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TERRAIN EXPLORATION OF A SEVENTH ORDER STREAM IN ATTINGAL MUNICIPALITY- A CASE STUDY OF VAMANAPURAM RIVER BASIN, SOUTHERN KERALA, INDIA.

Vinod Gopal, V[1]., Ravinesh, R[2]., Sabu Joseph[1] and Biju Kumar, A[2].
[1]*Department of Environmental Sciences, University of Kerala, Trivandrum-695 581, Kerala, India.*
[2]*Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum-695581, Kerala, India.*

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Abstract: Vamanapuram River (Length= 81.5 km; Area= 687.5 km^2; Order= 7th) originates from the Chemmungi *mottai* (elev. = 1717m. a.m.s.l.) in the upper slope of Western Ghats in southern Kerala and is traversing through the districts of Trivandrum and Kollam, and finally debouch into the Anjengo lake near Chirayinkeezhu. This river received attention due to variegated reasons, like the absence of reservoir in the entire stretch, rampant illegal sand mining throughout the course, brick sand mining, alteration of river banks, etc. In the physical map, various characteristics of bank (like cliffy, slumping cliff, steeply sloping, moderately sloping, and gently sloping); bank material, type of bank (erosional/depositional), channel width, depth, rock exposures, confluence of tributaries, etc. were noted. In the vegetative map, the riparian vegetation and land use (e.g., seasonal crops and tree crops) in the adjacent field were noted. Again, in the man-made feature map, details of man-made features like bridges, pump stations, roads, check dams, river protection walls, details of settlement, depth of water table in wells, sand mining kadavus, etc. were noted.

Key words: Vamanapuram, Physical, Vegetative, Man-made, Sand mining

INTRODUCTION

Kerala is a linear coastal State with unique physiography, biological richness, scenic beauty and cultural heritage. The rivers in the State are the important life supporting systems and comprise 41 west flowing and 3 east flowing small catchment rivers. The State has a civilization developed by the ancestors that ensured utmost care and wise use of the rivers and the fertile land. It is certain that degradation of the rivers will lead to ruin of the heritage, civilization and economic wellbeing of the people in the State. Unscientific and uncontrolled sand mining is one among many human interventions that has put the State in the shadow of ecological repercussions. Watershed analysis reveals the geomorphology of the basin as a whole. The preparation of current status of a river bank is a very tedious work and is inevitable for the health validation of the bank, when it being the primary step in the river protection contest. Need for protecting the rivers and its surrounding basin ecosystem is now become the sole matter of discussion and ultimate concern of human. They realised that the unsustainable actions should bounced back harder to their own life. The constructions of new check dam in the so called 'dam less river' of south India, Vamanapuram river, to minimise the impact of saline water intrusion is its reflection. They realised the impacts of bed lowering and extensive exploitation of natural resources and they are annoying for the decline in the availability of the fishes for satisfying their needs.

Baseline mapping requires steady field work. Apart from conventional remote sensing technique of aerial photographs and use of erosion pins such as PEEP (Photo Electronic Erosion Pin) Lawler (1991) thorough field work has been adopted for the entire study. Foreseeing the protection and conservation of rivers, the current status of the river health is essential. The

pollution, common fever, is now narrowed by resource exploitation. General ways of polluting a lotic ecosystem are untreated discharges from industries and households, hospitals, slaughter homes etc. The influxes from nearby land use / agricultural fields are also responsible for the fluctuations in the river ecosystem balance (Jennerjahn *et al*., 2008; Beena, 2010). The baseline mapping is a strainful field work. The entire basin baseline mapping is somewhat difficult with minimal time and facility. Hence the study area has been shrunken to seventh order stream only (23 km) for the current approach.

