverse effects on the productivity of the land, several instances of deleterious influence on crops and ill-health of human beings and animals are available.

India has vast amount of cattle wealth, one out of every fourth cattle in the world exists here. The last two decades marked the emergence of leather industries as one of the top five foreign exchange earners in India. The industry had undergone total metamorphosis and emerging as one of the significant competitors in the global market for leather and leather products. The earlier image of the country as an exporter of raw hides and skins and E.I. tanned leather had been left to oblivion and, at present, export value of rich finished product is most important. India's leather goods has ready acceptance even in quality conscious markets such as Germany, U.S.A., Japan and France. During the year 1990-91, the total exports of leather and leather products reached rupees Rs. 25,540 million, out of which value added products accounted for over 70 per cent, in the form of finished leathers.
1.4.10 Export Trends

The Leather Export Promotion Council envisaged an annual growth rate of 25 per cent in this sector for the next 5 years since 1991. The latest global statistics relating to the year 1988 revealed that share of Indian leather products still remain at a low level of about 3.5 per cent. The major competitors were South Korea, Taiwan, China, Indonesia, Thailand, Italy, Brazil and Pakistan. The Council endeavours to increase the share of Indian leather in the global market to at least 10 percent by the turn of the century.

1.4.11 Operational Size of leather Industry

The small scale sector has played a key role in the development of leather industry in India. Most activities within the leather sector are reserved for small scale sector. The three stages of manufacture are:

* Processing of raw hides and skins into semi-finished leather,
* Processing of semi-finished leather into finished leather, and
* Manufacture of leather footwear, garments and other leather products from finished leather.

The first and last stages are reserved for small scale sector. The organised sector units are permitted to manufacture finished leather only from the semi-finished stage, that is, stage 2. The organised sector can also enter stage-1 and stage-3, if they export at least 75 per cent of their products. The number of registered small scale units in 1981 was 24,667, it has gone upto 73,940 in the year 1990-91 and is expected to grow 1,12,400 in 1994-95 (Fig. 1.3). The leather tanning industry has been confined to the cottage and small scale sector. Out of the total number of 1083 registered tanneries in the country 1008 units are in small scale sector. These tanneries fall by and large, in a total of about 60 clusters.
Export of Leather and Leather Products
INDIA

Rs '000 million

PRODUCTS

- S-F Leather
- F-Leather
- Footwear
- Components
- Garments
- Goods
- Saddlery/harness

CLRI, MADRAS '90

Fig 1.3
There are only 75 DGTD units that is medium scale units, in this sector Madras, Ranipet, Ambur, Vaniyambadi, Dindugul, Erode and Trichirappalli in Tamil Nadu account for over 5 to 10 tanneries where as Calcutta accounts for 250 tanneries and Kanpur has about 140 tanneries. While tanneries in Tamil Nadu are particularly known for sheep, goat and calf leathers, Calcutta is famous for cow leather while Kanpur is the traditional centre for Buffalo hides tanning. With the modernisation of tanneries and the development of the end-product industry, the tanneries in India have the capability to produce different type of finishes to suit the global requirements of leather products.

The leather industries are established in Madras and North Acreot-Ambedkar District of Tamil Nadu, Calcutta, Kanpur, Agra, Delhi, and Bombay. A few leather garment and leather footwear units have also come up in places like Bombay, Hyderabad, and Jallandhar. The southern region has emerged as centre for high quality leather footwear and leather garments, while Calcutta has traditionally been concentracting on the production of hand bags and small leather goods. Agra and Kanpur have traditionally been the centres for production of horoichis, sandals, saddle items and other type of footwear, mainly for low priced segments. Delhi has registered an impressive growth in the leather garment sector and a number of leather footwear units have also recently come up. Bombay has a manufactured horoichis/sandal, handbags in addition to leather garments.

1.4.12 Employment Potential

It has been estimated that the leather sector provides employment for around 1.4 million persons, of which 600,000 persons are employed in the flaying and curing of hides and skins, over 700,000 persons are employed in the cottage and small scale sectors which are engaged in the tanning and finishing of leather and production of leather footwear, garments and other
leather products. Only less than 100,000 persons are employed in the medium and large scale sectors, mostly in footwear units. It is estimated that during the 7th Five Year Plan period (1986-90), modern factory employment has increased at least by 50,000 especially in the export sector. One of the striking developments associated with the growth of the leather products sector is high level of employment for women. Nearly 80 to 90 per cent of the employment in the modern leather footwear and leather garments units, particularly in Tamil Nadu have gone to womenfolk, leading to a social revolution of kind in these areas.

1.4.13 Promoters of Leather Industry: Government

The report of Seetharamiah Committee in 1973 was an important land-mark in the history of growth of leather industry in the country. The policy decisions taken by the Government of India based on the report of this committee led to the regulation of export of semi-processed leather and had given impetus to the growth of leather product sector. The V.C. Pande Committee Report in 1985 also highlighted the various measures needed for further growth of the leather products industry. Government of India has been adopting a consistent policy of encouraging export of value added products by offering benefits like Cash Compensating Support (CCS). The CCS given for finished leather exports was withdrawn in the year 1987.

The liberal and progressive import-export policies introduced during early 1980’s have facilitated the growth of exports in the leather and leather products industry. Inclusion of most of the machineries required by leather and leather products industry under the OGL list with duty concession has contributed to the modernisation and growth of this sector.

In the light of the growing demand for finished leather and leather products sector, the Government of India have allowed the import of raw
hides and skins/semi-processed leather/finished leather duty free under OGL scheme. Based on the representations from the Council for Leather Exports the government has allowed a large number of input accessories and embellishments for this industry under duty concession scheme.

The restrictions imposed by the Reserve Bank of India on imports in 1991 have caused serious jolt to the export promotional efforts. The leather products sector which had only about 10 per cent import content, contributed 90 per cent net foreign exchange earnings, had not been exempted from those restrictions. Consequent to the repeated representations through Council these restrictions have been with drawn related to some extent. The council has suggested further relaxations for the growth of this industry by abolition of excise duty on the footwear components and duty reduction for some of the essential inputs for the footwear industry.

1.4.14 Leather Council

The Council for Leather Exports was established in 1984 with the headquarters at Madras by merging erstwhile Leather Exports Promotion Council, Madras and Exports Promotion Council for Finished Leather and Leather Manufactures, Kanpur. At present the council has total membership of 4441 members. One third of the total membership is represented by the southern region of the council which revealed its importance. The council has been playing a key-role in the growth of the sector during the past 7 years. Various export promotional measures undertaken by the council include:

* Providing services by experts from advanced countries in design and product development and improving the production methods.
* Organisation of and participation in various international fairs for the leather products.
* Assistance to selected units for brand promotion efforts.
The council brings out in-house journal LEATHERS, which is a bimonthly and the council also publishes a journal by name FINANCE for international circulation which aims at improving the image of Indian leather products abroad. The council also brings out a monthly bulletin by name Leather News for circulation among the members listing out various news items of interest to the members. Council organisers Buyer-Seller meets and Sales-cum study teams in thrust markets.

* The Council mediates with the Government on the policy issues and procedural matters to find early solutions. The council plays a very active role in liaising with various trade missions abroad and keep members informed about various developments in major export markets. The council’s role in safe-guarding the interests of the member-exporters consequent to the ban on pestaecdoropherol (PCP) by Germans can be cited as one of the recent cases in point.

