INTRODUCTION

Pollution is the introduction of contaminants into an environment that causes instability, disorder, harm or discomfort to the ecosystem and ultimately the inhabitants. Pollution can take the form of chemical substance or energy, such as noise. Elements of pollution could be foreign substances or natural, when they exceed natural levels or may be defined as the introduction of chemicals, particular matter or biological materials that cause harm or discomfort to humans or other living organisms, or damages the natural environment into the atmosphere.

Pollution is often referred to as the ‘other side’ of development. Almost all major environmental issues have their origin to pollution or the result of pollution. Over exploitation of resources and unscientific production, utilization and disposal of a variety of products have rendered air, water and land unfit for their primary designated uses. Dusty air, dirty water and degraded lands across the world are the telltale ‘souvenirs’ of global development (Joseph, 2004).

Pollution was always a concern but became popular issue only after World War II, when the aftermath of nuclear holocaust becomes evident of the radio-active fallout from atomic warfare at testing. Then the conventional catastrophic event - Great Smog of London – the leaked industrial vapour of Union Carbide factory in which killed thousands of people (Mason, Hughes and Mc Mllan, 2001), also referred to as the Bhopal gas tragedy. It occurred on the night of Dec 2-3, 1984 at Union Carbide Indian Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh India. A leak of methyl isocyanate gas and other chemicals from the plant resulted in the exposure of hundreds of thousands of people. The official death toll on the spot was 3787 (http://www.mp.gov.in/bgtrrdmp/relaef.htm.), and about half a million people whom approximately 10000 died later (Kurzman, 1987). It was the worst industrial disaster in the history, has demonstrated the universality of such events, and has prompted nations to take measures for the environmental safe
guard by introducing acts e.g. Clean Air Act, Clean Water Act, Noise Control Act and the natural environmental policy Act. But still, particularly in developing and under developing countries a lot have to be done in this respect. The impacts of pollution on health are very complex, and available methods of geographical analysis are often rudimentary. In recent years, however, considerable progress has been made, especially in respect of air and water pollution along with disposal of municipal, bio-medical wastes, and noise pollution occurring due to rapid urbanization

**Rapid Urbanization**

Rapid urbanization means massive construction work and other infrastructure development, which ultimately causes pollution, to cope up with increasing demand of housing and other infrastructure facilities, construction is going on within and outside the municipal boundaries as well. Old buildings are being demolished, roads and underground cable work is undertaken. The haphazard expansion, encroachment of agricultural lands is regular phenomenon, new multistory apartment culture, causing not only the morphological changes but also the pressure on under ground water table. Since new settlements are not covered by the municipal corporation, the water withdrawn at will. Urbanization also causes garbage, solid waste and Bio-medical waste and their disposal etc.

India is facing a serious double burden of disease. Most of the old infectious diseases like malaria, filariasis, and tuberculosis have not yet disappeared. At the same time, other chronic, non communicable diseases such as cancer, diabetes, cardiovascular and respiratory disorders are becoming more dominant.

It is becoming clear that the pattern of economic growth that we are adopting is responsible for environmental pollution. A study in the regard has shown that the economy (1975-1995) grew by 2.5 times, but the industrial pollution load measured by 3.47 times and the vehicular pollution 7.5 times. The World Bank has estimated that India is spending Rs 45500 millions/ each year on the treatment of disease caused by ambient air pollution (Brandon and Homman, 1992). It is well known that the combustion of diesel generators
small particulate matter, nitrogen oxides (NO₂), Sulphur dioxide (SO₂) and Polycyclic Aromatic Hydrocarbons (PAH). Because of low cost of diesel, preference to diesel version of vehicles is getting popular. Situation in comparatively smaller cities like Aligarh the electric power cuts has further worsened the situation particularly in summer seasons. Long power cuts has forced the use of diesel operated power generators to supply power to industries, commercial centers and domestic sections as well, which not only produce power but also the life miserable particularly of those sleeping in open air.

There is an urgent need for comprehensive epidemiological studies to show how ambient air pollution is affecting people’s health in order to provide policy tools for air quality planning,

**Indoor Air Quality (IAQ)**

Generally the houses are made up of bricks and cement with few exception of mud houses. The size of the houses is very small keeping in mind the family sizes. One room/two room houses in general are not constructed in a planned way, having very poor natural light and air, neither cross ventilation nor water out lets. The supply of drinking water is neither safe nor adequate with the result every body is trying to get more by applying technology to suck fast from the supply lines, so is the case with electric power. Those who can afford are using powerful stabilizers, leaving very little to down trodden people. Unmanaged, garbage and other wastes make the area unpleasant and unhealthy.

A lack of ventilation indoors concentrates air pollution where people often spend the most of their time. Building materials produces gas. Paints and solvents give off volatile organic compounds as they dry, fuel that being used for cooking. Indoor pollution fatalities may cause by using pesticides and other chemical sprays indoors without proper ventilation (Narayan, 2008).

Carbon monoxide (CO), poisoning and fatalities are often caused by faulty vents or by burning of charcoal indoors. Chronic carbon monoxide
poisoning can result even from poorly adjusted pilot lights: Traps are building into all domestic plumbing to keep sewer gas, hydrogen sulphide out of interiors. Although the use of asbestos banned in many countries, but here it is still prevalent in domestic and industrial sectors left a potentially very dangerous material in many localities. Producing chronic inflammatory medical condition affects the tissue of the lungs.

Today the problem of protecting the natural environment and maintaining the balanced ecosystem has become a major task of all developing countries. Conditions in fact are moving from bad to worse and more and more new problems are coming up every day and these problems are largely concentrated in and around cities. New approaches are needed to halt the century's rapid environmental decline. The countries muster the political will to change before time runs out. Environmental degradation in cities is pervasive accelerating and unabated, putting at risk people's health and livelihood and hampering the economic growth needed to reduce poverty level and health problems. The severity of environmental problems is left more in developing countries which are experiencing rapid population growth. The scale of cities development in India is quite alarming and the size of urban population is more of the highest in the world. Which affect garbage profile i.e. municipal, biomedical waste, agriculture waste, but also not only the noise pollution, air pollution i.e. indoor and outdoor. The effects of pollution are not only devastating to human but also to animals, fish and birds. Polluted water is unsuitable for drinking, recreation, agriculture and industry. The increasing human population and the rising level of technology both have become significant factors in the variations in world climate and are responsible for the various changes in atmospheric conditions as well as environmental pollution (Khanam, 2005).

