CHAPTER 5
ENVIRONMENTAL DEGRADATION AND ECOLOGICAL CHANGES IN THE URBAN FRINGE OF ALIGARH CITY

A. LAND DEGRADATION AND RESOURCE UTILIZATION

City is a complex spatial and social phenomenon, characterized by the dense concentration of population, clustered pattern of settlement, urban way of living, and city-based economic activities (Vriser, 1983). Cities can be treated as natural ecosystems that have been heavily transformed by anthropogenic impacts, or as ecosystems with additional energy flows based on fossil fuels. Biologist Odum (1989) defines the city as a parasite on natural and agricultural ecosystems. Cities of the world are increasingly consumers of goods and ecological services provided by the planet, and hence represent a critical burden on the global ecosystem (Cigale, et al., 2006).

All natural or predominantly natural ecosystems tend towards the long-term stability and have a capability to adapt to external effects by absorbing or neutralizing them and creating a new equilibrium. In this way ecological stability is maintained over the long term. However, it can be disrupted by human impacts which are too powerful, or by rapid changes which act synergistically and thus alter the flows of matter and energy through the ecosystem. This brings unexpected and unforeseen environmental effects counter-acting to sustainable development (Park, 1997).

Therefore, the environmental impact of urban activities can be analyzed at three levels (Špes, 2000): global: via energy and resource consumption; regional: impacts on adjacent rural areas from pollution, land use pressures, interference in water flows and other natural resources; local: cities shape a specific internal environment with a changed quality of landscape-forming components.
Land is that natural resource which is not only used for agricultural purposes but also for many other purposes that are of ‘urban’ origin. Urban purposes for which land is brought for basic use are the construction of buildings, housing, parks, roads, railways etc. In Aligarh a hasty pace of urbanization, land is needed (for space and material) for day today construction and filling of depressions. In the urban fringe of Aligarh land degradation occurs due to strip mining, brick kilning, dumping of urban waste and coal ash dumping which is a dilatory matter of great concern.

a) Strip Mining of Soil

The demand of soil through strip mining (earth digging), is a demand of urban growth, a large amount of soil is taken lands through strip mining; it is difficult to know exactly how much soil is taken. Many areas suffered from strip mining disadvantages are seen in the form of eroded lands with steep slopes, broken land, soil spills, low lying areas and creating unproductiveness in soils. However, in due course of time, lands damaged by strip mining can only be reclaimed with heavy cost for agricultural purposes but, the land converted for urban use presumably is lost forever.

Digging of soil from lands belonging to rural areas to be supplied in urban areas has become a major problem. In most of Aligarh fringe areas the upper layer of soil has been removed which is most productive from the agricultural point of view. Consequently, the lands in rural areas are subjected to large scale degradation. According to an estimate, about 5000 ha. of land around Aligarh is on going to be barren as a result of strip mining of earth. All the activities of strip mining and the supply of soil is carried on in the night hours which is in the hands of mining mafia. In many cases farmers too are also involved in these activities. However, by the order of administrative authorities strip mining is totally banned in the radius of 10 km from the city but, the job is still persists. The major areas affected affected by strip mining earth are located in villages like: Alapur Garhia and Mahrawal near Delhi G.T.Road; Lausara Bisawan and Hardaspur along Tappal Road; Ibrahimpur on Gonda Road;
Madrak and Mukundpur on Agra Road; Boner and Panaithi along Kanpur G.T. Road; Talaspur and Asadpur Kayam near Ramghat Road; Chilkora near Dauharra Bypass Road; and Rathgaon and Manzurgari near Anupshahar Road.

The lands which are affected with the strip mining also pose threats of erosion for nearby farm lands (Fig. 5.2), as there always remain a danger of soil spilling and erosion from neighbouring farms. The areas after strip mining left for several years and ultimately they become low lying areas and remain unused by farmers or developers. One of such areas is located in Kwarasi area near Ramghat Road where about 42 ha. of agricultural lands were affected with the activity of strip mining, dug to a depth of 30 feet (Fig. 5.1). This land is now a low lying area without any residential or other development, whereas the entire surrounding area is has been developed and encroached for residential purposes.

Another site was found in Chilkora village along the Doharra Bypass Road where mining of soil continued for over five years, and digging was done upto a depth of about 50 feet. Now this land is water logged pit, and a threat to the nearby farmlands, which is neither in use of agriculture nor for residential purposes. Most strip mining of earth is carried out in the fringe areas of Aligarh and soil is taken for the purpose of filling low lying areas and the wetlands or water bodies in the built up areas of city, and to develop more residential units. Consequently, all mining areas are facing the problem of water accumulation during rainy season and also as permanent logging. It also affects the strength of roads edges, danger of soil collapse and act as the hidden places for illegitimate social activities. A very threat is also seen to the nearby farms which have the danger of soil collapse, erosion and formation of gullies and ravines.
Fig. 5.1 Imagery Showing a Strip Mined Area (in middle) Surrounded by Residential Areas and Farmlands Near Kwarasi Village.