* The Council is also organizing short-term training courses at the operators/supervisory levels at Madras, Kanpur and Delhi. The council also liaises with various agencies such as CCI and E, ECCI and customs, RBI and other banking institutions to sort out the general issues affecting this members.

* The Council publishes periodically Importers and Exporters Directory and also catalogues, various govt. notifications and circulars.

The Council will be implementing a project for export promotion with UNIDO assistance spread over the next 4 years.

The major components of this project are:

* Provision of the services of design and product development experts and marketing consultants from the developed countries for the benefit of leather products sector in the country; and

* Campaign for promotion of brand image for the country’s products in the major thrust markets.

The Council also plays a key-role in organising every year, India International Leather Fair at Madras, for the past 6 years. The level of
participation from both within and outside the country and the volume of business transacted in fair venue has been growing steadily over these years. The Tamil Nadu Government has come forward with an allotment of about 20 ha of land in Nandambakkam, within the Madras city limits, to develop a permanent fair site that the India International leather Fair and other such specialised fairs would be held in future with improved facilities such as permanent Exhibition Hall, convention centres and other amenities.

1.4.15 Organisations : Central Leather Research Institute (CLRI)

CLRI, Madras is one of the major research institutions in the world in the leather sector. Apart from attending to basic research relating to the leather tanning process, development of leather chemicals and auxiliaries, mitigation of pollution, the institute also contributes in a significant manner in meetings the trained man-power requirements of the industry.

Central Footwear Training Centre (CFTC)

CFTC, Madras and Agra also organise certificate courses in the leather footwear making.

Footwear Design and Development Institute (FDDI)

FDDI, New Delhi has just started functioning and will be organising training courses in the leather footwear sector.

State Leather Development Corporation

There are a number of State Leather Development corporation which function with different degrees of success in organising productions of leather and leather products. Tamil Nadu Leather Development Corporation (TALCO) deals with the setting up of common effluent treatment plants under the centrally sponsored scheme.
Indian Institute of Leather Products, Madras (IILP)

IILP, Madras had been set up with financial grants from All India skin and Hide Tanners and Merchants Association (AISHTMA) and Indian Bank, Madras. The institute has been playing a supplementary role in meeting the manpower requirements for the leather products industry.

1.4.16 EIA of Tannery

No study has been made on the global aspects of tanneries with reference to EIA covering all aspects. There are no specific guidelines for the tanneries to follow. Since the EIA is inter-disciplinary, it requires a lot of data sources, manpower, finance and time.

Tanning is an intensive water consuming industry, requiring enormous quantities of fresh water. The saline and hard water is not suitable for tanning. The fresh water is needed for all the tanning process. Groundwater is the current source of water for tanning as the Palar river runs along almost the year-round. For every 100 kg of skins/hides tanned, 3,500 litres of fresh water is used. Since the Palar river has become dry, the water source has become scarce. The bore wells are being drilled all along the Palar river basin for the industrial and and domestic purposes. Groundwater table has also become low, owing to over exploitation of groundwater sources. Farmers are depending on rain, now-a-days for raising crops. Since the tanneries consume all the water, the sources are drying up as well.

1.4.17 Tanneries in India

India produces about 100 million skins and hides; about 2.3 millions are employed in leather and allied industry; about 28,000 million rupees is earned annually as foreign exchange. The small scale sector has played a fundamental role in the development of leather industry in India. Most activities of the leather producing are reserved for small scale sector. The
number of registered small scale units in 1981 was 24,667, it has gone up to 73,940 in the year 1990-91 and is expected to reach 1,12,400 in 1994-95. Tamil Nadu accounts for over 570 tanneries along with unregistered tanneries, finding out the exact number of tanneries is difficult. Most tanneries are located in Ambur, Pernambut, Vaniyambadi, Ranipet (N.A.A. district), Pallavaram and Madhavaram (Madras), Tiruchirapalli, Erode and Dindigul all in Tamil Nadu state.

Leather sector as indicated earlier provides employment for around 1.4 million persons. Nearly 80 to 90 percent of the employment is in the modern leather footwear and leather garment units, particularly in Tamil Nadu have gone to womenfolk, leading to a kind of social revolution through seasonal differentiation. Out of 567 tanneries in Tamil Nadu above 347 tanneries are located in N.A.A. district, which employ about 27,500 workers from Ranipet, Ambur and Vaniyambadi areas. Most workers are low paid and have no job security. The fiscal benefit from the tanneries are direct as well as indirect.

1.4.18 Tanning process in the Study Area

Tanning was earlier done by vegetable tanning which was comparatively harmless. It used the barks of Avaram and Pongam and Myrobalam oil. This process is time consuming taking 40-45 days to change from skin to finish leather. This is called East India (E.I) with tanned leather. With increase in demand for finished leather in the world market, most tanneries turned sartent to chrome tanning also called the Wet-Blue Tanning. In this process, various chemicals such as sodium chloride (for preservation of skins/hide), sodium sulphide, ammonium sulphate, chromium sulphate, sodium carbonate, fat liquor, oil and dyes are used. This is a time-saving process and takes only three days to finish leather. The raw skins and hides are received in the tanneries in wet salted or dry salted form. The salt (sodium chloride) is used as a preservative and is first removed and then skins/hides are put into various processes like soaking, liming, airing, fleshing and deliming, followed by washing and tanning.
In the chemical process, after deliming, the skins are pickled before chrome tanned. The chemical process takes three days and is therefore preferred in most tanneries. Vegetable tanning has now given way to chrome tanning. The main difference between the vegetable and chrome tanning processes comes as follows.

Vegetable Tanning

* The treated skins are soaked in tanning water for preservation and then in myrobalam water.
* Drying, oiling, stretching again drying and packing
* Finishing by splitting into 2 or 3 layers and dyeing to the required colour.

Chrome Tanning

* Soaking the skins in a solution of chromic acid (sodium chromate and sulphuric acid)
* Oiling, drying, stretching and packing
* Finishing by splitting into 2 or 3 sheets of desired gauge
* Dyeing and finishing

In addition to the above two types of tanneries, there are the leather finishing units, which convert the tanned leather in a stage set for manufacture of finished products such as shoes and bags. The leather is split into 2 or 3 layers and after treatment with chemicals and dyes are polished to different shades and colours.

1.4.19 Waste Waters, Chemical Composition and Quantity

The water used in the tanning process is discharged as waste water which has a typical chemical composition. The major pollutant of the tannery is sodium chloride, at the rate of 3 to 4 tonnes for every 100 tonnes of hides tanned, besides chromium and sulphur compounds. The composite liquid effluents also
contain noxious, suspended solid wastes. Most tanneries let out effluents without treatment into the river, streams, sewages, tanks, open land and fields. The effluent water percolates through subsoil and contaminates groundwater table as well as results in the pollution of the entire groundwater in the Palar basin, which was once a major source for irrigation. The rain water also mixes with indiscriminately disposed solid wastes in the open fields and affects further the groundwater quality and soil fertility.

4.20 Problem and Procedure

Tanning and its allied operations are a source of considerable environmental impact on a tannery site and its adjoining areas. The impact not only affects its surroundings, but also concerns the whole environment. The use of different chemicals and heavy metal like chromium in various processes leads to occupational hazards, formation of hazardous wastes and concomitant difficulties in the effluent treatment. Immediate economic gains is surely guaranteed by the individual tanning enterprises, but the deterioration of natural resources resulting from pollution have a negative effect on the long term growth perspective of a country like India. Apart from this, this malaise imparts a slow poisoning of the workers.