Environmental pollution is one of the serious crisis to which we are facing today. It is fact that three basic elements air, water and land which constitute harmony of nature for proper and balance living of all organisms, it
was fortunate enough that such hospitable and balance environment was the destiny of our predecessors. But it is contrary to living of the present environment. With the rapid growth of population, urbanization, industrialization, commercialization, consumerism, fast changing life style, unplanned development etc. have deteriorated the ecological balance day by day and now it went beyond its sustainable limit the craze of progress in agriculture, industry, transportation and technology is taken as the general criterion of development of any nation. Such activities of man have created adverse effects on all living organisms in the planet of the earth.

Rapid industrialization has left with us polluted river and ground water, contaminated soil, depleted wild life and exhausted natural resources. Today the environment has become foul contaminated, undesirable and therefore, harmful for the health of living organisms including human beings. The root cause of pollution of the environment has been the man's unwisely and irrationally use of nature that develops the undesirable situation for conducive living of all organisms in the environment. The undesirable situation has threatened the survival of not only man but also all the organism of the biosphere (Khanam, 2005).

The increasing population and poverty are also the cause of environmental pollution which compels the people for over exploitation of natural resources of the region. Besides poverty, illiteracy, unawareness, lack of knowledge, irrational and unplanned development etc. also contributes to pollution of the environment at regional scale.

Scientist and some international organization are well aware of this phenomenon and are trying to focusing their researches at top priority levels in different countries of the world. Environmentalist, intellectuals and governmental agencies were very much concerned regarding the environmental problem. They passed many agenda and measures to reduce the pollution of the environment at global level.

The developing countries have showed significant economic shift from dominantly agrarian society to one base on manufacturing and services. Cities
in these countries have become focal point for all the activities. These cities, with their dense agglomerations of people, changing economic base and changing social and cultural environment put different pressure on living conditions. This results in great disparity in environmental conditions with in the city.

The city in India, generally characterized by problems such as neighbourhood degradation, increased road traffic, congestion, lesser mobility, socio-economic deprivation, inequality in health and access to facilities and services. They have become central issues, which in general are in poor state. There are incidences of great negligence in governance and even more significant is ignorance of population for these services leading to intra city disparity.

We are living in an increasingly urbanized world. At the turn of 21st century, about half of the world’s population (approximately 3 billions) lived in urban settlements. Estimations are that by 2025, this figure would reach 5 billions. Significantly, most of this alarming change will occur in developing countries – both in terms of the total global urban population as well as increased percentage of the individual country’s urban population. This would no doubt stress already impacted environments. However, all cities would not have similar impact, the developed world have largely overcome traditional environmental problems such as waste water removal, sanitation, water supply or indoor air pollution etc., (Fazal, 2000).

In the developing countries, the rapid increase of urban population, which is a generalized phenomenon has created a serious environmental challenges or crisis to inhabitants of the cities, as the existing infrastructure neither for so much people, nor administration is seriously trying to find out the ways to handle them, to avoid congestion on roads, unplanned housing, insufficient resulting slums, garbage heaps, blocked drains, which are posing severe threats to health and well being of the people, in Aligarh city.
An assessment of water quality showed a warning trend. All the samples found to be polluted and contaminated by faecal, coliform and bacterial count. The quality of water from the municipal piped water connection was found to be poorer than that of the hand pump. This is due to the use of uncovered storage tanks, poor maintenance by the Jal Nigam of old, rusted, leaking distribution pipes submerged in sullage. The use of boosters by consumers on the main municipal lines aggravates the problem of water pollution by sucking the waste product. The city has very poor sanitation condition characterized by, opens over flowing drains, non operative sewer lines, absence of water treatment plant, heaps of garbage and overflowed waste bins.

The topographical layout of the city is such that there is no natural drainage. The city is located in the central low lying tract. Not only does the dirty water from the city is store here, also the water from the neighbouring parts also flows in. as a result, the city suffers from water logging problem all the year round. There are 150 big and small open drains in which flows both the gray water (from kitchen, bathrooms, laundry etc.) and the black (from flush toilets). At about one third of the city area, the sewage system has been laid but it is mostly in operative. There is one waste water treatment plant but it is not functioning. So large amount of untreated waste water either finds its way in the fields or it re-enters the drains. The city has nearly 6000 dry and 3000 wet latrines (District Urban Development Authority, DUDA, 2005).

The excreta from the dry latrines are disposed either in the open drains or along the roadsides or in the garbage bins. Heaps of garbage, overflowing municipal bins, unlittered roads, rag pickers and animals spreading out the waste near the bins and exhausted land fill sites can be seen. The city suffers from the problem of uncollected garbage. It is very common to find large heaps of garbage in unorganized manner at every nook and corner of the city. Everyday about 120 tons garbage remains uncollected on the streets and there is no proper management for the solid wastes (DUDA, 2005).
City’s roads are encroached upon by commercial activities leading to chaotic situation. Expansion of built up urban area and the changing nature of land use have been the most crucial factors of spatial pattern of urban growth in the city. From 1981 to 2001, the development of the city was at its peak, during that period the growth took place in all direction of the city. Aligarh city has recorded a significant increase in built up area mainly due to growth of population and addition of secondary and tertiary activities. However, the expansion of built up area was haphazard and without any planning. Even most of the recent residential colonies are developed without the provisions of basic amenities, resulting in severe congestion in road traffic. The statistic shows that urban area has increased from 2234.3 hectares in 1974 to 5653.2 hectares in 2007 and recorded an increase of 153 per cent. During this period the city has witnessed changes among various classes of land use. The residential area recorded an increase of 2768.6 hectares (280.2 per cent), commercial area, 142.3 hectares (241.5 per cent) and industrial area, 86.3 hectares (138.7 per cent). These changes basically swallowed the agricultural land of the surrounding rural areas (Ashraf, 2007)

Uncontrolled urbanization in the city has led to various types of environmental problems like shortage of housing, unprecedented water crisis, contamination of water, excessive air and noise pollution, traffic bottlenecks and problem of waste management etc. the situation is worse in old parts of the city. All these situations have resulted in degradation of environment and severe health hazards in the city.

