STUDY OF EDAPHIC CHARACTERS OF SELECTED RIVER BANK SITES IN CENTRAL KERALA

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Abstract : Rivers are probably one of the most dynamic waterscapes on the planet which accounts for the creation of history, culture, lives and livelihood by its running arteries across the land. The complexion of a river is determined by the nature of plains it surges through, their slopes, altitude, latitude, and of course the soil texture. The soil sediments fetched by the rivers accounts for the creation of a different culture and history. Even the flora and fauna in and around the river sites are depends upon the nature of soil it carry. Kerala is rich in river diversity which holds unique characters, but during the last few years these rivers are in the verge of being vanished due to over pollution. So in this context it is important to study the edaphic characters associated with different rivers, for getting the actual status of the river. The present study is such an effort to study the edaphic characters of selected river sites in central Kerala.

***IndexTerms* – Edaphic, bulk density, Specific gravity, Moisture content, water holding capacity**

I. INTRODUCTION

River banks are the interface between land and a river or stream, also known as riparian (rip means river bank in Latin). Plant habitats and communities along the river margins and banks are called river bank vegetation/Riparian vegetation, characterized by hydrophilic plants. River banks are significant in ecology, environmental management and civil engineering because their role in soil conservation, their habitat biodiversity, and the influence they have on fauna and aquatic ecosystems, including grassland, woodland, wetland or even non vegetative area (Cooke, 1997). When riparian zones are damaged by construction, agriculture or silviculture, biological restoration can take place usually by human intervention in erosion control and vegetation. If the area adjacent to a water source has standing water or saturated soil for as long as a season it is normally termed a wetland because of its hydric soil characteristics. Because of their prominent role in supporting a diversity of species, river banks are often the subject of national protection in biodiversity .These also known as a plant or vegetation waste buffer. They provide native landscape irrigation by extending seasonal or perennial flows of water nutrients from terrestrial vegetation (eg :plant litter and insect drop) is transferred to aquatic food webs. The vegetation surrounding the river helps to shade the water mitigating water temperature changes the vegetation also contributes wood debris to streams which is important to maintaining geo morphology (Nakasone, 2003). Over clearing of catchment and river bank vegetation poorly managed sand and gravel extraction and stream, river straightening works are examples of management practices which result in accelerated rates of bank erosion (Farid, 1992). Effective strategies for combating slumping of bank collapse are generally aimed at stabilizing the bank toe and restoring bank vegetation (Brayan, 1972). Vegetation influences the degree of channel sinuosity (Murgatroyd and Ternan 1983, Ebisemiju 1994).

Kerala is the state with over 30 million people living within a 38,000 sq km area and is blessed with 41 west flowing rivers and three east flowing rivers. According to the Hindu mythology Kerala is believed to be originated from water by the act of parasuram and hence water and water bodies such as river, streams, lakes etc. plays an important role in its history creation. Major Rivers in Kerala are positioned within the Western Ghats and some originate from the laterite hills. The central part of Kerala is blessed with the presence of the major rivers such as Periyar, Chalakudy and Muvattupuzha etc., which attribute a major role in developing the riparian ecosystem in this area. These riparian ecosystems are very important systems in correlating the ecotonal properties between aquatic and terrestrial ecosystems. The riparian ecosystems in these areas are under constant stress from both biotic and abiotic factors and hence make it most disturbed ecosystem. Among the abiotic factors the soil plays a very important role in balancing the riparian vegetation. (Ellision, 1952).So it is important to understand the edaphic characters in these areas since most of the industries are situated on the banks of these rivers.

So the present study attempts to find the edaphic characters in the different river sites of Periyar, Chalakkudy River, and Muvattupuzha River within a time limit. It also emphasis to understand the pollution loads in these areas and thereby to take adequate conservation methods.

MATERIALS AND METHOD

The study was sampled at 6 different river bank areas in two districts such as Thrissur and Ernakulam, in central Kerala were selected (Fig.1).

Fig.1.Map showing study areas

The river sites selected from Thrissur district includes Kallur and Chalakudy and from Ernakulam district Aluva, Manjaly, and Muppathadam, and Ramamangalam respectively.

