

# Status of Heavy Metals (Fe, Zn, Cu, Mn) in the Mangrove Sediments of Rajapur Estuary, Coastal Maharashtra

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## ABSTRACT

*Mangrove tracts along the estuaries in the coastal areas nowadays affected due to the deposition of heavy metals like zinc, copper, lead, iron etc. Most of these heavy metals acts as a pollutants which is coming from the upstream areas of the estuarine or river basin, particularly collected from the agricultural and industrial sectors. The decline of mangroves is alternately influencing on the distribution patterns of heavy metal. The circulation of such metals in the food chain of the living things is also changing. In the present research work soil samples were collected from different mangrove sites of Rajapur estuary and analysed for the status of Iron, Zinc, Copper and Manganese.*

**Keywords:** Heavy Metals, Mangrove Sediments, Mangrove destruction, Iron, Zinc, Copper and Manganese.

## INTRODUCTION

Mangrove is a large tropical evergreen tree/forest, genus Rhizophora that grows on muddy tidal flats and along protected ocean shorelines. Mangroves play vital role in coastal areas than the inland areas or estuary. Because tsunami, cyclones, wind are firstly attack on coast. According to Forest Department of Maharashtra there are 20 species of Mangroves that have found in Maharashtra [1]. The mangrove ecosystem in south konkan playing significant role, provide various benefits to the local people. Every estuary have different pattern of mangrove cover. Along the estuary there are several villages and the activities of this people influenced on mangroves in and around the concerned area. People uses mangrove wood as a fuel wood and convert mangrove patches into salt pans and agricultural fields. Impact of small village and urban area is different in area to area. Growth of the urban area directly or indirectly affects on the natural estuarine environment. Waste water discharge from the urban areas directly or indirectly added to the estuaries through rivers or runoffs and that causes mangrove degradation [2], [3].

Along the Rajapur estuary there are mud flats or swamps, covered by Mangroves. Mangroves are developed in the inter-tidal zones of estuaries. Most of the mangrove resources are degraded. Observed degradation of mangrove in the study area is the result of mangrove utilization for various purposes i.e. disposal of waste water from settlements and from industrial areas also [4].

The mangrove ecosystem is a dynamic natural resource which provides various ecological benefits to the marine habitats and marine animals. This also protects the shoreline and inland agricultural and settlements from the natural calamities like cyclones, storms, floods and tsunamis [5].

In the natural and contaminated environments heavy metals are present and they are potentially hazardous sub-stances. In natural environments heavy metals are occurs at low concentration while in contaminated environments high concentration occurs. In the environment heavy metals arises from various industries like metal smelting, refining, scrap metal, plastic and rubber industry. After releasing these elements to the air, they travel for large distance and deposited onto the soil, vegetation and water [6]. The metals are tends to remain in the ecosystem for longer time and moves from one section to other within the food chain [7]. The heavy metals are deposited in the soils of mangroves which are adding through the garbage of the upstream cities and urban areas, agricultural fields, sewage treatment plants, oil spills, quarrying sites and industrial wastes [8]. The destruction of mangroves is influencing on the distribution patterns of heavy metals. The decrease in mangrove species in the swamps minimizes the intake of heavy metals, the sediments of mangrove sites are unable to capture the heavy metals which are distributed in the adjoining sites of marine environment through marine food and water bodies [9], [10].

Heavy metals have their impacts on mangrove health and pollution status of the ecosystem. Higher concentrations of metals in mangroves sediments are the resulting of natural or anthropogenic activities. Level of the heavy metals in the ecosystem need to be identified as toxic metals would be harmful for the flora and fauna of

the ecosystem. Identification of sources of metals is also important to understand pollution status and for remediation purpose [11]. In some regions, the mangrove sediments in the cores shows very high concentrations of Fe which might be due to diagenetic or anthropogenic activities [12]. As per geographical location heavy metals in the sediment is different. Proportions of heavy metals are higher in the monsoon season due to the influx of fresh water through irrigation channels and municipal drainage [13]. From industrial and anthropogenic activities pollutants are diverted in to the mangroves ecosystems, therefore mangroves habitats are used as pollution sinks [5], [10].

The above mentioned heavy metals if distributed more or less in the mangrove sediments then the impacts may also varies from place to place and also among the living things. Some characteristics of the heavy metals are reviewed here in connection with the impact on mangrove environment.

**Iron (Fe):** According to Weinberg, excessive/misplaced iron has resulting for an increasing number and a variety of disease conditions. The increased quantity of iron content in living bodies and its toxicity is responsible for growth deficiency and lung cancer [14].

**Zinc (Zn):** Zinc is an element which is present in plant, animal human and contributes in the biological processes. It also helps for the growth of plants, animals and humans. Toxicity of zinc rarely occurs but lower concentrations of zinc is resulting for growth retardation and loss of appetite [15].

**Copper (Cu):** Copper (Cu) is a metal which is not poisonous in its metallic state, however some of its salts are poisonous. "Copper is a powerful inhibitor of enzymes, needed by the human body for a number of functions, predominantly as a cofactor for a number of enzymes. Due to Copper Toxicity adverse effect may be seen on the nervous system, reproductive system, of the human beings" [16].

**Manganese (Mn) :** Manganese (Mn) is an element which is present in human body and all living organisms. It is freely available in rocks, soil, water, and food and also a part of food chain. Sometimes, toxicological effect may be observed in the human beings due to the high exposure of manganese. "Exposure to high oral, parenteral, or ambient air concentrations of Mn can result in elevations in Mn tissue levels and neurological effects" [17].

