

Impact of Land Use Changes on Riparian Habitats in Panchganga River System

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Abstract :

Riparian zones are critical habitats for Biodiversity. These narrow areas along river banks are potential conservation areas vital for sustainable agriculture as well as for fisheries as local livelihood. The ecologically sensitive Western Ghats region of south Maharashtra is catchment for 16 east flowing and 11 west flowing rivers. River Panchganga is one of the important tributary of river Krishna in Kolhapur district. Panchganga River System (PRS) is formed by 5 tributaries in its upper catchment namely Bhogawati, Kumbhi, Kasari, Dhamni and Tulshi. The study mainly focuses on present status of riparian ecosystem, biodiversity, and threats to riparian habitats in the PRS. The main, factors responsible for degradation of the riparian habitats are river valley projects, deforestation, mining, soil erosion and siltation, agriculture expansion, changing crop pattern from traditional food crops to sugarcane, brick kilns, industrial and urban pollution. These factors have singular as well cumulative negative impact, qualitative as well as quantitative, on the riparian habitats. Water level fluctuations in the river due to construction of dams and K.T weirs, and introduction of exotic fish species are some threats responsible for rapid decline in natural riparian habitats and local biodiversity.

Keywords: Panchganga River, Riparian habitats, Environmental Threats.

Introduction:

Riparian areas occupy the lowest topographic position in landscape and have natural connections throughout the Watershed. Rivers are very important and highly valued ecosystem under increasing pressure from anthropogenic factors such as habitat alteration (Sandin, 2009). Rivers and their flood plains are widely acknowledged as biodiversity hotspots (Rohde, 2004). As well as riparian areas have served as crucial sites for urban development and exploitation of natural resources. (Tockner, 2002). Unfortunately in general the river ecosystems are neglected and being more exploited the world over. Streams and rivers are most affected by human activities; the main reason of riparian habitat alteration is land use change. The river and its catchment are integrated habitats, any artificial alterations in watershed result in changes to the stream channel and subsequent change in flow regime and biota (Peterson, 1999). While comparing status of species extinction rate, fresh water species are at higher risk of extinction than their terrestrial counterparts (Weijters, et.al; 2009). The major factors responsible for rapid change in riparian systems are physical alteration, habitat loss, pollution and introduction of exotic species (Revenge, et al.; 2000). Land use change is a major threat to riparian ecosystem, when considering land use, agriculture occupies largest area of land where as urban land use is much smaller portion. Urban land use with low percentage of land exerts large influence on river ecosystem (Allen, 2004). In India, large river floodplain systems are extensively altered by anthropogenic activities. River regulations, drainage basin alteration, pollution, deforestation, over exploitation of aquatic

resources are major threats to freshwater ecosystem throughout India including the Western Ghats.

The Western Ghats are one of the two global 'biodiversity hot spots' in India and support a wide array of flora and fauna endowed with many ecological, climatic and societal functions. Due to average altitude of around 1000 MSL, Western Ghats are the origin of over 38 east flowing and 37 west flowing rivers in the peninsular India. Western Ghats in Maharashtra, locally known as 'Sahyadri', are origin of most of the rivers in the states. Being a major river system in south India, river Krishna and its tributaries are vital source of resources and livelihood in southern Maharashtra. Developmental activities leading to habitat fragmentation are considered to be responsible for the negative change in local biodiversity of Krishna basin. There are increasing reports of unstable nature of the rivers in the system related to flood damage, bank erosion, siltation, pollution, mass fish mortalities and loss of local biodiversity. In the past few decades Krishna river and its tributaries are under tremendous stress which in turn causes change in river dynamics, natural habitats, species density and diversity. As a major tributary of river Krishna, river Panchganga is no exception; all above factors are contributing in the Panchganga River System causing major threats to its riparian habitats and biodiversity. There are increasing reports of mass fish mortalities, pollution, river bank erosion and siltation.

Material and Methods:

Study area:

Panchganga is one of the important tributary of River Krishna, in its upper catchment, in Maharashtra.