Three years after the millennium, for the first time in human history, a majority of the world’s six billion people will live in cities (UNCHS, 1996). Motorization is inextricably linked to urbanization. Mobility in urban areas is of particular interest, because limits of space and high densities of land-intensive individual transport modes, (cars, two and three wheelers) result in congestion. The present study tries to investigate the influence of the process of urbanization on the vehicular traffic and vice-versa in Aligarh city. The result
show that the increases in income level, inadequate provision of public transport services, and uncontrolled expansion of urban limits have given rise to the number of vehicles in the city. There is also increase in the number of individual means of transport (motorized) apart from the public transportation system which has led to high emission level of pollutants. The situation is alarming, because there are ground level sources of pollution and a large number of people live, move and operate along the roads, and are thus exposed to automotive pollutants. Levels of traffic congestion and emission along the major roads of Aligarh city have been found on the basis of traffic surveys. Nearly 75 per cent (0.25 million) of all vehicles are two wheelers mostly two-stroke engine driven. The number of motor vehicles in Aligarh city has increased from an estimated 16,000 in 1971 to 81,000 in 2001 (Ashraf, 2007: 72).

The menace of noise pollution is growing in the city day by day due to increase in population, rapid industrialization, urbanization, commercialization and phenomenal growth in automobiles. The noise level in residential, commercial and industrial areas during 2006 is exceeding the prescribed limit at all the monitoring places. Noise can cause annoyance and aggression, hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances and other effects. Furthermore, stress and hypertension are the leading causes to health problems, where as tinnitus can lead to forgetfulness, severe depression and at times panic attacks. High noise can contribute to cardiovascular effects and exposure to moderately high levels during a single eight hour period causes a statistical rise in blood pressure of five to ten points and an increase in stress (http://www.wikipedia.thefreeencyclopedia)

The poor environmental condition and its manifestation in the form of ill health is quite visible in the study area i.e. Aligarh city as they are in other urban centers of India. These issues desire a serious attention because the unchecked and unresolved environmental pollution will bring the dwellers of Aligarh city at the verge of complete disaster.
Aligarh residents are unhappy with the unchecked growth of industrial units in the town and subsequent pollution, particularly 27 hazardous wastes generating units. Aligarh is famous for lock industry, brass exporters lobby making Rs.70 million per year but putting health risk to the habitants because of chemicals like trichloroethylene used in electroplating units to remove stains from brass products before they go for final polishing (Down to Earth, 2003). Nobody seems to care how many different types of hazardous chemicals are being used and dribbled in open drains in residential areas. But health problems like breathlessness, headaches and nervous disorder are common among the residents of Aligarh (Down to Earth, 2003).

What all this boils down to is that brass exporters in Aligarh will continue to get richer with government collusion. They will also continue to expose nearly 0.7 million residents to the hazards of chemical wastes that are being generated in their own backyards.

The present study attempts a geographic analysis for the concept of livability in a growing urban centre of north India. Here the concept of livability has been defined as the response of the population to the prevailing natural, social, cultural and economic environment. Livability is behavior related function of interaction between environment and personal characteristics. It is about the human requirement for social amenity, health and it includes both individual and community well being. Any causal visitor will notice the deteriorating condition of environment in the city. It is evident that various forces of use and exploitation are involved in putting the surroundings to such a pitiable condition. Further more the degradation is uniform through out the city.

In the present work an attempt has been made to study. “Impact of Environmental Pollution on the habitat of Aligarh City”, which is the home of approximately 0.67 million people, who are subject to sufferings. Unabated urbanization and lack of investment for infrastructure development have made
a disastrous impact. Attention should be given to the problems of cities. Like Aligarh which is no longer small, but they are fast developing big problems. Here clean and green environment of the city is a dream. There is an increasing problem of contaminated air, water, solid/liquid waste and noise, flies breed in human and animal excreta in the open. Solid waste logs drain and mosquitoes buzz over pools of dirty water. Drains are open full of water and solid waste mostly polythene) which remains stagnant. The Aligarh city main problems are waste disposal and drainage (municipal and bio-medical). There is mismanagement at the municipal, hospitals/ dispensary and households level. In Aligarh there is no outlet of waste water and proper management of disposal of solid waste therefore most parts of the city get submerged not only during the rainy season but water logging can be observed all the year round and heap of solid waste seen in many parts of the study area.

(i) Significance of the Study

It is axiomatic than destiny of the nation lies more unhealthy population, but many of us rarely appreciate the fact that the vast majority of our population is ill fed, ill clad and live in dilapidated houses. The vicious circle of disease- low production- low income- poor health services- more disease and more poverty not only poses a problem of health and sanitation but also of social welfare and social justice. Poverty is also hindrance in the protection of the environment. Dilapidated houses restrict fresh air, non availability of pure drinking water, sanitation etc.

Para dime shift from rural to urban and from agriculture to urbanization has added more to the already existing problem by polluting the environment at large scale i.e. air, water And soil in respect of RSPM, SPM, SO₂, NO₂ as well as mental concentration. Shrinking gap between supply and demand has caused anxiety among the scientist as the rivers are drying, water table is going down and the quality of potable water is getting bad to worst, causing more than 4500 to die every day in India from water related diseases. Urbanization on an
alarming rate has resulted in large number of vehicles, coupled with unplanned factories/industries have increased the noise and air pollution to a level which is harmful and causing stress related diseases.