Fig. 5.2 Imagery Showing a Strip Mining Field Surrounded by Farmlands Near Chilkora Village.
b) Brick Kilning Industry

Fast expanding urban area with increase in population implies an increasing demand for residential, commercial, industrial and public buildings and other physical infrastructure. Expanding construction in city requires large amount of construction material and bulk of that material comes from locally available clay, soil, sand and gravel. This can be seen from brick kilns, soil quarrying, and clay–sand–gravel pits around the Aligarh city. Bricks are one of the most important building materials used in construction. Baked bricks are made in India and it is the second largest producer of bricks in the world after China. India has more than 100,000 brick making units producing about 140 billion bricks annually (Singh and Asgher, 2004). The largest brick production in India comes from the vast alluvial plain of Ganga and Yamuna rivers, in which Aligarh is one of the important area in terms of quality bricks.

Brick making is one of the major activities leading to land degradation in the urban fringe of Aligarh. Due to large scale demand of bricks in construction, a number of brick kilns have been established around the city. About 50 per cent villages around Aligarh city consist of brick Kilns. The nearest villages in Aligarh fringe are Rorawar, Chohatta, Kishanpura, Subhkara, Hajipur, Pampur, Harduaganj, Karrowa, Sarsol, Kwarsi, Morthal, Nagla Asak Ali Nagla Mansingh etc. Due to abundant bricks Kilning activity around the city there are various problems of land degradation, such as removal of top soil layer, water logging, fallow depressions, low fertility of land etc., and air pollution.

The Figs. 5.3 and 5.4 show the images of two brick kilning sites in the southern outskirt of Aligarh. The first image is the evidence of the use of earth of the nearby farms which has became either unfit or unused for agriculture, and some lands have completely degraded or left unused for several years. This problem is evidently seen in almost all villages forming the urban fringe of Aligarh city. As a result of increasing activity of brick kilning there is an abrupt shift in land use and land cover.
Fig. 5.3 Imagery Showing a Brick Kiln and Affected Farmlands in Surrounding Near Hajipur Village in Southern Fringe.

Fig. 5.4 Imagery Showing a Brick Making Field Surrounded with Farmlands near Talaspur Village in Western Fringe Area.
c) Degradation of Ground Water Resource

Environmental concerns related to ground water generally focus on the impact of pollution and quality degradation in relation to human uses, particularly domestic supply. Due to high population growth and industrialization, greater amount of industrial and domestic effluents are discharged that lead to the pollution of ground water in shallow aquifers. Aligarh is one such city where underground aquifers are the only source of water supply but its degradation due to increasing economic activities is a serious problem. According to the results of a study on ground water vulnerability that, ground water in and around Aligarh city is under moderate to high pollution risk. In this study the city has been classified into three zones namely, low, medium and high vulnerable zone (Fig. 5.5). The study shows that 56.43 per cent area of the city falls under high vulnerable zone because of the discharge of chemicals and toxic waste in open drains by the industries which led to the pollution of shallow aquifers (Rahman, 2008).

According to the Water Supply Department of Municipal Corporation of Aligarh, the daily average requirement of water per person in city area is 78 litres which is increasing every year. During 2010, the total supply of water was 1824 million litre daily but the demand is about 1367 MLD. If leakages and wasting is stopped then there will be an increase of 927 MLD in supply of water. Therefore, there is need of 440 MLD more water, which is 24 per cent of the actual supply. In the context of recycling of water in Aligarh, the total capacity of sewage is 4,456 MLD of which recycling capacity in sewage farm is 2,330 MLD but the actual recycling is done for only 1,478 MLD.

The major affected areas of ground water degradation in the urban-fringe of Aligarh are the villages located at the margins. These villages are Barola Jafarabad, Sarsaul, Rorawar, Alahadadpur, Shahpur Qutub, Kasba Kol and Dhanipur. In these areas water quality is degraded having a change in colour and smell, and also the level of aquifers goes down.
The trend of increasing human pressure on groundwater resource has made it vulnerable. Therefore, it is necessary to improve our planning strategies of development and management of groundwater resources in order to use this precious resource safely without threats of pollution (Giri, et al., 2012). Hence in order to overcome the problems related with water supply and availability in the aquifers Aligarh Development Authority should impose the techniques of water harvesting in newly developed colonies, should layout plans for construction of infiltration systems at various locations in and around the city.
B. DESTRUCTION OF WETLAND ECOSYSTEMS AND LOSS OF BIODIVERSITY

On the entire earth, wetlands undergo impulsive alterations due to global warming and climate change. These have resulted in greater floods and soil erosion, reducing water quality and population of many plants and animals. Moreover, the underground replenishing of aquifers has also been affected, which results in problems like desertification. The impact of human pressure in the catchment areas has also led a decline in the ecological status of many wetlands in urban fringe area of Aligarh. Most of the wetlands in the area have been formed in low lying depressions, old river courses, oxbow lakes, canal seepage areas etc. The study has attempted to find out the problems and threats to urban wetlands in Aligarh city fringe, and their encroachments for urban purposes. This complexity highlights the need for critical analysis of the social and economic factors that underpin the dynamics of urban wetlands’ resource use, in planning for sustainable development of the environment.

a) Wetland Ecosystem and Urban Environment

The process of wetlands’ evolution is a result of both physical and socio-economic factors but the human activities are apparently predominant. The process of urbanization definitely has an impact on wetlands that lying in urban territory and in urban fringes. It is a phenomena of everywhere that, spatial expansion of urban boundaries lead to the disappearance of wetland ecosystems. Therefore, in rapid urbanized areas, having significant system of wetlands, it is important to study the impact of urban encroachment on wetlands and to formulate rationalize planning to protect these resources.

