Ecosystem Threat Assessment Using Relative Scoring Method Analysis – A New Methodology Approach to River Achencovil, Kerala

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Abstract: *Threat factor assessment of river Achencovil, a major river originating from Southern Western Ghats, was carried out. The study attempted to fill the knowledge gap in the potential of using Relative Scoring Method Analysis on tropical riverine ecosystem for rapid threat assessment. Eighteen threat factors obtained through reconnaissance survey were subjected to RSMA for assessment purpose. The analysis revealed that the midstream of the river face severe threat with high impact values of 11 threat factors (Grant index value – 382). Downstream segment also face commentable threat from 7 factors having maximum impact values (GI- 346) whereas upstream was the least affected (GI-81). From this study, it is revealed that midstream and downstream segment of this river is highly prone to pollution load and it is high time to formulate a management plan to rejuvenate this river and to eradicate the worst sources of contamination. The study recommends the restriction of high impact threat factors such as unscientific river bank cultivation, improper usage of agrochemicals, untreated discharge of industrial contaminants, waste disposal and sand mining to protect the river from degradation.*

Keywords: *Achencovil River, Relative Scoring Method Analysis, Western Ghats, Threat factor, Pollution.*

1. Introduction

Conservation of river has become a major priority for a region to withstand the impact of water scarcity to its local public. Human societies extract great quantities of water from rivers, lakes, wetlands and underground aquifers to meet agricultural, municipal and industrial demands. But their impact on rivers and other surface waters is staggering (Postel & Richter, 2003; Meitei *et. al*., 2004). Recent trends in polluting rivers have crossed the limits in terms of long-term effects on to the aquatic biota and local people sustaining on the stream ecosystem. Time consuming ecological assessment methods and transient pattern of remedial measures for conservation of aquatic ecosystems have to be functionally replaced with rapid assessment protocols in order to protect the dying rivers. The present study is a threat factor assessment approach to monitor the impact on Achencovil River, a major tropical river originating from Southern Western Ghats of Indian subcontinent.

The area, through which this river flows, is economically very rich and ecologically highly distributed with lot of interconnecting backwaters, lagoons interspersed with high degree of agricultural activity comprising mainly of paddy and coconut cultivation along with pineapples and rubber plantations. The formation of labour intensive commercial plantations, urbanisation, increased industrialisation and sandmining altered the river through chemical contamination and biotic habitat destruction (Prasad *et. al*., 2006; Padmalal *et.al*., 2008). All these caused deterioration of micro-climate and edaphic changes in the river and its biodiversity. Many of the anthropogenic activities resulted in such a state of affairs that caused the disappearance of many of the species from the riverine localities. Many animals have become rare and many are threatened with extinction (Molur *et. al*., 2011). So far, no detailed studies have been conducted for rivers of Kerala using threat factor assessment through rapid protocols. Hence an attempt is taken in this direction to assess the threat of Achencovil River from all possible threat factors and to quantify the threat caused by various threat factors and their intensity.

2. Materials and Methods

1) Study Area
Three segments were demarcated along the river for the analysis of threat factors, which were the upstream segment including the river origin ['$9^0$0'N- $9^0$10'N, $77^0$0'E-$77^0$16'E]; midstream segment [$9^0$13.59'N - $9^0$15.40'N and $76^0$40.49'E - $76^0$34.37'E]; and downstream segment [$9^0$21.01'N - $9^0$19.39'N and $76^0$27.37'E - $76^0$27.57'E].

2) Data Collection and Analysis
A reconnaissance survey was conducted throughout the bank of Achencovil River to identify the threat factors of this riparian ecosystem. Relative Scoring Method Analysis (RSMA) was used to analyse the data obtained (Sanalkumar & Sankar, 2009). Relative importance value of the obtained threat factors and their impact on the riparian ecosystem were expressed on a 10 point scale categorisation. The relative weighting of each determinant was done in three predetermined classes (high, moderate and low). Each class was given a weightage '3' for high, '2' for moderate and '1' for low. This was subjected to site-specific evaluation. The threat factors and the standards for deciding their degree of impacts are given in Table 1. Impact values and grand index values were computed for finding out the degradation status of each segment of the riparian system.

