AIM AND OBJECTIVES

The aim of the study is to evaluate the impact on environment that has occurred already with the following objectives:

- To assess the existing air quality.
- To assess the extent of pollution of water bodies due to developmental activities.
- To assess the quality of soil and extent of soil pollution and soil degradation.
- To assess the extent of noise pollution.
- To assess the quantities and types of solid wastes generated, assess the efficacy of present disposal method and to propose suitable methods of disposal.
- To assess the amounts of sewerage generated and its quality.
- To assess the efficiency of existing sewage system and propose sewage treatment facilities.
- To assess the existing biotic components in Pudukkottai town (flora and fauna).
- To assess the socio-economic impact of urbanization in Pudukkottai.
REVIEW OF LITERATURE

This section reviews the various aspects (Urbanization, Air, Noise, Water, Soil, Waste water, Solid waste, Flora, Fauna and Socio-economic status) that are related to the research work.

2.1. Impact of Urbanization

Maiti and Agrawal (2005) reported some of the important environmental problems caused by over population growth and rapid urbanization process in the metropolitan cities of India. Total urban population in India has increased more than ten times surpassing India’s total population growth, which has increased less than five times during 1901 to 2001. Also, there was about three-fold increase in the percentage of total urban population in Class-I city followed by almost a fifty-fold increase in the total population in the million plus cities in India from 1901 to 2001. Despite several Government housing policies, 41% of the total slum population of India is residing in million plus city alone.

A three-fold increase in the number of motor vehicles has been found in India in the last decade. In all the four metro cities SPM was found highest along with the problem of solid wastes. The noise pollution was noticed more than the prescribed standard in all the four metro cities. Five and more person residing in single room was faced by more than one fourth population of Mumbai followed by a little less than one fifth population of Kolkata and about 10% population of Delhi and Chennai both. Also there is an acute shortage of piped drinking water in these metro cities. India’s urban future is grave. Therefore there is an urgent need to tackle the urban environmental problem in a rational manner giving attention to the need for improving urban strategies.

Between 2005 and 2030, the world’s population is expected to increase by 1.7 billion people, from 6.5 billion in 2005 to 8.2 billion in 2030. Almost all growth of the world’s population between 2005 and 2030 is expected to occur in less developed regions. In particular, the projected population growth at the world level will be primarily accounted for by the growth in the urban areas of the less developed regions.
That is, while the world population is projected to grow by 1.8 billion people between 2005 and 2030, the urban population is projected to increase by 1.7 billion. The absolute growth in the total population is lower than that of the urban population because of a declining rural population over the next 25 years (U.N. 1993).

2.2 Air Pollution

The main source of air pollution are industrial plants, power stations, automobiles, locomotives, aeroplanes, jets, missiles, domestic furnaces, dead bodies burning, burning of oils, sewers, refuse burning, etc. The emissions from these sources mainly consist of aerosols, odour, and gases. These air pollutants affect man, animals, vegetation and also having economical, sociological and psychological impact. It causes irritation of the mucous linings of the eyes, nose and throat, headaches, nausea, chronic bronchitis, bronchial asthma, asthmatic bronchitis, pulmonary emphysema, cancer, death etc.

Nowadays, acid rain has become the talks of the day. Today every body has a craze for having own vehicles and in most of the cities automobiles are rapidly becoming the main source of air pollution. Although the number of vehicles, plying in Indian cities including metropolitan is still insignificant as compared to the number of USA, Europe and Japan, due to the inferior maintenance of vehicles in combination with lower combustion efficiency is making the vehicular exhausts a menace to the city dwellers. The automobile are mostly driven by petrol or diesel. The petro-burning vehicles emit carbon monoxide, hydrocarbons and oxides of nitrogen. Diesel engines emit relatively little of these but produce more particulates and smoke. Oxides of nitrogen and hydrocarbons interact in the presence of sunlight to produce oxidant smog which irritates the eyes and lungs and damage sensitive plants (Trivedy and Goel, 1995).

Djen (1992) concluded that urban heat island effect is large and has enhanced with time. During recent decades, the urban centre of Shanghai has experienced lower wind speeds, lower humidity, fewer fog days, fewer sunny days, increased low cloudiness and increased overcast days. Concurrent variations at nearby rural stations were dissimilar. Solar radiation in urban Shanghai shows
accelerating decreases of both direct solar radiation \((S)\) and global radiation, but increase of both diffuse radiation \((D)\) and average turbidity \((D/S)\).

Air pollution is a major issue amongst many environmental problems of Calcutta, especially from the health perspective. The air quality of the city becomes worse during winter due to frequent thermal inversion and low wind speed. When present condition of air pollution in the city was found to be a cumulative effective of many factors. The environmental problem was found acute in core-Calcutta whose area is 104 sq km and night time population of 3.4 millions and that of day time 6.0 million (Gautam, 1998).

Robert and Douglas (1977) reported that urban areas affect the wind flow pattern and hence the transport of contaminants in the atmosphere. The central park station (Singapore) was initially taken to be the most urban location and deviations between the wind speed at the park and at each of the other locations along the stream flow line were determined. The deviation of wind direction along each available stream flow line was determined relative to the wind direction at the first upwind rural site. During both day time and night time hours there exists a critical rural wind speed below which air is accelerated as it flows over the rough, warm city.

Maccarrone (1989) monitored three heavily trafficked roads in Australia with different traffic volumes and speeds for air quality volumes and wind patterns coinciding with pollutant measurements were monitored. The level of reduction of air lead level with increasing distance from the road way was determined by simultaneously monitoring its level at distances 20.50 and 80m from the road way. Sabbak (1990), conducted a comprehensive field study of atmospheric nitrogenous pollutants in Jissah, Saudi Arabia for the period of 1984-1987. The decrease in NO concentration from 1984-87 was mainly due to two reasons(i) Phasing out of many construction and industrial projects.(ii) Enforcement of the Motor Vehicle Periodic Inspection(MVPI). The analysed data showed lower mean than International air quality standard.

Alam et al (1999) suggested that by introducing mass transportation system like rail or monorail it may be possible to reduce the number of motor vehicles on
In the developing countries like India, urbanization is quite revolution that is engulfing the country. This urbanization is intricately linked with the process of economic development and hence it is considered inevitable. Urbanization while having a positive impact on income levels employment and other various developmental factors has also brought about certain negative impacts on the environment of the area. It is found that the overall quality of urban environment is fast deteriorating over the years. The problem of air pollution came into existence when man first learnt to start fire in his cave for cooking and providing light. Now harmful gases in large quantities get released into the atmosphere due to various activities of man.

Marsh and Foster (1967) reported that due to increased concern about the effects of air pollution on both people and materials, many countries have introduced legislation designed to control the amount of pollution in the air. The annual average concentration of sulphur dioxide at individual sites is strongly correlated with the consumption of local installations emitting their effluents from chimneys less than 21m high.

Ghosh and Seth (1994) reported that atmospheric pollutants get deposited on the earth’s surface through various physical and chemical process. Precipitation pathway for deposition of atmospheric aerosols and anthropogenic materials contain pollutants of varying nature, causing deterioration of physical, chemical and biological characteristics of waters.

Bitan (1992) reported that the future most of the world's population will live in urban areas and there also most economic activities will be concentrated. This will lead to enormous environmental and climatological problems, unless urban planners and architects develop a new urban planning strategy and building design methods, which will enable the continuation of the growth of urban areas and also enable its population to live and work in a good climatic environment. To achieve this goal the combination of using alternative energy sources together with integrating climatological factors in all urban planning levels should be designed to achieve an expected improved climatic and environmental quality of the urban area. Chary Srinivas (1992), estimated the concentration levels of CO, HC, NOx, SOx, Pb across five dense roads of Delhi.
The ambient air quality data in Delhi showed that the annual and 24hr mean value of SO$_x$ and NO$_x$ did not exceed the stipulated standards during 1989 where as the annual mean values for SPM exceeded 200mg/m$^3$ at the monitoring stations.

Luria (1986), analysed the data obtained at the Jerusalem municipal air monitoring station, during the years 1979-1983. Seasonal and long term trends in air quality were determined. The results indicated that ambient air quality levels in Jerusalem were influenced not only by local forces but also by transport of air pollutants from Israel’s coastal areas. It was found that in 1981 concentration of pollutants including the total suspended particulate were high. Hence it was concluded that air pollutants level in the city were influenced more by multi annual change in dispersion conditions than by the combination of all local anthropogenic sources.

Prasanthi and Rajeswari (2003) conducted a survey at major traffic points in Kurnool town to investigate the effect of vehicular emissions on the health of 53 traffic policemen. It was found that these personnel were directly exposed to vehicular emissions for nearly 8 hours per day. The main symptoms observed were cough 80%, breathlessness 20%, headache and dizziness 30% and passage of black sputum in the morning 3% and also conducted pulmonary function test (PFT) on these personnel. Some of them exhibited normal pulmonary function test. About 60% showed mild to moderate obstruction, out of which 65% were non-smokers and 35% were smokers. In case of 20% of smokers the obstruction was severe. It was concluded that traffic policemen were suffering from respiratory disorders due to exposure to vehicular pollution.

Diesels engine exhausts have significantly higher particulate and gas phase pollutants. The chemicals associated with the particles may interact with the lung cells and cause damage, inflammation and excess mucus production (Santondilonata et al., 1978).

Pedro et al (2007) study applied a methodology for discriminating local and external contributions of atmospheric particulate matter (PM) at a rural background station in the North-western coast of Spain. The main inputs at the nearest scale had come from soil dust, marine aerosol and road traffic. At a larger scale, the highest
contributions had come from fossil-fuel combustion sources, giving rise to relatively high ammonium sulphate background levels, mainly in summer. External contributions from long-range transport processes of African dust and nitrate had been detected. Morocco and Western Sahara were identified as the main potential source regions of African dust, with a higher content of Al and Ti than other crustal components. Geographical areas from central and Eastern Europe were identified as potential sources of particulate nitrate.

Infante et al (1990) reported that the concentration of particles < 2 µm in diameter remained constant during the sampling period while the concentration of particles > 7 µm showed time variations. Aerosol from Ponce, Puerto Rico was area is greatly composed of particles > 7 µm in diameter, they accounted for over 45% of the Total Suspended Particulate (TSP) of this area. Over 75% of the aerosol concentration was from particles > 3.3 µm, approximately only 20% of the aerosol concentration was from particles < 2 µm in diameter. A linear relationship was observed between the different particle size and the TSP. The size distribution and its time variation were explained in terms of local sources such as agricultural burning, natural contributions and industrial activities, as well as contribution from the Sahara haze that crossed the Atlantic from Africa and reached the Caribbean region during the summer.

Gautam et al (1998) reported that air pollution became acute in Calcutta during winter. Pollutants could not disperse easily, mainly due to inversion, low wind speed and high concentration. Calcutta was known to be one of the world’s most polluted cities. The average SPM concentrations during the winter in 1992, 1993 and 1994 were 982mg/m³, 1007mg/m³ and 1181mg/m³ respectively. The anthropogenic SPM was more toxic than the SPM of natural origin. Various factors like use of kerosene and coal as cooking fuel by a large portion of the city dwellers, large number of registered and unregistered factories, poorly maintained cars, poor quality of fuel, bad condition of the city streets, small road area compared to the total city area, high population density, miserable slum conditions of habitation and overall poor socio-economic status of city dwellers were together responsible for the serious air pollution in the city.
Panda and Kar (2003) reported that in Rajesthan the mine area the maximum SPM in winter H-block was 146mg/m³ as per standard. Air pollution was controlled by afforestation. The silica content in the respirable dust was within permissible limits. The noise levels recorded was around 50dB during daytime and <40dB in night time. The solid waste generated was in the form of overburden at a rate of 2.54 lakh tones per annum. Topological advantages of the hilly terrain were taken to facilitate drainage.