Wetland is an ecological landscape with the richest biodiversity in nature, and one of the most important living environments for human beings. As one of the
three greatest ecosystems (the other two are forest and oceans), it has many beneficial functions, e.g., climate regulation, water regulation, waste treatment, habitat, food production, recreation and research, and education. However, at the same time wetland has been dramatically destroyed with the development of human society (Ren, L. et al., 2010). Wetlands are decreasing; ecological function deteriorating and biodiversity reducing have produced a series of adverse environmental effects, e.g., frequent floods and serious loss of water and soil (Herath, 2004; Hook, 1993; Jones et al., 1995). Wetlands continue to be among the world’s most threatened ecosystems, owing mainly to ongoing drainage, conversion, pollution, and over-exploitation of their resources.

b) System of Wetlands and Water Bodies around Aligarh City

The city of Aligarh has originated from an ancient settlement known as Kol or Koil. In some historical texts and legends, the meaning of Kol has been variously referred to as a place name, mountain, sage, demon and jhil (lake). This area was abounded by many Jhils and depressions in olden times, which were silted up in the course of time, and a settlement come up at the bank or in the vicinity of a Kol (Jhil), that could have given the place its name as Aligarh.

Shallow lakes and wetlands lying in the fringe areas of Aligarh city form a very peculiar type of physical setting. The Aligarh city is situated at 130 km to the south of Delhi in the alluvial plains between the Ganga and the Yamuna rivers. It is one of the most important land mass of the Ganga plain in India. Nature has blessed the region with perennially flowing Himalayan rivers. There are several natural depressions, forming wetlands, including those formed by river valleys and other drainage lines lending a variety to the landscape. These Wetlands are scenically located amidst the verdant countryside of the urban fringe of Aligarh city.
The growth in urban population has led to urban encroachments in fringe areas which are marked with low level of development and a high degree of resource exploitation, at the cost of degradation of environment. According to Master Plan Report 2001-2021 of ADA, the total urban built-up area is 4482.45 ha., out of which the area under wetlands is 152.85 ha. Loss of wetland resources is a burning issue in the fringe areas of Aligarh city, where out of total 42 wetlands, 22 have dried up, 10 have disappeared as a result of encroachment and remaining are under the clutches of
human pressures (Table 5.1). Ecological changes and loss of biodiversity too are the problems associated with wetlands around Aligarh. Some of the live urban wetlands, such as Kalideh, Charakhwalan, Kukikhera, Hiranagar, Premiere Nagar, Lal Diggi, Gular Road, Awas Vikas, Bihari Nagar, Sludge Farm, Nagla Masani, Nagla Mallah etc., have been identified for restoration and mitigation programmes with a handsome project costs but, still they are in doldrums. Two of these examples are described in the Fig. 5.6.

c) Root Causes of Destruction and Mitigation of Wetlands

It is evident from Table 5.1 that, the proximate root causes of wetlands’ loss are predominant in the wetlands of all four zones of the fringe. The southern and western areas of the fringe of Aligarh city are more affected by the socio-economic root causes and overall human pressure. Failure of policies and unsustainable development is found as the level of high intensity cause in each of four fringe zones. In the Northern and Eastern Fringes, most root causes of wetlands’ loss have low intensity of impact which is marked with high level of socio-cultural and economic development (Table 5.2).

The analysis shows remarkable changes that, most of the areas in the fringe are illegitimately lying in the depressions of older wetlands. These wetlands were earlier meant for the discharge of urban water and monsoonal floods. Now they are permanently water logged residential areas because of low plinth levels while, the other parts of the city are facing the problem of seasonal floods, even without rains. The environmental impact of wetland loss has profound repercussions on the aquatic ecosystems, associated with biodiversity, increasing pollution, and decline in underground water table.
Table 5.1 Root Causes of Loss and Wetlands Affected in the Fringe of Aligarh City

<table>
<thead>
<tr>
<th>Root Causes</th>
<th>Northern Fringe</th>
<th>Eastern Fringe</th>
<th>Southern Fringe</th>
<th>Western Fringe</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Number of wetlands identified</td>
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<td>10</td>
<td>13</td>
<td>10</td>
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<td><strong>Socio-Economic Root Causes</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Population growth</td>
<td>7</td>
<td>8</td>
<td>12</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>In-migration</td>
<td>7</td>
<td>8</td>
<td>12</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>Poverty/ marginalization</td>
<td>8</td>
<td>7</td>
<td>11</td>
<td>10</td>
<td>36</td>
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<tr>
<td>Cultural changes</td>
<td>9</td>
<td>10</td>
<td>13</td>
<td>9</td>
<td>41</td>
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<tr>
<td>Overall human pressure</td>
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<td>10</td>
<td>13</td>
<td>10</td>
<td>42</td>
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<td><strong>Proximate Root Causes</strong></td>
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<td></td>
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<tr>
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<td>13</td>
<td>9</td>
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<tr>
<td>Ecosystem changes</td>
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<td>10</td>
<td>13</td>
<td>10</td>
<td>42</td>
</tr>
<tr>
<td>Biodiversity loss</td>
<td>9</td>
<td>10</td>
<td>13</td>
<td>10</td>
<td>42</td>
</tr>
<tr>
<td>Overall environmental changes</td>
<td>9</td>
<td>10</td>
<td>13</td>
<td>10</td>
<td>42</td>
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<td><strong>Political and Local Root Causes</strong></td>
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<tr>
<td>Policy failures</td>
<td>7</td>
<td>9</td>
<td>13</td>
<td>9</td>
<td>38</td>
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<tr>
<td>Land conversions</td>
<td>5</td>
<td>6</td>
<td>12</td>
<td>8</td>
<td>31</td>
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<tr>
<td>Lack of control over resources</td>
<td>9</td>
<td>10</td>
<td>13</td>
<td>10</td>
<td>42</td>
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<tr>
<td>Weak legislation</td>
<td>6</td>
<td>7</td>
<td>11</td>
<td>9</td>
<td>33</td>
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<tr>
<td>Unsustainable development</td>
<td>9</td>
<td>10</td>
<td>13</td>
<td>10</td>
<td>42</td>
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</tbody>
</table>