Another big problem associated with urbanization is the problem of solid waste, bio-medical waste and its disposal. Problems become more severe when the bio-medical waste is mixed with municipal waste,” half of the bio-medical waste generated in countries hospitals is just dumped with municipal garbage without any special treatment”. Hence causing disease like Asthma, Conjunctivitis, Rhinitis, Tuberculosis, Eye inflammation, Malaria, Headache, mental problems, insomnia, Diarrhea, Dysentery, and Jaundice etc. therefore it is imperative to find out the causes so that in can be managed and remedial measures can be taken.

(ii) Objectives of the Study

- To know the physical and general characteristics particularly of sampled wards and Households of the study area, which provide necessary base framework for generation and utilization of resources.
- To analyze the nature and intensity of environmental pollution in the study area, i.e. air, water, and noise pollution.
- To analyze the problem related to solid waste generation its composition and its disposal.
- To examine the levels of indoor and outdoor noise and air pollution and its impact on health.
- To examine the water supply conditions in Aligarh city- sources of water supply, status of water supply quality of water, drainage, sullage and water logging problem in study area and its impact on health.
- To assess the generation of waste, disposal, mode of storage of household waste, and collection frequency.
- Finally to analyze the impact of environmental pollution on human health and measure to minimize its impact on the habitats of the city.
(iii) Hypothesis

1. Unplanned, rapid influx of migrants to the city in large number makes the system defunct and results in environmental degradation.

2. Rapid urbanization with increased number of vehicles not only causes jams here and there but also pollutes the air, making life miserable, particularly of those living on road sides.

3. Increased number of vehicular traffic and the factories coupled with power generators (Largely Diesel versions) to make up long power cuts, which not only keep on producing the hazardous smoke but deafening noise as well.

4. Most of the water lines in the old city are running along with sewerage channels or sewerage lines, result in serious threat to the habitats as it gets polluted with sewerage.

5. Health of the inhabitants depends upon the surrounding as well indoor environment.

(iv) Database and Methodology

The data were collected mainly from primary and partially from secondary sources. This study is mainly based on primary sources of data which has been collected through field survey.

- Survey of the sampled households in the selected wards of the city on the basis of questionnaire / interviews.

The field work was done by the author during the year 2006. For getting the accurate information, the sampled wards and households were visited frequently. Data from secondary sources have been collected from the different government publications and records.

- National Informatics Centre (NIC) District Collectorate Road, Aligarh.
• Ambient Air Quality (2007), CPCB, Ministry of Environment and Forest New Delhi.
• Aligarh Municipal Board, Sewa Bhawan, Aligarh. Refuse Removal Department, Sewa Bhawan, Aligarh.
• Aligarh Development Authority, (ADA), Ramghat Road, Aligarh.
• District Urban Development Authority, Sewa Bahawan, Aligarh.
• Regional Pollution Control Office, Aligarh.

The secondary data has been taken from the above government agencies. Though, government data is not 100 per cent reliable, but it is the only source to cover up large area. That is why the work related to secondary data is not very much appreciated. To check the authenticity/reliability of the government data a sample survey was taken up to collect the primary data for reliability check.

It is found that in some cases it is by and large correct e.g. population figures but other related information is not correct, for example Garbage is scheduled for weekly collection. But is not being picked up for weeks, in the same fashion on High court directive polluting Brass industries was banned in the residential areas but are still there etc. (Down to Earth, Nov. 30, 2003).

Methodology

The following methods were used in this study:

(1) Preparation of questionnaire
(2) Sampling procedure

For the purpose of selecting the sample, multistage stratified sampling design was adopted.

The selection of wards was purposeful one. Aligarh city is subdivided into 60 wards. Eleven wards were selected on the basis of their location (Core area, civil lines area and peripheral area)
Table 1 Classification of the Sampled Wards on the Basis of Location

Aligarh City

<table>
<thead>
<tr>
<th>Location</th>
<th>Wards Numbers</th>
<th>Ward Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the old part of the city</td>
<td>5</td>
<td>Sarai Bala</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>Kala Mahal</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>Rasalganj</td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>Tan Tan Para</td>
</tr>
<tr>
<td>In the new part of the City</td>
<td>9</td>
<td>Kishore Nagar</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>Begpur</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>Dodhpur</td>
</tr>
<tr>
<td>In the Peripheral part of the city</td>
<td>8</td>
<td>Nagla Mehtab</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>Bhujpura</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>Hamdard Nagar</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>Dori Nagar</td>
</tr>
</tbody>
</table>

Source: Based on field survey, 2007

Selection of Household

From each of the selected wards ten percent of the total households belonging to different income category were selected using stratified random sampling technique. The total sampled size consisted of 1925 households.

Table 2 Households Selection on the Basis of Income Level

<table>
<thead>
<tr>
<th>Income group</th>
<th>Income (Rs/month)</th>
<th>Number of sampled households</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>&gt;10000</td>
<td>387</td>
<td>20.06</td>
</tr>
<tr>
<td>High</td>
<td>5000-10000</td>
<td>505</td>
<td>26.07</td>
</tr>
<tr>
<td>Medium</td>
<td>3000-5000</td>
<td>565</td>
<td>29.38</td>
</tr>
<tr>
<td>Low</td>
<td>&lt;3000</td>
<td>468</td>
<td>24.29</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1925</td>
<td>100.00</td>
</tr>
</tbody>
</table>
To achieve the objective of the study, primary data were obtained through a questionnaire, interviews and personal observations of the selected households by the author and the information obtained so is correct and reliable. For getting accurate information about the area under sample survey, selected households were visited and the questions given in the questionnaire were asked also the related aspects were discussed and the responses were taken on the sheet. During the course of survey author observed that some of the residents were reluctant few, even some refused to cooperate but by and large author was able to extract the information required by taking another household. The response of the inhabitants were not uniform, varied from ward to ward, the worst were from Bhujpura ward where the maximum refusals (30 per cent) were faced may be due to ignorance and illiteracy, as that is inhabited by traditional society. Where as from Kishore Nagar and Dodhpur wards areas, the responses were almost 95 per cent that may be attributed to education and awareness particularly among women.
Test of Water, Air, and Noise

For testing the water quality 22 samples were collected from 11 selected wards (11 samples from municipal tape water and 11 from hand pump water) and put to physical, chemical and bacteriological test. The test was conducted at Regional Pollution Control Office Lab, Aligarh. Average exposure of noise of the sampled wards in Aligarh city was also tested by the Regional Pollution control office, 2007.

