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Risk Assessment of Pulp and Paper Mill Effluent in *Cyprinus carpio* Using Histopathological Biomarker

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Abstract

Industries are the major sources of aquatic pollution among which pulp and paper mill are one of them, which affects the aquatic biota. And thus a study was carried out on the effects of paper mill effluent (PME) exposure on a commonly cultured fish, *Cyprinus carpio* that has high ecological relevance. Histopathological studies are used as biomarkers in order to predict the role of PME in causing toxicities to the fingerlings of *Cyprinus carpio* on gill architecture at 7, 14, 21 and 28 days of exposure using light microscopic study. Results at sublethal dose of 1.45% (v/v) illustrate incurred alterations in the gill at 7, 14, 21 and 28 days durations. Anomalies such as epithalial lifting, mucous secretion, leucocyte infiltration, clubbing of secondary lamellae, hyperplasia, hypertrophy etc. were prominent. The study concluded that the effluent, even in greatly diluted form, was highly toxic and the severity of responses was duration dependent as a result this raises a severe alarm as this fishes are commonly cultured as well as consumed by the local inhabitants and thereby eventually affecting human health.

Keywords: Effluent, histopathology, carp, gill.

Introduction

Increased industrialization had added to environmental pollution particularly the aquatic system as it is an ultimate sink of anthropogenic discharges. The pulp and paper industry is one of the oldest and largest industries in our country contributing a lot towards the pollution in Indian aquatic environment. The paper industries in India are not as modernized as in western countries, with more than 55% of these mills lacking adequate effluent treatment facilities. As such, paper mill effluents (PME) are released into the environment without any prior treatments [1,2]. Most of these mills often discharge effluents in and around water bodies and cause aquatic pollution [3]

Cachar Paper Mill (CPM) in Assam is a bleach kraft mill situated by the confluence of river Dhaleswari with river Barak (24°51 ″ 16.9 ′ N 92°35 ″ 33.6 ′ E), the waters of both these rivers are used by the local people for drinking, domestic usages and irrigation purposes. The mill empties its effluent into both the rivers and at the adjoining agricultural fields and thereby affecting the aquatic biota. Consequently, there is a rising public concern regarding the health hazards and ecological risks associated with the effluents of this mill. Fish either through branchial respiration or by dietary uptake zooplankton and phytoplankton readily bioaccumulate and biomagnify a variety of aquatic contaminants [4]. The use of fish in environmental risk assessment as bioindicators are of increasing importance as they provide early warning of a specific detrimental biological endpoint [5]

Biomarkers, representing toxicant-induced changes in biological systems provide associations between an environmental contamination and its effects. In this era of

Cadmium Hyperaccumulating Plants from Barak Valley, South Assam, India for Phytoremediation