In 1986 Trivikramaji pointed out the sand mining in Neyyar river basin. Report by Collins and Seattle (1995) pointing the finger to the physical alterations happened to the riverine environment and Salmonid habitats due to the indiscriminate mining of sand and gravel. Padmalal (1995) conducted a preliminary study on sand mining in Pamba river. Saritha *et al*. (1996) analysed the impact of sand mining in Vamanapuram river basin. Naiman and Henri (1997) commented on the role of riparian zones in water and landscape planning and in the restoration of aquatic systems by reducing the rate of bank erosion and Stephanie *et al*. (2002) discussed various provisions of riparian ecotone. Impacts of indiscriminate sand mining was emphasised on the work done by CESS (1998) in Maniamala river. Soman and Baji (1999) went through the status of Kallada river facing threat of severe sand mining. Anthropogenic influences on the river catchment are discussed by Dakova *et al*. (2000). Sheeba and Arun (2003) note down the habitat destruction of fishes followed by excessive sand mining in Ithikkara river. Muvattupuzha river, a sand mining analysis was carried out by Chandramoni and Anirudhan (2004). Sreebha (2008) discussed the environmental impact of sand mining in the river catchments of Vembanad lake in her ph.D thesis. Strategic assessment of sand mining and its adverse effects on the ecosystem is discussed by Leeuw *et al*. (2009). Both direct and indirect impacts of anthropogenic activities like sand mining and gravel mining on the biodiversity of fresh water ecosystem are discussed by (Mori, *et al*., 2011 & Jones *et al*., 2012). Das and Wadadar (2012) studied the correlation between the sedimentation and bank failure and its impacts on the daily life of inhabitants.

Study area

The basin consists of Vamanapuram River, which originates from the Chemmunji Mottai (Elev. =1717 a.m.s.l) and after traversing a distance of 7

