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AN OVERVIEW OF THE RIVER ECOLOGICAL DIVERSITY, STRUCTURAL-FUNCTIONAL CHANGES, AND POLLUTION ASSESSMENT

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ABSTRACT

The most significant sources of freshwater are rivers, and many different uses are made of their water. Cities near rivers have recently had a significant detrimental impact on the water quality, causing the rivers to get worse every day. This is due to the increased urbanization of these areas. The relationship between biodiversity and ecological functions is currently a major scientific topic that requires understanding and prediction. Studies conducted on terrestrial ecosystems, for instance, have shown how species-specific traits and functional biodiversity affect key ecosystem structures and functions related to the storage and cycling of organic material. Many changes occur in ecosystem biomass because of polluting contaminants. Others are in the hydrophone structure type, while some are in the biomass summary. Greater biomass densities and a lack of diversity distinguish the contaminated river flow from the surrounding environment. Many different strategies and underlying concepts have been employed in environmental protection initiatives. Assessing the potential of any or all ecosystem components is necessary for identifying hazards. Hazard assessment describes the degree of harm any potentially harmful chemical or action will cause to ecosystem components. The assessment method needs to be extremely specific due to the changing nature of the riverine environment.

Keywords: *River, ecosystem variety, Structural-functional variations, pollution evaluation*

Rivers are the most important freshwater resources, and their water is used in a variety of applications across all development sectors, including public water supply, aquaculture, agriculture, transportation, and industry **(Shukla, D. et al, 2013).** Surface waterways, on the other hand, are the most vulnerable to contamination and pollution due to their accessibility to both treated and untreated wastewaters. Heavy organic load from home, agricultural, and industrial practises enter rivers, causing water quality to deteriorate **(Shukla, D. P. et al, 2018).** Water bodies are also heavily polluted because of urbanisation and industry. Because of rapid urbanisation, cities located on riverbanks have had substantial negative effects on water quality in recent years, causing the rivers to deteriorate day by day. **(Gangwar, 2013).**

TABLE-1 THE ECOLOGICAL CONSEQUENCES OF DIRECT OR INDIRECT RIVER MODIFICATION

Activity/ Modification	Effect
Construction of Barrage or Retention Wall	Enhancement of Eutrophication hampered species migration, lift silt sedimentation, Enhancement of water density, block sunlight penetration
Damming	Enhancement of Eutrophication (bottom anoxia, high organic matter in surface waters etc.) complete storage of sediments resulting in potential fish kills (high ammonia, BOD and TSS)
Dredging	Continuous high levels of TSS and resultant silting of areas in downstream reaches, regressive erosion upstream of dredging areas may prevent fish migration
Flood Plain Reclamation and River Bed Channelization	Loss of Ecological diversity, including specific spawning areas, loss of Biological habitats especially for fish.

AQUATIC BIODIVERSITY AND ECOSYSTEM FUNCTIONS

Understanding and predicting the link between biodiversity and ecological functions is a major scientific challenge today. Ecosystems, according to Mar-galef (1968), have evolved to function in a unified, cybernetic fashion, with feedbacks synchronising important ecosystem activities. Species-specific features, rather than species richness per se, may have a major influence on the regulation of ecosystem functions and accompanying structural factors. **(Bolam et al. 2002 and Giller et al. 2005).** Terrestrial studies, for example, have revealed that species-specific characteristics and functional biodiversity influence important ecosystem structures and functions related to organic material storage and cycling. **(Hooper et al. 2005).** Similarly, **Hasan A. et al. (2009)** found that functional biodiversity, rather than species richness, governed soil respiration and leaf litter mass loss. Mineralization in the water column and benthic environments, recycling, and transport of reactants across the sediment-water interface, and removal of organic and inorganic compounds by sediment burial are key ecosystem functions related to the cycling and overall fate of organic material in aquatic environments **(Giller et al. 2005).** Marine benthic fauna's activities have far-reaching impacts on the oxic-anoxic boundary and the multidimensional distribution of solutes within the sediment, as well as the transfer of reactants and metabolites across the sediment-water interface. **(Aller, 2001).** For example, oxygen consumption is a critical ecosystem function in benthic environments that combines abiotic and biotic processes, including respiration by the fauna **(Middelburg et al. 2005).** Benthic creatures not only provide oxygen to anoxic sediment locations, but their burrow irrigation also causes recurrent redox oscillations in the nearby sediment **(Hulthe et al. 1998).** Field and laboratory studies have shown that repeated successions of oxic, suboxic, and anoxic conditions promote efficient mineralization of various types of organic material, reducing the accumulation and storage of organic material in the sedimentary record. **(Aller 2001 and Hulthe et al. 1998).**

As a result, fauna may significantly modify the rates and pathways of organic matter mineralization, as well as the overall diagenetic features (e.g., sediment reactivity and capacity for solute mobilisation) of the sedimentary environment compared to what would occur in the absence of fauna. diverse species, however, have diverse activity patterns, and the importance of faunal activities for system management is typically related with particular species characteristics **(Shukla, D. P. et al, 2017)**

IMPORTANCE OF FLORA AND FAUNA

MAINTAINS ECOLOGICAL BALANCE.