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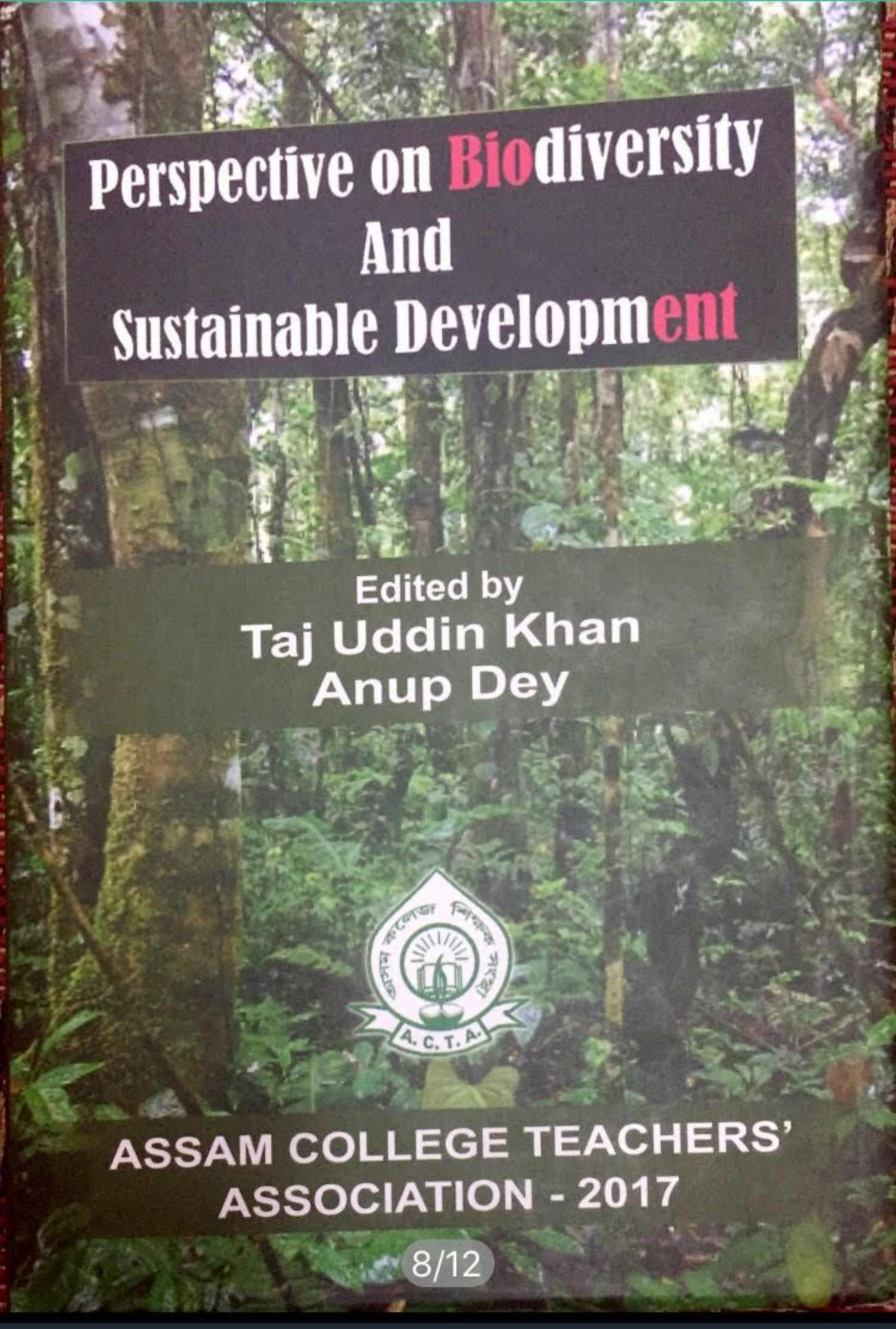
Abstract

Cadmium (Cd) is recognized as one of the major environmental pollutants and produces toxic effects in living organisms. It bioaccumulates in tissues of mammals particularly in kidney and liver, which are considered to be critical target organs and result in their damage. Cd is used in batteries, predominantly in rechargeable nickel-cadmium batteries, electroplating, pigments and plastic production and these have produced sharp increase in contamination of air, water and soil pollution. Existing technologies for Cd remediation such as leaching, solidification/stabilization and excavation are currently expensive, time consuming, and soil disturbing. However, phytoremediaton of Cd from contaminated site is a lucrative and emerging concept which is not only cost effective but also ecofriendly. It is based on the fact that certain plants, during the process of nutrient uptake, remove pollutants from the environment. Such species can hyperaccumulate pollutants in their root, shoot and leaves. Several plant species of Barak Valley, South Assam, in the north east part of India, possess substantial hyperaccumulating potential that can be used for Cd phytoremediation from soil and water. Present study thus explores phytoremediation potential of such plants found in this region.