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Table 1: Standards for the determination of degree of impacts

Threat factors	Degree of impact	Standard
Summer river bank cultivation	High	Cultivation throughout the length on both banks
	Medium	Cultivation intensive only mid and downstream
	Low	Cultivation irregular without chemical pesticides and fertilizers
Industrial discharge	High	Several factories make their exit throughout the length
	Medium	Only a few industries localized in some parts
	Low	Very few industries effluent discharge after scientific treatment
Sulphur contamination from rubber factories	High	Several factories with their annual turnover in crores discharging untreated wastes
	Medium	Very few factories but discharging untreated wastes
	Low	Very few factories discharging scientifically treated wastes
Hospital wastes	High	Several hospitals discharging untreated wastes including amputed parts
	Medium	A few hospitals discharging untreated wastes without amputed parts
	Low	Discharging scientifically treated wastes
Slaughter house wastes, poultry farm wastes, market wastes and wastes from marriage auditoriums	High	Several, discharging more than 100 Kg wastes to river without treatment per day
	Medium	A few discharging below 50 Kg wastes to river without treatment per day
	Low	Discharging treated wastes
Fertilizer/Pesticide/Fungicide/ Heavy metals	High	Intensive use throughout the year and influx into the river
	Medium	Moderate use and occasional influx into river
	Low	Localized use and low influx into river
Sand mining	High	More than 100 loads of sand carried away with and without official pass per day
	Medium	Less than 20 loads of sand carried away with official pass per day
	Low	Less than 10 loads of sand per day and prohibition of mining in some months
Laundry washing	High	Intensive with washing soaps throughout the year in many areas
	Medium	Washing with soaps in some months but many areas
	Low	Localized washing with soaps and frequency very low
Household garbages/ hotel wastes	High	Severe, load more than 100 Kg per day from a village/town/municipality
	Medium	Load less than 50 Kg per day from a village/town/ municipality
	Low	Occasional and accidental spillage not continuous
Pilgrim tourism	High	More than 50 lakhs people visiting per annum
	Medium	Less than one lakhs people visiting per annum
	Low	Occasional visitors intensity very low
Feacal contamination	High	Severe public toilets found their exit into river without treatment
	Medium	Very few toilets found their exit into river without treatment
	Low	Discharge with scientific treatment
Drainage from polluted tributaries	High	Several polluted tributaries make their exit into river/carrying load high
	Medium	Very few polluted tributaries make their exit into river/carrying load medium
	Low	Tributaries occasionally carry pollutants to river/carrying load low

3. Results

Eighteen threat factors were identified in this study area which can exert low to high impact on the very existence of this riparian ecosystem (Table 2).

The relative scoring method analysis of threat factors of upstream revealed that among the threat factors, heavy metals, polluted tributaries, summer cultivation, industrial discharge, sulphur contamination and hospital waste discharge are totally absent in upstream while all other factors exert very low possible threat (Table 2, Fig.1). A grand index value of 81 was obtained which is very low indicating pure water in this segment of river. At the same time, almost all the threat factors are imposing greatest threat in the midstream of the river according the computed index values.

Paper ID: NOV152856

629

Table 2: Relative Scoring Method Analysis of three segments of river Achencovil

Sl. No	Threat factor	Importance Value	Upstream		Midstream		Downstream	
			Weight	Impact Value	Weight	Impact Value	Weight	Impact Value
1	Summer river bank cultivation	10	0	0	3	30	3	30
2	Industrial discharge	10	0	0	3	30	2	20
3	Sulphur contamination	10	0	0	3	30	2	20
4	Hospital waste discharge	10	0	0	3	30	2	20
5	Slaughterhouse waste discharge	9	1	9	3	27	3	27
6	Poultry farm waste discharge	9	1	9	3	27	3	27
7	Market waste discharge	9	1	9	3	27	3	27
8	Waste from convention centres/marriage auditorium	5	1	5	3	15	2	10
9	Pesticide contamination from plantation	8	1	8	3	24	3	24
10	Fungicide contamination	8	1	8	3	24	3	24
11	Fertilizers contamination from agrofarms	5	1	5	2	10	3	15
12	Sand mining	10	1	10	3	30	3	30
13	Laundry washing	3	1	3	2	6	3	9
14	Household garbage disposal	3	1	3	2	6	3	9
15	Pilgrim tourism	7	1	7	3	21	1	7
16	Feacal contamination	5	1	5	3	15	2	10
17	Drainage from polluted tributaries	7	0	0	2	14	3	21
18	Heavy metal contamination	8	0	0	2	16	2	16
	Grand Index Value			81		382		346

