stop all mining and quarrying activities along the river Umkhrah and its tributaries, (v) regulate washing and cleaning of clothes and automobiles in river Umkhrah and its tributaries, (vi) motivate people to participate in a river cleaning drives, (vii) undertake tree planting activities along the stretch of river where land is available, (viii) conduct periodic monitoring of the river water quality and (ix) establish an institutional and organizational mechanism for implementation of these suggestions.

Being a hill stream and located in a place receiving high rainfall, the river recovers and rejuvenates to some extent every year during rainy season due to fast flow of water which carries away the solid wastes and sewage from the main river. The river is still in a state where from it can be restored and if the above suggestions are implemented, there is a good possibility that the river Umkhrah will attain its past glory of a pristine river full of life and beauty in near future.

**SUMMARY**

Water is the most vital resource essential for survival of life on the earth. Although, about two third of the total surface area of the earth is covered by water, the availability of freshwater required for sustenance of terrestrial life is somewhat limited. It is estimated that the total water resource on the earth is about 1360 million cubic kilometers. Out of which only 0.2 million cubic kilometers (0.01 % of all water) is freshwater available in rivers, lakes, wetlands, soil moisture, shallow ground water and reservoirs to meet the demands of all the plants, animals and humans
inhabiting this planet. Freshwater is therefore a scarce natural resource. Rivers are a major source of freshwater. These are characteristically diverse and biologically productive environments in their natural forms and the water quality of such aquatic ecosystems are maintained by the homeostatic mechanisms. The water quality of any river system is of paramount importance as the use or potential use of the river water primarily depends on its quality.

Meghalaya has only about 0.3% of the total riverine length of the country and most of the river stretches of the state are still relatively clean. However, flowing right through the middle of the capital city, Shillong, the river Umkhrah is one of the polluted rivers in the state. This river is also one of the main rivers feeding the Umiam (Barapani) reservoir located about 15 km downstream of Shillong, the state’s largest source of hydro-electricity.

The river Umkhrah is faced with several anthropogenic problems. With the city having no sewerage and sewage treatment system, all the sewage and wastewater from domestic and commercial sources enter the river through the open drains directly causing organic and faecal pollution in the river. The river has also become a dumping site for municipal solid waste and waste of construction activities, which obstruct the river flow and raise the river bed causing flash floods in the low-lying areas of the city during rainy months. A number of sources and activities contribute towards the pollution and ecological degradation of river Umkhrah and its tributaries and drains. The Point Sources of pollution include the dry latrines located along the river Umkhrah and its tributaries that discharge raw sewage directly into the river and effluents from hotels and restaurants, automobile workshops, hospitals and nursing homes, slaughter houses, vegetable, meat and fish markets situated in the catchments while the Non-Point Sources are indirect discharge of untreated sewage, municipal wastewater, dumping of solid wastes and agricultural run offs. Sand and gravel quarrying, deforestation due to urban development,
dumping of garbage and spoils from the construction sites are certain other activities that add significantly towards the pollution of river Umkhrah.

Considering the importance of the river Umkhrah, since it receives the waste loads from almost 80% population of the Shillong Urban Agglomeration, it was felt highly necessary to assess the quality of the river water with a view to ascertain its human use potentials. The specific objectives of the study are to assess the quality of river water using physico-chemical and biological characteristics and to suggest suitable measures for the improvement of the Umkhrah river water quality.