North Arcot-Ambedkar district is nicknamed as 'Dollar District' thanks to the presence of tanneries. Tanneries here are either registered with the relevant authorities or exist unauthorisedly. The capacity of tannery varies from a few hundred kg to a few tonnes of raw hides/skins per day. Each kg of raw material processed discharges 35-40 liters of abnoxious effluent. The effluent is let out without any treatment on to land, lakes and rivers. The tanneries also dispose solid sludges on roads and available open places. The wet blue tanning process involves the use of 250 types of chemicals, of which chromium salts are more lethal. Contaminated lakes on irrigation spreads the menace to wide area on irrigation. Impounded effluent pollutes groundwater aquifers.
Two decades back, the prosperity of the district area was associated with the river Palar. Its waters quenched the thirst of humans and the arable lands. Its water flow brought however a bee-hive of tanneries. The river Palar (river of milk in Tamil) over years has become rightly, the 'river Uppar' (river of salt). The tannery waste has made potable water, scarce and prime agricultural lands saline. The agricultural scenario has changed from cultivation of value rich crops to less profitable ones like millets. Polluted well water has caused low productivity and the agricultural labourers has low man-days of work per year. Migration of people to nearby cities has become common. The hazardous effluents have deteriorated the health of men and beasts. The lives of tannery workers are miserable and occupational illness is predominant. The impact on spoilt environment in this study area is clear even to a new visitor.

Aims and Objectives of the Study

The study aims at making an assessment of environmental impact of the tanning process, effluent characteristics, impact on agriculture and health, seasonal variation in pollution and perception of local people towards the environment of N.A.A. District. The major objectives set forth are:

1. To examine the growth and distribution of tanneries in North Arcot-Ambedkar district.

2. To demarcate the major pollution zones based on the location of tanneries using water quality measures.

3. To analyse well water and the effluent water to determine the chemical composition and to make comparisons with the International Standards.

4. Mapping of the pollution zones on the basis of E.C. (Electrical Conductivity) value and to estimate the extent of severely and moderately affected areas.
5. To examine the pollution impacts on agriculture and health of the people in the area and to suggest means of resolving problems through degradation combating strategies.

1.6 METHODOLOGY

An array of techniques has been employed to study each objective. Cartography, statistical applications and computer analysis have been used. Cartographic techniques have been used to demarcate the polluted areas using chopleth map. The isoline maps have been drawn on the basis of computer estimated score values to find out the seasonal variations of pollution over four years. Simple line graphs have been used to determine the seedlings impact due to pollution and chromium water.

The cluster analysis has been used to obtain the hierarchy of levels of pollution in wells which are polluted. Cross correlation technique has been used to examine the relationship between water quality parameters. Trend Surface maps have been drawn with the use of SYSTAT package for the polluted areas. From the factor analysis, the pollution impact on agriculture is found. The seasonal and quinquennial water quality changing pattern has also been derived.

To estimate the magnitude and pattern of pollution, data have been collected, using the perspectives of various disciplines. As this study includes aspects of environmental pollution, it was difficult to do intensive field work as it has involved time, manpower and resources constraints. The data pertaining to tanneries were collected from District Industrial Centre, Vellore, where the data on the date of issue of industrial license alone might be correct. However, the data on capacity, raw materials, quantity and workers employed were found to be incorrect on checks.

The existing tanneries in N.A.A. district are both officially registered and unofficially functioning units. For the study, only the registered units were
considered and their data on capacity, process, raw materials, waste water, soak water and pollution load were collected/calculated. The geological structure of the study area has been given importance in the study, as the discharge of pollution moved according to the type and structure of rocks and surface slope.

The details on the existence of bench mark wells were obtained from the Groundwater Division, Public Works Department, Madras and also the Regional centre at Vellore. Data on cropping pattern, intensity, productivity and the study area were collected from the Block Statistical Office at Vellore. In order to know the chromium impact on plants, black gram seeds were allowed to germinate and the percentage of germination assessed to the graded levels of concentration of chromium in the control water and tannery effluent. The weight and length of the shoot and root were also measured. The pytoplanktons were collected from polluted lake and from normal pond to score bio-diversity and biotic populations.

The soil and water samples from various places in the study area were collected and analysed personally to assess the extent of damage caused availing the facilities existed in Tamil Nadu Agricultural University Extension Centre, N.A.A. district and Department of Agriculture, Government of Tamil Nadu. The physical and chemical characteristics of tannery effluent were collected from the Department of Environmental Toxicology, Central Leather Research Institute (CLRI), Madras. Details on the location of existing tanneries, processes and raw materials were also collected. The chromium content was analysed at the Institute of Basic Medical Sciences, Taramani, Madras. for data on the occupational health of tannery workers, at the Employee State Insurance (ESI) hospitals at Ambur, Pernampet and Walajapet were contacted.
A personal observation survey has been made in the tannery affected and non-affected areas among the farmers to record the impact on agriculture and their awareness about the pollution in this district with the help of 340 questionnaires. Lastly, pollution zones were delineated on the basis of selected parameters and suggestions were given for proper management of the study area.

1.7 DATABASE/RESEARCH DESIGN

Since the research called for an interdisciplinary approach, it ordains collection of data from various departments for the analysis (Chart 1.1 & 1.2). In order to find out the water quality in the study area, both seasonal and temporal data of 15 years from 1975 to 1990 have been collected from the Ground Water Division of the Public Works Department at Madras and its zonal office at Vellore. The parameters like Electrical Conductivity (E.C), Total Dissolved Salts (TDS), Calcium (Ca), Sodium (Na), Potassium (K), Magnesium (Mg), Chloride (Cl), Carbonate (CO₃), and Bicarbonate (HCO₃) have been collected and interpreted for 58 well water in the entire study area. The water levels of wells have also been collected from the same department. The general information of the study area has been collected from the Census tracts, District Statistical Office, Vellore and the Department of District Town and Country Planning, Vellore. Remotely Sensed Image Interpretation has been done for the preparation land use and geomorphological maps of the study area, at the Photogeology Laboratory, Institute of Water Studies, Taramani, Madras. Regarding health impacts, the data have been collected from the Employee State Insurance (ESI) hospitals at Ambur and Walajapet.

Primary data has been generated from questionnaire survey (Appendix I) for assessing the socio-economic conditions of the people, farmers attitude, awareness and perception of tannery pollution, drinking water problems and health hazards. Apart from the questionnaire survey, the water and
# RESEARCH DESIGN AND DATABASE

## PRIMARY DATA

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>TIME</th>
<th>PARAMETER</th>
<th>SAMPLES</th>
<th>PRESENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB TESTED Water Quality</td>
<td>2 seasons</td>
<td>All parameters</td>
<td>15 wells in each zone near controlled wells. Total 60 samples.</td>
<td>Table/map (Average)</td>
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<tr>
<td>(Well water)</td>
<td>Winter - 1990</td>
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<tr>
<td></td>
<td>Summer - 1990</td>
<td></td>
<td></td>
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<tr>
<td>Chromium</td>
<td>1990</td>
<td>Chromium alone</td>
<td>2 samples each in well water drinking water effluent water soil at 4 zones total 32 samples</td>
<td>Map</td>
</tr>
<tr>
<td>Soil</td>
<td>1990</td>
<td>E.C and pH</td>
<td>4 samples in each zones. Total 16 samples</td>
<td>Table</td>
</tr>
<tr>
<td>SURVEY Questionnaire Survey (Chart 1.2)</td>
<td>1991-92</td>
<td>General household education employment land ownership crops grown, input output health status medical facilities perception of environmental hazards.</td>
<td>85 sample in each zone 85x4 = 340 samples 3 Taluks 5 Blocks 6 Villages in each block</td>
<td>Table/Compared with 1982 data</td>
</tr>
</tbody>
</table>