To examine the degree of impact of household environmental pollution on human health of study area, some important independent variable of household pollution and dependent variables – disease affecting to human health have been analyzed using standard statistical techniques. Household environmental pollution has been divided under four sub headings i.e. household air pollution, household water pollution (water supply and sanitation condition), household noise pollution and household solid waste generation and disposal.

To examine the degree of impact of household environmental pollution on human health, primary sources of data have been generated through conducting field survey during 2006 to 2007 taking 10 per cent household sample from selected wards of the city, i.e. 11 wards (Fig. 2) the numbers of households are varied from wards to wards depending upon their size. Detailed questionnaire has been prepared for obtaining the information from the respondent. Different age group, men and women have been interviewed.

During the course of survey affected and non affected people from different disease use interviewed and information pertaining to disease affected from nearest private nursing home, Govt. hospitals and medical college. The information obtained from primary and secondary sources has been organized, categorized, analyzed through standard statistical techniques i.e. simple percentage.
The relationship between dependent and independent variables has been analyzed using Karl Pearson’s technique of correlation of coefficient. The testing of the hypothesis and the findings shows a significant level of correlations between the variables, which have been calculated on the basis of Karl Pearson’s Model of Correlation.

\[
r = \frac{\Sigma xy - \frac{\Sigma x \Sigma y}{N}}{\sqrt{\Sigma x^2 - \frac{(\Sigma x)^2}{N}} \sqrt{\Sigma y^2 - \frac{(\Sigma y)^2}{N}}}
\]

Where, \( r \) refers to coefficient of correlation
\( x \) and \( y \) are independent and dependent variables
\( N \) denotes number of observation

Significance test of coefficient of correlation

\[
t = r \sqrt{\frac{N - 2}{1 - r^2}}
\]

Where, \( t \) = Calculated ‘t’ value
\( r \) = Coefficient of correlation
\( n \) = Number of observation

To find out the intensity of household environmental pollution (household air, water, noise pollution) has been examined using Z-score or standard score technique. In this method each variable has got standardized. The scores measure the departure of individual observations expressed in a comparable form. It is a linear transformation of the original data based on the composite mean Z-score the index of development of each component aerial unit has been estimated.

Z-score
\[ Zi = \frac{x_i - \bar{X}_i}{\delta_i} \]

Where,  
- \( Zi \) = denotes standard score of \( i \)th variable  
- \( Xi \) = original value of \( i \)th variable  
- \( \bar{X}_i \) = Mean of \( i \)th variable  
- \( \delta_i \) = Standard deviation of \( i \)th variable

The model of composite Mean Z-score is thus

\[ CS = \frac{\sum Z_{ij}}{N} \]

Where C.S refers to the composite Mean Z-score  
- \( Z_{ij} \) = standard score of \( i \)th variable at \( j \)th unit of study,  
- \( N \) = Number of variables.

Besides pictorial presentation of analyzed data has exhibited in the form of graphs, diagrams and maps using GIS techniques software Arc view 3.2 version.

**Selected Ward’s Profile for the Study**

The study area spread over eleven selected ward from the total 60 wards of the Aligarh city (Fig.2). The sampled wards can be category into three parts on the basis of location.

(i) Wards located in the old area of city.  
   (Rasalganj, Tantanpara, Sarai Bala and Kala Mahal)

(ii) Wards located in the new area of the city  
    (Dodhpur, Kishore Nagar and Baigpur)

(iii) Wards located in the peripheral area of the city  
     (Hamdard Nagar, Nagla Mehtab, Dori Nagra and Bhujpura)
Chapter Scheme

The whole work has been divided into seven chapters besides introduction and conclusion. The main thrust is on the environmental pollution and its impact on the inhabitants of Aligarh city.

Introduction includes the definition of environmental pollution and its impact on health in general and study area in particular, urbanization, indoor pollution, significance of the work its main objectives, hypothesis, data base and methodology, conceptual framework and finally the literature review. Chapter first deals with the study area, its physical and socio-economic environment, covering physical settings and aspect of socio-economic conditions i.e. population, industrial development, commercial activities etc. Chapter second focuses on air pollution its sources, impact on health, seasonal and occasional variations. Its also include average concentration of So₂, No₂ and growth of vehicles in recent decades and the air quality along the road side.
Chapter third takes up noise pollution its sources noise level in some Indian cities, average ambient noise level in Aligarh city- day and night at different location and the occasional noise records. Chapter fourth deals with the water pollution, its sources, status of water supply in the city and its quality – water analysis of municipal and underground water of Aligarh. Chapter fifth deals with solid waste its generation, waste collection zones, disposal and management in Aligarh city, and finally the biomedical waste of two major health centers.

Chapter sixth analyses the general characteristics of sample household, cause of air, water, noise and solid waste generation in Aligarh city. Chapter seventh is the core chapter which evaluates the nature of indoor pollution (air, water, noise, and solid-wastes), its impact and intensity with associated diseases. Lastly conclusion and suggestions protect the habitat and inhabitant from suffering and the area may be saved at least from further deterioration.

(v) Conceptual Frame Work

As defined environmental pollution could be of different origin i.e. air, water, noise and solid or bio-medical waste etc. It could be outdoor or indoor as well e.g. Air pollution, which has no geographical boundary, the dust of volcanic eruption sometimes covers many countries or the smoke of oil burning in Gulf made the life miserable of neighboring countries for months together. There is primary pollutant, secondary pollutants of different nature; coming from different sources i.e. automobiles, industries, power houses, and domestic sections etc. causing health problems.