In view of the present research work mangroves sites of Rajapur estuary has focused. Nate, Sakhri Nate, Devache Gothane and Karel these four villages are situated along the Rajapur estuary. People who lived near the mouth zone of estuary are aware about the mangrove conservation but this view or attitude is not that much positive

near the middle and upstream zones of estuarine villages. Most of the people are unknown about the importance of mangroves and therefore degradation of mangroves has increased in this area, simultaneously affecting on the heavy metal distribution and its status.

## METHODOLOGY

Soil samples were collected from six sites. For the sample collection estuary was divided into three zones i.e. Mouth zone, middle zone and upstream zone. Soil samples were collected from both banks of the estuaries. Therefore 'L' and 'R' codes have given to the Left and Right bank respectively. Mouth zone consider 1 and middle and upstream zones 2 and 3 on the contrary. So, samples were securely labelled with a sample codes [18], [19] at the sample site with reference to their location i.e. Soil samples along the Rajapur estuary coded With RA and for left bank and its zone L1, L2, L3 codes were used, as for right bank R1, R2, R3 codes have used. Heavy metals in the soil like Copper, iron, manganese and zinc were analysed by using AAS Spectrometer.

## DISCUSSION

Jaitapur is well known for proposed nuclear power plant along the Rajapur estuary which is under construction. Residential population of Jaitapur and surrounding area are opposing this power plant, because they think that the plant may affect on mangroves, fish and mango plantation. Water, which will be used for cooling system in nuclear plant, will be poured out in sea for 20 to 25 km from the coast land. But people think that, water may come back to the estuary during the high tide and this will disturb the estuarine ecosystem. Local natives are conscious about the mangroves here.



Fig. 1 (a) Collection of soil samples ; (b) Garbage disposal in mangrove swamps (Plastic bottles,

cloths etc.) ; (c) Garbage disposal in Nate village along the Rajapur estuary.

Untreated waste water and waste disposal from settlements gets discharged into the rivers and creeks which results in killing marine organisms that live within the mangrove forest (Fig 1). Such situation is seen along the Rajapur estuary at the Nate village. Development or change in land use pattern is resulting for change in mangrove land. Mangroves are converted into salt pans or shrimp farms. The commercial view causes degradation of mangroves. At the Dale and Burbewadi village large mangroves area was converted into the shrimp farms.

Table I and II shows the physico-chemical properties of soil samples collected from the Mangrove sites during post- monsoon and pre-monsoon season. The variations in the quantity of heavy metals have seen due to the uneven growth of the mangroves in the sites of Rajapur estuary. Healthy mangroves represent the deposition of more amounts of heavy metals in the sediments of the mangroves. The degraded sites of mangroves are unable to hold and absorbed the heavy metals and redistributed in the adjoining sites.

**TABLE-I**  
Physico-chemical properties of soil samples during post-monsoon season

Post – Monsoon (year Oct 2014)						
Station	RAL1	RAR1	RAL2	RAR2	RAL3	RAR3
Iron (ppm)	33.2	3.24	6.68	36.16	38.56	54.24
Zinc (ppm)	1.9	0.82	0.12	0.84	0.96	1.82
Copper(ppm)	5.56	0.64	0.6	5.76	7.74	8.78
Manganese (ppm)	29.06	3.5	4.08	30.92	29.52	30.62

**TABLE-II**  
Physico-chemical properties of soil samples during pre-monsoon season

Pre – Monsoon (year April 2015)						
Station	RAL1	RAR1	RAL2	RAR2	RAL3	RAR3
Iron (ppm)	44.32	40.16	38.76	39.44	35.78	42.5
Zinc (ppm)	1.2	2.7	2.02	1.46	2.52	2.16
Copper(ppm)	1.36	0.74	5.1	4.86	7.88	5.9
Manganese (ppm)	7.74	8.28	20.54	29.36	28.26	26.32

At the mouth and middle zones of the estuary the amount of iron was increased during

pre-monsoon at left and right banks than the post monsoon season. But at the upstream zone the proportion of iron in the soil was increased during post-monsoon season. From mouth to upstream zone iron varies from 3.24, to 54.24 ppm during post monsoon. And the quantity of iron ranges from 35.78 to 44.32 ppm during pre-monsoon season.

It has observed that, zinc content in the Rajapur estuary was lower during post-monsoon and higher during pre-monsoon in all the zones. From mouth to upstream zinc content in the soil was 1.9-0.82, 0.12-0.84, 0.96-1.82 ppm during post monsoon and 1.2-2.7, 2.02-1.46, 2.52-2.16 ppm during pre-monsoon.

Amount of copper in the sediments of Rajapur estuary was lower during post-monsoon season than during pre-monsoon season. There was variation in the proportion of copper in the soils of left and right bank of the estuary. It was ranged from 5.56-0.64, 0.6-5.76 and 7.74-8.78 ppm during post-monsoon and during pre-monsoon it was 5.28-10.06, 9.8-9.74 and 9.08-12.52 ppm in respect to mouth, middle and upstream zones.

Manganese in the mangrove sediments varies at all sites of Rajapur estuary. It has seen there is an uneven distribution of this heavy metals at the mouth zone and the up-stream zone. In the mouth zone of the estuary at right and left banks the range of the manganese was 3.52 ppm to 29.06 ppm. In upstream zone content in soil were 29.52-30.62 ppm and 35.26 -34.04 ppm during pre and post-monsoon respectively.

## CONCLUSION

Some of the mangroves sites in Rajapur estuary are degraded due to the waste water disposal and garbage. Mangroves are the shelter and habitat of micro organism, marine animals, birds etc. Therefore destruction of any mangrove sites in study area will disturb the ecosystem of adjoining areas and marine environment. Simultaneously the degradation of mangroves may also affect on the deposition and distribution systems of heavy metals in mangrove sediment.

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