Humans cannot exist in the absence of vegetation and fauna. The flora produces and releases oxygen, which the fauna requires for respiration. In exchange, the fauna creates and emits carbon dioxide, which the flora needs for photosynthesis. It's a mutually beneficial connection. Similarly, humans cannot exist without both vegetation and fauna. The flora provides the oxygen we breathe in, and the carbon dioxide we exhale is essential for the flora. Humans also benefit greatly from flora and fauna in terms of food, medicine, and water. Plant and animal species provide the majority of our sustenance **(Shukla, D. P. et al, 2017).** Flora provides almost 90% of the medicine we use to treat ailments. There would be no water if it weren't for the flora, which means we wouldn't exist right now. creatures also maintain overall equilibrium by predating plants and other creatures that might otherwise have burst in population. By pollinating other plants, they also allow other rare species of plants to grow. Plants benefit from animal droppings as a source of fertiliser. Animals that die serve as additional minerals for plants. Furthermore, animal droppings provide an abundance of food for microorganisms on the Earth's surface **(Middelburg et al. 2005 and Shukla, D. P. et al, 2017).**

AESTHETIC VALUE

It goes without saying that humans adore and value nature. Because of its aesthetic appeal, many people like spending time in settings such as woods, natural regions, parks, and other green places. The proliferation of plants and animals is primarily responsible for its aesthetic value. According to statistics, up to half a billion people visit magnificent, protected landscapes such as national parks, recreation areas, indigenous forests, historic sites, animal refuges, and wild and picturesque rivers each year to enjoy the beauty of the landmarks. This emphasises the importance of flora and fauna in our daily lives **(Middelburg et al. 2005 and Shukla, D. P. et al, 2017)**

EXPANDS LOCAL ECONOMIES

Flora and fauna provide significant contributions to most world economies in terms of tourism. The Amazon's flora and animals, for example, draw many scientists and explorers. The Amazon rainforest is predicted to generate $50 million to the Brazilian economy. Exotic holiday destinations such as the Caribbean, Bahamas, Panama, and Indonesia, among others, attract more tourists than any other country due to its diverse flora and fauna **(Middelburg et al. 2005)**.

ANTHROPOGENIC IMPACTS ON RIVER BIONETWORKS

Because of changes in abiotic and biotic conditions, the hydro-ecological state of rivers is changing because of anthropogenic activity. Anthropogenic activities have an impact on water streams through hydro-technical projects and irrigation, as well as the discharge of polluting substances **(Shukla, D. P. et al, 2017)**.

STRUCTURAL AND FUNCTIONAL CHANGES IN THE RIVER

Changes in biomass in ecosystems because of contaminating pollutants, many changes occur. Some are in the biomass summary, while others are in the hydrophone structure type. The contaminated river flow is distinguished by greater biomass concentrations and a lack of diversity. **(Chutter F.M 1972, Daley 2013 and Frisbie S.H 2012).** Biogenic elements and various microelements are used by heterotrophic and autotrophic bacteria to boost zooplankton and zoobenthos (which bacteria and organic substances use) and phytoplankton development. Higher flora is developed as photosynthetic reaction pathways are promoted. As a result of these activities, phototroph and lithotroph biomass output increases. The use of synthetic biomass degrades the oxygen balance and the ecological circumstances. **(Kamble**

K.J 2016 and Kurunthachalam 2013). Variations in Diversity Under anthropogenic conditions, biomass is changing, as is the type of biocoenosis structure - phytoplankton, phyto-benthos, zooplankton, zoobenthos, bacterio-plankton. **(Gebreyohannes F. 2015 and wilhm J.L 1968)**. The pollutant's influence is a shift in the consequences of the pollutant's bioaccumulation at different trophic levels, which is part of the fundamental ecological processes. Organic substances determine both the competition for food substances and the pressure on the food chain. They disrupt the ecology by shortening the trophic chain. **(Frisbie S.H 2012 and Hartmann L. 1993**). Theoretically, a link exists between the type and concentration of organic molecules and the number of heterotrophic organisms. Polluting substances have an impact on the relative competitiveness ability of the many types that comprise the ecosystem. Individuals of one type or populations of distinct types modify their relationship as their abilities in the fight for food and habitat improve or deteriorate. Changes in the special and trophic ecological niches accompany this process. **(Hogan C.M, 2010).** Anthropogenic pollution that exceeds the limiting concentration norms causes aquatic ecosystems to lose their durability and reliability (the ability of the aquatic system to maintain the mechanism of self-purification and ensure water quality), resulting in a progressive decline in water quality. **(Kurunthachalam S.K. 2013).** Certain population parameters change when organic and inorganic substances of anthropogenic origin are present **(Chan C.B, 2012).** Indicators of River Ecological Status Various measures assess the natural quality of rivers. The hydro-biological parameters are river ecosystem features. They disclose biotic and abiotic elements. They are based on the number and structure of aquatic organisms since they respond to more than just one **(Chutter F.M 1972 and Hartmann 1993).** More common measures of biological prosperity include 1. The link between phytoplankton production and destruction; if the production exceeds the destruction, the hydro-ecological balance is disturbed. The link between autochthonous phyto-biomass production (P) and heterotrophic organisms' oxygen consumption (B). Three zones along the river flow can be defined based on parameter values in the river. The first zone was P/B 1 - normally the upper flow of the river; the second zone was P/B = 1 - usually the intermediate flow of the river; and the third zone was P/B > 1. **(Wilhm J.L 1968, Shukla D.P 2017, Rajaram T. and Das A. 2008).**