## EXPERIMENT

<table>
<thead>
<tr>
<th>EXPERIMENT</th>
<th>SUBJECT</th>
<th>PRESENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Germination Study</td>
<td>i) Green gram germinated in cr. and found % of germination growth length of shoot/root weight of shoot/root</td>
<td>Table/graph</td>
</tr>
<tr>
<td></td>
<td>ii) Germinated in Cr. and Tannery Effluent water-found % of germination weight of shoot/root length of shoot/root</td>
<td>Table/graph</td>
</tr>
<tr>
<td>Species Diversity Phytoplankton Study</td>
<td>Collected one in each sample at polluted and non-polluted lakes for 2 seasons viz. summer and winter.</td>
<td>Found seasonal variation of pollution and water quality analysis.</td>
</tr>
</tbody>
</table>

Contd
<table>
<thead>
<tr>
<th>INFORMATIONS</th>
<th>DEPARTMENT</th>
<th>DESCRIPTIONS</th>
<th>YEAR</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Population</td>
<td>Census of India Madras</td>
<td>Population Block / Talukwise Total male/female workers etc.</td>
<td>1970, 80, 90</td>
<td>Table</td>
</tr>
<tr>
<td>2. Health</td>
<td>ESI Pernambut</td>
<td>Collected occupational diseases particulars</td>
<td>1992</td>
<td>Table/graph</td>
</tr>
<tr>
<td>3. Agriculture/Crops</td>
<td>Block Statistical Office Vellore</td>
<td>'G' Return for 20 blocks</td>
<td>1992</td>
<td>Table/graph representation</td>
</tr>
<tr>
<td>5. Soil</td>
<td>Soil and water test lab, Malathur, Gudiyatham</td>
<td>pH and E.C. Quality of 4 villages in each zone SAR &amp; Na for 21 taluks</td>
<td>1982</td>
<td>Map</td>
</tr>
<tr>
<td>6. Water quality</td>
<td>GWD, PWD, Vellore and Madras</td>
<td>58 wells 2 seasons total 116 wells</td>
<td>1975 - 1990</td>
<td>ANALYSIS</td>
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<td></td>
<td></td>
<td></td>
<td>Winter/Summer</td>
<td>Cross correction</td>
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<td>Factor analysis</td>
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<td>Cluster analysis</td>
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<td>Trend surface analysis</td>
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<td>Graph/Table</td>
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<td></td>
<td>Feb</td>
<td>Landuse</td>
</tr>
<tr>
<td>8. Geology/Geomorphology Imagery - IRS - L - I</td>
<td>Photogeology Section Institute of Water Studies Taramani, I.R.S Madras</td>
<td>For entire study area</td>
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<td>For preparation of base map</td>
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<td></td>
<td></td>
<td>and thematic map</td>
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<tr>
<td>9. Maps</td>
<td>Survey and Land Records, Madras</td>
<td>All 7 taluk maps</td>
<td>1992</td>
<td></td>
</tr>
</tbody>
</table>
soil samples were collected from wells and fields for testing. The content of chromium from potable, irrigation and effluent waters and soil has been determined. The phytoplankton study was carried out to understand the pollution level in Pernambut lake water. In order to find out the tannery impact on agriculture, an experiment was conducted on black gram using graded levels of chromium and effluent water.

1.8 ORGANISATION OF STUDY

The present study on "Environmental Impact Analysis: A case of tanneries in N.A.A. district, Tamil Nadu," is organised in seven chapters. The first chapter deals with the subject matter, the problem, investigative procedures and also a review of literature.

The second chapter presents the geographical background of the study area, the tannery distribution over the country, Tamil Nadu state and N.A.A. District which is the study area. Further, this chapter touches also upon the varied aspects of the river Palar.

The third chapter deals with the tanning process, effluent chemical composition, characteristics and quantities. The fourth chapter reveals the extent of pollution N.A.A. district. The fifth chapter discusses water quality and its impact on agriculture and health.

The sixth chapter reveals the perception of people on tannery pollution and the Common Effluent Treatment Plant. The last chapter provides a brief summary, on the EIA of Tanneries in North Arcot-Ambedkar district, policies, implications of findings, policy changes, strategies and the environmental impact statement for making environment of N.A.A. district a better place to live.
1.9  REVIEW OF LITERATURE

Every human society, be it rural or urban, industrial or more technologically advanced, disposes of certain kinds of by-products and wastes, which when injected into the biosphere in quantities, affect the normal functioning of the ecosystem and have an adverse effect on plants, animals and man (Smith, 1977). The United Nations Environmental Programme (UNEP) defines pollutant as a substance or an effect, which adversely alters the environment by changing the growth rate of species, interfere with the food chain, affects health, comfort, amenities or property values of people. Process studies made by Hameed (1985) pointed out how the present aquatic pollution in the country has come to be localised at particular stretches of different river systems of the country.

Chemicals of the industrial wastes are toxic and cause lethal or sublethal effects on aquatic fauna and flora and on cultivated plants (Verma et al, 1977; Srinivasan, 1977). There are about 4,054 major industries in India causing air and water pollution and most of these industries do not have Effluent Treatment Plants (ETPs) and even the ETPs are not used properly by these industries. The control of the industrial wastes in the industrial areas, is a prerequisite for prevention of pollution and development of water resources (Jainulabedin 1991). The pollutants such as chemical substances, hydrocarbons and heavy metals percolate into the subsoil and contaminates groundwater, through natural water, by the leaching of industrial solid waste dumps and by accidental leaks during storage and transport. Generally groundwater is vulnerable to pollution than the surface water. Because, though the overlying strata act as a filter (except in the case of hardrock area), pollutants do attain the water aquifer and in view of the normal slow movement of groundwater it may reside for considerable lengths of time. The percolation of the pollutants, normally be fast in soft rock area and in groundwater of unprotected fissures.
Tanning has two types of processes, such as vegetable tanning (where vegetable tanning materials are employed) and chrome tanning (where the basic chromate is used). In the very beginning of tanning, vegetable tanning was in operation than chrome tanning in the N.A.A. District. But today, almost all the tanneries process their leather through chrome tanning to reduce the time and to produce quality leather.

Tanning involves three types of products, namely, raw to finish, raw to semi-finish and semi-finish to finish which requires more water. The effluent discharged is highly coloured, alkaline and foul smelling with high amounts of suspended and dissolved impurities (Sastry et al, 1984a,b; Teekaraman et al 1982; Sekar 1982). The tanning effluent is acidic greenish in colour and contains trivalent chromium (Sastry et al, 1980; Patro et al, 1984). The pH content of this effluent normally ranges from 2.6 to 3.2 and chromium content from 1,000 to 2,200 mg/l. To prevent diseases and to avoid an increasing putrefying bacteria on raw hides are generally preserved with the aid of common salt (NaCl). A disadvantage the disposal of the levels accumulated thereby lies in the fact that the increasing saline water and sodic soils in the tannery areas (Zanpiieri, 1989).