*Source: Based on primary survey 2009-10*
Table 5.2  Intensity of Root Causes of Wetlands’ Loss in the Fringe of Aligarh City

<table>
<thead>
<tr>
<th>Root Causes</th>
<th>Northern Fringe</th>
<th>Eastern Fringe</th>
<th>Southern Fringe</th>
<th>Western Fringe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population growth</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
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<tr>
<td>In-migration</td>
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<td>■</td>
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<tr>
<td>Poverty/ Marginalization</td>
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<td>□</td>
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<td>■</td>
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<tr>
<td>Cultural changes</td>
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<td>■</td>
<td>□</td>
<td>□</td>
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<tr>
<td>Overall human pressure</td>
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<td>□</td>
<td>■</td>
<td>■</td>
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<tr>
<td>Water pollution</td>
<td>□</td>
<td>□</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>□</td>
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<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Ecosystem changes</td>
<td>□</td>
<td>■</td>
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<td>■</td>
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<tr>
<td>Biodiversity loss</td>
<td>□</td>
<td>□</td>
<td>■</td>
<td>■</td>
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<tr>
<td>Overall environmental changes</td>
<td>□</td>
<td>□</td>
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<td>■</td>
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<tr>
<td>Policy failures</td>
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<td>Land conversions</td>
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<tr>
<td>Lack of control over resources</td>
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<td>■</td>
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<tr>
<td>Unsustainable development</td>
<td>■</td>
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</tr>
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</table>

*Index: □ Low Intensity Cause  ■ High Intensity Cause*

Source: Based on primary survey 2009-10

The study provides evidences about a variety of causal factors underlying the loss of urban wetlands that can be put under three heads: a) Socio-economic root causes; b) Proximate root causes; and c) Policies and local root causes. This is clearly revealed that, most of the root causes of wetlands’ loss have a common approach i.e. unplanned human development. The economic, political and socio-cultural structures have shaped the present panorama of Aligarh city with the promotion of all resource consumptions and transformations, and recognize little value in eco-compensation. The loss of wetland ecosystems can be found in all zones of the urban fringe of
Aligarh city and promoting unsustainable resource consumption at the cost of environmental degradation.

**Fig. 5.7 Multispectral Model Revealing the Impacts of Wetlands’ Loss on the Socio-Economic and Physical Environment, and to Mitigate them.**

In the case study all the factors at once- either separately or in conjunction with one another are responsible for the loss of wetland resources. A model based strategy could be applied for the restoration of destructed wetlands and protection of exited ones. The Fig. 5.7 shows a multispectral model describing various aspects of wetlands’ into three strategic heads: Impact on ecosystem and biodiversity; environmental degradation and socioeconomic changes.
C. ENVIRONMENTAL POLLUTION AND CLIMATE CHANGE

a) Air Pollution

Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms or damages the natural environment, into the atmosphere. Some of the major causes of air pollution are given below.

- Urbanization means increase of population in an area. That population needs more food, clothes and other materials to live. To fulfill the needs industries grow by which air is polluted.
- More people burn more fuels which create carbon dioxide, carbon monoxide and other air polluting gases.
- More people need more vehicles for transportation, which pollute air rapidly.
- Industries are the main components of urbanization from which various types of gases released and will cause the incidence of acid rain.
- For urbanization forest lands and many other agricultural lands encroached upon, which have reduced. It effects the environment badly.
- In urban areas people use refrigerators, air cooling systems which produce CFCs.
- In urban areas construction of buildings is a continuous process, air is got polluted when dust particles are mixed with air due to construction works.

The level of air pollution depends on the technology and pollution control, particularly in energy production. Using cleaner fossil fuels (such as natural gas and higher-grade coal), burning of these fuels is more efficient, and increasing reliance on even cleaner, renewable sources of energy (hydro, solar, geothermal, wind) are some of the best ways to reduce air pollution without limiting economic growth.
Coal is considered to be the “dirtiest” of the fuel sources, although a lot depends on its quality and methods of combustion. In many ways nuclear energy is one of the “cleanest” sources of electricity, but safe disposal of nuclear waste and the risks of radioactive pollution in case of a serious accident are of major concern. Sources with the least environmental impact, such as solar energy, accounts for only a small fraction of generated electricity worldwide.