ASSESSMENT OF THE IMPACT OF POLLUTION

Environmental protection measures have used a wide range of approaches and underlying philosophies. These range from those that react to problems as they occur to those that attempt to anticipate problems, those that are based on the suspicion of a causal link between activity and effect, those that seek a detailed scientific understanding of the linkages, those that are based on recognition of the potential for action and substances to cause harm, and those that are based on an assessment of the likelihood of those likelihoods being realised in the real world **(Calow, 1997).** Essentially, in any given condition, hazard identification and hazard assessment must be addressed. Things become more complicated at the ecosystem level, and the target at danger must be recognised. The identification of hazards entails assessing the potentials of any or all components of an ecosystem. The level of damage produced to ecosystem components by any or all hazardous chemical or action is referred to as hazard assessment **(Suter, 1997; Calow, 1997).** Because the riverine ecology is dynamic, the assessment technique must be highly particular. Because the elements affecting at the point of release and at the site of action differ greatly, the point of waste disposal is critical in determining the impact. However, in several cases, the physiochemical differences are examined preferentially and are not effectively connected with the biotic condition of the riverine or estuary system. Several studies have demonstrated the significance of parameters influencing pollution movement and/or accumulation in an aquatic ecosystem. The evaluation of environmental status, particularly in terms of pollutant load, is being investigated using two quite distinct methodologies. One of the standard ways involves exposing laboratory animals, including certain non-chordates and fish, to varying dosages of a single or a mixture of contaminants. Such research has revealed the negative effects of agrochemicals and other industrial chemicals on many systems and the biology of animals used in experiments. The results of such laboratory experiments are extrapolated to field or natural situations, which may be an oversimplification and overexploitation of scientific knowledge gained. Another approach is to investigate the field conditions **(Buikema et al., 1982). Cairns and Dikson (1976)** strongly advocated for using an ecosystem viewpoint to

assess pollution impacts as indirect effects on the structural (e.g., diversity) and functional (e.g., system rate changes) integrity of the ecosystem.
There are two assessment procedures proposed:
a) top to down and
b) bottom to up.

TOP TO DOWN APPROACH

Perry, 1994 define an ecosystem as a network of synergistic interactions and interdependencies among its many components and levels. As a result, assessing hazards using this approach is currently problematic since it falls under a multisystem analysis, which includes a range of functions at different levels in an ecosystem **(Suter, 1997).** Even when an impairment or influence on ecosystem function is observed, it is frequently difficult to identify the causative agent, explain such a cause-effect relationship, and adopt preventive actions. It is difficult to rationalise and deduce numerical requirements for a healthy ecosystem, or even to operationally define a normal or unpolluted ecosystem **(Forbes & Forbes, 1993; Chapman, 1995).**

BOTTOM TO UP APPROACH

Another method is to assess the hazards and risks of pollutants based on a more manageable or observable biological unit, such as an organism or a small community of these species. The dangers and risks discovered in this approach are extrapolated from organism to population to community to ecosystem **(Norton et al., 1992; Chapman, 1995).** One of the most essential parts of ecotoxicological studies is the bottom to up method **(Landis et al., 1994; Taub, 1997).** Species richness, or the number of species present in each location, is identified in such research **(Cairns and Pratt, 1993; Boulinier, 1998).** The community structure is proposed based on these findings **(Gaard, 1999; Park and Marshall, 2000).** Furthermore, knowledge of food and feeding behaviours, as well as organism biology and prey-predator relationships, allows for the identification of food chains and food webs **(Kim et al., 2000).** Any change in the typical diversity and distribution pattern of numerous organisms can be linked to the pollution level of the area under investigation. A little variant of this complete ecosystem level study is also proposed, in which a specific group of species is studied for its distribution, diversity, and biology **(Hwang and Heath, 1997).** The knowledge of such a collection of animals' interactions is used to analyse data at the ecosystem level **(Hacker and Gaines, 1997).**

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