Panchganga basin lies between 16° 19' 12" and 16° 55' 21" N latitudes and 73° 44' 10" and 74° 42' 20" E longitudes, Located in northern Western Ghats in Maharashtra. Panchganga River System (PRS) is formed in the upper western part of the district by five tributaries namely Bhogawati (83km), Tulashi (34 km), Dhamni (41 km), Kumbhi (48 km) and Kasari (69 km). The five tributaries unite to form Panchganga River at Prayag near Kolhapur city. After the confluence Panchganga flows for about 67 km and meets river Krishna at Narsinghwadi. The total length of PRS is 338 km Panchganga basin includes seven tahsils namely Radahnagri (480.76 sq.km), Gaganbawada (266.24 sq.km), Panhala (399.20 sq.km), Shahuwadi (310.08 sq.km), Karveer (521.76 sq.km), Hatkanagale (369.76sq.km) and Shirol (388.04 sq.km). (Fig:1)

This study was aimed to evaluate the present status of PRS as a part of the detail assessment of the changing riparian habitats in the Panchganga river system. Methodology adopted for the study was based on field visits and personal observations, review of literature, reference of records and interaction with knowledgeable locals and subject experts. The study focused on the threats to riparian habitats and ecological changes in the riparian system.

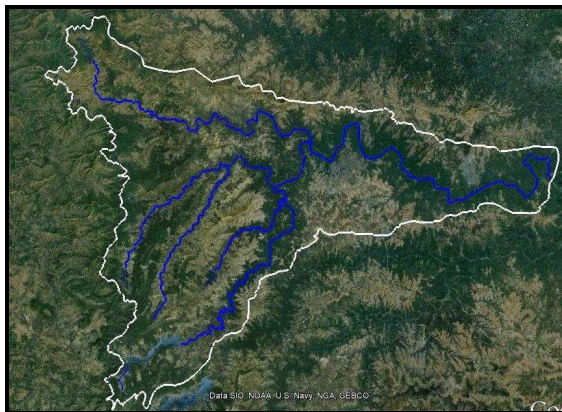


Figure 1. Satellite imagery of the Panchganga River System (PRS)

Landscape Functions and Values of Riparian areas

Biologically riparian areas are valuable interdependent mosaics of micro-ecosystems in any landscape. Because of their high productivity and inherent connections with rest of the watershed, riparian areas provide a crucial source of habitat diversity at the landscape level. The Landscape of natural river corridors consists of geomorphic features like channels, bars and islands with diverse riparian habitats. (Ward, 2001) Riparian area degradation is a major environmental threat in most of the river systems in any country and more so in the mountainous catchments such as the Western Ghats.

The riparian areas despite their ecological significance are one of the most neglected and less studied areas in environmental sciences. Riparian ecosystems are more fragile and vulnerable due to the mosaic of narrow liner habitats and wider conflict surface area. During the study it was observed that in most places, particularly in the upper and middle catchments of PRS, agricultural expansion, destruction of riparian vegetation and removal of farm soil river banks for brick kilns was responsible for increase in river bank erosion and flooding of larger areas. In the lower catchment changing land use practices, urbanisation, and industrialisations are the major threats to the riparian habitats. These activities are responsible for the decline or absence of the sensitive natural riparian habitats and drastic reduction in diversity, density and distribution of the riparian biodiversity in Panchganga River System.

Ecological Corridor:

Upper catchment areas in PRS are more important for preserving and conserving biodiversity as these are ecologically more sensitive areas with high biological diversity. The last remaining narrow corridors, especially along the first order streams in hilly regions, need to be preserved on priority as they are vulnerable and on the verge of extinction. Major and medium dam catchment areas (e.g. Radhanagari Dam, Asane Tank, Malewadi Tank catchment in Radhanagri Wild life sanctuary) in PRS have good forest cover, with first order streams supporting high floral and faunal diversity. However, now these dam catchment areas are exposed and threatened due to 'developmental' activities like mining and river valley project. Similarly Minor irrigation (MI) tanks and percolation tanks also had good biodiversity (e.g. Berki and Vesruf dam catchment). These areas are now threatened mainly due to agricultural expansion and terracing practices on hill slopes for cultivation of sugarcane. Therefore the earlier ecologically rich, sensitive, and fragile areas functioning as wildlife corridors must be now protected on highest priority.