Fuel combustion by motor vehicles is another major source of suspended particulate emissions in urban areas. These emissions are particularly detrimental to human health because pollutants are emitted at the ground level. Motor vehicles are much more common. But motor vehicles in developing countries still cause serious air pollution because they are concentrated in a few large cities, many are in poor mechanical condition, and few emission standards exist.

Dust particles possessing airborne heavy metals are the most harmful particulate pollutants. Young children are especially more vulnerable: lead poisoning of children leads to permanent brain damage, causing learning disabilities, hearing loss, and behavioral abnormalities. In adults it leads absorption cause of hypertension, blood pressure, and heart diseases. The main sources of airborne metal particulates are motor vehicles using leaded gasoline, industrial processes such as ferrous and nonferrous metallurgy, and coal combustion.

According to a study conducted by Lone, P.M. and others (2005) ‘Dust Pollution Caused by Vehicles in Aligarh City’ in which four major national highways: Anupshahar Road, Delhi Road, Agra Road and Kanpur Road of Aligarh city were selected. In the study it was found that, the dust pollution was maximum on Kanpur road (46.44 gm/m²/month) followed by Agra road (38.94 gm/m²/month) and Delhi road (34.52 gm/m²/month). A least amount of dust pollution was recorded on Anupshahar road (20.10gm/m²/month). In general, the rate of dust fall per unit area was highest within a circle of 3 km inside the city (38.66 gm/m²/month) closely
followed by starting point (37.27 gm/m²/month) and least at a distance of 3 km outside city (29.09 gm/m²/month). On an average the rate of dust fall per unit area was estimated to be about 35 gm/m²/month in Aligarh city.

Urbanization not itself cause any pollution, as urban areas usually have a lot of vehicles and factories which cause pollution in a small area. This mainly affects the health of city dwellers as lot of pollution in a small area leads to lower air quality and generate more disease. However, one can argue that suburbanization has caused more pollution overall than the urbanization, because it means people have to commute by cars or other means, taking public transport, etc, and they have to travel longer when they do drive from one place to another.

Table 5.3 Average Quantity of Elements of Ambient Air Quality at Various Locations in Aligarh City (2010)

<table>
<thead>
<tr>
<th>Locality</th>
<th>Category</th>
<th>Particulate Matter microgram/m³</th>
<th>Sulphur Dioxide microgram/m³</th>
<th>Nitrogen Dioxide microgram/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Estate Exhibition Road</td>
<td>Commercial/Residential</td>
<td>220.2</td>
<td>7.1</td>
<td>43.3</td>
</tr>
<tr>
<td>Sarsaul, Delhi Road</td>
<td>Commercial/Rural</td>
<td>207.4</td>
<td>6.2</td>
<td>44.1</td>
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<td>Gandhi Park, G.T Road</td>
<td>Commercial</td>
<td>193.0</td>
<td>6.5</td>
<td>38.2</td>
</tr>
<tr>
<td>Sasni Gate, Agra Road</td>
<td>Residential</td>
<td>164.7</td>
<td>4.3</td>
<td>40.8</td>
</tr>
<tr>
<td>Aligarh Muslim University Area</td>
<td>Institutional/Residential</td>
<td>89.1</td>
<td>3.7</td>
<td>26.1</td>
</tr>
<tr>
<td>Talanagri, Ramghat Road</td>
<td>Commercial/Residential</td>
<td>127.0</td>
<td>5.2</td>
<td>39.3</td>
</tr>
<tr>
<td>Power Station at Kasimpur</td>
<td>Residential/Rural</td>
<td>233.0</td>
<td>8.8</td>
<td>46.2</td>
</tr>
<tr>
<td><strong>Aligarh City Average</strong></td>
<td><strong>Mixed Landuse</strong></td>
<td><strong>176.3</strong></td>
<td><strong>5.9</strong></td>
<td><strong>39.7</strong></td>
</tr>
</tbody>
</table>

*Source: Pollution Control Board, Aligarh Centre*
As far as the ambient air quality in Aligarh city is concerned, Table 5.3 shows that, the average quantity of particulate matter in air is 176.3 mg/m$^3$, whereas, the sulphur dioxide and nitrogen dioxide 5.9 and 39.7 mg/m$^3$. The least quantity of these pollutants found in the university campus is 89.1, 3.7 and 26.1 mg/m$^3$, respectively. As the area falls under institutional and residential categories of landuse, and characterized with dense vegetative cover, open spaces, lowest traffic, and free from industrial and household pollution. Reverse conditions are seen in Industrial Estate along Delhi side rail route which falls under commercial cum residential category, the three elements of ambient air quality are found highest in the city in order of 220.2 mg/m$^3$ particulate matter, 7.1 mg/m$^3$ sulphur dioxide and 43.3 mg/m$^3$ nitrogen dioxide (Table 5.3).