Tannery wastes in general are highly found in polluted effluents. (Kamalam and Raj, 1980; Patro et al, 1984; Arora and Venugopal 1985; Mahadevan et al, 1984; Rao, 1971; Luck and Schadl, 1987; Muthusamy et al, 1989; Landmann, 1990; Zhou, 1990; Selvarangan 1990; Prasad, 1991). In chrome tanning composite untreated waste has very high contents of Suspended Solids which are detrimental to aquatic life and a vegetable tanning waste, which has a deep brown colour when mixed with water, is highly unaesthetic if not harmful when compared to chrome tanning, (Rao and Nandakumar, 1981). Of the total volume of the effluent discharged by a tannery the vegetable tan liquor contributes 10 percent but contributes about 30 and 50 percent of the BOD (Biological Oxygen Demand) of the total effluent. The chloride content of 601.8 mg/l to 3115.2 mg/l, which
is in excess of the maximum available concentration of 355 mg/l and the effect of the present method of effluent disposal on the important soil characteristics and on well irrigation waters and on crops have deteriorated (Ganapathy, 1976; Eye and Lawrence, 1971; Rao, 1981; Srinivas et al, 1984; Muthusamy et al, 1989).

Chromium is the most toxic effluent in the environment due to the untreated tannery effluent disposal. Chromium does not appear in its natural state and usually comes from the let out of industrial waste water. Generally chromium appears in two forms of oxidation, as trivalent chromium, water from chrome tanning contains high quantities of chromium and high toxic to any organisms (Patro and Kumar, 1984; Wehling, 1984). The hexavalent chromium is toxic than Cr III (Dorn, 1987). Chromium VI is not stable and the only prefcast is cr III appears mainly in the form of particles (chromium salts that is used in tannery) and hexavalent chromium (Parish, 1974; Bhaskaran, 1977; Batlett et al, 1979; Carre et al, 1983; Arora et al, 1985).

Effluents vary with the type of raw materials used, processes employed and products and nature of water supply. And the effluent from the chrome tanning is considerably different from that of the vegetable tanning process. And also both the composition and volume of wastes vary widely within short periods. The presence of chromium salts in tannery effluents to be discharged into the stream is highly objectionable as the chromium salts inhibited the activity of the micro-organisms (Santhappa and Madhavakrishna 1974; Rao and Raghuraman, 1972; Sastry 1986; Jovanouski, 1990).

1.9.1 Physio-chemical studies of tanneries

Studies on the effect of tannery effluent on the water quality and on the behaviour and oxygen consumption of macrobrachium, malcomsonii shows that the tannery wastes alter the physio-chemical properties of the water in the Kattuvaikal channel area (Selvam, 1987). Salinity is the main contributor of the
dissolved solid load. A similar result in total suspended solids has been obtained which may be mostly due to organic materials such as flesh and hair from the raw hides (Kothandaraman et al., 1972). Michael (1969) has carried out a study on seasonal trends in physio-chemical factors and plankton of a fresh water fish pond and their role in fish culture. He pointed out that the concentration of free carbon-di-oxide is directly related to the amount and the nature of biological activity in water. The tannery effluent under his study contained 24 mg of free carbon-di-oxide per litre and it might be due to lower photosynthetic activity of the primary producers.

Apart from the chromium, the potential impact on the environment from waste discharge in various recipients are the chlorides, nitrogen, sulphates, phosphorous, lime, ammonia salts and were the inorganic pollutants found in significant quantities and these pollutants are of more permanent nature, unless they are in suspended state or precipitated from solution and settled down (Sastry and Madhavakrishna, 1984).

The tannery wastes are high in Total Solids (TS), rich in total chlorides because of the use of sodium chloride for pickling the hides. The effluent is high in BOD and COD (Chemical Oxygen Demand) because of the fleshings as such and are precipitated by lime and the organics in the vegetable tan liquor. The liquor from the operations of liming and vegetable tanning are known to be the strongest from the point of view of BOD, COD, total solids and suspended solids. The composite are as high as 20,000 mg/l in total solids, 17,000 mg/l in dissolved solids and 3,000 mg/l in suspended solids and 7,000 mg/l, whereas in chrome tanning the effluent chromium found in trivalent and hexavalent, composite effluent is the final raw effluent resulting from both vegetable as well as chrome tanning processes (Huk, 1977).

The discharge of untreated waste water in water courses which affect the physical, chemical and biological characteristics of the water and deplete dissolved

The problem of salinity in tannery wastes and recovery of salts are continuous process. The effluent discharged from tanneries is highly discoloured, turbid, foul smelling and very heavily laden with putrescible organic, suspended and dissolved impurities. The effluent has high BOD ranging from 400 to 2,500 ppm. Besides high organic matter content, tannery wastes also contain very high chloride which is derived chiefly from the soaking and pickling operations (Veeraraghavan and Hariharan 1960; Rao and Raghuraman, 1972; Parish, 1974). The dark brown colour of the effluent is due to large scale vegetable tanning. The ISI (Indian Standard Institution, 1981) has recommended that as far as possible, and practicable, the colour should not be present in the effluents to be discharged into the surface water bodies. The Dissolved solids including chlorides in the effluent are much higher than the tolerance limit. This may be related to various salts like the sodium chloride that are used in the tanning process in large quantities.

1.9.2 Analytical studies

Raju (1991) has made an attempt to evaluate longitudinal and lateral dispersion co-efficients by experimental designs. The co-efficients have been calculated using dispersivities in both directions. The dispersion coefficients govern the variations of concentration of tracer or pollutant with time and distance while passing through a porous media. According to his results, for upward and downward seepages, the longitudinal and lateral dispersivities have been calculated for various concentrations (0.5 per cent, 1.0 per cent, 2.0 per cent and 5.0 per cent by weight) of pollutant for particular concentrations. Further he has stated that with the increasing concentration of pollutants, there is a gradual increase in the lateral and longitudinal dispersivities for both upward and downward seepages.
1.9.3 Studies on Groundwater

The effluent discharged from the tanneries located in N.A.A. district have caused serious deterioration in the ground water quality of the surrounding region. Consequent reduction of the quantity and quality of agricultural production are noticed. The chloride contents are excessive than tolerance limits (Srinivas et al., 1984; Muthusamy et al., 1989; Subramanian and Kulasekaran, 1988). Salt concentration increased during irrigation cycle, whereas monsoon rain prevented salt accumulation in the surface layer. Survey indicated that the TDS and chloride values of ground water in Vaniyambadi were above the tolerance limit (Ahmed et al., 1977; Batcha, 1986). The chromium hexavalent are more toxic than trivalent which is said to be carcinogenic (cancer producing substances). The BOD, chlorides, sulphates, nitrates in the effluents are considered to be the most hazardous for the normal aquatic life and well-being of human, animal and plant life.

Bhaskaran (1977) states that the discharge of untreated tannery effluents into streams depletes the dissolved oxygen of the streams, destroys the aquatic life and rendered the stream unsuitable for community water supply and other beneficial uses. The suspended matter present in effluents, form sludge banks on the stream beds and causes obnoxious odours. Discharge of tannery effluents on land, pollutes ground water with high chlorides and chromates. The productivity of the soil decreases when tannery effluents are applied to fields indiscriminately and in course of time, the land becomes unfit for agriculture. The waste water discharge from the tanneries in North Arcot Ambedkar district not only polluted wells and also affected palar river water (Arora and Venugopalan, 1985).