River bank cultivation, industrial discharge, sulphur contamination, hospital waste discharge, sand mining, slaughter house waste, poultry waste, market waste discharge, pesticide and fungicide contamination, and pilgrim tourism have high impact, while wastes from convention centres, fertilizers from agro farms, faecal contamination and drainage from polluted tributaries have moderate impact and laundry washing along with household garbage disposal contributes to the low impact on the river. A grand index value of 382 was obtained which is very high and very near to the highest possible theoretical value in the present context and hence reveals that midstream of this river is facing very high threat (Table 2, Fig.1). The River, at the downstream segment, also faces high threat from the threat factors in similar pattern as in the case of midstream. A grand index value of 346 was obtained which is also very high, indicating a high threat existing in this segment of river (Table 2, Fig.1).
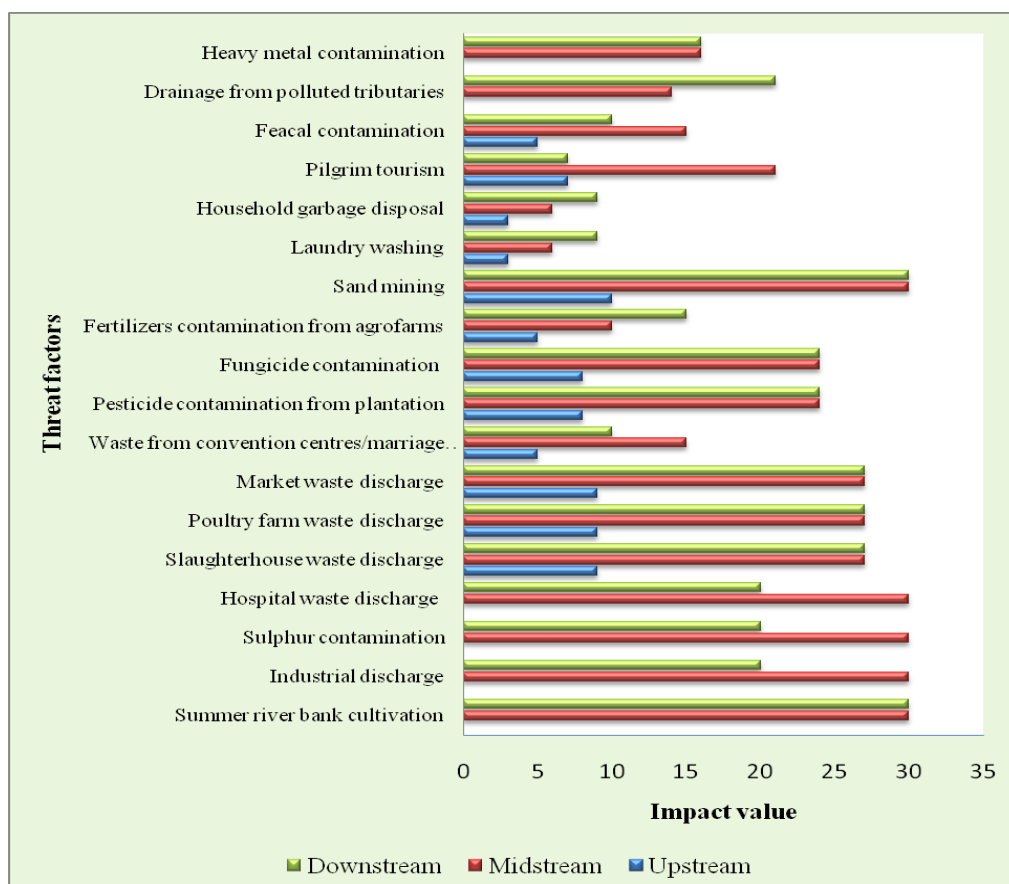
Figure 1: Impact levels of ecosystem threat factors at three segments of river Achencovil

630

4. Discussion

River ecosystem is very dynamic and can repair some of the impacts from environment, whether anthropogenic or seismic. But at the same time, most of the ecosystems are facing high threat from human intervention, crossing the limits of tolerance capacity. The stream in the present study originates from dense forests of Southern Western Ghats where human disturbances are totally prohibited by Forest and Wildlife Act and hence least threatened at its origin. Although mild but illegal and occasional excavation of sand from the river bed, seen in the upstream may alter the normal course of the river leading to the degradation in future. The midstream segment of river is facing the highest threat from multiple factors. Most of the identified threat factors are imposing high impact in this segment of river. In addition to identified threat factors in this area, encroachment of river bed using fence and wall could be found in many parts of the segment.

Downstream of this river also faces very high threat mostly due to anthropogenic factors. The pollutants from the co-existing rivers such as Pamba and Manimala also enter downstream of Achencovil river through many connecting channels across the rivers near Veeyapuram village. The major problem in this segment of river is pesticide and fertilizer contamination. Most of the biological investigations in this area of Kerala, especially Kuttanad wetlands revealed the high intensity of pesticides and other agrochemical contamination of water. This in turn affects the different trophic levels of the food web and ultimately makes passage to human beings (Sanil & Andrews, 2000).

Achencovil river is the backbone of Upper Kuttanad agro ecosystem. The heavy influx of heavy metals from the midstream segment of this river finally enters the Kuttanad ecosystem which is the rice bowl of Kerala State. From this study, it is revealed that midstream and downstream segment of this river is highly prone to pollution load and it is high time to formulate a management plan to rejuvenate this river and to eradicate the worst sources of contamination. Recent studies in nearby rivers also revealed the same status of pollution from different threat factors and corresponding decline of biodiversity (Vijayasree & Radhakrishnan, 2014). Rivers are the lifeline of human culture and development. Protection of Achencovil River is very important in this context as it is giving life blood to the people of two main districts of Kerala.

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