CHAPTER - VI
It was since the beginning of 1970's that the environment pollution became a serious problem in India. Because of rapid increase of population and concentration of Factories around the city.

The intensity of irrigation in the Ganga basin is very high practically the entire dry weather flow is diverted to the upper Ganga canal at Haridwar and whatever flow is regrated between Haridwar and Aligarh is again diverted to lower Ganga canal at Aligarh. As a result of this, there is very little dry weather flow in river Ganga at Kanpur. There is heavy flow of pollutants in this stretch the Biochemical oxygen demand in the river often rises to 10 to 20 mg/l against a permissible limit of 3 mg/l. According to a rough movement at present about 550 MLD of municipal waste is being discharged in river Ganga from the six class-I cities (Haridwar - Rishikesh, Farrukhabad - Fatehgarh, Kanpur, Allahabad, Mirzapur, and Varanasi) situated along with banks Ganga in the state of Uttar Pradesh. The population of Kanpur at present is nearly 27 Lakhs and demand of water is more than 600 MLD. Where as the availability of water is only around 320 MLD. Thus the domestic water supply is grossly inadequate.

Kanpur is the Industrial Metropolis city, which is situated on the right bank of the river Ganga. The total water supply in Kanpur after use, major parts of it goes down the drains, nallas and sewers ultimately discharged in Ganga. The Three hundered and sixty five (365) Industries are established on the banks of the river Ganga. The various Industries in Ganga water at Kanpur like Textile waste, power plant waste, Inorganic, organic chemicals, pesticides, Insecticides,
Oil, Grease and Tanneries effluents are discharged without any treatment in the river.

Broad spectrum pesticides were currently used for pest control in many ways to the soil, water bodies, crops and to the stored grains in the form of liquids and dusts and sprayers of granules. Therefore, entire food chain becomes poisonous.

In aquatic ecosystem, the presence of extraneous organic and inorganic materials leads to significant changes in the biological components of water. Influx of allochthonous organic materials through drains, channels and due to floods considerably increases the population of decomposers, especially the Protozoans, Bacteria, Crustaceans, Algae and Fungi.

The association of bacteria is more common with the animal tissues whereas the Bacteria play a major role as decomposers in aquatic ecosystem. Biological quality of water to a very great extent depends upon the qualitative and quantitative Pattern of bacteria. The concentration of these organisms varies with the organic load, Season, water current, Depth. Nature of pollutants and physico-chemical quality of the water. A large number of Townships and Industries are located in the middle and lower stretch of the Ganga. Untreated wastes from the industries and municipalities are discharged directly in the river which results in high concentration of bacteria. Significant count of heterotrophic bacteria i.e. Total Coliform, Faecal Coliform Salmonella and Faecal Streptococci was made in the lower stretch of the river and the count was much higher than acceptable in river water. The FC/FS ratio indicate faecal contamination of water. Water
containing such high faecal and pathogenic bacteria is, therefore a potential risk to health. The population of Coliforms and enteropathogens increases significantly during the summer and rainy seasons.

The Zooplankton comprises of Protozoans especially Ciliates. These are Colopodes and Paramoecia. Their density increases at all such points of discharge of town sewage. Zooplankton population was maximum during Summer and minimum during winter at all the sites studied. At the point of discharge of waste from a factory, where the water temperature was about 38°C and pH 8–6, free living protozoans were abundant. But most of them were killed when this toxic effluent mixed with the main stream of the Ganga water. Besides Protozoans, Zooplankton comprises of Rotifers are useful indicators of organic pollution.

The Algae were studied to sort out such algae which are indicators of organic pollution. Algae were categorised on the basis of sensitivity and tolerance capacity with the change in the prevailing physico-chemical set up of the water due to the input from sewers.

(i) Those algal forms which were confined to sewage discharge and mixing points only are can be treated as Pollution tolerant forms.

(ii) Another group whose algae were highly sensitive to toxic pollutants and were found in clean water.

(iii) This group did not show any consistent behaviour to changed environment.
On the basis of industrial activities at Kanpur and possible contribution to water pollution especially in river Ganga, which receives practically at the domestic and industrial effluents either directly or indirectly, the following parameters have been selected for details investigation: Temperature, pH and Dissolved Oxygen. The main features of the present investigations are as follows:

1. Collection of fishes from river Ganga at Kanpur and their acclimatization in the laboratory condition.

2. Study of the Morphological changes of control and high Temperature, pH and low Dissolved Oxygen treated fishes.

3. Effect of Temperature, pH and Dissolved Oxygen on survival time of fishes.

4. Study of the Physiological changes of control and Temperature, pH and Dissolved Oxygen treated fishes.

Chapter IV presents the results obtained in the experimental investigations and their discussion.

Section 1. Shows the morphological changes due to input of different parameters, e.g., Temperature, pH and Dissolved oxygen on growth and development on Heteropneustes fossilis.

In case of Temperature the weight and length increased by 0.04
per cent and 0.03 per cent respectively after 20 days in control. In high Temperature treated fish, the weight and length were decreased by 3.02 per cent and 1.9 per cent in 35 Degree centigrade after 20 days.

In case of pH in control group weight and length increased by 0.29 per cent and 0.9 per cent respectively after 20 days. In high pH treated fishes weight and length were decreased by 4.0 per cent and 3.0 per cent in 10.0 pH after 20 days.

In case of Dissolved Oxygen the weight and length increased by 0.12 per cent and 0.10 per cent respectively after 20 days. In low Dissolved oxygen treated fishes the weight and length were decreased by 9.5 per cent and 7.0 per cent in 3.0 to 4.0 ppm after 20 days.

Section 2. Shows the tolerance limits of *Heteropneustes fossilis*, *Clarius batrachus* and *Channa punctatus* in different parameters. Tolerance limits for different parameters are follows:
<table>
<thead>
<tr>
<th>Fish name</th>
<th>Tolerance limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temp.</td>
</tr>
<tr>
<td>Heteropneustes</td>
<td>38 Deg.C.</td>
</tr>
<tr>
<td>Fossilis</td>
<td></td>
</tr>
<tr>
<td>Clarias batrachus</td>
<td>35 Deg .C.</td>
</tr>
<tr>
<td>Channa punctatus</td>
<td>35 Deg.C.</td>
</tr>
</tbody>
</table>

Section 3. Shows that the rate of operculum movement decreased as the Temperature, pH increased and Dissolved Oxygen decreased. In control group of fishes, breathing rate was normal. While it is reduced in high temperature, pH and low Dissolved Oxygen treated fishes.

In all the three fishes investigated the impact of each parameter was interestingly similar. All the three fishes investigated are commonly found in river Ganga, one of the most important river both for agriculture as well as for industry in India. In each case irrespective of Temperature, pH and Dissolved Oxygen taken for fish under investigation, it was observed that
the high Temperature, pH and low Dissolved Oxygen level of water, which cause scarcity of oxygen in water. It is expected that failure of respiratory organs lead to suffocation in fishes and ultimately death.

This is also reflected by the fact that the size of the fish does not have any favourable effect on tolerance level of the Temperature, pH and Dissolved Oxygen. There are two possible explanation:

(i) Due to high Temperature and low Dissolved Oxygen scarcity of oxygen is taking place in the water and death is caused due to suffocation.

(ii) A large amount of water contains high pH is passed through the gills, responsible for respiration and obviously the precipitation of organic matter in the gills.