1. **Kallur(KR)-**10.23^{0}N, 76.33^{0}E

Fig.2-Kallur River Site (KR)

Kallur (Fig.2) is a small village situated in Thrissur district of Kerala and located 13 kilometres away from Thrissur city. The nearest village is annamannada. Kallur village comes under the Kadukutty Grama Panchayath and is blessed by the presence of Chalakudy River.

2. Chalakudy(CR) -10.30^{0}N, 76.33^{0}E

Fig.3-Chalakudy River Site(CR)

Chalakkudy(Fig.3) is a place in Thrissur district, situated on the banks of Chalakudy River. It is a place of historical importance and situated 22 km away from Cochin international airport. The study site was near to the over bridge area and these is no cultivation was observed is selected spot because of those area are dominated with weeds such as *Colocasia*, *Ficus* and *Cuscuta*. Vegetation is very less due to human encroachment

3. Aluva(AR) *(*Kunjunnikkara-Uliyannur)- 10.11^0N, 76.34^0E-(Fig.4)

Fig.4-Kunjunnikara River site(AR)

River bank interrupted by constructing walls. There is no open area most of the regions private owned. In this spot most of them are homestead and mixed cultivation.

4. Manjaly(MR)-Over bridge Area-10.15^0N, 76.27^0E

Manjaly (Fig.5.) is a small town in Ernakulam district, Kerala. These is no cultivation was observed due to bridge construction and private owned land with construction.

Fig.5-Manjaly River site, near over bridge(MR)

5. Muppathadam(MUR)-Edayar-10.08^0N, 76.31^0E

Fig.6-Muppathadam River Site (MUR)

Mupathadam (Fig.6) is the place situated on the banks of the river Periyar, a highly polluted area. In this spot homestead cultivation was observed. Only one cultivated plot was selected in this spot. It is mixed crop cultivation approximate land area 25 cent.

6. Ramamangalam(RR)-9.94^0N, 76.47^0E

Ramamangalam is a village in Ernakulam district. The study site was located on the banks of Muvattupuzha river with comparatively undisturbed natural vegetation.

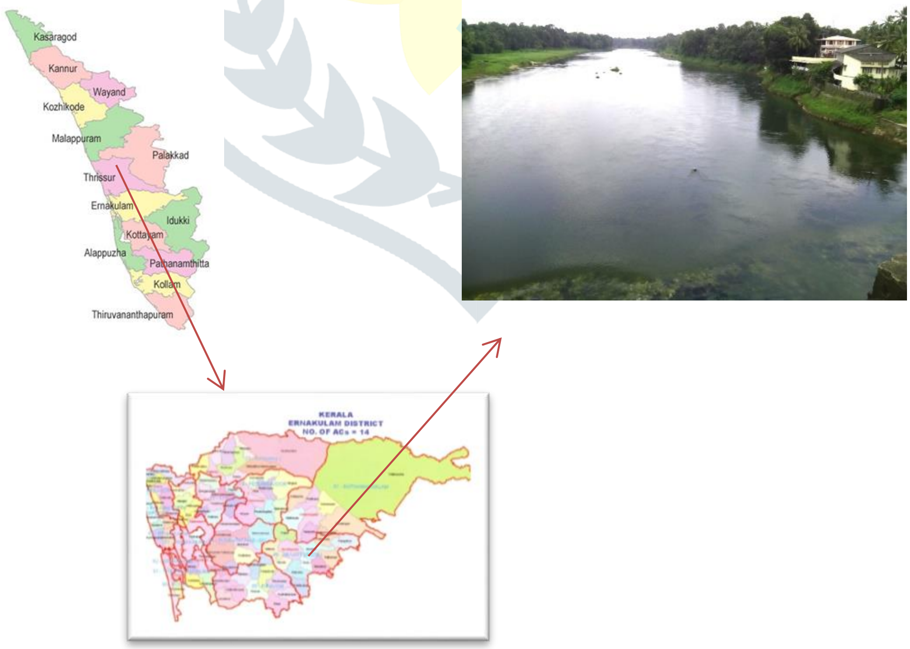

Fig.7-Ramamngalam River Site(RR)

Field sampling and processing

It is well accepted that, any type of degradation affects the texture and quality of the soil in that area. In order to know the soil characteristics of each study area, samples were collected in separate sealed containers and then taken to lab for further analysis. The collected soils were labelled including the name of sample site, time and date of collection.

After sample collection the soil samples were subjected for further processing such as removal of unwanted substances such as stones, roots, twigs etc.