Singh (1988) has done a study on the quality of drinking water supplied to Jamalpur town and analyzed it seasonally. He compared values with WHO and ICMR prescribed limits and found total hardness has been slightly higher. Garu and Goyal (1989) have analysed the water from six tube wells which form the
main sources of drinking water in Roorkee city and it was carried out along with the physio-chemical and biotic analysis. The presence of bacterial community in relation to biotic factors is also determined through this analysis.

The high chloride contents would make water lose its freshness of taste (Patro and Kumar, 1984; Varadarajan et al, 1970; Sahoo, 1991). The arsenic and chromium present in tannery effluent would render the water unsuitable for drinking (Bhaskaran, 1977; Rao and Nandakumar, 1981). The high sodium content in water has been found to affect the physical conditions of the soil (Rawal, 1978). The ground water has been found to be affected where the waste waters from tanneries are ponded, or lagooned, spread out on land or discharged into dry river beds. The groundwater is reported to be rendered unfit for drinking and irrigation wherever tanneries are concentrated. At Ambur, wells have been reported to be affected even to a distance of 1 km from the tanneries with a Total Dissolved Solids (TDS) value of 1,200 mg/l. At a distance of 0.6 km, the total dissolved solids content in well waters was found to be high as 6,000 mg/l (Miakhan and Raman, 1972). The discharge of effluents on lands is dangerous as it materially pollutes the groundwater resources and also made the land unsuitable for cultivation (Santhappa and Madhavakrishna, 1974; Sekar, 1982).

The tannery effluent largely contaminates groundwater quality seriously within a short period and this effect cannot be rectified and repaired and the land becomes polluted due to seepage of the effluent (Manivasakam, 1987). The hardness is always expressed in terms of calcium carbonate. In the analysis of the effluent, 524 mg/l has been observed. When the hardness is above 300, it is described as very hard and it reflects its effects on the aquatic ecosystem. When sodium is present as sodium chloride in high concentrations in the effluent, the percentage of sodium exceeds the tolerance limit. If the effluent is not properly treated, the water becomes unsuitable for irrigation. Sulphide is the damaging constituent when present in larger quantities in the tannery waste. The effluent
also increases the hardness and the spoilage of water in the wells due to tannery effluent problem at Pallavaram which is alarming (Yusuff and Ismoii, 1984).

1.9.4 Impact on environment

The environmental conditions of the area where tanneries were located was appalling and the wastes were allowed to stagnate on open land creating obnoxious conditions (Bhaskaran 1977; Sekar 1982; Teekaraman 1982; Buckyavathy 1986). Batcha (1986) has studied the ecology of a fresh water with reference to environmental parameters like temperature, pH, dissolved oxygen and salinity in comparison with tannery waste water effluents different stations (Batcha, 1986). His study revealed impact of increased temperature pH and salinity values present in the tannery waste water effluent has been more than the clean water (Batcha 1986; Sharma et al, 1981). The salinity level and irrigation regime affected, the uptake and distribution of various nutrients in different ways.

The soil of an area where there is a tannery steadily becomes infertile. In the affected belt of land the soil completely looses its productive capacity and turns the land into white and black by the accumulation of mostly NaCl salt (which is used in tannery). Due to the over deposition of flakes mostly in the form of organic matter it curtails the paddy the quality of grains (Iyer et al, 1951). Further it was also found that the sub-soil water from the affected area had a pH value of about 8 and had the composition of Total Solids 958.4. The discharged wastewaters of the tanneries close to the arable lands, deposits the salts and toxic substances. These substances soak through the soil and adversely affect the composition of the soil, limiting the plant growth.

Study in many places particularly at Kanpur in Uttar Pradesh, exhibited several difficulties with sewer chockage. The decomposition of the organic matter present in the effluent converts the lime into calcium carbonate that turns the soil more acidic than ever before. The hair and fleshing develop a binder with like
substance calcium carbonate. These substances block the free flow of the sewage system causing an overflow of sewage water in the nearby areas. The overflow of water causes health hazards to people of that region (Chakrabarty et al, 1965).

1.9.5 Studies on Aquatic Life

The industrial waste survey on tanneries of Uttar Pradesh found that the alkaline nature of the tannery effluent damaged the aquatic ecosystem seriously (Chakrabarty et al, 1965; Ranjithakani, 1983).

1.9.6 Studies on Soil

One of the most important ways in which soil texture affects the plant growth is through the impact of texture on water quality. It has been observed that water holding capacity of fine textured soil is greater than the soils of coarse texture. Pal and Tripathi (1982) have observed this fact. The presence of high amounts of salt and sodium in Palar river tract and well water made the soil less productive (Varatharajan et al, 1970; Kotur and Rao, 1988; Muthusamy 1989). The electricity conductivity of the soil increased with increase of saline water irrigation (Sharma et al, 1981). The presence of sodium in irrigation water will affect crop growth (Kotur and Rao, 1988).

1.9.7 Studies on Agriculture

Tannery effluents not only contain nutrients that stimulate growth of many crops but also have toxic chemicals which may retard germination (Stoberg et al, 1984; Saxana, 1986). Tannins and tannery effluents also found to affect plant growth like sugarcane cultivation (Mahadevan 1985; Sekar 1982; Teekaraman 1982; Varadarajan et al, 1970). Varatharajan et al. (1970) carried out an analysis to find out the cause of decline in yield of sugarcane growth in over 2,000 Ac and an increased rate of salinity in well water in about 500 wells in the areas around Ambur Co-operative Sugar Mills. The tannery effluents in the well water resulted in considerable amount of sodium compounds and injurious salts of arsenic and
chromium. And these injurious salts deteriorated the crop growth, as irrigation water from the well which has its source in the tannery polluted areas. The yield of bhendi (gram) was adversely affected by dumping up of tannery effluent and the effect is more pronounced with increase in concentration of effluent (Kamalam et al, 1980). A study of Saxena et al, (1986) evaluated that impact of tannery effluent on the crops like mug, urid, gram and pea germination and growth under tannery effluent mixed water is retarded considerably (8-34 %). The same impact has been observed by Kamalam et al, (1980) on ragi crop. He observed that the germination, dry matter production and nutrient uptake of the crop were reduced significantly by the increase in concentration of the effluent.

Tannery effluents not only contain nutrients that may stimulate growth of many crops but also have toxic chemicals which may retard germination (Stoberg et al, 1982 and Saxana 1986) also corroborated the same statement. The sodium and potassium which is in a large quantity in the tannery waste is considered to be toxic for aquatic like (Wong, 1981). Metal pollution is active agent in the deterioration of aquatic environment (Forstner and Wittman, 1979).

Study on impact of tannery effluents on seed germinability and chlorophyll content in Paddy (Garuprasada Rao and Nandakumar, 1983), soil salinity on germination of some seeds (Mehta and Desai, 1957; Rao et al, 1969) and on sunflower varieties (Gaur and Tomar, 1975) also proves the effect of effluents on plant growth. All these studies reveal that the percentage of germination and growth rate decreased with increases in the concentration of industrial effluents. The percentage of germination and growth rate of v. radiata (green gram) are found to be affected only in those treated with 50, 75 and 100 per cent of tannery effluent. It may be due to the excess of chlorides, the total dissolved and suspended solids and the absence of dissolved oxygen which may disrupt the osmotic relationship.
The chemical effect of certain bark substracts on the germination and early growth of epiphytic orchids is studied (Frei and Dodson, 1972) and it is found the tannin has not only a delayed effect but also a depressing effect on seed germination. The physiological imbalances due to hexavalent chromium in fresh water algae resulted. In 10 per cent and 25 per cent tannery effluent its growth is more or less similar to the control because chromium in low concentration might be a stimulant. At low concentration, chromium may stimulate growth (Thangaraj et al, 1964; Bharathi, 1979; Beavor Wong, 1981).