Karue et al (1992) analysed suspended particulate matter in air at three different sites in Nairobi. The values were well within the WHO standard but when compared to the values in some European countries they were found to be high.

Zannetti et al (1977) reported that Sulphur dioxide concentration in the historical centre Venice and its surroundings are related to meteorological parameters.

Alison and William (1985) examined national trends in Sulphur dioxide concentrations from 1975 to 1982 in USA. From the analysis it was found that SO₂ levels were (statistically) scientifically lower in the later years of their study than in the earlier years, due to various control measures taken by the Government.

Marshall et al (1986), reported that in Atlanta, U.S. both SPM and sulphur compounds increased in summer from winter values probably due to enhanced production of particulate sulphur from gaseous precursors. Kuntasal (1987), conducted air quality trend analysis for hydro carbons(HC),NO and CO from 1968 to 1984 at South Coast air basin of California. Emissions and air quality trends were compared. It was found that the ambient HC,NO trends were some what different from estimated emission trends of HC and NO whereas there was a definite downward trend of ambient CO was consistent with vehicular emission control measures.

Capannelli et al., (1977) reported that NO is found in all the high temperature combustion processes. Later part of the NO reacts with the atmospheric O₂ to form NO₂.
Bower et al (1991) reported that no site in the U.K. breached the NO₂ Directive Limit Value during the year 1987, though the closest approaches were at the two London stations. Annual average NO₂ concentrations, which varied from 23 to 39 ppb, were consistent with the top five percentile of long-term measurements from a national survey of over 360 U.K. urban areas carried out in 1986. The temporal variability of NO₂ concentrations was substantially lower over all time scales than that for NO. Winter/summer ratios for all sites averaged 2.9 for NO and 1.3 for NO₂. Most sites showed strong diurnal variations for NO which were primarily influenced by traffic emissions during rush hours, although these variations were less marked for NO₂.

Pandey et al., (1992) reported the diurnal patterns in the concentrations of ozone (O₃), nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and total suspended particulate matter (TSP) in the urban atmosphere of Varanasi city in India during 1989. The city was divided into five zones and three monitoring stations were selected in each zone. Ambient concentrations of NO₂ and SO₂ were maximum during winter but ozone and TSP concentrations were highest during summer. NO₂ and SO₂ concentrations peaked in the morning and evening. Peak concentrations of O₃ occurred in the afternoon, generally between noon and 4 p.m.

Mrinal et al (2005) reported that the public health implications of vehicular emissions were substantial. The particulate matter, particularly that less than 10 µ in size, can pass through the natural protective mechanism of human respiratory system and plays an important role in genesis and augmentation of allergic disorders. They discussed the approach for the selection of air monitoring stations, the methodology adopted for sampling and subsequent analysis. The results of SPM, RPM, NOₓ, SO₂, CO and Pb levels indicated that they were at levels dangerous to human health. In order to mitigate air pollution in the city a strategic air pollution management plan was proposed and the possible different measures that could be adopted to maintain the balance between sustainable development and environmental management have been discussed.

Fung et al (2005) studied the role that ambient air pollution plays in exacerbating cardiovascular and respiratory disease hospitalization in London, Ontario from 1 November 1995 to 31 December 2000. The number of daily cardiac
and respiratory admissions was linked to concentrations of air pollutants (sulphur dioxide, nitrogen dioxide, ozone, carbon monoxide, coefficient of haze, PM$_{10}$) and weather variables (maximum and minimum of temperature and humidity). Results showed that current day carbon monoxide and coefficient of haze produced significant percentage increase in daily cardiac admissions of 8.0% and 5.7% for people < 65 years old. PM$_{10}$ was found to be significantly associated with asthma admission in the > 65 group, with percentage increase in cardiac admission of 25% and 26.0% for current day and 2day means, respectively.

Shangedanova and Burt (1994) estimated the pollutant emissions and air quality in MOSCOW. The concentration of NO$_2$ was the major aspect of air pollution. But during recent years of considerable reduction of SPM and SO$_2$ levels were achieved due to increased use of natural gas. Ostria Sergis and Lawrence Michel (1994), believed that intelligent highway systems (IVHS) improved and increased the operation and efficiency of the transport system in USA. Air quality problems associated with congestion, poor vehicle manitanance, wasted travel and too many vehicle trips were alleviated by IVHS.

Prakasa Rao et al (1992) studied all the wet and dry deposition samples for major cations and anions along with pH. Dry depositions were minimum in the monsoon season and maximum in the winter season though there was no significant difference in pH values. The wet deposition of all ionic components was found to be higher than the dry deposition. The depositions of the ionic components from natural sources (soil and sea) were higher than those from anthropogenic sources. The dry deposition velocities of the aerosols were found to be increasing with increase of their mass median diameters.

The chemical composition of the dry deposition at Pune indicated maximum depositions of the alkaline substances, which are the main cause for the alkaline pH of rain water. Their results further suggested that the atmospheric composition in the city was strongly influenced by natural sources rather than anthropogenic.

Air quality in major cities has deteriorated to a large extent because of the rapid growth on the number of motor vehicles every year. Inhalation of diesel exhaust components such as particulate, SO$_2$, NO$_2$ and Ozone are associated with
health effects ranging form increased mortality and hospital admission to subtles changes in lung functions at low to very low concentration (Brunekreef et al., 1995).

Lutmer et al (1967) reported that O₃, NO and NO₂ were potential enhancing agents for the formation of carboxy haemoglobin during short-term exposure to concentrations of CO in experimental animals.

Marsh and Foster (1967) reported that in recent years there had been increased concern about the effects of air pollution on both people and materials, and many countries have introduced legislation designed to control the amount of pollution in the air. This control had two main aims. The first was to reduce the amount of pollution emitted at a great enough height to give sufficient dilution of the pollutions by the time they reach ground level. The second aim was that the height of chimney must be defined so that it would allow the required dilution of its effluents-ideally, in all weather conditions.

Daniel and Bytnerourniz (1993) measured ambient levels of the nitrogenous pollutants NO, NO₂, HNO₃, ammonia particulates at a Southern California mountain forest location severly imparted by urban photochemical smog. Air quality at the location was characerised by high levels of nitric acid and per oxyacyl nitrates PAN.

Quin and Chen (1993), measured the traffic related air pollutant concentration, wind speed, traffic volumes and vehicle speed in street canyons at Guangzhou city of China during winter and summer of 1988. It was found that the ground level air pollution in Guangzhou had changed from coal combustion emission type into traffic source emission type. The average contribution of this source to the concentration of CO and NO₂ was about 87% and 67% respectively.

Michel hall and Juli (2003) suggested that the climate and health connection is at best, complex .Climate changes across time-scales, influencing ecological systems through direct and indirect events in turn affecting diseases conditions.

The vehicular emission load of the major metropolitan cities in India exceedd more than 3596.8 tons/day and contained more than 450 different organic chemical
compounds either in gaseous or particulate or in the combined form. Many of these substances have been shown to be genotoxic, cytotoxic, fibrogenic and carcinogenic (Chellan and Jackson, 1999).

The first episode of effect of sulphur dioxide on human health occurred in Belgium’s Meuse Valley on December 1, 1930, which took a toll of 60 lives. The incident occurred due to the accumulation of pollutants emitted by sulphuric acid plants, steel works, zinc works. Sulphur dioxide concentrations were estimated to be as high as 9.338ppm. It was found that sulphur dioxide increased the incidence of respiratory diseases. Sulphur dioxide was also found to increase and promote bronchitis (Perkins, 1974).

It was found that mild doses of NO₂ suppresses growth in plants and causes leaf bleaching. It was observed that 0.5ppm of NO₂ for 10-12 days suppressed the growth of beans and tomatoes. Yellowing of leaves (chlorosis) was also found due to damages caused by smog (Rao et al., 1989).

The effects of realistic mixture of nitrogen dioxide with other pollutants on the cuttings of Populates nigra were studied. It was found that the total main non structural carbohydrates in the leaves were reduced but those in the roots were unaffected. The gases were found to cause more damage on older leaves than younger ones (Bucker and Ballach, 1992).

In lesser concentrations nitrogen dioxide causes eye irritation. Nitrogen dioxide has adverse effects on health. It has been found that 24 hour NO₂ concentration between 0.062-0.019ppm or greater causes acute respiratory diseases (Rao and Rao, 1983).

Khan (2005) suggested that the freshness of the air in one's environment has a most fundamental and direct impact on the quality and length of one's life. Air is more a necessity of life than either food or water.

Inhalable particulate present in urban air frequently co-exist with other respiratory irritants such as oxidant gases like ozone or acidic aerosols. Exposure to NO₂ at concentrations of 500ppm or greater for short periods of time can results in
pulmonary edema with broncho pneumonia and finally death. 1ppm of SO₂ exposure caused consistent changes in pulmonary compliance, breathing frequency etc. Extrinsic nerve reflexes and direct action on smooth muscles may mediate broncho constriction (Hine et al., 1970; Koening and Luchtel, 1997).

The adverse effect of this complex mixture on lungs include increased incidence of respiratory infections, bronchitis, asthma, pneumonia, emphysema, cancer etc (Bofetta et al., 1990).

Anon (1989), found that emission from automobile sources comprise about three quarters of gross NOₓ emissions in Sydney.

2.3. Noise Pollution

Professor Gunther Lehman, President of International Association Against Noise has observed, “Noise is not a measure of the progress of technology but a sign of regression” (Encyclopedia Americana, 1991).

Noise pollution, as it affects humans, has been a recognized problem for decades, but the effect of noise on wildlife has only recently been considered a potential threat to animal health and long-term survival. Research into the effects of noise on wildlife, which has been growing rapidly since the 1970s, often presents conflicting results because of the variety of factors and variables that can affect and/or interfere with the determination of the actual effects that human-produced noise is having on any given creature. Both land and marine wildlife have been studied, especially in regards to noise in the National Parks System and the onslaught of human-made cacophony in the oceans from military, commercial and scientific endeavours. Most researchers agree that noise can affect an animal's physiology and behaviour, and if it becomes a chronic stress, noise can be injurious to an animal's energy budget, reproductive success and long-term survival. Armed with this understanding it should follow that humans would attempt to minimize the threat to wildlife by reducing the amount of noise that they are exposed to in natural areas; but this has not been the situation.

Natural areas continue to be degraded by human-made noise, wildlife continues to suffer from these disturbances, and to date the majority of the debate revolves around the egocentric demands of people to either produce more noise in
nature (through motorized recreation, scientific research, military exercises etc.) or experience natural areas in the absence of anthropogenic noise. Neither side has adequately addressed the issue from the bio centric view of wildlife and the known, or as yet undiscovered, damage that our increasingly noisy human-altered environment is inflicting upon them (Sharma and Khur, 1994).

Noise is a disturbance to the human environment that is escalating at such a high rate that it will become a major threat to the quality of human lives. In the past thirty years, noises in all areas, especially in urban areas, have been increasing rapidly. There are numerous effects on the human environment due to the increase in noise pollution. Slowly, insensibly, we seem to accept noise and the physiological and psychological deterioration that accompanies it as an inevitable part of our lives. Although we attempt to set standards for some of the most major sources of noise, we often are unable to monitor them. Major sources of noise can be airplanes at takeoff and landing, and a truck just off the assembly line, yet we seem accept and enjoy countless other sounds, from hard rock music to loud Harley Davidson motor cycles (Nunez, 2000).