Flood control:

Naturally vegetated riparian areas help in reducing the force and volume of surface runoff and floodwaters at a particular point along a stream by allowing water to spread out horizontally along the floodway and across the floodplain. Beside flood control, riparian vegetation is also important in controlling soil erosion and siltation. Upper catchments in PRS have thick riparian vegetation. Which provides riparian wildlife habitats for species from both the adjoin habitats, aquatic as well as terrestrial. But in the middle catchments of PRS, the riparian vegetation is reduced and scanty as affected due to agricultural expansion on either bank of PRS.

Increasing urbanization and industrialisation has almost entirely reduced natural riparian vegetation in lower catchment area.

Economic Values:

Riparian areas are a good source for natural resources like vegetation, fodder, water, fish, soil and sand. With controlled utilization of these natural resources, the ecotonal habitats can be used for good economical benefits. Over exploitation of these resources, as the current practice, can not only hamper the riparian system's health but also reduce its economical benefits. Only if the riparian ecosystem is well maintained it can locally improve water quality and quantity with associated increase in other resources. Such as water - resource for drinking and irrigation, fish – for food and socio-economic development of fisherman community, monitored extraction of soil and sand from river bank and river bed respectively for construction purpose. Besides giving livelihood and earnings to the locals it generates revenue for the state.

Recreational and aesthetic Values:

Riparian areas have good aesthetic values throughout the year owing to its natural beauty and wide spread of flora and fauna. Moreover, the attractive landscapes along the PRS, particularly in the upper and middle portion, can encourage eco-tourism by its recreational value. Riparian areas provide breeding sites for many wildlife species and become essential component for maintaining stream quality which in turn benefits the associated biodiversity. Because of these aspects riparian wetlands can attract scores of students from schools and colleges and provide them opportunities for recreation as well as scientific study.

Threats to riparian habitats in PRS

Riparian habitats in PRS are facing tremendous pressure of developmental activities in the catchments. The main reason being changing landuse practices, particularly in last few decades has deteriorated the vital ecotonal habitats in PRS. The developmental activities such as river valley projects and mining in the upper catchment areas are responsible for deforestation and changing natural riverscape. Soil erosion and siltation, loss of riparian vegetation, agricultural expansion, urban and industrial pollution are the major threats observed all along the five tributaries and river Panchganga.

Dams and K.T weirs – In PRS, all the tributaries, major as well medium size dams have been constructed across them in its upper catchment region. Out of these four dams are already completed while dam on Dhamni River is under construction. The ongoing Dhamni dam is a good example for studying threats of negative environmental impacts to

natural riparian ecosystem. This dam is under construction for over past 6 years with no definite time for its completion. The large amount of hill cutting and river bed excavation for this project has depleted the forest cover in the catchment area. In past couple of years, mainly during summer, it has been observed that the river had frequently dried out due to dam construction works. This encourages water blocking for agricultural purpose at Kolhapur Type (K.T.) Weirs and small bunds along the remaining river stream. Therefore the prolonged construction activity has resulted in water level fluctuations having adverse impact on riparian biodiversity. Also ad hoc management of K.T. weirs are responsible for frequently changes in water level and flow in river systems which also have negative impact on fisheries in the PRS.(Plate 1: c,d)

Loss of riparian vegetation - Riparian vegetation is vital for any river as it helps to stabilize and protect river banks from soil erosion and siltation. It also plays a great role in controlling adverse impacts flooding in the fragile ecotonal area. According to Dosskey, et.al; (2009) riparian vegetation typically occupy a small fraction of the landscape, but they often play a disproportionately key role in controlling water and chemical exchange between surrounding lands and stream systems. In PRS riparian vegetation is mainly affected due to agriculture expansion and fragmentation of riparian habitats is observed in the upper as well as middle catchments in all the five tributaries. In lower catchment of Panchganga riparian vegetation is either very meagre or completely lost and the area is now dominated by grasses. (Plate 1: f)