Since, the beginning of human history water has played a very important role that is why all the ancient civilizations flourished on the bank of rivers. But with passage of time the quality and quantity of water available suffered setback. The quality suffered on account of pollution of its sources and the quantity suffered from over stretched demand due to rapid increasing of
population, more water is needed to grow more food and industrial revolution causing health problem of various nature.

Noise Pollution: Noise when exceeds the recommended level becomes pollution. It has auditory effects and non auditory effects, causing fatigue, deafness if exposed for a longer period, may cause noise interference with speech communication between 300-500 Hz frequencies which comes out generally with vehicular horns etc also results in psychological changes, and mental disturbances, irritation etc.

Solid, Bio-medical and Municipal Waste: Solid waste is by product of domestic, industrial, commercial or agricultural waste where as bio-medical wastes that comes from health centers. While municipal wastes are generally consist of garbage, fresh or anything discarded by domestic sector, or commercial establishments or the roads and streets cleaning. The generation and disposal of all the wastes need proper management by segregating them and disposing accordingly.

Indoor Pollution: it is most important aspect as the family spent most of the time inside, particularly ladies, exposed to different sort of indoor pollution affecting their health.

(vi) Literature Review

The earliest known writings concerned with pollution were written sometime between 9th and 13th century by the Persians scientists such as Mohammad Ibn Zakaria Razi, Ibn Sina and Al-Masihi etc. covering different aspects of pollution such as air, water, soil and solid waste problems in certain areas. In this regard some important decisions were afterwards too, like banning of sea coal burning by King Edward Ist in England after its smoke had become a problem in 1272 and during the industrial revolution problem of Great smog of 1952, followed by extreme cases of water pollution of river
Thames in 1858 which forced the administration to opt for proper sewerage system for London to save the lives and the problems of similar nature and a lot has been written about their impact at different level in different countries of the world including India.

A review of literature here involves only those studies in last thirty years, which are concerned with the variables of the present study. In this chapter the total volume of literature collected has been dividing into subgroups dealing with different aspects of pollution viz., air, water, noise and solid waste etc.

Agarwal, & Ghosh (1974) monitored levels of air pollution in various parts of Kanpur city and correlated level of air pollutants with incidence of respiratory diseases. This study opened a new direction to scientist including geographers for further research. Bhattacharya, et al (1978), says that environmental hazards are caused by man himself. These may either be health hazards caused by man's inability or insufficiency of space for human living and movement resulting in congestion due to imbalance between increase volume of traffic and space for its flow. The National Environment Engineering Research institute (NEERI, India) conducted a study in 1983 and published a report on the air quality of the different selected cities in India. The city of Calcutta (Kolkata) has been divided into different functional zones and air quality of those has been studied in different seasons viz winter, summer and monsoon: The main pollutants are SPM, SO₂, CO₂, NO₂ and hydrocarbons. The report gives a good idea about the spatial a well as temporal variation of pollutants in the city. Singh (1993) conducted a detailed study on Air Pollution analysis of Varanasi city. Automobile exhaust is the main cause of air pollution in city as it causes toxic gases in the atmosphere. Further,
author has concluded that as the number of motor vehicles will increases in the city the amount of gases emitted from them will also increase owing to increase in traffic density per hour at congested crossing of Varanasi city. Bhargava (1994) in his study of air pollution in Kota, Rajasthan has made to deal with industrial, domestic, vehicular and some extent garbage disposal and incinerations are the source of air pollution. Joumard (1996) studied paper in the scientific content of the 3rd symposium: “Transport and Air Pollution”, held in Auignon in June 1994 has observed between the issues dealt with namely the impact of air pollution, pollutant emissions and potential solutions as well as balance between the various modes of transport. Pfeffer, (1996) et al concluded their paper entitled air pollution monitoring in street canyons in North Rhine Westphalia-Germany that road traffic is one of the most important sources of air pollution in cities. According to a new section in the German Federal Clean Air Act authorities may restrict or even ban motor vehicle traffic under certain conditions .An ordinance proposed by the federal government will define the details to prepare the implementation of the ordinance. The North Rhine. Westphalia-state environment agency started a pilot programmed to measure nitrogen dioxide benzene, root and other air pollutants at two sites with heavy traffic in Dussel Dorf and Essen. The essential of the proposed ordinance, the monitoring programmed and results of the measurements are presented. Ghose and Banerjee (1996) have studied in thir paper the importance of coal washeries in India is growing as local coals have a high ash content .At present, there are coal washeries with an annuals rated input of 45 million tones. During the various operations in washeries, large amount of dusts and gaseous pollutants are generated .Air monitoring stations were set up in local industrial, residential and sensitive area and air pollution samples were collected along with micro-meteorological data. Diurnal variations of SPM,
SO\textsubscript{2}, NO\textsubscript{x} and CO are discussed. It was observed that about, 50 per cent of the dust particles were less than 10\textmu in diameter. Morecroft (1996) has studied that the damaging effects of nitrogen dioxide and nitrogen containing gases on the natural environments, were initially thought of as a secondary problem. This paper discusses the dramatic rise in the last 100 years in the deposition of air born pollutants of which nitrogen dioxide and ammonia are the most important and outlines the effect of this rise on natural and semi-natural ecosystems. It concludes that the most effective way to mitigate its negative effects is to reduce the level of nitrogen emissions from vehicles and power stations.