Sudden and unexpected noise has been observed to produce marked changes in the body, such as increased blood pressure, increased heart rate, and muscular contractions. Moreover, digestion, stomach contractions, and the flow of saliva and gastric juices all stop. Because the changes are so marked, repeated exposure to unexpected noise should obviously be kept to a minimum. These changes fortunately wear off as a person becomes accustomed to the noise. However, even when a person is accustomed to an environment where the noise level is high, physiological changes occur (Broadbent, 1957).

Airplane noise can be a much greater disturbance to sleep than other noises. Research indicates that near a major airport-London (Heathrow) Airport- the number of people awakened by airplanes was about 50% greater than the number awakened by other noises (Wegman, 1967).

In the United States airport noise has been hit the hardest, than any other developed country due to the large geographic area. In 1966, in the United States there were 500 commercial air passengers per 1000 inhabitants, versus 106 for the United Kingdom, 85 for West Germany, and 36 for France (Alexandre, 1970).
Obviously, with the number and variety of factors known to contribute to these events, there is good reason for contradictory results. Even with the relatively ambitious steps currently being taken or envisioned to control noise in most countries, sound levels and exposure to noise will remain high, and possibly increase. At the same time rising living standards will bring about demands for better environmental quality and probably lead to more vigorous and more organized protests against noise. These protest may even be triggered by lower noise levels than in the past, for it is highly likely that as the public acquires more amenities it will want to be exposed to "comfortable" rather than merely tolerable levels of sound (Bauer, 1970).

Other researchers have found the same kind of relationship. For example Cohen et al (1973) determined that elementary school students living for at least 4 years in the lower floors of an apartment complex near heavy traffic show greater impairment of reading ability than children living on higher floors away from the traffic. In the studies, indoors sound levels varied form 66-dB on the lower floors of an apartment to 55-dB on the higher floors. In a recent U.S. EPA classification, "noisy residential areas" averaged 58-dB and were rated low socioeconomic, while "quiet residential" averaged 38-dB and were rated affluent neighborhoods. These, of course, were outdoors sound levels. With indoor levels of 55-66-dB, concentration, the ability to pay attention, may well be difficult to nonexistent.

Almost everyone has had one experience of being temporarily "deafened" by a loud noise. This "deafness" in not permanent, although it is often accompanied by a ringing in the ears, and one can hear another person if he raises his voice. Likewise, normal hearing comes back within a few hours at most. This sort of partial hearing loss is called Temporary Threshold Shift (TTS) (Bugliarello, 1976). A TTS may be experienced after firing a gun or after a long drive in the car with the windows open. This type of exposure to noise does not have to be as loud as a gun being fired; it can be as simple as a person shouting across the room. The type of hearing loss is any degree from partial to complete hearing loss. This loss, usually, is permanent and is not satisfactorily corrected by any devices such as, hearing aids.
The loss is caused by the destruction of the delicate hair cells and their auditory nerve connections in the Organ of Corti, which is contained in the cochlea (Bugliarello, 1976). Every exposure to loud noise destroys some cells, but prolonged exposure damages a larger amount of cells, and ultimately collapses the Organ of Corti, which causes deafness.

Most of society is now aware that noise can damage hearing. However, short of a threat that disaster would overtake the human race if nothing is done about noise, it is unlikely that many people today would become strongly motivated to do something about the problem. Yet, the evidence about the ill effects of noise does not allow for complacency or neglect. For instance, researchers working with children with hearing disorders are constantly reminded of the crucial importance of hearing to children. In the early years the child cannot learn to speak without special training if he has enough hearing loss to interfere effectively with the hearing of words in context (Bugliarello et al., 1976). In this respect, there is a clear need for parents to protect their children’s hearing as they try to protect their eyesight. If no steps are taken to lessen the effects of noise, we may expect a significant percentage of future generations to have hearing damage. It would be difficult to predict the total outcome if total population would suffer hearing loss. Conceivably, the loss could even be detrimental to our survival if it were ever necessary for us to be able to hear high frequencies. Colavita has consistently been unable to find among university students in his classes any one could hear 20 kHz, although the classical results of Fletcher and Munson show 20 kHz as an audible frequency (Fletcher, 1953).

There are two types of hearing loss: conductive and sensorineural. In conductive deafness sound-pressure waves never reach the cochlea, most often as a consequence of a ruptured eardrum or a defect in the ossicles of the middle ear (Bugliarello, 1976).

The three bones form a system of levers linked together, hammer pushing anvil, anvil-pushing stirrup. Working together, the bones amplify the force of sound vibrations. Taken together, the bones double, often triple the force of the vibrations reaching the eardrum (Bugliarello, 1976).
Mitigation of potentially harmful amplification occurs via muscles of the middle ear. These muscles act as safety device protection of the ear against excessive vibrations from very loud noises, very much like an automatic damper or volume control. When jarring sounds with their rapid vibrations strike the eardrum; the muscles twist the bones slightly, allowing the stirrup to rotate in a different direction. With this directional shift, less force is transmitted to the inner ear: less, not all (Bugliarello, 1976).

The human ear is a delicate and fragile anatomical structure on the other hand it’s a fairly powerful physical force. These muscles act quickly but not always as in examples of when the ear catches the sound of gun being shot unexpectedly. The muscles of the ear were relaxed and were unprepared for such a blast, because of this damage were done.

Conductive hearing loss can be minimized, even overcome by use of the familiar hearing aids. The most common is worn over the mastoid bone behind the pinna. It picks up sound waves and transmits them through the skull to the cochlea.

Sensor neural hearing loss, the most common form in the United States, occurs as a result of advancing age as well as exposure to loud noises. In both instances there is a disruption of the organ of Corti. The organ serves two functions: converting mechanical energy to electrical and dispatching to the brain a coded version of the original sound with information about frequency, intensity, and timbre. The hair cells of the organ of Corti send their electrochemical signals into the central nervous system, where the signals are picked up by thousands of auditory nerve fibers and transmitted to the brain. It is the decoding of all the information that enables a person to distinguish the unique and separate sounds of a violin, trumpet, and clarinet, even all three are playing the same note. The organ of corti, a gelatinous mass, is one of the best protected parts of the body, encased as it is within the cochlea which in turn is deeply embedded in the temporal bone, perhaps the hardest of the 206 bones (Bugliarello, 1976). Nonetheless, loud noise can damage the hair cells and the auditory nerve, producing at times, depending on the type of noise, sudden and often total deafness.
Sustained noise over a period of time can also engender sensorineural deafness in the form of gradual losses in hearing. This is the most common loss in teenagers today listening to loud rock music (Bugliarello, 1976). Until a few years ago, sensor neural deafness could not be helped by hearing aids. However, with advances in electronic wizardry and miniaturization, devices for insertion into the auditory canal are available.

Kenichi Ohsakas, a Yamato City official who keeps track of noise levels, has been reported as saying, "it’s just like living inside a subway car." Yamato holds regular weekly takeoff and landing exercises to keep its pilots skills honed, and night sessions are particularly important. Be that as it may, the residents are unimpressed, cannot sleep, and prefer the training sessions to be moved elsewhere. Aircraft noise began to be a major problem with the great surge in air transportation that followed World War II. The introduction of jet airplanes, which came into widespread use by the end of the 1950 led to a second revolution in aviation, as well as to an escalation of the noise level from aircraft’s. Since then, annoyance to people living near airports caused by the noise of jet takeoffs and landings has become a psycho physiological and economic problem of enormous magnitude and complexity. Still a third escalation in aircraft noise will occur when supersonic transports come into commercial operation, and if general aviation and, above all, vertical take off and landing (Bugliarello, 1976).

Determining the effect of noise on wildlife is complicated however because responses vary between species and between individuals of a single population. These variable responses are due to the characteristics of the noise and its duration, the life history characteristics of the species, habitat type, season, activity at the time of exposure, sex and age of the individual, level of previous exposure, and whether other physical stresses such as drought are occurring around the time of exposure (Busnel and Fletcher, 1978).

Aircraft noise is not simply a problem for those trying to sleep. Well-designed, well-controlled studies have demonstrated that exposure to high levels of aircraft and environmental noise can adversely affect reading ability in school-age children.
Maser et al (1978) reported that children who attended school beneath the Seattle-Tacoma airport in-flight paths showed a deficit on standardized tests of scholastic achievement compared to students in quiet schools.

One example of psychological trauma is the research of Jenkins and his group at the London Institute of Psychiatry (Jenkins et al., 1979). It reviewed the findings of two studies conducted in the area of London Heathrow Airport. These studies had compared rates of admission at Springfield Psychiatric Hospital among residents living near Heathrow. Findings suggested that areas closest to the airport, with presumably higher levels of noise, also had the highest rates of hospital admission.

The problem of aircraft noise is complicated by the great economic significance that the aviation industry holds to the economies of developed countries. For instance, at the end of 1971 the U.S. scheduled airlines alone had revenues of close to $10 billion, and employed almost 300,000 employees. Without airlines, a number of economic activities of great importance to national economies from business and tourism, to the transportation of mail, would be severely affected. Sleep disturbances are probably the most widespread source of annoyance caused by noise, if anecdotal responses are any criteria. Recently, French investigators (Vallet, 1979) studied the problem under real-life conditions in bedrooms of people living close to freeways and airports. Using miniaturized electronic units; they recorded ECG, eye movements, muscular activity, and heart rhythm with remote-reading equipment. Noise inside the rooms was recorded continuously. With the noise from the highways, subjects took longer to fall asleep and had less deep sleep so that the young to middle-aged group became more like the 50-60-year old group in their depth of sleep. Rapid eye movement (REM) sleep was also reduced. If both deep and REM sleep are physiologically and psychologically important, this type of alteration may well be damaging. But this remains to be substantiated by further study.

Given the concern over noise, one wonders just how desirable a quiet town would be. Darlington, near Newcastle, England, was almost such a place. Between 1976-1978, Darlington was designated a "quiet town experiment" (Gloag, 1980).
Noise abatement zones and better traffic management was instituted, as were vehicle noise testing and stricter enforcement of noise regulations.

According to the investigations of Cohen (1969) reading and math scores of third grade students in noise abated classrooms were higher than those in classrooms without those qualities were.

Peterson and Northwood (1981) to demonstrate in rhesus monkeys that moderate levels of realistic noise can produce sustained elevations in blood pressure without significant alterations in the auditory mechanism.

Noise undoubtly has psychological effects. The question is how these effects can be assessed and whether they lead to damage. No clear case has been made thus far for psychological damage caused by moderately high levels of noise, the levels that would cause hearing damage to only a small fraction of the people exposed. Indeed, fears have been expressed that over emphasis on damage may backfire when people come to realize that the truth of the matter seems to be simply that people can express violently their dislike about being disturbed by noises. This is recounted vividly by Connell (1972). A middle-aged woman living in Soho became affected by the incessant noise from a newly open discotheque. She complained to the management, the Police, the Local Authority but nothing was done to reduce the noise. Her action took the form of suicide. In Italy a 44 year old man took an overdose of drugs because his eleven children made too much noise while he was watching the Olympic Games on television. In a quiet part of Middlesex with an ambient noise level of 30 to 40 decibels lived Fred, a lusty, healthy builder’s labourer. The M4 Motorway was built within a few feet of his cottage home. The resultant traffic caused the noise level to rise to 80 and 90 decibels so this poor man suffered an increase of 100,000 times in the noise level. He took it for some weeks. Discovered there was nothing he could do about it and his action was also directed against the self.

