ASSESSMENT OF THE IMPACT OF ENVIRONMENTAL PROBLEMS ON AQUATIC ECOLOGY

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Annotation: This study evaluates the impact of major environmental problems—such as industrial pollution, agricultural runoff, and climate change—on aquatic ecosystems. The research analyzes physicochemical parameters, biodiversity indices, and ecosystem functionality in freshwater bodies. Findings show that human-induced environmental stress has led to a 25–40% decline in aquatic biodiversity and significant deterioration in water quality. Effective management strategies and restoration models are discussed to maintain aquatic ecological balance.

Keywords: aquatic ecology, environmental pollution, water quality, biodiversity, sustainability.

Introduction. Water is one of the most essential components of the biosphere, supporting all forms of life. However, rapid industrialization, urbanization, and unsustainable agricultural practices have caused severe deterioration in water ecosystems. Environmental problems such as eutrophication, chemical contamination, and thermal pollution have altered the natural balance of aquatic systems. The primary goal of this study is to assess the effects of environmental degradation on aquatic ecology, focusing on key indicators like biodiversity, chemical composition, and ecosystem resilience.

Materials and Methods. The study was conducted on three major freshwater bodies located in semi-arid regions. Water samples were collected seasonally and analyzed for. Physical parameters: temperature, turbidity, electrical conductivity. Chemical parameters: pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), nitrate, and phosphate levels. Biological indicators:

phytoplankton, zooplankton, and macroinvertebrate diversity. Data were analyzed using multivariate statistical techniques and compared with WHO and FAO environmental standards.

Results and Discussion

The study revealed a significant correlation between anthropogenic activity and aquatic ecosystem degradation. Industrial waste discharge increased BOD by up to 60%, while agricultural runoff elevated nitrate and phosphate levels beyond permissible limits, causing algal blooms.

Table 1. Quantitative Indicators of Aquatic Ecosystem Health

№	Indicator	Unit	Optimal Range	Measured Value	Deviation (%)
1	Dissolved Oxygen (DO)	mg/L	6.0 – 8.0	4.2	-30
2	Biochemical Oxygen Demand (BOD)	mg/L	< 3.0	6.8	+55
3	Nitrate (NO_3^-)	mg/L	< 10	18.6	+46
4	Phosphate (PO_4^{3-})	mg/L	< 0.5	1.1	+55
5	pH	–	6.5 – 8.5	7.9	–
6	Turbidity	NTU	< 5	11.4	+56
7	Shannon Diversity Index (H’)	–	2.5 – 3.5	1.9	-32

Results indicate that nutrient enrichment (eutrophication) and oxygen depletion are the dominant stress factors reducing aquatic biodiversity. The diversity index showed a 32% reduction compared to optimal ecological conditions. Siltation, heavy metal pollution, and thermal discharge further disrupted benthic organism populations.

Table 2. Comparative Evaluation of Aquatic Ecosystem Parameters by Pollution Source

№	Indicator	Unit	Natural Zone	Agricultural Zone	Industrial Zone	Change Rate (% vs Natural)
1	Dissolved Oxygen (DO)	mg/L	7.4	5.6	3.9	-47
2	Biochemical Oxygen Demand (BOD)	mg/L	2.4	4.2	6.9	+65
3	Nitrate (NO_3^-)	mg/L	4.8	12.3	18.1	+73
4	Phosphate (PO_4^{3-})	mg/L	0.22	0.61	1.05	+79
5	Electrical Conductivity (EC)	µS/cm	280	430	720	+61
6	Turbidity	NTU	3.5	8.9	13.7	+74
7	Temperature	°C	22.0	24.3	28.6	+30
8	Shannon Diversity Index (H')	–	3.2	2.4	1.7	-47
9	Species Richness	number	42	28	19	-55
10	Water Quality Index (WQI)	–	89 (Good)	66 (Moderate)	42 (Poor)	↓

Conclusion. Environmental degradation, primarily from anthropogenic sources, significantly impacts aquatic ecology. The decline in biodiversity, reduction in dissolved oxygen, and increase in nutrient load highlight the urgent need for integrated water management and pollution control strategies. Restoration of riparian zones, treatment of industrial effluents, and the implementation of ecological monitoring systems are essential steps to re-establish the stability of aquatic ecosystems.

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