A crucial set back is with the Qasimpur area (Harduaganj Thermal Power Station Project Colony), which lies 16 km from Aligarh city. The installed capacity of power house is 665 MW which consists of seven generation units and required a supply of 1.98 million metric tonnes of coal per annum. Here oxides of sulphur and nitrogen (8.8 and 46.2 mg/m$^3$) and particulate matter (233 mg/m$^3$) which are present in highest quantities. This phenomenon is due to the burning of a huge amount of coal in the Harduaganj Thermal Power Station. There is also a cement factory of Ultratech Ltd. in which clinker processing generates a substantial amount of particulate matter polluting the entire area. The other industries near to this area are: Heinz India Limited (Glaxo Laboratories) and Satha Sugar Mill which also uses coal for heating purpose. As a result, the residential localities and agricultural farms in the nearby villages are very badly affected and on hazardous risk to the health of the people, field crops and biodiversity.

**b) Generation of Urban Waste**

In general, one can say that waste is useless, unwanted or discarded material resulting from agricultural, commercial, and industrial activities. Waste includes
solids, liquids and gaseous. Broadly, it can be categorized as domestic, institutional, commercial and industrial. As cities grow economically, business activity and consumption patterns generate solid wastes in substantial quantities. At the same time, increased traffic congestion adversely affects the productivity of the solid waste fleet. Productivity loss is exacerbated by longer hauls required for fleets, as open lands for disposal are used farther away from urban centers.

According to the World Bank Report 2009, in developing countries, municipalities spend 20-50 per cent of recurring budgets on solid waste management. Yet, it is also common, that 30-60 per cent of all the urban solid waste in developing countries is uncollected and less than 50 per cent of the population is served. In some cases, as much as 80 per cent of the collection and transport equipments are out of service or need repair or maintenance.

Table 5.4 Category wise Generation of Waste in Aligarh City (2010)

<table>
<thead>
<tr>
<th>Waste Generation Category</th>
<th>Waste Generated Per Month (in MT) (per cent to total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household or Domestic</td>
<td>7,125 (59.4)</td>
</tr>
<tr>
<td>Street Sweeping</td>
<td>2,275 (18.9)</td>
</tr>
<tr>
<td>Hotels &amp; Restaurants</td>
<td>200 (1.7)</td>
</tr>
<tr>
<td>Markets (e.g. Fruit-vegetable markets, Mandis etc.)</td>
<td>1,500 (12.5)</td>
</tr>
<tr>
<td>Commercial establishments</td>
<td></td>
</tr>
<tr>
<td>(including offices, institutions etc.)</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12000 (100.0)</strong></td>
</tr>
</tbody>
</table>

*Source: Municipal Corporation, Aligarh, 2010*

Being an important industrial and commercial centre, Aligarh is facing the problem of urban waste generation and its disposal, resulting in environmental degradation through air, water and soil pollution. According to the Aligarh Municipal
Corporation, during the year 2010, the total quantity of urban waste generated from the municipal area of the city was about 12,000 metric tonnes. The major problem is the generation waste from residential areas (7,125 mt. i.e. 59.4 per cent), Streets (2,275 mt. i.e. 18.9 per cent) and markets (1500 mt. i.e. 12.5 per cent). Other categories like hotels and restaurants (200 mt.) and institutions (900 mt.) which share 1.7 and 7.5 per cent, respectively (Table 5.4). According to an estimate, about 60 per cent of this waste is disposed off and dumped in peripheral areas of the city, along the roads and railway lines, while remaining 40 per cent remain dumped in the city in the respective localities and vacant places.

c) Dumping of Urban Waste

Dumping of urban waste (municipal garbage), and outlets of city drains and sewages is another urban generated problem faced by the urban fringe of Aligarh city. There are various grounds in the outskirts as well as in the in-skirts of Aligarh city where the dumping of garbage is done. These dumping grounds are located in vacant fields along the roads, railways routes and in depressions. The outlets of drains are also found in open spaces along Mathura road where large vegetable fields are affected with toxins, heavy metals and other harmful chemicals generated from industries. All these activities have created environmental pollution in the form of soil degradation, which directly affects agricultural production, particularly the market gardening.

There are nearly 55 locations in the municipal area of the city, which are used for open disposal of urban waste. Besides, these, there are 6 major waste disposal grounds, outside the municipal area they are either located in farming areas or in newly developed residential areas of the fringe. One of such ground is located in the Kwarasi area along the bypass road (Fig. 5.8), which is neither in agricultural use nor for residential purposes. It has become a threat to nearby vegetable farms, making the
land unfit for cultivation. It is also creating diseases in nearby residential areas and causing health problems. Some other disposal grounds having similar problems are located along Khair Road bypass, Delhi G.T Road, Gonda Road, Dhanipur area on Kanpur Road and Mukundpur on Agra Road.

Fig. 5.8 Imagery Showing a Waste Dumping Ground (in middle), Residences and Farms near Kwarasi Village along the Bypass Road.
Fig. 5.9 Imagery Showing the Municipal Animal Slaughtering House, Blood Defecation, Residences and Farms near Gonda Bypass Road.