Hearing loss can be entrapping in onset. Years of traumatic exposure to high levels can occur before symptoms become manifest. The popularity for portable sound equipment such as Walkman-type radios and tape players has already produced a sharp increase in clinically verified hearing loss, especially among rock
music addicts who prefer their music very loud (EPA, 1971). Obviously, the Walkman-radio industry believes it is not their products that are the problem; rather it is improper use. If, they say, the volume is kept down, there would be no problem, which is equivalent to saying that if we all drove cautiously there would be no accidents. Considering that earphone listening has been around for some 20 years, why has the problem only recently surfaced. Apparently the pattern of listening has changed. Currently, earphones are used while walking or running on noisy easy streets rather than in the privacy of the home or other relatively quiet area where the listener did not wish to disturb others. Now the volume must be turned up to overcome the noise of city traffic. The listener wants the Walkman to blot out the "noises of the city."

Yet it has been argued that because noise produces no dramatic ill effects, the public has been largely uninterested in its suppression. It may be more to the point to say that the degree of annoyance and discomfort that people will endure is astonishing. Although noise is an integral part of civilization, it would appear that unless some definite steps are taken to reduce the present inordinate levels in both industry and community generally, more people will become auditory cripples.

Noise is one of the most pervasive problems, penetrating all areas of human activity. All symbols of civilization from jet planes, vehicles and railway engines to factories, generators, demolition and construction, television and radio, public address system and public voice have one thing in common—it is noise. The man made activities are responsible for the increase in the ambient noise level particularly in the urban areas (Sapru, 1987; Sharma, 1990).

As the urban centres grow in size both in population and in area, they too develop a number of environmental problems. Hence it is of immense importance to study the various aspects of pollution, especially noise, because of its adverse effect on health (Gopikrishna, 1978).

Noise does not kill, there is no evidence even of hearing loss due to environmental noise, but it does produce stress. It is a matter of quality of life and quiet can be considered as a luxury (Brownz, 1998).
Researchers at the University of South Ampton are investigating the scope for neutralizing low frequency brass notes by generating “antiphase” sound with an ordinary Hifi system (Environmental resources abstracts, 1985).

According to Anand Shah, an ENT specialist, though all individuals are exposed to high sound levels, the damage varies from individual to individual. The recovery from temporary threshold shift depends on the type of exposure, the severity of the hearing shift, person-to- person susceptibility (The Sunday observer, 1987).

In Britain it is an offence to play noisy instruments or to sing in streets near offices and homes. People who regularly play their radios, sterios very loudly are liable to be prosecuted under British law (The Hindu, 1988).

A study done at Central Institute for the Deaf in St.Louis, Chichillas exposed Guinea pigs to brief intermittent periods of above normal but supposedly tolerable noise levels. It developed swollen cochlear membranes and obliteration of inner ear hair cells (The Encyclopedia Americana, 1991).

Bombay is considered to be the third noisiest city in the world. New Delhi is said to be closely following Bombay in noise pollution. The World Health Organisation has fixed 45 dB as the safe noise level for a city. Bombay, New Delhi, Calcutta and Madras usually register more than 90 dB. Table 2.3 gives the noise exposure limit specified by WHO- 1980(EPA, 1971).

The persons living along the sides of London’s Hearthrow airport that have significantly higher rate of admission to mental hospitals than persons living in otherwise comparable localities(Kudesia and Tiwari, 1993). The din and noise of crackers during Diwali (which can more correctly be called the ‘festival of sound’ instead of ‘festival of light’) are so loud and unbearable that it is necessary to think seriously about the health hazards associated with it(Sharma and Kaur, 1995). Los Angeles airport have implemented a scheme requiring all aircrafts not complying the federal noise regulations to take off and approach over the sea between 11 pm to 6 am (Singal, 1995).
Harshavardhan *et al* (2003) reported that acoustic pollution is a significant environmental system problem. It can be defined as a sound without agreeable quality or as unwanted sound. The problem of noise is likely to increase in coming years as mines become larger and more mechanized employing bigger and more powerful machines in greater number. Hindrance in vocal communication in an environment of high noise may cause accidents. Masking of warning signals as in case of roof falls may lead to serious consequences. Also a person becomes irritable and quarrelsome and loses concentration. These results in decreased efficiency and increased incidents of errors. The most serious effects of exposure to high noise levels are deafness, which is initially temporary but with prolonged exposure to high levels, gradually becomes permanent. Hence the noise of the levels higher than the standards laid down by the Ministry of Environment and Forest must be abated not only to achieve greater percentage production, but also to restore physical health of workers at work place.

Bhatnagar and Srinivas (1992) has studied shopping is an important activity of a common urbanite in any town. The shopping complexes have several problems like distance from residential areas, over crowding and increased vehicular traffic in the vicinity. The air in these shopping centres is humid and lacks freshness. Further high level of noise are observed to be a prominent environmental parameter in these area. A worker in South India is never free from noise at any part of the aspects. He wakes up to noise from transistors works in a noisy industry, goes to his work-place through noisy streets lives with loud speakers and returns to a noisy home. By all standards, he is exposed to noise levels which exceed the permissible noise levels (Kameswaran, 1992).

Panday and Ravi Verma (1997) reported that rapid urbanization, industrialization, transportation and mushrooming of settlement along the highways have contributed significantly to increase in noise levels. For assessing the noise pollution in an urban centre, a systematic study is required involving objective measurement and supportive study involving subjective reaction of the people affected by the environmental noise.
Naik and Purohit (2003) reported that the noise levels were measured at ten residential locations at Bondamunda both during day and night time exceeded the noise standards recommended by CPCB. The noise generally came from many sources such as radio, TV, VCR, Music system, Coolers, motor cycle, Chattering among people, Children playing, traffic noise, use of loud speakers at the religious, cultural and social functions etc.

Ravindran and Sriram (2004) carried out ambient noise level at various locations of the Kanchipuram town during March 2003. The comparison of the data showed that the noise levels at various locations (residential, commercial and silent zones) of the town were more than the permissible limits. Vehicular traffic and air horn were found to be the main reasons for high noise levels.

A study by USEPA studied the magnitude of the U.S. population exposed to noise, and the percentage expressing annoyance with specific sources of noise. Considering that 60-dB is akin to the sound of an air conditioner at a distance of 20ft, it was evident that with a population in excess of 280 million approximately 7%, or 17+ million people were exposed to noise levels, from traffic alone, of from 70 to over 80 dB (U.S. EPA,1980).

Pal et al (1992) undertook a study on the workplace noise problems in coal washery industry. The study revealed that the workers had been affected by noise with auditory effects.

Extent of noise pollution from household equipment and appliances was conducted in two colonies of Ludhiana and two villages of Ludhiana district. The noise levels produced by the use of household equipment and appliances ranged from 40dB (A) to 97dB (A) which were quite high and intolerable as compared to acceptable noise level of 45 dB (A)(Nagi Gurupret et al.,1993). It revealed that the urban families experienced more noise nuisance from interior sources as compared to the rural folks. The excessive noise was found to cause multi farious ill effects and reduced working efficiency among people.

Bansal (1996) reported noise level status of Bhopal city during 1994. Noise level in the sensitive areas of Bhopal was in the range of 32 dB(A) to 78dB(A)
during daytime, while during night time it was in the range of 30dB(A) to 60 dB(A). In these areas about 43.3% values were found exceeding the limit of dB(A) during night time.

Bhattacharya et al (1996) examined the presence of potential noise hazard to health and safety in the working areas of two drilling sites of petroleum in the open field by evaluating and analyzing noise levels and characteristics. The results showed that the sound pressure levels ranged from 96 to 102dB(A). All exceeding the standard noise exposure limits of 90dB(A).

Padmanabhamurthy and Satapathy (1996) assessed the efficacy of different types of screens by conductivity controlled noise migration experiment in an open site at Jawaharlal Nehru University. They suggested two screens, namely plywood and aluminium were most effective. Sound attenuation was found to be more in case of plywood screen compared to aluminium. To assess the efficacy of bushes and hedges the experiments were also conducted at two localities. Sound pressure level attenuation was found to be higher in case of hedges compared to other vegetation.

The status of noise pollution in Tiruchirappalli was studied by Ravichandran et al (1997). The result revealed that in all the commercial, residential and silence zones, the noise exceeded the limit prescribed by Central Pollution Control Board.

Edison Raja et al (1999) assessed noise pollution due to automobiles in Cuddalore, which revealed that the traffic policemen were exposed to high noise levels during peak hours.

Alagappa Moses et al (2000) carried out noise pollution assessment in Chidambaramm, Erode and Thanjavur in Tamilnadu. Noises levels exceeded the ambient air quality standards for noise in all these places. The vehicular traffic was found to be the major cause for noise pollution in these places.

Varshney (2003) reported that the Diwali may be an unsafe one, with authorities turning a deaf ear to the pleas of health experts and the masses. Study conducted that noise generated by fire crackers was much higher than the prescribed
levels. The permitted noise level is 125 decibels as per the Environment (protection) Rules, 1999.

Kalyankar et al (2004) reported that the noise levels recorded in places under silence zone, residential zone and commercial zone were higher than the prescribed limits. None of the place was found to be calm. The residents in these areas were exposed to high noise levels and as a result they would develop auditory and non-auditory effects in due course of time.

Robert et al., (2004) reported that the noise was the most pervasive pollution in America.

2.4. Water Pollution

As our communities grow, we notice many visible changes, including housing developments, road networks, expansion of services, and more. These changes impact our precious water resources, with pollution of water resources being one potential impact. To understand how our water supplies can become polluted, it’s important to understand the oldest solar-powered “recycling” system: the water cycle, also called the hydrologic cycle. The hydrologic cycle transports water between earth’s land, atmosphere, and oceans. The major processes moving water are evaporation, transpiration, condensation, and precipitation. Evaporation occurs when the sun’s energy turns liquid water on the earth’s surface into water vapor, which enters the atmosphere. Water vapor leaves plants in a process called transpiration. Collectively, these two processes are called evapotranspiration. The water vapor in the atmosphere cools to form clouds (condensation). Through precipitation in the form of rain or snow, the water returns to earth. Snow accumulates in the mountains, providing storage in the form of a snow pack that will slowly melt and release water in the spring and summer. Some of the rain runs off the land, into rivers or lakes. While it’s hard to believe, rivers contain only about 0.0001 percent and fresh water lakes only about 0.009 percent of all water on earth! Rain also soaks into the ground, or infiltrates, and replenishes.

The increase in impervious or hard surfaces, including rooftops and pavement (roads, driveways, and parking lots), decreases the amount of water that soaks into the ground, or infiltrates. This increases the amount of surface runoff. The
impervious surfaces collect and accumulate pollutants, such as those leaked from vehicles, or deposited from the atmosphere through rain or snowmelt. The runoff water carries pollutants directly into water bodies. Because there is less infiltration, peak flows of storm water runoff are larger and arrive earlier, increasing the magnitude of urban floods. Paving may alter the location of recharge, or replenishment, of groundwater supplies, restricting it to the remaining unpaved areas. If infiltration is decreased sufficiently, groundwater levels may decline, affecting stream flows during dry weather periods. Lowered groundwater levels can result in subsequent well failures. While the effects of urbanization on the water cycle can be major, if wise choices are made during the development process, the impacts can be minimized and our future water supply protected (ENVIS, 2005).