Anjum (1997) has made an attempt to point out the overall habitat, environmental degradation and quality of life of Abdullahpur District Meerut. As a result of water and air pollution several diseases are prevalent in the area. The study area requires serious attention to maintain and protect environmental quality. Ramachandariah (1998) has analyzed the rising air pollution levels as a consequence of growing number of vehicles in the twin cities of Hyderabad-Secunderabad. Since most of the vehicles are petrol driven, they account for about 90\% of the total pollution load. Some of the industries in the city are emitting huge quantities of SO\textsubscript{2} and NO\textsubscript{2}. The main values are also high for many localities. High SPM levels Hyderabad falls in the category of critical as per the CPCB norms. Saxena (1999) has contributed to the study of air pollution and its hazardous effects and this study has discussed the efforts going on worldwide to control air pollution. Ghosh (2000) studied that air pollution load as suspended particulate matter (SPM) is found to be high in Calcutta. In his paper an attempt has been made to expose the association between levels of air pollution and health condition of the people of Calcutta. Dhar (2000) highlighted the nature and acuteness of air pollution in the Jharia
coalfield to locate the vulnerable zones requiring necessary control measure. Day (2000) observed that air pollution from industries and automobiles are causing a number of diseases like lung cancer, asthma and bronchitis. Automobiles and diesel engine exhaust contain lead, which is a carcinogenic causes severe problem. Finally author has suggested some remedial measures to overcome the problem of air pollution.

Kapadnis (2002) conducted a detailed study on the Air pollution in Nasik: An Industrial City of Maharashtra. The paper reviews the recent development of industries in Nasik city. Its impact on air pollution, GIS and cartographic techniques for mapping air pollution in Nasik city. The air pollution study of the city indicates that the average concentration values of air pollution such as \( \text{SO}_2, \text{NO}_x \) are with permissible limits. However such studies will have to be carried out at different seasons to assess the pattern. In his paper an attempt is made to use of GIS and cartographic techniques for mapping spatial variation in the intensities of air pollution levels in Nasik city and also comparison with other physical and cultural attributes, such as roads, vegetation, urban functions etc.

Devi (2003) has pointed out a highly industrialized region in Orissa arid one of the 22 hot spots of India which is reeling under massive industrial pollution and environmental degradation. Air pollution has been the most alarming phenomenon censed by a variety of manufacturing activities, large scale coal mining, combustion of fossil fuel and vehicular movement on roads and has brought about undesirable incidence of cardio-vascular and respiratory diseases among the people in Talcher-Angul industrial region. This region is suffering much from air pollution that affects human health very adversely.
According to a report Parivesh (2003) Air quality is affected not only due to conventional air pollutants but also due to odour. The present issue of Parivesh newsletter is an attempt to throw some light on the causes and processes of odour formation and also sampling measurement and control technologies. Das (2004) studied that the physical, social and ecological aspects of environment are all related to human health and well being. Residents of east Kolkata are facing a lot of respiratory disorder due to several thousand of household products, which pose a serious threat to indoor air quality. However after 2004 several studies such as Pattnaik (2006), Saxena (2006), Jat and Mathur (2007), Sinha and Bahuguna (2007), Reddy (2008) and Mohan (2008) have been completed.

Sinha (1991) has classified various human activities that cause water pollution. Human activities relate with water pollution comprise various industries such as mining and agriculture. Unsanitary water and malnutrition account for most of the illness and health. The increasing concentration of population has invited the concentration of pollution sources. Edwin et al (1996) study on the intensity of ground water pollution in Ariyalur Udayarpalayam regions of south India. The study reveals that ground water pollution occurs due to many sources, which includes chemicals and other toxic; wastes of agricultural and industrial activities. Ranjan (1997) has studied that mining activities adversely affect the surrounding environment. It has posed serious problems for human health and causes various diseases among mine professionals and local inhabitants. The discharged water as effluent containing soluble and insoluble particles causes serious water pollution. Singh et al (1997) in their research paper entitled impact of mining activities on
surface water quality: A case study. The paper aims at focusing upon the deterioration in surface water quality of rivers, reservoirs and nalas due to mining activities in the region. For this, an extensive field survey was made and samples of water from Rihand reservoir and Balia Nala, and affluent discharged from Jayant and Khadia Coal mines were collected and analyzed for physico-chemical characteristics to know the suitability of water for human and aquatic life. Saxena (1999) studied that the rapid growth of population, urbanization, industrialization and increasing use of chemicals has resulted in water pollution. Sewage and polluted water are responsible for several water-borne diseases. Author has also suggested some remedial measures to control water pollution. Katiyar (2000) examines that the major pollutants of water are organic pollutants, sediments, radioactive materials and thermal pollutants. Pollutants can be treated through scientific advancement. The stage involved in the treatment of polluted water has also been, discussed. Rehman (2001) conducted a detailed study of assessing ground water quality in the shallow aquifers of Aligarh city. The study reveals that the concentration of heavy toxic metals especially Cd and Pb are above the permissible limit. This poses danger to a large section of people living in the city.