Fig. 5.10 Imagery Showing an Animal Slaughtering House of an Export Company with Total Waste Management System, near Gonda Bypass Road.
Table 5.5 Estimated Number of Industries Generating Waste in Aligarh

<table>
<thead>
<tr>
<th>Type of Industry</th>
<th>Large-scale</th>
<th>Medium-scale</th>
<th>Small-scale</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Processing</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Lock Industry</td>
<td>0</td>
<td>2000</td>
<td>0</td>
<td>2000</td>
</tr>
<tr>
<td>Household Industry</td>
<td>0</td>
<td>0</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>500</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>2000</td>
<td>3500</td>
<td>5006</td>
</tr>
</tbody>
</table>

*Source: Municipal Corporation, Aligarh, 2010*

Other type of waste generated is from the industries, which is hazardous to the farm lands and to health of the people in nearby residential areas. There are 5006 industries in Aligarh including 6 large scale, 2000 medium and 3500 small scale or household industries (Table 5.5). In the fringe of Aligarh there are five animal slaughter houses out of these three houses throw their solid and liquid wastes in open fields. The Figs. 5.9 and 5.10 clearly show the location sites of two slaughter houses. First one is used under license of Municipal Corporation of Aligarh, and the second is of a private company. There is a difference in their waste management, in the former blood and other defecated materials is disposed off in open ground, and in later there is adoption of the technology for total waste recycling systems. The metal industries too generate large amount of acids, toxins and heavy metals. These pollutants are disposed by mixing of water in the open fields or in nearby water bodies. Resultantly, these pollutants either get percolated in the ground to mix with subsurface water or they severely pollute the soils of the vegetable farming zones in the western fringe of the city.

Contamination of water with the discharge of waste material from industries and residential areas is another problem of the fringe of Aligarh city. On the name of water harvesting schemes of the government, some industrial units are illegitimately
indulged in contaminating the underground water. They pour untreated waste water into the ground or in the nearby grounds or pits which add water in the aquifers. In all such areas many reports confirm coloured water comes from hand pumps and the residents are bound to use it for domestic purpose. As a result some areas along the ITI road and Baraula village are facing the problem of contamination in drinking water, and are on high risk of waterborne diseases. Similar situation is also observed in the areas of the western fringe of the city, such as Shahjamal, Bhujpura, Rorawar village, Shahpur Qutub and Alahdadpur.

d) Dumping of Coal Fly Ash

Another critical problem associated with environmental degradation in the northern fringe areas of Aligarh city is the dumping of coal fly ash in agricultural fields from the Harduaganj Thermal Power Station. This thermal power station is located in Kasimpur village of Jawan block at a distance 13 km from Aligarh city. Here large cultivable lands have been converted into dumping yards for coal ash (residue of coal after burning) generated in the power station. Because of the presence of fly ash in air these grounds have become threat to the local environment, public health and off course to agricultural fields.

Coal fly ash is the residue generated due burning of coal, and comprises fine particles that penetrates into the atmosphere with few gases. Ash which cannot rise with the air is known as bottom ash. In an industrial context, fly ash usually refers to ash produced during the combustion of coal. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash consist of substantial amounts of silicon dioxide (SiO₂) and calcium oxide (CaO₂), Among toxic constituents, it may consist one or more elements or substances in quantities from trace amounts to several per cent: arsenic, beryllium, boron, cadmium, chromium, cobalt, lead, manganese, mercury, molybdenum, thalium and vanadium.
Fig. 5.11 Imagery Showing the Yards of Coal Ash Dumping, Agricultural Lands and Harduaganj Thermal Power Station.

In the past, fly ash was generally released into the atmosphere, but pollution control equipment mandated recently, and now requires that it can be captured prior to its release, and is generally stored at coal power plants or placed in landfills. These Landfills or dumping grounds are located in the nearby agricultural areas. When old grounds are completely filled then the process of acquiring new lands start to make a new area. In this way there are two dumping yards one is old (55 ha.) and another is operating (190 ha.) lying at a distance of 1 km and 1.5 km, respectively, away from the power station (Fig. 5.11). The land covered in these grounds and in catchment is fertile agricultural land. This coal ash moves with the wind and is hazardous to health of people and cultivated fields, in the surrounding areas.
e) Climate Change and Global Warming

The warming that results from urban heat islands over small areas such as cities is an example of local climate change. Local climate changes resulting from urban heat islands fundamentally differ from global climate changes in that their effects are limited to the local scale and decrease with distance from their source. Global climate changes, such as those caused by increase in the sun’s intensity or greenhouse gas concentrations, are not locally or regionally confined (United States Environmental Protection Agency, 2010).

Climate change, broadly speaking, refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from:

- Natural factors, such as changes in the sun’s intensity or slow changes in the Earth’s orbit around the sun.
- Natural processes within the climate system (e.g. changes in ocean circulation).
- Human activities that change the atmosphere’s composition (e.g. burning fossil fuels) and the land surface (e.g. deforestation, reforestation, or urbanization).

The term climate change is often used interchangeably with the term global warming, but according to the National Academy of Sciences, “the phrase ‘climate change’ is growing in preferred use to ‘global warming’ because it helps convey that there are other changes in addition to rising temperatures” (US EPA, 2010).