Freshwater resources all over the world are threatened not only by over exploitation and poor management but also by ecological degradation. The main source of freshwater pollution can be attributed to discharge of untreated waste, dumping of industrial effluent, and run-off from agricultural fields. Industrial growth, urbanization and the increasing use of synthetic organic substances have serious and adverse impacts on freshwater bodies. It is a generally accepted fact that the developed countries suffer from problems of chemical discharge into the water sources mainly groundwater, while developing countries face problems of agricultural run-off in water sources. Polluted water like chemicals in drinking water causes problem to health and leads to water-borne diseases which can be prevented by taking measures even at the household level. (http://www.vyh.fi/eng/environ/sustdev/indicat/rehevoit.htm)

In a survey conducted by the Central Pollution Control Board, there were 2000 large and medium scale industries in the country which polluted the ground water. Of these only 27% had adequate treatment plants 14% of the industries the treatment units were still under construction. Of the 17% sugar industries, only 6% had effluent treatment plants. The remaining 42% industries were simply disposing the wastes without any sort of prior treatment into the aquatic bodies which were the potential sources of public water supply. They generated enormous problems of water pollution (Trivedy and Goel, 1984). Now 50% of industries simply disposing the waste water without treatment (www.industrial effluents.com).
Studies have revealed that some of our major rivers are polluted far beyond the permissible limit prescribed for human use and consumption. The mighty Ganga in the North and Cauvery in the South are also heavily polluted that the once life giving forms have now become a menace to aquatic life and human population. India suffers from water, air and soil pollution contributing to the overall degradation of the environment. Indiscriminate water pollution is a phenomenon particularly in densely populated industrial cities at India (Babacar et al., 2005).

Schueler and Holland (2000) suggested that the effects of urbanization on the water cycle can be major; if wise choices were made during the development process, the impacts could be minimized and our future water supply be protected.

Purandara et al (2003) reported that with the rapid growth of population and industrialization in the country, pollution of natural water by municipal and industrial wastes had increased tremendously.

Danilo (1993) reported that the impact on urban areas, with their extensive hardened surfaces and inadequate storm water infrastructure to manage urban runoff, could be significant.

Sheridan et al (1996) reviewed the implications of inadequate provision of water and sanitation on children’s health and general development, especially in urban areas. Research into health differentials showed that child mortality and morbidity rates in poor urban settlements was equal or exceed those in rural areas. The chemical composition of ground water depends upon the soluble products of rock weathering and decomposition and changes with respect to time and space in addition to the external pollution agents (Mariappan et al., 2000).

Groundwater is a precious natural resource for several vital functions such as for public, industrial and agricultural water supply. It provides drinking water to almost a third of the population and irrigates about 17% of the crop land. Due to the increased demand of water the groundwater is excessively exploited. Now a days, the increasing effects of pollution on and overexploitation of ground water have become a serious threat. Many workers such as Kaza et al (1991), Ravichandran and Pundarikanthan (1991), Dayal (1992), Ali Akram and Iqbaluddin (1992), Mittal et al
Activities such as indiscriminate disposal of human and agricultural waste, manure spreading over the vicinity of human habitation, housing of livestock, onsite human waste disposal system, septic systems and open defecation etc, are responsible for fecal contamination of ground water in the rural areas of the country. The American academy of microbiology has opined that the quality of drinking water is declining all over the world mainly because of bacteriological contamination, a significant cause of gastro-intestinal diseases. As a consequence immunity to gastro-intestinal disease following exposure to contaminated water is slowly disappearing. Eric Minz of the US, centre for disease control estimated more than 3 million cases of diarrhea in all over the world per year leading to 10 million deaths caused by water borne micro organisms(Conboy and Goss, 2001).

2.4.1. Groundwater and its contamination

Many areas of groundwater and surface water are now contaminated with heavy metals, POPs (persistent organic pollutants), and nutrients that have an adverse affect on health. Water-borne diseases and water-caused health problems are mostly due to inadequate and incompetent management of water resources. Safe water for all can only be assured when access, sustainability, and equity can be guaranteed. Access can be defined as the number of people who are guaranteed safe drinking water and sufficient quantities of it. Urban water generally have a higher coverage of safe water than the rural areas (Allen et al., 1980).

In the urban areas water gets contaminated in many different ways, some of the most common reasons being leaky water pipe joints in areas where the water pipe and sewage line pass close together. Sometimes the water gets polluted at source due to various reasons and mainly due to inflow of sewage into the source. Ground water can be contaminated through various sources and some of these are mentioned below (Allen et al., 1980).
2.4.2. Pesticides

Run-off from farms, backyards, and golf courses contain pesticides such as DDT that in turn contaminate the water. Leechate from landfill sites is another major contaminating source. Its effects on the ecosystems and health are endocrine and reproductive damage in wildlife. Groundwater is susceptible to contamination, as pesticides are mobile in the soil. It is a matter of concern as these chemicals are persistent in the soil and water (Joshi et al., 2004).

2.4.3. Sewage

Untreated or inadequately treated municipal sewage is a major source of groundwater and surface water pollution in the developing countries. The organic material that is discharged with municipal waste into the watercourses uses substantial oxygen for biological degradation thereby upsetting the ecological balance of rivers and lakes. Sewage also carries microbial pathogens that are the cause of the spread of disease (Tyagi, 1998).

2.4.4. Nutrients

Domestic waste water, agricultural run-off, and industrial effluents contain phosphorus and nitrogen, fertilizer run-off, manure from livestock operations, which increase the level of nutrients in water bodies and can cause eutrophication in the lakes and rivers and continue on to the coastal areas. The nitrates come mainly from the fertilizer that is added to the fields. Excessive use of fertilizers cause nitrate contamination of groundwater, with the result that nitrate levels in drinking water is far above the safety levels recommended. Good agricultural practices can help in reducing the amount of nitrates in the soil and thereby lower its content in the water (Achuthan Nair et al., 2005).

2.4.5. Synthetic organics

Many of the 100 000 synthetic compounds in use today are found in the aquatic environment and accumulate in the food chain. POPs or Persistent organic pollutants represent the most harmful element for the ecosystem and for human health, for example, industrial chemicals and agricultural pesticides. These chemicals can accumulate in fish and cause serious damage to human health. Where
pesticides are used on a large-scale, groundwater gets contaminated and this leads to the chemical contamination of drinking water. Acidification of surface water, mainly lakes and reservoirs, is one of the major environmental impacts of transport over long distance of air pollutants such as sulphur dioxide from power plants, other heavy industry such as steel plants, and motor vehicles. This problem is more severe in the US and in parts of Europe (Kataria, 1994).

Ramakrishnan et al (1991) had studied the physico-chemical parameters of five drinking water sources at Tiruvannamalai. All parameters except DO Calcium and magnesium were found to be in the permissible limit.

Gupta Hari Om and Sharma Brijmohan (1993) had analysed quality of water at Lalitpur, an industrial area of Donnvalley. Calcium, magnesium and PO_4 were found above the permissible limit in natural waters. The river and canal water confirmed the increased pollution due to industrial development.

Vaithuyanathan et al (1993) studied the transport and distribution of heavy metals in Cauvery River. Tributaries Hemavathii and Kabini draining highly mineralized areas contribute significantly to the heavy metal load of the Cauvery River. Particulate metal transport is influenced by the presence of major dams built across the river.

Prakash et al (2004) studied on E.Coli bacterial contamination of drinking water, a common problem in many rural areas. In that areas about 18.85% hand pumps, 40% of pipeline water supply and 46.43% mini water supply sources were affected by E.Coli.

Radha (2003) suggested that microorganisms are widely distributed in nature and are found in most natural waters. Their abundance and diversity used as a guide to the suitability of water for fish, animals or recreational and amenity purposes (African Technical review, 1986). With increasing urbanization and industrialization, water sources have been adulterated with industrial as well as animal and human wastes. As a result, water has become a formidable factor in disease transmission. The presence of non pathogenic organisms is not of major concern, but intestinal contaminants of fecal origin are important. These pathogens
are responsible for intestinal infections such as bacillary dysentery, typhoid, fever, cholera and paratyphoid fever etc.

Panday and Soni (1993) had analysed physico chemical quality of Naukuchiyatal lake water in Kumaun Himalaya. The lake was highly polluted and contained high amount of free CO$_2$, total alkalinity and pH except DO during 1991 as compared to study report of 1978.

2.4.6. The effects of Water pollution

Water pollution is the acceleration of the eutrophication processes of waters. Eutrophication is the aging of a lake by biological enrichment of its water. In a young lake the water is cold and clear, supporting little life. With time, streams draining into the lake introduce nutrients such as nitrogen and phosphorus, which encourage the growth of aquatic organisms. As the lake's fertility increases, plant and animal life burgeons, and organic remains begin to be deposited on the lake bottom. Over the centuries, as silt and organic debris pile up, the lake grows shallower and warmer, with warm-water organisms supplanting those that thrive in a cold environment. Marsh plants take root in the shallows and begin to fill in the original lake basin. Eventually the lake gives way to bog, finally disappearing into land. Depending on climate, size of the lake, and other factors, the natural aging of a lake may span thousands of years.

However, pollutants from man's activities can radically accelerate the aging process. During the past century, lakes in many parts of the earth have been severely eutrophied by sewage and agricultural and industrial wastes. The prime contaminants are nitrates and phosphates, which act as plant nutrients. They over stimulate the growth of algae, causing unsightly scum and unpleasant odors, and robbing the water of dissolved oxygen vital to other aquatic life. At the same time, other pollutants flowing into a lake may poison whole populations of fish, whose decomposing remains further deplete the water's dissolved oxygen content. In such fashion, a lake can literally choke to death. Moreover in the case of lake and reservoirs with a long time of water turnover phosphorus will accumulate in the aquatic ecosystem determining periodic cycles of algal proliferation with inorganic P being organized in the algae cells followed by microbial decomposition of algal
residues with the organic P being remineralized. Only the removal of organic substance from the lake either as sludge accumulated on the bottom or as living organism (e.g. fish) can reduce the water body eutrophication.

The cities among the coastal areas are discharging their effluents in sea and oceans. The coastal area of Bombay has become slightly acidic and polluted. The main areas of old and New Delhi are on the West Bank of Yamuna, while the old Shahdara is located on the left bank. At Wazirabad, where the river enters the Union territory of Delhi, it is tapped for the water supply. The river leaves the union territory at Okhla, where the city waste water is discharged after treatment. During 48km of its length a large number of drains meet the river and carry into its sullage and other waste waters from various parts of the city. As for sewage system is concerned there is only partially sewered. Even in the sewer area all sources of waste water are not connected to the sewerage system. As a result a significant volume of waste water is not connected to the sewerage system. As a result a significant volume of waste water generated, finds its way into the open drains. Usually, 80% of the water supplied to the community returns as waste water (Babacar et al., 2005).

Pondicherry has large and medium industries and 1108 small scale industries out of which 101 units are responsible for water pollution. The city has plan for laying down sewers to collect the pump most of the sewage on sewage farms after marginal treatment through settling process. But at present sewage and sullage flows through a number of open drains into sea through various backwaters (Bandopadhyaya, 1986).

Except in big cities no testing of ground water is done although, ground water is generally bacteriologically free but it gets contaminated with sewage or industrial seepage. Most of the sewer and water supply lines are found parallel to each other. Sometimes tap water, wells water area found contaminated with sewer water. Many water borne diseases like encephalitis, schistosomiasis, malaria, diarrhea are increasing. To these may be added typhoid, cholera, dysentery, gastroenteritis and hepatitis which are spread by contaminated water or dirty hands as well as scabies, yaws, leprosy and conjunctivitis diseases which are aggravated by insufficient water for washing purposes (Sharma and Khar, 1995).
Kshipra (1991) analysed trace metals of the textile mill effluents and sediments in water of river Khan. Higher Concentration were usually found in the upstream regions.

Ruparelloa et al (1993) reported that the pollution of river Bhadar is caused by dyeing and printing industries in the belt of Jetpur Dhoraji taluka of Saurashtra region.

Manzoor (1993) studied the water quality of a mining area in Keonjhar district for drinking and agriculture. Examination of agricultural parameters revealed that the water flowing down the mines was suitable for irrigation purposes with most of the irrigation water quality parameters except in case of salinity and residual carbonate.