Chattopadhyay (2003) studied about basinal characteristics and environmental degradation case studies from selected rivers of Kerala. Higher levels of TSS and IDS due to land degradation have also been discussed. The present issue of Parivesh (2003) is an attempt to have a comprehensive scenario about ground water to promote better appreciation of the concept of sustainability and poor our efforts in conserving groundwater resources of our country. Depletion and deterioration of ground water quality have become a
major issue of national concern. Mahindru (2004) in the United Nation Conference of Environment and Development (UNCED) had indicated way back in 1992 that 70 percent of water is polluted and 80 percent of the diseases are water related and responsible for 33 percent of the total deaths. The situation is needed extremely grim. Yang, et al (2004) found that Changquing, an industrial city, has been experiencing serious water pollution problem due to rapid economic growth in recent years. He applied human capital approach to assess the economic losses and damages caused by water pollution and categorized it into two types- damage to ecosystem and non-ecosystem. Akhtar, N et al (2005) made a detailed study undertaken to assess the ill effects of water pollution on human health in urban area (D-type colony) of Faisalabad. In Pakistan the problem of water pollution is also growing at an alarming rate. The phenomenal increase in country’s population has brought unprecedented pressure on safe drinking water. Water born diseases account for 20 to 30 percent of all hospital cases and 60 percent infant deaths. Chaudhury (2006) outlined the quality of soils and ground water in Faridabad. Based on the concentration of different parameters (i.e. PH, DO, BOD, COD, Alkality, Sodium, Potassium, Magnesium and Moisture), collected from five sampling stations, he conclude that the ground water of the city is highly polluted and unfit for drinking as the level of all the tested parameters is higher than the admissible limits. There are many studies after 2006 regarding water pollution such as Peter and Mollinga (2006), Saxena (2006), Oelofse, (2007), Jat and Sujata, M (2007), Ghosh, A (2007) Bahuguna and Rajiv, (2007), Kumar, (2007), Reddy, (2008) and Mohan (2008).
Dhar (1993) conducted a detail study in his paper entitled "Noise Pollution: Impact and Analysis Noise by itself is a by-product of human activity. The area of exposure increases directly in proportional to the population growth. The need for higher power generation, increased transport and such other activities disturb the natural ecosystem. Noise pollution, which is hazardous to hearing, can be produced by a variety of sources, depending on the intensity end duration of exposure. Bhargava (1995) studied that noise pollution is a major environmental hazard, it can cause occupational nuisance and work zone problems and can lead to severe health hazards. Mini steel plants and large scale plants in India have begun to give serious consideration to the problem of noise pollution by adhering to the guidelines for pollution control as envisaged by the environmental protection act 1986 and other environmental regulatory standards for noise. Verzinin et al (1995) has made an attempt to study about an interdisciplinary urban noise pollution. Interdisciplinary research in two stages was carried out in Coroloba, Argentina, in four zones with different urban noise characteristics. Ramani and Madhuri et al (1996) have analyzed that environmental noise control can be achieved by stipulating and-proper implementation of environmental standards. They observed that noise levels at important traffic junction of the city. Swaminathan (1997) made a detailed study of Madurai metropolitan city with special reference to noise pollution generated by high density of vehicles, markets and people’s activities. He found low noise level in peripheral areas and higher in the core areas of the city. Dhak (1998) found noise pollution due to power generation, increased transportation and other developmental activities as one of the most pervasive environmental problems
of urban and industrial society and emphasized that the area of exposure increases proportionately to the pollution growth.

Mahendra (2001) has discussed the regional planning for air and noise monitoring network. The state has high population, high growth rate, heavy and small scale industries many of which are polluting type. There has been a change in the quality of air and noise. A GIS based analysis has been done to arrive at the locations to be monitored, with scaling and weighting technique adopted for, identification of locations with maximum vulnerability. The profile for noise has been described by Saxena (2006), Jat (2007), Sharma and John (2007), Sengupta (2007), Sinha and Bahuguna (2007) and the other aspects by Saha (2009).

Bhide et al (1972) has rightly pointed out that refuse disposal is a persistent problem in Calcutta city. The author has identified that due to tremendous increase in refuse beyond capacity of the disposal sites has created ugly and unhealthy conditions. Rao and Datta (1977), have studied the industrial effluent, unlike municipal domestic sewage are highly variable in composition and nature. The characteristic of the industrial waste depends upon the type of industries and vary from plant to plant even of the same industry. The technology involved, the raw material used, chemicals consumed quantity of the main and bye-products produced etc. are by and large responsible for determining the volumes and the pollution strength of the wastes produced. Bhandari and Palria (1989) made a detail study of problem of industrial pollution in Jodhpur city. The industries are the principal source of waste both in terms of quantity and toxicity. Most of the industries of the
city produce substances and chemical which are not potentially toxic. The authors have also suggested some remedial measures to control the pollution of the city. Hamza (1989), says that the government of Alexandria lacks the personnel’s and equipment needed to remove waste from the streets and piles of solid waste in the streets, at sorting sites and open dumps are breeding areas for flies, which creates an unhealthy and unpleasant environment.

Chon, et al (1995) provided a comprehensive analysis of soil pollution in the Seoul metropolitan city and found heavy concentration of metals (Cu, Pb, Zn and Cd) in the soil due to brass and bronze factories, and vehicular emission. Sharma (1996) and others have carried out work in the area of photochemical, Chemical and biochemical treatment of hazardous industrial waste. Hazardous wastes inducing non-biodegradable plastics may be co -incinerated with low-grade coal in rotary cement Kilns. Refining coal can control pollution form the combustion of coal. Hazardous and other wastes including hospital wastes may be incinerated in specially designed incinerators.

Ananad (1999) has made an attempt to study the waste Management in Madras. In this paper examines how households in Madras view garbage problems, what their preferences are for improved service and extent to which they would pay for them. The findings highlight how people are willing to cooperate and pay substantial sums for waste collection, but for other waste management costs. Singh and Srivatava (1999) have conducted a detailed study on problems and management of solid wastes of Lucknow city. Out of 1608 tons of garbage generated per day only 1074 tones are disposed of due to insufficient number of vehicles. The garbage accumulated on streets market
contras in residential colonies on roads and other places. On the bases of study it may be noticed that Lucknow city is facing severe health problem due to improper disposal of solid waste and its faulty management system.

Basu (2000) studied that the management and disposal of solid waste posing a severe problem for this rapidly developing industrial city Durgapur of West Bengal. The researcher has taken an attempt to bring forward the direness of the situation and also seeks to find out possible remedial measures. Somasheker et al (2001) has taken an attempt to study the environmental scenario of municipal waste management of Tukmur city Karnataka. The study reveals the open dumping and incineration of solid waste is responsible for environmental degradation. From the present study it is concluded that Tukmur city has an improper waste management system. Mariappam and Rajan (2004) keeping in view the present study was carried out assess environmental impact of Tannery Hazards in Dindigul city of Tamil Nadu. The disposal of industrial waste and industrial effluent is becoming a major problem. Ansari (2004) in his article Health Care Waste-A Public Health problem studied that for effective management of health care waste, a nation wide concerted effort is needed to tackle the problem. Periodical monitoring should be done to assess the efficacy of various disposal methods. There should be an adequate programmed for proper collection, transportation and disposal of waste. A recent waste pollution study by Ananthaswamy (2005), Dhamija, U. (2006), Saxena (2006), Asnani, P.U. (2006), Krishna (2006), FICCI(2007), WMC( 2007), Kumar and Mahadevia (2009) evaluated the detailed study on problem and management of solid wastes.
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