Global warming is an average increase in the temperature of the atmosphere near the earth’s surface and in the lowest layer of the atmosphere, which can contribute to changes in global climate patterns. Global warming can occur from a
variety of causes, both natural and human induced. In common usage, “global warming” often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities. Global warming can be considered part of global climate change along with changes in precipitation, sea level, etc. (US EPA, 2010)

The impacts from urban heat islands and global climate change (or global warming) are often similar. For example, some communities may experience longer growing seasons due to either or both phenomena. Urban heat islands and global climate change can both also increase energy demand, particularly summer season demand, and associated air pollution and greenhouse gas emissions. (US EPA, 2010).

i. Urban Heat Island Effect and Climate Change

One of the fundamental components that set a city apart from its rural surroundings is the climate that prevails over urban environments. In urban areas, buildings and paved surfaces have gradually replaced preexisting natural landscapes. As a result, solar energy is absorbed into roads and rooftops, causing the surface temperature of urban structures to become 50 - 70 °F higher than the ambient air temperatures. (Taha, Akbari and Sailor 1992). The Fig. shows albedo values for various urban surfaces, the albedo is a measurement of the amount of solar energy reflected by the surface. As such, low albedo implies higher surface temperatures since the larger amounts of energy are absorbed. As surfaces throughout an entire city become warmer, overall ambient air temperature increases. This phenomenon, known as an "urban heat island," can raise air temperature in a city by 2 - 8 °F. (Oke, 1987 and World Meteorological Organization, 1984).

The resulting higher temperature caused by the urban heat island has the effect of increasing demand for cooling energy in commercial and residential buildings. This increased demand for energy can cost to consumers and municipalities, which
have additional expenditure on electricity. In addition, increased electricity generation by power plants leads to higher emission of sulfur dioxide, carbon monoxide, nitrous oxides, and suspended particulates and as well as carbon dioxide, a greenhouse gas known to contribute to global warming and climate change. (SOS, 1995).

As urban areas develop, changes occur in their landscape. Buildings, roads, and other infrastructure replace open land and vegetation. Surfaces that were once permeable and moist become impermeable and dry. These changes cause urban regions to become warmer than their rural surroundings, forming an "island" of higher temperatures in the landscape (Fig. 5.12).

Heat islands occur on the surface and in the atmosphere. On a hot, sunny summer day, the sun can heat dry, exposed urban surfaces, such as roofs and pavement, to temperatures 50–90°F (27–50°C) warmer than the air, while shaded or moist surfaces, often in more rural surroundings, remain close to air temperatures. Surface urban heat islands are typically present day and night, but tend to be strongest during the day when the sun is shining.

In contrast, atmospheric urban heat islands are often weak during late morning hours and throughout the day and become more pronounced after sunset due to the slow release of heat from urban infrastructure. The annual mean air temperature of a city like Aligarh with one million people or more can be 1.8–5.4°F (1–3°C) warmer than its surroundings. On a clear, calm night, however, the temperature difference can be as much as 22°F (12°C).
Fig. 5.12 Profile of Urban Heat Island and Different Albedos in the Urban Environment.

Source: EPA-NASA Urban Heat Island Pilot Project
RELATIONSHIP OF SURFACE AND AIR TEMPERATURES

Surface temperatures have an indirect, but significant, influence on air temperatures, especially in the canopy layer, which is closest to the surface. For example, parks and vegetated areas, which typically have cooler surface temperatures, contribute to cooler air temperatures. Dense, built-up areas, on the other hand, typically lead to warmer air temperatures. Because air mixes within the atmosphere, though, the relationship between surface and air temperatures is not constant, and air temperatures typically vary less than surface temperatures across an area, as given in the figure below.

Surface and atmospheric temperatures vary over different land use areas. Surface temperatures vary more than air temperatures during the day, but they both are fairly similar at night. The dip and spike in surface temperatures over the pond show how water maintains a fairly constant temperature day and night, due to its high heat capacity.

Note: The temperatures displayed above do not represent absolute temperature values or any one particular measured heat island. Temperatures will fluctuate based on factors such as seasons, weather conditions, sun intensity, and ground cover.

Source: Climate Protection Partnership Division, U.S. Environmental Protection Agency
ii. Why do we care about heat islands?

On the grounds of surging urban congestion (mainly industrial and transportation) and resulted sprawl, and loss of wetlands, green and open spaces, the elevated temperature from urban heat islands, particularly during the summer, can affect environment and quality of life in Aligarh city and its peripheral fringe area. While some heat island impacts seem positive, as during winters such as lengthening the plant-growing season, and comparatively warmer nights, but most impacts are negative and include:

- **Increased energy consumption**: Higher temperatures in summer increase energy demand for cooling and add pressure to the electricity grid during peak periods of demand. According to an estimate the heat island effect is responsible for 5–10 per cent of peak electricity demand.

- **Elevated emissions of air pollutants and greenhouse gases**: Increasing energy demand generally results in greater emissions of air pollutants and greenhouse gas emissions from power plants. Higher air temperatures also promote the formation of ground-level ozone.

- **Compromised human health and comfort**: Warmer days and nights, along with higher air pollution levels, can contribute to general discomfort, respiratory difficulties, heat cramps and exhaustion, non-fatal heat stroke etc.

- **Impaired water quality**: Hot pavement and rooftop surfaces transfer their excess heat to storm water, which then drains into storm sewers and raises water temperatures as it is released into streams, rivers, ponds, and lakes. Rapid temperature changes can be stressful to aquatic ecosystems.
References


District Statistical Diary, Aligarh 2001 and 2011, Economics and Statistical Division, Lucknow, Uttar Pradesh.


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