Singh et al., (1994) analyzed the effect of effluent from the Sindri fertilizer factory in the river Damodar. The range of pollutants discharged included inert deoxygenators, nitrogen and phosphorus compounds and poisonous substances. These compounds increased the BOD and COD load of the water body, leading to anoxia conditions.

2.4.7. Plankton

The term plankton refers to unattached organisms that are dispersed individually or in colonies in water. Phytoplanktons are plant plant plankton, and zoo planktons are animal plankton. The plankton is specific for a particular environmental condition and they are considered to be the best indicators of environmental quality. The enrichment of water body by the supply of nutrients through various sources leads to a condition of eutrophication. However the general impact of environmental stress, both external and internal to the aquatic environment, is manifested on these organisms. The presence or absence of certain organisms in the aquatic environment shows the extent of contamination of water bodies. The identification and quantification of these organisms serve as inexpensive and efficient early warning and control system to check the effectiveness of the measures undertaken to prevent damages to ecosystem.
2.5. Soil Pollution

Soil is the natural medium for the growth of land plants. Soil covers land as a continuum except on rocky slopes and in regions of continuous cold. Its characteristics in any one place results from the combined influence of climate and living matter, acting upon rock material as conditioned by relief over periods of time. Soil is a dynamic three dimensional piece of landscape that supports plants. It has a unique combination of both internal and external characteristics. Its upper surface is the land; its lower surface is defined by the lower limits of soil forming processes; and its sides are boundaries with other kinds of soil. In short, each soil is a natural body which is surrounded by other soils with different properties (Sharma and Khar, 1995).

2.5.1. Evolutionary nature of soil

The soils undergo continual change. Each soil has a life cycle in terms of geological time. The soil properties have been influenced by the integrated effects of climate and living matter acting upon parent material over a period of time. Weathering of bedrock provides the debris which is the parent material for the evolution of soil profiles. Over a period of time a soil horizon will come into existence.

2.5.1.1. The soil profile

When soil is examined vertically it shows the presence of more or less distinct horizontal layers. Such a section is called a “profile” and the individual layers are called as horizons. The horizons found above the parent material are collectively called as solum. The word “solum” is a latin word meaning soil, land or a piece of land (Sharma and Khar, 1995).

2.5.1.2. Horizons of soil

The upper layers of soil contain large amounts of organic matter. These layers are the major zone of organic matter accumulation. The underlying subsoil contains lesser organic matter. In mature humid regions of the soil the subsoil layers may be a) an upper zone of transition b) a lower zone containing sufficient amounts of compounds like iron, aluminium oxides, clays, gypsum and calcium carbonate.
2.5.1.3. Components of soil

Soil is a mixture of mineral matter, organic matter water and air. The approximations are as follows – mineral matter 45%, organic matter 5%, water 25%, air 25%. These proportions vary from time to time. The volume of air and water bear a reciprocal relationship. Half the volume is pore space.

2.5.2. Soil nutrients

For the growth of plants certain elements are definitely essential. The capacity of soils to supply the essential elements and crop residues are often amended in order to enhance plant growth and crop returns. The soil nutrients can be divided into two classes-Macronutrients and Micronutrients.

2.5.2.1. Macronutrients

Six elements are used in large quantities and they are “nitrogen, phosphorus, potassium, calcium, magnesium and sulphur”. Growth of plants may become retarded if these are available too slowly or if they are in adequately balanced by other nutrients. Nitrogen, Phosphorus and potassium are commonly supplied to the soil as farm manure and commercial fertilizer.

2.5.2.2. Micronutrients

The other nutrient elements like iron, manganese, copper, zinc, boron, molybdenum chlorine and cobalt are required by the plants in very small amounts. These are called micronutrients or trace elements.

2.5.3. Life in the soil

Living organisms in the soil, both fauna and flora are very essential in the process of degradation and synthesis of humus. These organisms are essential for the numerous biochemical changes, help to stabilize the structure of the soil. The soil is not complete without the living components (flora and fauna) and can not function. Of all the microbes, bacteria are by for the most numerous (one thousand million in single gram of soil) followed by viruses, fungi, actinomycetes, algae, protozoa. They create air ways within the soil that are essential to plant roots.
2.5.4. Soil deterioration

1. Fragility: - Man’s influence severely upsets the natural balance.
2. Progressiveness: - The vicious circle of “cause and effect” can also damage the soil.

Due to these reasons erosion and deterioration of soil can lead to desertification. Looking after soil which was the original meaning of cultivation is literally the basis of human culture. Yet man’s many activities is increasing converting the fertility and productivity of soil into an irreversible situation of unproductivity. Yet arable land is being thoughtlessly consumed for infrastructural facilities.

2.5.5. Soil Degradation

Agriculture plays a key role in the development of any economy. Agriculture provides basic sustenance to all living beings. It is very important that ecologically, socially and economically sustainable agriculture should become the backbone of the development process of the State. Agriculture should be sustainable so that the natural resources such as soil, water and biodiversity are used efficiently and equitably. It should be economically viable and lead to increasing employment opportunity, socially feasible, strengthening the role of women and other marginalized sections of the people. Equity in sharing benefits is vital for community participation in the conservation and enhancement of natural resources. Agriculture continues to be the prime mover of the State economy supporting 62 percent of the population and contributing 13 percent of the State income as of 2004-05. The Government is aiming to achieve 100% food security in the State and also to create avenue for export of agricultural produce for economic enlistment of the farming community. During the Tenth Plan period, the State is aiming an annual growth rate of 4% in agriculture and 8% in horticulture crops for sustainable agricultural development, employment generation and poverty alleviation. The Government is focusing its policies towards overall development of agriculture sector in terms of increasing the cropping intensity by bringing every piece of land under cultivation, productivity increase, maximizing natural resources with parallel efforts to conserve them (Anon, 2005).
In Tamil Nadu 94 soil families were identified and classified according to soil taxonomy into six orders. Among the six orders inceptisol formed 50% of the total geographical area followed by alfisols (30%). Soil depth is not a limiting factor for crop growth in Tamil Nadu except shallow soils which occur in 14 percent of the total geographical area of the State. The texture of surface soil of the State shows that 18 percent area has sandy surface soil, 53 percent has loamy surface soils and 22 percent has clayey surface soil (Anon, 2004).

2.5.6. Soil erosion

Soil erosion is caused by wind or water. Erosion causes depletion of fertility through the removal of the valuable and fertile surface soil. In Tamil Nadu erosion was observed about 13 lakh ha (Anon, 2004).

2.5.7. Salinity and alkalinity

Salinity in soil hinders crop growth and results in reduction in crop yield. The estimated extent of soils affected by salinity and alkalinity was estimated at 2.48 L.ha. besides 1.23 L.ha. suffering from acidic soils (Anon, 2004).

2.5.8. Mining and Environmental degradation

It has been estimated that 16250ha were under mining in Tamil Nadu of which 3285 ha were in the district of Salem followed by 3155 ha in Cuddalore district. The other districts which had fairly substantial area under this category include Namakkal, Perambalur, Tirunelveli and Sivagangai (Tonapi, 1980).

2.5.9. Water logging and marshy land

Excess water hinders plant growth by reducing aeration, which in turn decreases the water absorption and nutrient uptake by roots. The coastal regions of Tamil Nadu face heavy damages due to water logging. The command areas in major irrigation projects experience waterlogging problem. In TamilNadu 44,820 ha. was estimated as marshy lands. About 14 percent of the area in Tamil Nadu was under very poorly drained soils. Another 16 percent was under moderately well drained to well drained soils and 15 percent was somewhat excessively drained soil (Anon, 2004).
2.5.10. Agriculture progress, problems and constraints

2.5.10.1. Depletion of water resources

Tamil Nadu's geographic area consists of 17 river basins, a majority of which are water-stressed. There are 61 major reservoirs; about 40,000 tanks and about 3 million wells that heavily utilize the available surface water (17.5 BCM) and groundwater (15.3 BCM). Agriculture is the single largest consumer of water in the State, using 75% of the State's water. A recent World Bank report has shown that the agriculture sector faces major constraints due to dilapidated irrigation infrastructure coupled with water scarcity due largely to growing demands from industry and domestic users and intensifying interstate competition for surface water resources. In some parts of the state, the rate of extraction of groundwater has exceeded recharge rates, resulting in falling water tables. Water quality is also a growing concern. Effluents discharged from tanneries and textile industries and heavy use of pesticides and fertilizers have had a major impact on surface water quality, soils and groundwater. The State Government has taken a number of progressive actions on water resources and irrigation management, particularly through the Bank-assisted Tamil Nadu Water Resources Consolidation Project (WRCP). Tamil Nadu was one of the first states to pass a groundwater bill. The State had prepared a planning framework for water resources management, and a State Water Policy (Anon, 2004).

Hundal et al (1988) reported that soil moisture content influenced the presence of most organic pesticides in soil. Combined with adsorption and biomass measurements, the experiments were used to describe the mechanisms by which soil water influenced the rates of microbial degradation of the herbicides. The size of the microbial biomass in the soil was found to have a direct influence on the rates of degradation of diallatae and triallate and since the water content influenced both the size and survival of the biomass, it indirectly influenced the degradation rates.

Paul et al (1985) reported heat and soil moisture function together in the inactivation of soil microbes. Sensitivity of micro organisms to heat is affected by soil moisture. The role of heat in micro organism inactivation is better understood than that of soil moisture. Heat directly affects survival since cellular components such as protein, membrane lipids and nucleic acids are unstable at elevated temperatures. The effect of soil moisture is not as readily apparent. Water probably
acts as a catalyst in the heat denaturing process. It lowers the amount of heat required to reach the activated state, denature bio molecules and subsequently inactivate cells.

Sharma and Gupta (1989) reported that trees improved soil fertility. The organic carbon increased from 0.03 to 0.47 and total nitrogen from 0.07 to 0.43% under Prosopis, whereas P$_2$O$_5$ increased from 14.95 to 33.68 Kg/ha.

2.5.10.2. Decline in soil organic matter

The soil health is deteriorating. The organic matter content in the soil has gone down from 1.20% in 1971 to 0.68% in 2002 in Tamil Nadu, because of less use of organic inputs (Anon, 2004).

Olaniya et al (1992) reported that organic matter increased when soil was amended with compost ans sewage sludge containing heavy metals. But water percolating from such soil adds chlorides, sulphates and nitrates to ground and sub soil waters.

The pattern of land ownership is unfavourable for agricultural development. The average size of holdings has declined from 1.25 ha in 1976-77 to 0.95 ha in 1995-96. The all India figure for average area owned per household is 1.59 ha. This reflects the pressure of population on land. The share of total land operated by small and marginal farmers has increased from 42 percent to 52 percent during the same period. The growth in number and extent of small and marginal farmers is a major hurdle in promoting capital investment in agricultural sector and modernizing agriculture sector. Fragmentation of land results in uneconomic land holdings (Anon, 2004).

2.5.11. Soil Treatment

The demand of land for various productive propose is on an increase. The degradation of land resources is taking place at an alarming rate. This is due to the diversion of lands in a fragile ecosystem for various purposes like – dams and roads, the reckless destruction of forest wealth, expansion of irrigation without adequate concern for the treatment of the catchments, danger of water logging, salinity,
desertification, floods and droughts, improper agricultural practices, toxic effects of agricultural chemicals and industrial effluents.

2.5.12. Agriculture and Horticulture Waste Land

A recent estimate showed that in 20 districts of Tamil Nadu, there was waste land to the extent of 36.28 lakh ha (Table 2.9). Special schemes have been drawn to put these lands to productive use by suitable reclamation of land and cultivation of select crops, with the technical and financial support of the Government of Tamil Nadu. If the landless agricultural labours were the target beneficiaries of the scheme, it will generate employment opportunities to at least 20 lakh farm workers. Mobilisation of required resources and economically viable operational strategy would make the scheme a success. Emphasis must be on participatory development through collective community based efforts, because individual tiny farms are economically not viable on such marginal and sub-marginal lands (Anon, 2005).