Saxena et al, (1986) has done study on the impact of tannery effluents on some pulse crops. They have reported restricted growth of radicle and plumule and suppression of seed germination with untreated tannery effluents in Vigna mungo, cicer arietinum and pisumk sativum. Rao and Nadvakumar (1981) have reported a reduction in root length an shoot length in the seeds treated with tannery effluent in cicer arietinum. Relatively higher concentrations of N, P and K in the shoot was recorded by Pea compared to their crop species. At latter stage of growth legumes showed higher concentration of N both in the root and shoot than that of the cereals and in all the crop species the roots recorded higher concentration of N than the shoots. The concentrations of N, P and K in the root and shoot of rice bean increase and those in other crop species decreased with plant age.

The effects on tannery waste on the phyto-plankton characteristics of waste water from tanneries are such that the plantonic population has declined in the Kalingarayan channel (Ranjithakani 1983). Bandyopadhyay and Barman (1987) have examined zooplankton community of two brakish water impoundments of Hoogly matlah estuarne complex and have given result as higher the pollution lesser the species community. Significant reduction in zooplankton occurred in all exposed effluent waters. Production of chironomid larvae significantly reduced in all highly exposed effluent waters. The effects of
chlorpyrifos on DO, free CO₂ contact, zooplankton and chironomid larvae production reveals that the contamination of natural water with chemical constituent damage fisheries (Ahuwalia et al, 1989).

The chromium which is said to be toxic is present in tannery pollution affected fields. It affects the soil fertility and make land unsuitable for further cultivation (James et al, 1983). Plants were severely damaged by Cr (VI) formed from Cr (III). In fresh soil samples the Hexavalent Cr is stored with moisture at 25°C. The effect of chromium III depend on complex interactions between the sludge, the soil to which it is added and the plant species grown (Srinivasan et al, 1988). The crop absorption of chromium has increased with the sludge application rates (Chang et al, 1984; Stonbrg et al, 1984).

Yusuff and Ismail (1984) reported that the spoilage of water in the wells due to tannery effluent problem at Pallavaram. As per Second Citizen's Report (1984-85) survey, the untreated indiscriminated effluent from about 250 tanneries at Ambur and Ranipet had turned the agricultural land into wasteland with 70 per cent reduction in crop production.

1.9.8 Toxic Action and Health Hazards

Fairhall (1949) states that the toxic action of chromium is confined to the hexavalent compounds of chromium. In contrast to the trivalent compounds, the hexavalent compounds are extremely irritative, corrosive, and under some circumstances, toxic to the body tissues. The harmful effects may be due to the oxidising ability of these compounds or to properties associated with heavy metals. Chromic acid is particularly corrosive because it is an oxide of a heavy metal, an acid, and an oxidizing agent, in common with other heavy metal, an acid, and an oxidizing agent. In common with other heavy metals, the hexavalent chromium compounds in certain circumstances cause denaturation and precipitation of tissue proteins.
The hexavalent chromium compounds affect chiefly the skin and respiratory tract with which they come into intimate contact. Gastrointestinal irritation occurs upon ingestion of these compounds. Systemic toxic reactions have rarely been reported in industrial workers but such reactions have resulted in men from ingestion of chromium compounds and from the therapeutic application of chromium compounds to damaged skin. Harmful effects have resulted also from the experimental injections of chromium compounds subcutaneously and intravenously in animals.

The tannery workers and the public are mostly exposed to chemical hazard, which are primarily due to local action, inhalation and ingestion. Some toxic chemicals cause dermatitis, eczema, ulcers and even cancer by primary irritant action (Park and Park, 1977). Occupational dermatitis is a major problem in tanning industry. Inhalation of dusts, gases, metals and its compounds are common hazards of the tanning industry.

Ulcers of the eyelids and irritation and ulceration of the conjunctiva and cornea may occur as a result of contact with chromic acid and its salts. Corrosion of the lymphatic membrane and ulcers of the external canal of the ear have been studied by Kovalev et al, (1977).

Piecemeal investigators particularly Germans like Mancuso (1951) and Mager (1953) reported that the prolonged inhalation of chromate dust caused chronic irritation of the respiratory tract resulting causes as congestion and hyperemia, congestion of the larynx, chronic inflammation of the lungs, chronic contract, chronic bronchitis, Chronic pharyngitis, emphysema.

Kidney lesions in men have been more frequent than any other type of systemic damage reported by Hepler and Simons (1946). The nephritis involves chiefly the tubules with the destruction of epithelium. Anuria and death may result in severe cases of acute nephritis. Other systemic effects which have been
reported in men or experimental animals, include hemorrhages in the intestinal tract, bronchi and serious cavities, purulent fibrinous mucus in the respiratory tract, liver damage, hyperglycemia, glycosuria, anemia, fall in blood pressure, loss of weight, leukocytosis, muscle cramps, staggering, paralysis, convulsions and death.

The result of inhalation of chromate dust or chromic acid mist is ulceration and perforation of the nasal septum. Legge (1924) has found in his study on chromium compounds and their effects, that 71.5 per cent of the chromate workers investigated had perforation of the septum. The U.S. Public Health Service Division of Occupational Health has conducted study of 'Health of workers in chromate-producing industry' and found that coloured workers had a higher frequency of nasal of septum perforation than white workers, the percentage is being 76.6 per cent and 49.3 per cent, respectively. Although perforation usually appears between the sixth and twelfth months of exposure to the chromates, the inhalation of chromate dust frequently causes perforation of nasal septum and ulcers of the nose. Legge (1924), Klenfeld and Rosso (1965)s and Horigochi (1980) has said from their study that impairment or loss of sense of smell has been reported in 24 workers exposed to chromates. A diffuse dermatitis may occur as a result of contact of the skin with the hexavalent chromium compounds. These materials are irritating even to the normal intact skin and may cause an inflammatory type of dermatitis.

1.9.9 Studies on Hazardous Wastes

Barlon et al, (1952) studied the pollution effects of tannery effluent on the environment and stated that chronic exposure to chromate dust correlates very well with increase in the incidence of lung cancer. Ponarat and Leake (1954) studied the chromium toxicity and were found to be capable of including abnormal morphological transformation and chromosomal damage in cultural mamalian cells.
Wlodek (1955) has studied the effect of tannery waste waters on organisms. He finds the adverse effects of tannery waste water on organisms of surface waters, points out that the wastes when discharged into water courses cause death of fish and other organisms for they depleted their dissolved oxygen, brought along with them considerable amount of hairs from the animal skins processed in the tannery which would prevent free movement of gills of the fish and also introduced toxic chemicals such as chromium which would prove toxic to aquatic organisms. Most of the toxic effects were associated with hexavalent chromium. The trivalent chromium had little or no acute toxicity even on long term administration on massive doses.