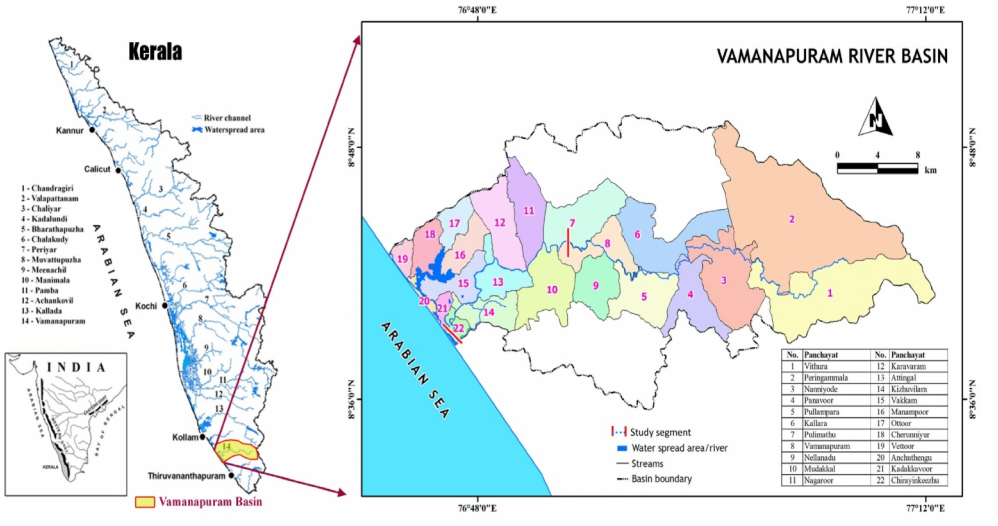

Fig. 1. Panchayats with river banks falling under the study area

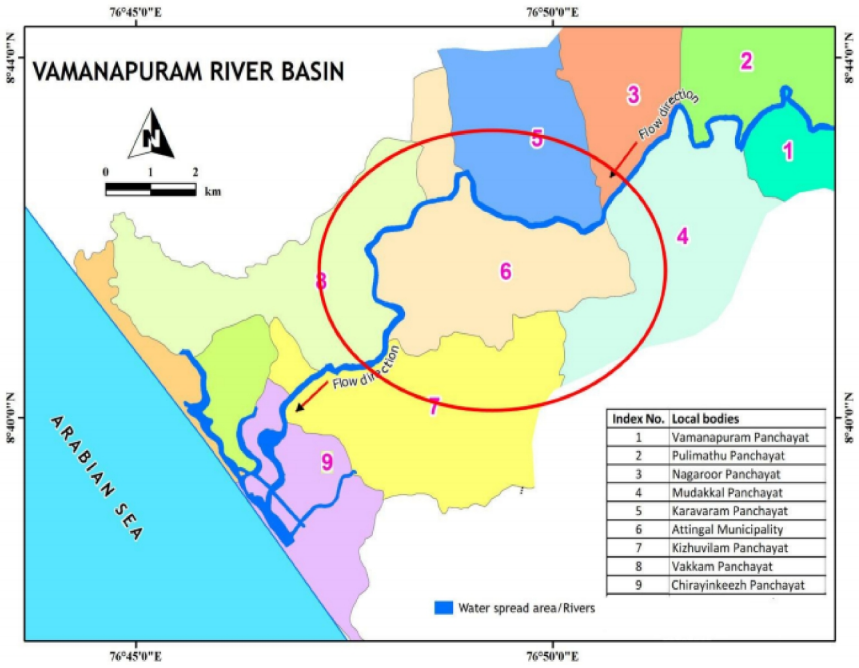

Fig. 2. The 23 km river segment studied

Table 1. List of Panchayats with river bank under Study area

Left Bank		Right Bank	
Name of Panchayat	**Bank length**	**Name of Study area**	**Bank length**
Vamanapuram	4.83	Pulimathu	5.57
Mudakkal	6.06	Nagaroor	2.87
Attingal Municipality	8.16	Karavaram	3.97
Kizhuvilam - Kadakkavoor	2.6	Attingal Municipality	1.27
Chirayinkeezhu	1.25	Vakkom	6.2
		Kizhuvilam- Kadakkavoor	0.8
		Chirayinkeezhu	2.29
	22.9		**22.97**

km, it receives the Kalaiparai Ar. rising from the Kalakul Motai. At Kallar, two more tributaries, the Pannivadi Ar. and the Ponmudi Ar. join it. From there, the river takes a slightly meandering course till its confluence with Upper Chittar from where river become seventh order. It covers 8 panchayats and one municipality before debouches into the Anjengo lake near Chirayinkeezhu.Various panchayats falling under this river basin are shown in Figure 2 and listed in Table 1. Atttingal municipality holds the longest bank (cumulative length=9.43 km) among the panchayats under the study area.

MATERIALS AND METHODS

The study includes plotting of manmade infrastructures, slumped areas, riparian variability, type and status, thickness of the riparian zone, counting the survey stone to assess the rate of degradation (illisite mining). The proposed length for the study of Vamanapuram river is 23 km more or less 6 km up and down to the Attingal municipality. The whole process of data collection and thorough analysis of terrain is by using the cadastral maps of various panchayats sharing the riverbank under study

Table 2. Physical and Manmade features of the seventh order stream

Physical features			Manmade features		
Category	**Left Bank(m)**	**Right Bank(m)**	**Category**	**Left bank(m)**	**Right bank(m)**
Cliff	15.75	13.24	Side wall protection	910	450(m)
Deposition (Gentle Slopes)	0.22	0.11	Pump house	3	4
Erosion (Cliff & Steep Slopes)	1.19	1.50	Water intake points	2	4
Gentle Slopes	2.74	5.32	Survey stone	7	21
Moderate Slopes	1.76	0.70	Bathing kadavu	2	11
Steep Slopes	0.14	1.61	Sand mining spots	57	47
Slumping	1.10	0.49	kiln	8	4
Total	22.90	22.97			
Tributary	29	42			