Hundal et al (1988) have said that after incubation with green manures the phosphorus absorption characteristics of the soil was changed.

Totey (1989) have reported that green manure adds organic matter in surface soil treated with moong, of soil nitrogen and phosphorus in surface and subsurface layers.

2.6. Waste Water Treatment

Importance of waste water

According to world health organization (WHO) almost 80% of the diseases in the world are attributable to inadequate water and the related problems of sanitation. It is reported from various parts of our country that 50 to 70% of the pollution load of rivers and streams is from domestic sewage (Acheson, 1983).

The waste water usually contains numerous pathogenic micro organisms that enter into human body and dwell in the intestinal tract.

Chatterjee et al (1967) studied the utilization of sewage for fish culture on oxidation ponds. The ponds were designed to treat 720,000 gallons of sewage per day, the per capita water supply of the town ship, being in the order of 100 gallons per day.
Alagarswamy et al (1967) studied the succession of different micro fauna and their correlation to BOD reduction in a high rate deep stabilization pond. It was shown that the stalked ciliates existed in great numbers in the later stages which incidentally coincided with the higher BOD reduction.

Bopardikar (1967) discussed on the microbiology of waste stabilization pond for sewage treatment. Sehgal and Siddiqi (1969) analysed the characteristics of the waste waters of Kanpur city and concluded that the waste wateres from the city could be utilized for irrigation after making suitable dilution with water from river Ganges.

Bokil amd Agarwal (1976), Studied the performance characteristics of high rate shallow stabilization ponds . It was found that overall BOD removal efficiency was about 85%.

The establishment of waste water management scheme for a small community is highly essential since waste water discharges disrupt the ecosystem. The domestic sewage has its own effects on the human health as well as on other organisms. The purpose of sewage treatment is to remove at lowest cost, contaminants of the waste water, so that the final effluent can be discharged to a receiving water with minimal effect on the natural flora and fauna and on the subsequent use of the water. Thus waste water analysis and their treatment have become increasingly important and were worked out by many authors.

Bokil and John (1981) described the feasibility of developing the flocculating algal bacterial system under (Natural) sunlight. It was found that the optimum removal efficiencies were 80% for COD, 72% for total nitrogen and 58% for total phosphorous.

Kankal et al (1987) studied the relationship of detention period and dissolved oxygen concentration on the efficiency of treatment by aerated lagoons. Longer detention period resulted in higher DO which improved the quality of effluent.

Katyal and Sataka (1989) have discussed the stages of sewage treatment and have designated as primary, secondary and tertiary treatment. Primary treatment was able to remove organic material responsible for 25-35% of BOD of the sewage.
Arceivala (1990) have studied the importance and use of aquatic plant ponds. The growth of algae, vascular aquatic plants, water hyacinths, hydrilla etc have been cultured in ponds for waste water treatment to remove heavy metals such as Hg, Pb, Cd, phenols, Ni, pesticides, nutrients etc from waste water.

Tripathi and Shukla (1991) conducted a study on laboratory scale to evaluate the potential role of *Eichhornia crassipes*, *Chlorella* and *Chlamydomonas mirabilis* in waste water treatment. Sewage of Varanasi city, mixed with the effluents of about 1200 small scale industries was used for the tests. Water hyacinths were grown in tanks of waste water with 15 days retention time. This resulted in very high reduction of BOD (96.9%), suspended solids (78.1%) and COD (77.9%).

The researchers reported that human waste mainly contains undigested food comprising of organic matter such as carbohydrates, proteins and lipids. Bacteria in conventional sewage treatment systems use enzymes to oxidize the organic matter, in this process electron are released. Normally electrons power respiratory reactions of the bacteria’s cells and eventually combine with oxygen molecules (Microbial fuel cell, 2004).

Lakshmi and Sundara Moorthy (2004) investigated the germination and seedling growth behaviour of Paddy and Groundnut seeds grown with tannery effluent. The germination percentage, seedling growth, fresh weight and dry weight of seedlings showed better performance upto 10% effluent concentrations when compared with control.

2.6.1. Aquatic Macrophyte

Duckweed and water velvet both have shown bioaccumulation co efficient of about 1000 for Cu and Cr (Rutiner, 1953). Of all the aquatic plants used for waste water remediation more basic biology and remediation application work has been described for species of family lemnaceal commonly called duckweed(Tarver,1986).The plant is easy to grow under simple laboratory condition (Hillman, 1961).
2.7. Solid Waste Management

The United States Environmental Protection Agency (USEPA) projects that the annual production of municipal solid waste in India will climb to about 200 million tons by the year 2000 and to 230 million tons by 2010. These projections have prompted interest in composting municipal solid waste as an alternative to landfills and incineration. Municipal solid waste (MSW) is composted to reduce waste volume and disease-causing organisms, and to cycle nutrients. While municipal solid waste can be converted into compost, the question arises about what to do with the compost once it is produced. Since there are limited markets and few standards on how to utilize MSW compost on land, only 30% of all such compost is used for agriculture, landscape, and horticulture, while 70% of the compost is land filled. Agricultural lands are excellent sites for beneficially using municipal solid waste compost as an organic soil amendment. The organic matter present in many soils throughout Minnesota and the U.S. has gradually decreased over the past 100 to 200 years. Most agricultural cropping systems result in the depletion of organic matter. Soil organic matter acts as a sink and source of nutrients in the soil system because it has a high nutrient-holding capacity. It also acts as a large pool for the storage of nitrogen, phosphorus, and sulfur, and has the capacity to supply these and other nutrients for plant growth. Soil organic matter interacts with trace metals, often reducing their toxicity to plants. The physical benefits of organic matter on soil include improved soil structure, increased aeration, reduced bulk density, increased water-holding capacity, enhanced soil aggregation, and reduced soil erosion. The application of municipal solid waste compost to agricultural soil can be a means to return the organic matter to agricultural soil and in some cases reduce the cost of municipal solid waste disposal.

The weight of solid waste generated per person per day usually lies between 250 and 1000 gm worldwide and the main constituents of domestic waste are vegetable putrescible matter, inert matter, paper glass and metals (Flintoff and Millard, 1969).

Solid waste may be defined as municipal solid waste resulting from commercial, institutional operations or Industrial solid waste and that generated in effluent treatment facilities. Therefore the term “Solid Waste/Refuse” encompasses
a wide variety of material such as discarded food, paper, plastic, metal, glass and others. These wastes results from diverse societal operations. Such wastes are collected by municipality for disposal in a common treatment facility. In some locations, these wastes are handled along with liquid wastes also (Britoon, 1972).

According to Becker (1979), yield was higher in soil amended with municipal solid waste compost compared to soil with no compost, except for the first year on a sandy loam soil. Compost carry-over effect was observed on corn yields three to four years after compost application. On the other hand, annual compost application (40 tonnes/acre) resulted in consistent yields for the three years of compost application. Supplementing the 40 tonnes/acre compost rate with half the Nitrogen needs for corn was sufficient to give optimum yield. Generally, the percent of compost N available to the crop ranged from 5% to 11%.

Deborah (1989) reported that Japanese incinerate 23 percent waste and US 9%. As population wealth, and the ability and willingness to produce disposable packaging and products increase, waste volumes also increase. This generation of waste is expected to continue to increase. Incineration is the fastest growing option in waste disposal management. The disadvantages of incineration include a large amount of money required for construction, the special need for skilled employees and high maintenance of repair costs.

Solid waste management in class I cities in India (1999) gives the information about composting process and the various types of composting. It gives the waste management by all means of treatment and has considered corresponding financial aspects (Shekdar et al., 1989).

Solid waste disposal has become a major problem because of the increase in the quantity of waste materials. Water and air pollution can result from poor disposal practice of solid waste. Other types of solid waste like hazardous waste can also become a part of municipal solid wastes. The important aspects of SWM are protection of public health, economical handling, collection, storage and disposal and resource recovery with due consideration to acceptability and conservation (Flintoff, 1976).
Giovanni Vallini and Antonio Pera (1988) suggested that the vegetable waste can be composted to green compost. He has given the performance of the composting system adopted together with physico-chemical characteristic of the starting material and the final product. Some microbiological and phytotoxicological details concerning the green compost products is also given.

Municipal solid waste management systems, as they exist in India, consist of collection, transportation and disposal, occasionally with material recovery on processing (Shekdar et al., 1989).

2.7.1. Generation of Municipal Solid Wastes

Municipal bodies have to manage the solid wastes arising from residential, commercial and institutional activities along with waste from street sweepings. Normally the municipal bodies handle all the waste, deposited in the community bins located at different places in the city. The municipal solid waste is transported to processing / disposal facilities. Majority of the municipalities do not weigh their solid waste vehicles but estimate the quantities on the basis of the number of trips made by the vehicles. Since the density of waste is considerably less as compared to the material for which these vehicles are designed to carry, such data on quantity can not be relied upon. In a number of studies carried out by NEERI the waste quantity was measured. The data indicates that the quantity varies between 0.2- 0.4 kg per capita per day depending upon the population of the urban centre. In metropolitan cities quantities upto 0.5kg/ capita/day have been recorded (Table 2.11). The percapita waste quantity tends to increase with the passage of time due to various factors like increased commercial activities, standard of living, etc. Increase in percapita waste quantity is also known to occur at a slightly lesser rate than the increase in GDP / Capita. This increase is estimated to occur in India at a rate of 1-1.33% per year (Gaikwad et al., 1985).

2.7.2. Waste Composition

The organic content is high due to the practice of the common use of fresh vegetables and fruits in the food. The high organic content also necessitates frequent collection and removal of the waste. The paper, glass and plastic content is small; these materials are sold by the citizens to hawkers, who collect and sell them for
reuse or recycling. Hence it is only that fraction which does not have a resale value and is in a non usable form, remains in the waste. The waste contains a high percentage of ash and fine earth. This is due to the common practice of depositing street sweepings in community bins. Similarly in many case the surfaces adjoining the roads are uncovered and a large amount of earth materials are swept away and mixed with the waste materials. The calorific value of Indian solid waste varies between 300- 500 kg/ m³ (Bhide and Sundaresan, 1980).

2.7.3. Trace Elements and MSW Compost

Many metals and metalloids are present in minute ("trace") amounts in the soil and water. These trace elements occur naturally as a result of the weathering of rocks. They can be leached into surface water or groundwater, taken up by plants, released as gases into the atmosphere, or bound semi-permanently by soil components such as clay or organic matter.

Metals appear in the municipal solid waste stream from a variety of sources. Batteries, consumer electronics, ceramics, light bulbs, house dust and paint chips, lead foils such as wine bottle closures, used motor oils, plastics, and some inks and glass can all introduce metal contaminants into the solid waste stream. Composts made from the organic material in solid waste will inevitably contain these elements, although at low concentrations after most contaminants have been removed.

In small amounts, many of these trace elements (e.g., boron, zinc, copper, and nickel) are essential for plant growth. However, in higher amounts they may decrease plant growth. Other trace elements (e.g., arsenic, cadmium, lead, and mercury) are of concern primarily because of their potential to harm soil organisms and animals and humans who may eat contaminated plants or soil. The impact of metals on plants grown in compost amended soils depends not only on the concentration of metals, but also on soil properties such as pH, organic content and cation exchange capacity. Different types of plants also react very differently to metals which may be present (Linsay, 1973).
2.7.4. Effects on Water Quality

In addition to affecting plant and animal health, trace elements contained in MSW composts may be leached (carried by water) from the soil and enter either ground or surface water. As with plant uptake, soil pH, organic matter content, and other soil characteristics affect the amount of leaching.