The colour, smell and texture of the soil samples(Fig.8) were analysed for future reference.

Fig.8- Soil Samples kept for analysis

The physical and chemical properties of the soil samples were analysed to evaluate its status in terms of fertility and pollution load. Physical parameters of the soil including bulk density, Specific gravity, Moisture content, and water holding capacity were studied using the following methods;

1. **Bulk density**

It is the mass per unit volume of the soil, which varies with different soil types. Determination of bulk density is considered to be important because it restricts infiltration and make soil impermeable. Also it prevents root penetration into deeper regions. It is determined by drying the soil volume to a constant weight at 105°C.

$$\text{Bulk density } (g/cm^3) = \frac{\textit{Weight of soil in grams}}{\text{Volume of soil in cm3}}$$

2. Specific gravity

The relative weight of the given volume of soil compared with an equal volume of distilled water at a given temperature is called specific gravity.

$$\text{Specific gravity of soil} = \frac{y-y1}{z-z1}$$

y=final weight of bottle with soil

y_1=initial weight of bottle used for soil

z=final weight of bottle with distilled water

z_1=initial weight of bottle used for soil

3. Moisture content

Moisture content of the soil is its water content. Presence of water in soil determines its texture and compactness which ultimately reflects its suitability to support life.

Calculation

$$\text{Moisture content (\%) of the soil sample MC} = \frac{(I-F)\times 100}{I}$$

Where;

I=initial weight of soil sample

F=final weight of soil sample

4. Water Holding Capacity (WHC)

Physical and chemical characteristics of soil determine its ability to hold water. When the soil flooded with water, considerable amount of water gets in filtered and fills all the pore space leaving no space for the ingress of atmospheric air. This is the stage at which the soil is said to be at its maximum water holding capacity.

Calculation

$$\text{WHC} (\%) = \frac{(F2-F1)-(F1-I)\times 100}{(F1-I)}$$

I=Initial weight of soil box (in g)

F_1=final weight of soil box with water

F_2=final weight of the soil box with water saturated soil

Chemical parameters of soil include ph, nitrate, calcium, ammonium

1. PH

PH of the soil sample is determined by using ph meter.

2. Nitrate

For finding the amount of nitrate in the soil sample test for nitrate is used. In this reagents used were Diphenylamine and H_2SO_4.The formation of blue colour indicate presence of nitrate. If deep blue colour appeared it indicate high nitrate content whereas light blue colour indicate low amount of nitrate.

3. Ammonium

For finding the presence of ammonium in the soil sample test for ammonium is used. In this the reagent used is nessler's reagent. Formation of brown colour indicates presence of ammonium. Deep brown colour indicates high ammonia content whereas formation of pale brown colour indicates low ammonia content.

4. Calcium

For finding the presence of calcium in the soil sample test for calcium is used. In this the reagent used is ammonium oxalate. Presence of white precipitate indicates the presence of calcium. Large amount of white precipitate indicate high calcium content and presence of less precipitate indicate low amount of calcium.

II. Results and Discussion

The details of observations and the data obtained by analysis from each spots are summarized as follows.