Agriculture expansion – Agriculture landuse often increases non point pollutants, in the form of agrochemicals, in river and also impacting natural riparian habitat. In PRS river catchments are more vulnerable due to the rapidly changing crop pattern from traditional food crops like paddy and millet to cash crop like sugarcane. Especially in the upper catchment of PRS, in the recent years demand for sugarcane cultivation has exponentially increased owing to increase in the number of sugar factories in the region. To fulfil this rising sugarcane demand farmers have shifted to terrace farming in the hilly region. Adverse effects on riparian vegetation are found along the riverbank mainly due to agricultural encroachment by cutting the bank trees like *salix tetrasperma* , *Terminalia arjuna* , *Syzygium cumini* and *Pongamia pinnata* etc. species . (Plate 1: e)

Soil erosion and siltation- Soil erosion in the hilly upper catchments due to deforestation, mining, and developmental activities like dam and road construction and preparation of new lands for agriculture has resulted into enhance rate of siltation as observed In the PRS, which is visible in the very turbid flood waters. After removal of riparian vegetation, now the fertile soils along

the river bank are used for brick manufacturing. In recent times there has been increasing demand for bricks, made from the silt from the riparian areas, which has amplified due to large scale construction and developmental activities in Kolhapur region. Such huge soil excavation leads to destruction of river embankment and increase in soil erosion. Also conversion of the most fertile river bank soils for non productive purpose is a serious environmental issue. Considering the long time taken for formation these humus enriched soils and possible shortage of these fertile lands essential to ensure food security in future, the river bank soils must be protected and conserved on top priority for their ecological value.

Pollution – Agricultural activities, associated habitat modification, fertilizers, pesticides, and sediment runoff are greatest threats to fresh water biodiversity. It is observed that many aquatic plant species are being severely affected by habitat degradation due to industrial effluent and large scale use of pesticides and insecticides. (Kumar, et.al; 2011) The entire catchment of PRS is subjected to varying degree of pollution mainly due to sugarcane cultivation and establishment of agro industries right from the origin of some tributaries. Lower catchment of PRS is the most affected river stretch by industrial pollution. Frequent discharge of untreated sewage from cities, towns and villages on the river banks and effluents from several agro industries and MIDCs has lead to periodic total eutrophication of river stretch near Ichalkaranji and Terwad. (Plate 1: a, b). The lower portion of the middle and the entire downstream of the lower part of the PRS is heavily polluted thus affecting the riparian habitats and the biodiversity associated with it. According to Ghate *et al.* (2002) pollution of Krishna river could be a major factor leading to severe decline in the population of the endemic *Schismatorhynchos nukta*, now assessed as endangered species. During interaction with Fishermen it is found that fish catch has gradually decline in past few years, earlier common fishes like *Wallango attu*, *Glossogobius giuris*, *Tor khudree* are now locally became rare in the river system.

Conclusion

Developmental activities in the catchments, leading to habitat fragmentation and destruction are responsible for change in riparian habitats and local biodiversity of the PRS. Rapid change in agriculture pattern and land use, urbanization, industrialization, pollution, construction of dams, K.T weirs, bank soil and river bed sand mining are the threats with varying impacts aggravating the current situation of environmental decline in the riparian habitats in PRS.

Environmental impact evaluation of the activities such as constructions of dams, K.T.weirs, bridges across

the tributaries, fragmentation of river bank vegetation reclamation of river banks by agriculture expansion, decline in riparian habitats by bank soil mining, by urban and industrial expansions in the flood plains and RRZ need to be independently performed to minimize the present trend of riparian habitats destruction and conserve the vital habitats for future.

In general streams and riverscape in PRS are strongly affected by anthropogenic activities. River valley projects, deforestation, mining, soil erosion and siltation, agriculture expansion, changing crop pattern from traditional food crops to sugarcane, brick kilns, industrial and urban pollution being major threats to riparian habitats in PRS. These factors have singular as well cumulative and incremental negative impacts on the riparian habitats. Since riparian habitats are directly associated with livelihood of locals it must be protected and conserved on priority. It's high time that the existing River Regulation Zone (RRZ) rules and regulations are strictly enforced by the government agencies to avoid annihilation of riparian ecosystem.

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Plate 1



a) Over flow of untreated sewage-Jayanti nala b) Total Eutrophication of Panchganga near Terwad



c) Dam Under construction on Dhamni river d) A typical Kolhapur Type (K.T.) weir



e) Agriculture encroachment in Tulshi river f) Loss of Riparian Vegetation due to bank soil mining and siltation