Table 3. Riparian features of the seventh order stream

Sl. No.	Species Name	Family Name	Class
1	Anacardia *occidentale*	Anacardiaceae	Tree
2	Andropogon *gayanus*	Poaceae	Grass
4	Artocarpus *hirsutus*	Moraceae	Tree
3	Axonocarpus *compressus*	Poaceae	Grass
5	Bambusa *chunjii*	Poaceae	Tree
6	Bridelia *crenulata*	Euphorbiaceae	Tree
7	Calamus *rheedii*	Arecaceae	Shrub
8	Calophyllum *polyanthum*	Clusiaceae	Tree
9	Calotropis *gigentea*	Apocynaceae	Shrub
10	Chrysophyllum *lanceolatum*	Sapotaceae	Tree
11	Coffea *arabica*	Rubiaceae	Shrub
12	Cullenia *exarillata*	Malvaceae	Tree
13	Holigrana *arnottiana*	Anacardiaceae	Tree
14	Macaranga *peltata*	Euphorbiaceae	Tree
15	Mangifera *axillaris*	Anacardiaceae	Tree
16	Millettia *pinnata*	Fabaceae	Shrub
17	Pandanus *odoraissimus*	Pandanaceae	Shrub
18	Persea *macarantha*	Lauraceae	Tree
19	Phyllostachys *aurea*	Poaceae	Tree
20	Setaria *viridis*	Poaceae	Grass
21	Theobroma *cocao*	Malvaceae	Tree
22	Thespesia *populnea*	Malvaceae	Tree
23	Zizyphus *rugosa*	Rhamnaceae	Shrub

(1:4000) and 1967 toposheets (1:50000) collected from survey of India, for field verification. GPS with minimum error 5m is used to locate and fix control points such as bridges, pump houses, cross sectional areas, survey stones etc. The whole data we collected are attributed in such a manner to construct 3 encrypted panchayat levels maps. For that banks are segmented into number of 100 m long sectors and explore all the details entitled physical, vegetative and manmade features. The data are reordered in keeping with the length of survey plots that are very next to the bank itself for the easiness of representation and interpretation, that are very much useful to common man.

RESULTS AND DISCUSSION

The 23 km long seventh order stream possess 9 panchayats and one municipality having thick population and all are deadly dependant to the stream. Over exploitation and unscientific management of nature and natural resources should degrade the quality of the ecosystem and thereby affect the human progress in future. The bed lowering is the major cause for cliffing of banks; it almost covers 63% of the total study area and 87% of the Municipality under study. Erosion rate is 10 times higher than deposition implies rate of degradation. Among the 104 mining sites 33 are from Attingal municipality, more over 2 brides and new one is under construction besides the check dam to prevent saline intrusion, 2 brick kilns etc. the more details are conferring through Table 2-4.

What following are the maps prepared for Attingal municipality using the all physical, vegetation and anthropegenic interventions stuck so far (Fig. 3-5).

CONCLUSIONS

Lack of adequate scientific information on the mining processes and its impacts on various environmental components is a major lacuna for properly addressing the problem. Imminent need for strengthening our understanding on anthropogenic degradation of the rivers is a must. River bed lowering leads to groundwater table lowering and then to the

Table 4. Bank delineation results of Attingal municipality

Physical Features			Vegetative features	Man-made Features
No.	**Features**	**Length (km)**		
1.	Total length	9.43	Adjoining Land use is Coconut, mixed tree crops, rubber and seasonal crops. Riparian vegetation (sparse) includes mixed trees, bamboo, pandanus and other shrubs. Thickness varies from 0-5m	Bridge = 2 Brick kiln = 4 Check dam = 1 (under construction) Ferry = 3 sand mining *kadavu*= 33 Bathing *kadavu* = 4 Pump house = 2 Side wall = 210 m
2.	Cliff	8.25		
3.	Erosion (Cliff & Steep Slopes)	0.14		
4.	Erosion (Gentle & Moderate Slopes)	-		
5.	Deposition	-		
6.	Gentle Slopes	0.75		
7.	Moderate Slopes	0.21		
8.	Steep Slopes	0.08		
9.	Not Assessed	-		
	Total	**9.43**		