The methodology adopted for carrying out the study included a survey along the river Umkhrah water course to identify sources of pollution, to record the river water uses and polluting activities and to select the water sampling locations in such a way to get the representative water quality data for the whole river stretch. The selection of physico-chemical and biological parameters for water quality monitoring of the river was carried out in order to assess the quality of water of the river. Five water sampling stations were selected along the course of river Umkhrah considering the location of inflowing tributaries and drains that carry the runoff and effluents to the river. Five major tributaries were also selected for water quality assessment with the objective of including representative tributaries and covering full stretch of the river. The river water samples were collected on monthly intervals for a period of two years i.e. November, 2001-October, 2002 and November, 2004-October, 2005. The water of tributaries was sampled for one year during November, 2001-October, 2002. Water sampling, preservation of collected water samples and analyses were performed as per the standard methods described in APHA (1985). All chemicals, reagents and solvents used for the analyses were of analytical grade. Spatial and monthly variation of water temperature, water temperature, pH, chloride, total
hardness, alkalinity, conductivity, turbidity, total suspended solids, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, nitrite, nitrate, phosphate, sulphate, iron, total coliform bacteria and phytoplankton and zooplankton population were analysed. The data were put to statistical analysis using ANOVA and correlation coefficient.

From the analyses of water quality characteristics of the river Umkhrah it was found that the river water quality has deteriorated and it has become polluted. Since it shows high turbidity, high total suspended solid and high iron concentration, presence of nitrite, low dissolved oxygen (DO), high chemical oxygen demand (COD) high biochemical oxygen demand (BOD), and high total coliform count. Similarly it was found that the water in the tributaries has also become polluted as it shows high turbidity, high total suspended solid and high iron concentration, presence of nitrite, low dissolved oxygen (DO), high chemical oxygen demand (COD), high biochemical oxygen demand (BOD), and high total coliform count. Downstream of the river was found to be more polluted as compared to the upstream as most of the sewage effluents, organic wastes and untreated wastes are carried to these locations. The water quality was found to be worse during the winter seasons as compared to other season of the year. The plankton population was found to be more during the pre-monsoon season compared to the post-monsoon season. Presence of pollution indicator species of planktons corroborated the inferences drawn from the physio-chemical analyses of water samples. The plankton species diversity in river Umkhrah revealed that the water of the river is moderately to highly polluted. Higher turbidity, TSS, iron, nitrite, COD, BOD and total coliform count and lower values of DO content also suggests that the river water contains excess load of organic substances that greatly impairs the quality of the river water. The bacteriological characteristics of the river water also indicate that the water has become unsuitable for any domestic use.
The study revealed that the pollution loads increase along the river course. Though the river is polluted from the source point itself (i.e. Lapalang) up to the middle point the pollution load remains nearly constant. This fact is required to be considered while formulating any action plan for cleaning of river Umkhrah. Comparison of river Umkhrah water quality with the “Designated Best Use” notified by the Central Pollution Control Board revealed that the river water falls under “E” category indicating that the river water can be used only for irrigation, industrial cooling and controlled waste disposal.

A comparison of the pattern of monthly variation in the water quality assessment parameters suggest that the two years did not show similar pattern of monthly variation. This was attributed to significant variation in rainfall during the two years of study. The spatial variation in water quality parameters also did not follow a general pattern along the river stretch and was largely regulated by the inflow of effluents from the tributaries. The study therefore reveals that the water quality of small rivers passing through cities and receiving effluent at several points along its course is governed by rainfall and input of effluents from the tributaries.

The study has revealed that the water quality of the river Umkhrah is very poor. Therefore, immediate measures need to be taken by the government and local bodies to restore the river Umkhrah back to a condition which is acceptable to the society and makes it healthy and fit to perform the ecosystem functions and provide ecological services to the people of Shillong. A number of short and long term measures need to undertaken in order to bring down the pollution levels to the acceptable limits. Based on the findings of this study some suggestions can be made for promoting the quality of water in Umkhrah River. These can be listed as follows: (i) stop direct disposal of solid wastes into the river, (ii) stop discharge of sewage and human feaces from latrines located along the river, (iii) establish a decentralized sewage
treatment systems, (iv) stop all mining and quarrying activities along the river Umkhrah and its tributaries, (v) regulate washing and cleaning of clothes and automobiles in river Umkhrah and its tributaries, (vi) motivate people to participate in a river cleaning drives, (vii) undertake tree planting activities along the stretch of river where land is available, (viii) conduct periodic monitoring of the river water quality and (ix) establish an institutional and organizational mechanism for implementation of these suggestions.

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