While other data on leaching from MSW composts is scarce, the evidence from long-term applications of sewage sludge suggests that the rate of leaching is low. Leaching of metals into groundwater is only likely to occur with heavy, repeated applications of MSW composts over many years in areas with sandy soils or other conditions that limit the opportunity for adsorption of metals by soil (Sinha et al., 1977).

2.7.5. Effects on Soil Organisms

Little is known about the effect of trace elements in MSW composts on soil organisms such as invertebrates (e.g., earthworms) and micro-organisms (e.g., nitrogen-fixing bacteria). When sewage sludge is applied to land, the concentration of some trace metals (e.g., cadmium) in earthworms is increased, but this increase does not pose a significant risk to the worms or to wildlife that consumes them based on the risk assessment performed to establish the new APL (Acceptable Permissible Limit) values for sewage sludge. The average values of lead, copper, and zinc in MSW composts exceed soil limits proposed by a group of European researchers to protect soil invertebrates. Those limits may be conservative, however, since metals are often less biologically available in composts than in mineral soils. There is contradictory evidence as to whether metals in MSW composts may harm soil micro-organisms, including nitrogen-fixing bacteria (Stevenson, 1982).

2.7.6. Long-term Concerns

As organic matter decomposes, the concentration of metals in compost and thus, in the soil to which it has been applied may increase. The available data suggest that if large amounts of MSW composts are applied to agricultural soils, half of the organic matter may decompose within one or two decades. Metal concentrations in soil are unlikely to exceed the concentration present in the original
compost, unless very large amounts of compost high in organic matter are applied. Over time, metals generally become less available to plants and other organisms unless soil pH decreases greatly or the soil is flooded for a long period of time (Sinha et al., 1977).

2.7.7. Potential Benefits of Trace Elements in MSW Compost

Singh et al (1994) reported the potential adverse effects of heavy metals and metalloids in MSW compost. There are also potential beneficial effects for agriculture and horticulture. Soils that have been cropped for many years may be deficient in nutrients such as boron, zinc and copper, and MSW compost could mitigate such deficiencies. Other benefits include improved soil physical characteristics such as increased water-holding capacity, improved chemical characteristics such as nutrient retention capacity, and stimulation of microbial activity that can improve plant growth and decrease the leaching of pollutants into water supplies. MSW compost may also limit harm to plants by tying up trace pollutants and toxic organic compounds (Linsay, 1973).

2.7.8. Related Regulatory Issues

For most heavy metals and metalloids, the levels in MSW compost are low relative to proposed standards for sewage sludges, such as the newly established APL values for sewage sludge. With the significant exception of lead, MSW composts can usually meet these limits. However, it is essential to remember that these values, developed for sewage sludge, may need to be adjusted for MSW compost. In addition, some toxicologists and policy makers are concerned that the risk assessment methodology used to develop such standards is based on incomplete knowledge and are advocating a more conservative approach (Woodbury, 2005).

Almitra Patel (2001) suggested that City compost helped to improve the soil condition, which is depleted due to the excessive use of fertilizers. Compost contains useful microbes and humus that aerates soil, and improve water retention and resistance to both drought and water logging, thereby reducing irrigation requirements. Organic manure invariably increased crop productivity compared to synthetic fertilizers.
Mamo et al (2002) reported that the conditions for efficient biological decomposition of organic waste depended on optimum temperatures, moisture, oxygen, pH levels and carbon to nitrogen ratios of the feedstock. If conditions deviated from these optimum levels, the composting process was slowed and chemically unstable compost may be produced.

Khambe and Bamane (2003) suggested that Garbage was an unavoidable consequence of prosperous high technology. Hospitality industry as it is called has increased multi fold during the last two decades in most of the urban centres in India. In big and medium cities due to various socio-economic factors, there is sudden increases in number of big, small and roadside eateries around every nook and corner of the city. This has contributed to a large quantum of solid waste generated in big cities. These waste can be grouped as dry waste and wet waste. Amongst the various methodologies for treatment of the solid waste from hotels the reuse and recycling methodology of dry waste whereas vermicomposting method for treatment of wet biodegradable solid waste found to most suitable, feasible and economical method because it is pollution free and purely natural process.

Indra and Sarangthem (2003) reported that increasing use of sewage on soils of sewage farms is a common practice. However a heavy load of heavy metal in organic waste may inflate the concentration of the hazardous metal ions in soil plant ecosystem and thus may find their way into the food chain of human beings and animals (Novel and Lindsay, 1972).

Zehnder et al (2007) reported that Municipal solid waste compost (MSW) results from the process of breaking down the organic components of garbage, such as paper, food scraps, and yard waste. This process helps reduce the load on landfills while enhancing utilization of normal household trash. More than 50% of normal household trash consists of organic waste (vegetable and food scraps, paper, straw, coffee grounds, egg shells, leaves, sawdust, weeds, wood, ash, and plant trimmings) that can be composted. Currently, MSW compost can be used as a soil amendment for farm fields, roadsides, lawns, nurseries, and golf courses. Alternative uses for MSW compost are possible because some MSW compost contains low concentrations of regulated elements and can be provided in large and consistent quantities.
One such alternative is to use MSW compost as bedding in cattle feedlots. Currently, paper or crop residues are widely used for cattle feedlot bedding materials. However, because of increased interest in recycling paper products in recent years, paper is no longer affordable for cattle feedlots. Similarly, some costs associated with harvesting, storing, and processing cornstalks or other crop residues for bedding may be eliminated if MSW compost emerges as an acceptable bedding alternative.

A study was conducted by the University of Minnesota to determine the impact of using MSW compost as bedding on cattle health, tissue element residues, and the environment. It was also intended to help formulate general guidelines for the use of MSW compost as a cattle-bedding alternative. The study involved bedding two pens over two consecutive cattle feeding periods (summer and winter) with either MSW compost or cornstalks. Bedding use, feed intake, and manure output were measured and sampled to gauge flow of nitrogen and phosphorous and concentrations of regulated elements. A selected sample of cattle were also monitored for regulated element concentrations in their blood and feces (throughout the feeding period) and in their kidneys and liver (at harvesting), as well as for polychlorinated biphenyl (PCBs) concentrations in their perirenal fat (at harvesting). In the trial conducted by the University of Minnesota, a veterinarian examined the cattle at the start and ends of each feeding period, and reported no abnormal observations. Nor did bedding cattle with MSW compost affect blood concentrations of macro-elements, electrolytes, glucose, or liver and kidney enzymes. Concentrations of some regulated elements found in kidneys and livers harvested from cattle in a selected sample at the end of each feeding period. Kidneys of cattle bedded with MSW compost had greater concentrations of copper and lead. Lead concentration in the livers of these cattle was greater than those of cattle bedded on cornstalks. In spite of these differences, tissue concentrations of both copper and lead fell within the normal ranges observed in healthy cattle. Accumulation of copper and lead in tissue likely resulted from MSW compost being inhaled or consumed. Further evaluation of concentrations of these elements in feces indicated that some cattle within the selected sample were deliberately consuming some MSW compost.
This resulted in concentrations of lead and copper in feces that were similar for cattle on either bedding system before the study began, but increased more for cattle on MSW compost with extended exposure to MSW compost. PCBs were not detectable in fat samples from cattle bedded with either material. All these observations, taken together, supported the conclusion that cattle bedded on MSW compost were healthy throughout the study. Also, although some MSW compost may be consumed or inhaled, concentrations of regulated elements in kidneys and livers did not increase beyond normal concentrations (Zehnder et al., 2007).

2.8. Socio-Cultural Determinants of Urban Occupation

All the human elements that determine or affect man’s occupation or livelihood can conveniently be grouped into three broad categories (a) Social elements-comprising a number of elements related with society, (b) Cultural elements-referring to the process and stage of development of a society which includes the level and trends of urbanization, economic advancement-agricultural and industrial development, transportation and communication network, public health and education system etc and (c) Personal elements-denoting the individual characteristics of man such as his age, sex, health and education together with his attitude and psychology. Age and sex are very important aspects of personal environment in determining one’s capacity and ability to adopt an occupation.

The quantum strength of labour force is determined by age-structural of population. The age structure influences the economic and social interactions, social attitudes and social and occupational mobility. Education and training are most influential factors to determine man’s occupation. It is education and training that encourage rural to urban migration motivated by the objective of acquiring prestigious non-agricultural occupations and also accelerate the pace of occupational mobility from agriculture to diversified non-agricultural fields. Education strengthens the capacity of the social groups to respond to them and there by promotes the process of development. It is a fact that high ratio of educated and trained persons make the task of economic development much easier. Further education level is higher in urban areas than in rural areas where most of the population is illiterate and uneducated.
2.8.1. Belts of Vegetation of Irregular Shape

Several kilometres around urban areas have come to be called green belts. Their purpose is to prevent further expansion of city, reduce heat and pollution and to preserve the special characteristics of some historic cities. The development of green belts was conceived long ago. This idea is almost a precursor of the present day emphasis on ecological development and conservation. The green belt, for its success, requires that there is no grazing in the area. In the absence of grazing, forests and grass lands grow undisturbed and act effectively against dust storm.

Kedir (2005) reviewed the quantitative and qualitative evidence on urban poverty in Ethiopia. The review covered the discussion of key correlates/dimensions of poverty, such as livelihood insecurity, gender, household income, prices and HIV/AIDS.

Cobus de Swardt (2005) reported that urban sprawl decreased the amount of open space, agricultural land, and natural habitats in regions surrounding cities. These regions were affected by the waste and pollution produced by the city, and were also depleted natural resources used by the city. As people move out of the city into surrounding regions, the cities expanded, and further pollution and resource depletion occurred as people traveled longer distances from home to work. Rural-urban migration also has a strong impact on the demography of rural areas. There was often a pattern in such migration with respect to age and gender, and this migration can act as a sort of "brain drain", whereby rural areas were left with the least educated people, placing them in a position of even lower social and political power.

Cities have strong socio-cultural impacts on their surrounding rural areas. The mass media depicts city life as superior to rural life, the "standard" language is deemed that of the national capital, and better services are received in the city due to its wealth. National symbols and values are generally more evident in urban than rural areas, since they attempt to bind otherwise isolated city dwellers. The fertility rate in cities are often lower than in rural areas due to the absence of agriculture, the cost of children, food and living space in cities, and family planning (Zehnder et al., 2007).
In Urban areas, there is more population density, shortage of houses, congestion, more automobiles, more crimes, prostitution, juvenile delinquencies, social tensions, riots, shortage of parks, playgrounds and open spaces, cattle problem, air, water and noise pollution, traffic hazards, industrialization. Besides this there are more contaminants, dust, more cloudiness, more fog in winter, high temperature, less humidity, less radiation, less wind speed, more unemployment in comparison to rural areas. The ecology of urban India is on the verge of collapse. One can find haphazard and chaotic growth of cities and towns, misuse of land, slums, jhuggis and jhonparies in all parts of cities. Industries are established on political ground without consideration of pollutants. Most of the residential areas are having obnoxious and noise creating industries. Heavy traffic passes through residential colonies. There are also problems for energy, electricity and water supply, health and hygiene facilities, etc. The crisis in urban areas is due to wrong orientation of science and technology, misuse of political and administrative powers, rampant corruption, nepotism, favouritism in most of the departments, misuse of funds, lack of interest in welfare activities, deterioration in morality of the people, lack of national character, implementation of the plan by untrained personnel; escapism from responsibilities, division of society in the basis of caste, creed, class, religion, etc. (Vanden Berg, 1997).