Santappa and Madhavakrishna (1974) have studied the effects of chromium salts in tannery effluents and stated that the discharge into a stream is highly objectionable since they are highly toxic to microorganisms. Fish could not survive in the presence of chromium and water is rendered unfit for domestic and other uses. They further state that, under practical conditions, most of the chromium gets precipitated upon mixing with spent lime, liquor and the residual chromium gets diluted to a great extent with the result that there were only traces of chromium remaining in the final effluent. Further hexavalent chromium was no longer present in the waste tan liquor since the tanning processes now in vogue used only one bath process, which contained trivalent chromium which could be easily precipitated with lime.

Veeraraghavan and Hariharan (1960) stated that the important problem in tannery effluents is very high sodium chloride content which is derived from soaking and pickling operations. The waste which are discharged from these operations are highly saline besides being laden with organic matter. The discharge of effluent into water courses affects ultimately adversely the salinity of ground water and renders it unsatisfactory for use for drinking and domestic purposes and for irrigation also.
Edward (1970) has calculated the sodium imbalance in drinking water and tabulated the causes of deaths due to vascular lesions of central nervous systems, rheumatic heart diseases, arteirosclerotic and degenerative, hypertensive heart diseases, diseases of liver, gall bladder and nephritis. Severe damages have caused damages to kidney as the dilation of the glomerulous capillaries and the deformations in Bouman's capsules-Necrosis in haemipoietic tissues and enlargement in renal tubles are also observed in fish.

Monge (1984) studied nitrated intoxication in cattle. His investigations of 800 adult animals with a history of sudden death, lameness, low fertility, abortion, low productivity and retarded growth revealed nitrate intoxication from the drinking water. Strand and Person (1984) have conducted experimental poisoning of pheasant chicks with nitrate and nitrates in their drinking water and observe that higher nitrate or nitrite is lethal at 500 ppm or 15 ppm respectively. But hyperaemia or distrophic changes in liver, kidneys and small intestinal mucosae are noticed. Smith (1981) has recorded the effect of high concentrations of zinc sulphate in drinking water of dairy cattle. Excess zinc sulphate reduced water consumption and pancreatic damage is recorded in highest concentrations.

1.9.10 Studies on Treatment

In tanning many individual physio-chemical or biological processes are required for converting the hides into leather, they may be grouped under two major operations, beam house and tanyard. In the beam house operations, the hides are prepared for tanning and in the tanyard the skins are converted into sole leather by using tan solution. The spent vegetable tannings are quite strong, having high Chemical Oxygen Demand (COD), Bio-chemical Oxygen Demand (BOD) and color, the pH averages about 4.5. These solutions have high dissolved organic and colloidal. A possibility of utilising the interaction between waste proteins or vegetable tanning agents to the effective pretreatment of tannery waste
water is pursued. The above components from water soluble polyelectrolytic complexes separable by sedimentation, filtration, or centrifugation; in this way 40-80 per cent of the original pollution can be eliminated (Hoffmann et al, 1990).

The implantation of a tannery effluent treatment secondary and biological system, emphasizing that its good results shall dependent on the perfect performance of the primary system (Mario and Pierano, 1987; Yi and Xie, 1987). Vinikarek, 1987; Henz and Pfenninyer, 1987). Most of the investigations conclude that suspended metals are better removed than dissolved metals, then differ in their findings that primary treatment process have better metal removal efficiencies than secondary treatment processes (Rao and Veraraghavan, 1991).

Chromium recovery from the liming effluent is a problem due to technology and cost (Rajalinkam et al, 1992). Chromium can be removed by various methods. It can be removed by rice husk (Srinivasan et al. 1988). Benzoxyhydroxamic acid was the most suitable and preliminary experiment showed that the extracted Cr III has potential tanning capacity. It is economically unattractive because of the high ratio required and the energy cost of the recycling process (Brown et al, 1986). Chemical precipitation using lime is investigated and shown to be the cheapest for the removal and recovery of chromium. Filtration of the settled sludge through slow sand filter is more simple and economical than through filter cloth (Arumugam, 1976). The common salt in liming can be reused to avoid pollution and reduce cost (Zampieri, 1989). The salt can be recovered from the effluent (Vulliermet, 1988). The lime from the solid waste can be used as a fertilizer and lime plaster in building (Sudarsanam, 1967).

Chromium is one of the major constituents of tannery effluents and poses difficulty due to its toxicity. In this preliminary investigation dried fallen leaves were used for the removal of Cr from tannery effluent. Effect of certain factors like the concentration of leaf powder, the period of treatment, the pH of the effluent
liquor, temperature and the concentration of Cr in the spent chrome liquor, on
the removal of Cr was studied (Suseela, 1987).

Maximum possible exhaustion of chrome during the tanning process has
had a lot of emphasis on pollution control recently, especially with respect to the
toxic chrome content in the tannery effluent (Duraikannu et al, 1982). The spent
chrome liquor has assumed greater importance now because of the effluent
control and the necessity to recycle the chrome liquor content in the exhaust
liquor (Ramamoorthy et al, 1982)). Experiments with recycling of chrome liquors
show that in a compact installation for the conversion of chromium in spent
liquors reducing the chromium content in the run off to 6 ppm.

The quality leather versus effluent observed that the processes described
enable substantial reduction to be made in content of dangerous chemicals in
tannery effluents. The use of Derugan Z, a condensation product with the known
advantages of aldehyde and acrylic polymers, during or before chrome tanning
give substantial advantages, leading to savings in chrome. This was of special
interest and could partly replace chrome salts from the effluents (Busford, 1983).

Removing ammonium ions from the biologically treated tannery waste
water using ion exchange method on natural zeolite has been done (Koneky,
1990). Anaerobic and Aerobic lagoon is suggested by many authors like Parker,
1970; Jayangoodar et al, 1984; Ramesh and Kasturi, 1988; Simonchi et al, 1989;
Ptasat, 1991. Coagulation and floculation are very important operations to obtain
good results in a tannery effluent system. (Mario, 1987; Schrolde, 1991).
Activated aluminium and Y Zeolite are used in waste water purification. The
common effluent treatment plant (CETP) is suggested for the groups of tanneries
for economical and seable purposes (Rahman, 1987; Yi and Xie, 1987; Rao,
A techno-economic approach has been made utilising anaerobic lagoon and using aerated lagoons or oxidation in the treatment and utilisation of tannery effluent with the support of a service firm having a rural-based tannery in Tamil Nadu (Rajamani and Madhavakrishna, 1982). The pond system is a cost-effective and low technology method for handling tannery effluents (Rowswell et al., 1983). The anaerobic and aerobic system which have been used to treat tannery beam house waste has also been successful in treating vegetable tanning wastes. Its attributes included a 90 per cent reduction in applied total COD and methane production which was high enough to be of value in reducing energy costs. In addition, the need to waste some of the sludge produced is prevented by a recycle system (Michel et al., 1985).

It was observed that the effluents needed dilution for the growth of algae and hence experiments were conducted with sewage and water for diluting the effluent algae chlorella, Oscillatoria grew well in ponds. Considerable reduction in the BOD as well as other chemical parameters were observed (Jayangoodar, 1984). The lime treated effluent can be further treated in an aerated lagoon of 5 days detection to bring the BOD down to about 30 mg/l (Mason, 1987; Prasad, 1991).

The growing demand for cleaner environment, especially in the context of increasing population, necessitates early measures for the control of pollution for tanneries (Sastry, 1986; Gopal, 1988). Leather production yields emissions to water, land, and air all of which increasingly subjected to legislative control (Sykes and Corsing, 1987; Balkau, 1990; Zhou, 1990; Venkatachalam, 1990; Germann, 1990; Alexander et al., 1992).