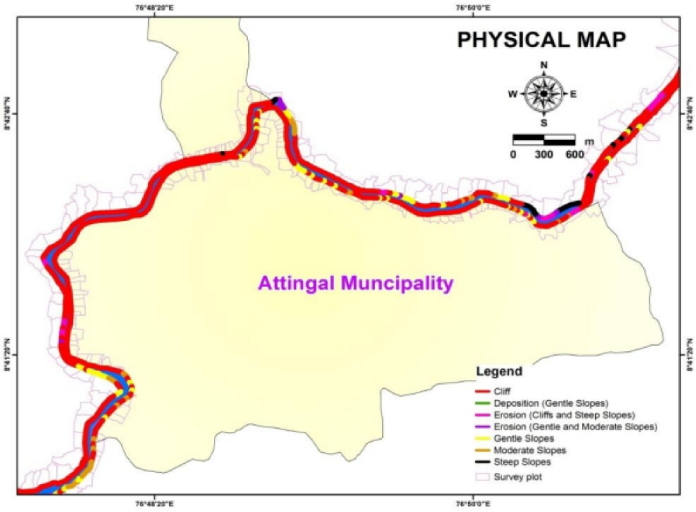

Fig. 3. Physical map of Attingal Municipality

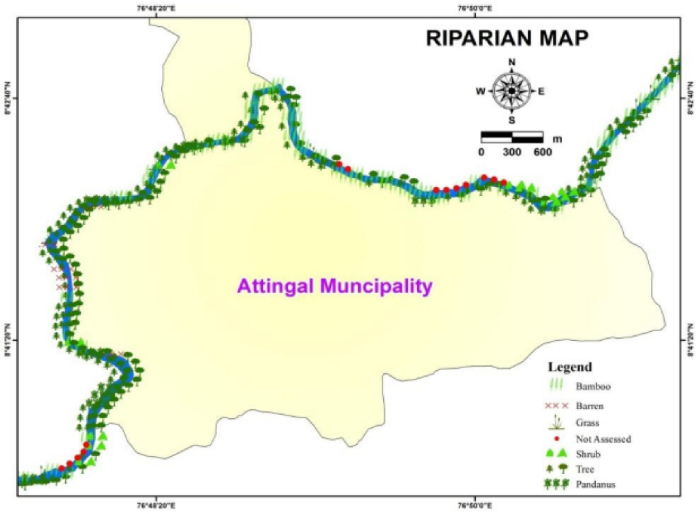

Fig. 2. Vegetation map of Attingal Municipality

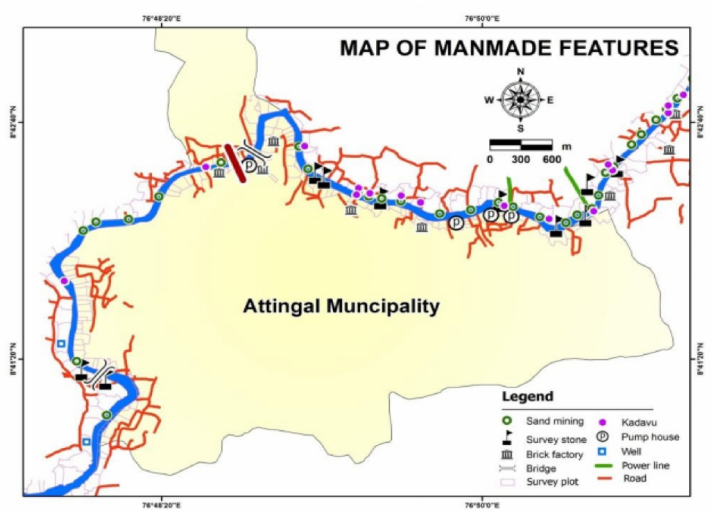

Fig. 2. Anthropogenic intervention map of Attingal Municipality

scarcity of potable water. About 63% of river banks are under the class cliff: this is a clear cut evidence of river bed lowering. Reclamation, encroachment, channel incision, caving of river banks and construction of unscientific engineering structures across the river are some of problem associated with riparian degradation.

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