Key words: cadmium, hyperaccumulator, hazards, phytoremediation

Introduction

Cadmium (Cd) is a non-essential, highly toxic heavy metal having toxicity 2 to 20 times higher than many other heavy metals [1]. It is placed in seventh position in the top ten priority hazardous substances list as provided by the American Agency for Toxic Substance and Disease Registry [2], and therefore is considered as a one of the major environmental pollutants and produces toxic effects in living organisms. The contamination of soil and water by Cd is contributed from electroplating industries, nickel-cadmium batteries, industrial smelts pigments and plastic production agricultural applications of fertilizer, and sewage sludge. The elevated levels of cadmium in the environment have drawn the key attention because these are posing serious threat to mankind as well as fauna and flora [3]. Currently, conventional remediation methods of heavy metal contaminated soils include electro kinetical treatment, chemical oxidation or reduction, leaching, solidification, vitrification, excavation, and off-site treatment. These clean up processes are expensive and environmentally destructive [4]. Keeping in mind the above scenario of Cd pollution, continuous efforts have been made to develop technologies to remediate Cd that are easy to use, sustainable and economically feasible. The use of plant species for cleaning polluted soils and waters, named as phytoremediation, has gained increasing attention since last few decades, as an emerging cheaper technology [5, 6]. Metal accumulator plant species are usually referred to as hyperaccumulators that concentrate metals in their aboveground tissues to levels far exceeding those present in the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Heavy Metal Phytoremediation Potentials of Some Wetland Plants of Northeast India

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Metals and metalloids are natural constituents moving between living and non-living things. Heavy metals are toxic at higher concentration specifically when the concentration causes a detrimental environmental effect on the living organisms. They infect the environment by affecting soil properties its fertility, biomass and crop yields and ultimately human health. (Jing *et al.*, 2007)

The **environmental contamination** with different heavy metals is a worldwide concern that has resulted from anthropogenic activities. Heavy metal or metalloids are naturally occurring component found in the earth crust, soils, sediments and water bodies. The whole living world and the sustainability of whole ecosystem depends on land and water for their maintenance. Anthropogenic activities, rapid industrialization and urbanization contributed the contamination of soil and water by **heavy metals.** Globally all countries have been exaggerated, though the severity of heavy metal contamination. **Heavy metals** are recognized as one of the major environmental pollutants due to their persistence in the environment and produces toxic effects in living organisms. They cannot be destroyed biologically but cab be transformed from composite to another form and cause different health problems (Ali et al. 2013; Memon and Schröder, 2009). They have the tendency to

Histopathological anomalies in two carps, *Labeo gonius* and *Labeo angra*, collected from a polluted wetland site in Southern Assam

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Abstract

Labeo gonius and *Labeo angra* were the two commonly available teleost sampled from a polluted wetland site (24°52'15.33"N and 92° 34'55.92"E), in Barak Valley. Fish were sampled in the post-monsoon season of the year 2015 to ascertain their health, vis-a-vis consumability. Histopathological biomarkers were chosen to confirm the pollution load on these fish. The fish samples were collected by gill net and immediately preserved in formaldehyde for histopathological examinations of gill, liver, and kidney tissues. The water samples of the lake were also analysed for various physicochemical properties. *Labeo gonius* and *Labeo angra* tissues showed myriad of anomalies. Gills showed chronic anomalies in the form of epithelial lifting, gradual lamellar fusion and curling of tips, all indicated severe respiratory impairments. Similarly, liver showed fatty deposition, necrosis, and inflammatory inflammations, amongst others. Likewise, Kidney also showed several structural changes, all of which points towards severe histopathological damages.The major concern that stems out of this work is that these fish species are consumed by local people. Hence, health hazards associated with fish consumption cannot be ruled out.

KEY WORDS: histopathology, fish, tissues, wetland.

Introduction

Environmental impact of anthropogenic actions have great influence in altering the quality of water, soil, and air. The disposal of toxic materials and efluents in the environment causes serious damage to aquatic ecosystems, as water bodies are considered the least expensive and the most opportune system for the disposal of waste. The effluents, released from industrial activities, may contain complex mixtures of toxic metals, causing serious damage to organisms [1]. As a result, identification and monitoring of the effects of such pollutants has become extremely important [2]. Wetlands are low-lying areas with shallow waters. These ecosystems serve as an unique environment for several biota, including fish [3]. In North-East India, the flood plain wetlands have rich in biodiversity as well as have great ecological, economic and social values in ensuring livelihood of people. However, these wetlands are under threat and gradually degrading due to various anthropogenic reasons.
The Barak river is amongst the one of major river of Southern Assam of North-East India.