1. Bulk density

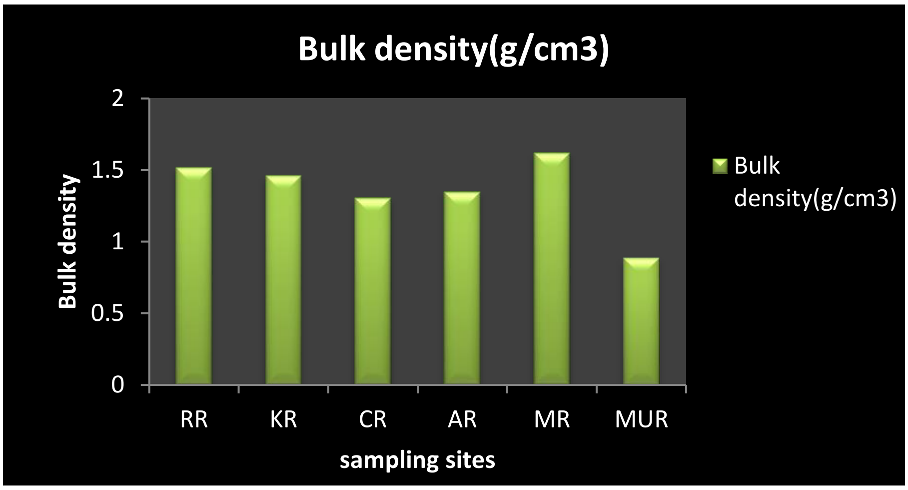

Fig. 9 comparison of bulk density in six different sampling sites

2. Specific gravity

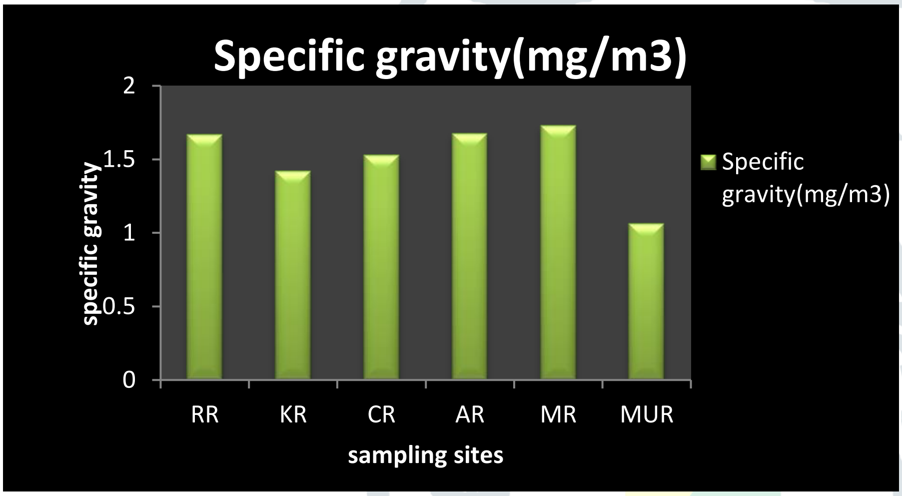

Fig. 10 comparison of Specific Gravity in six different sampling sites

3. Water Holding Capacity –WHC

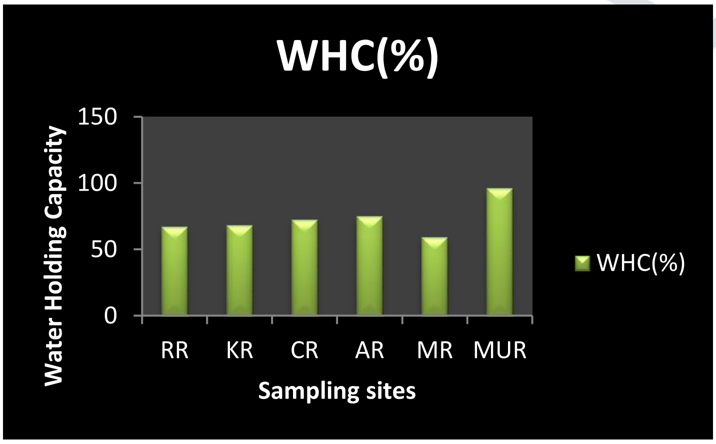

Fig. 11 comparison of WHC in six different sampling sites)

4. Moisture Content

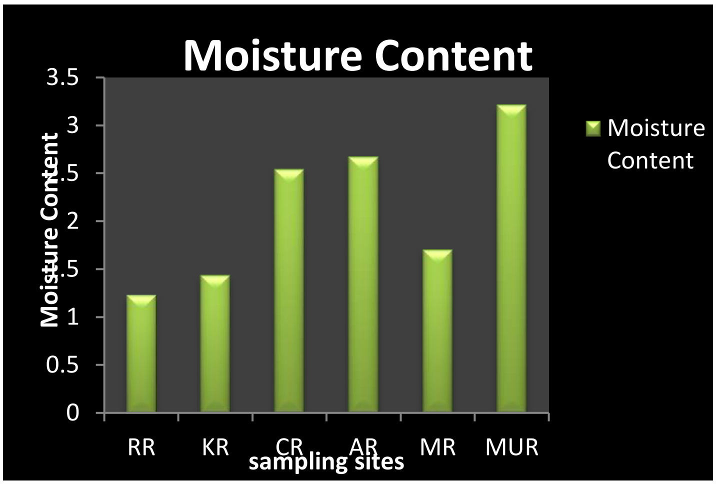

Fig.12 comparison of Moisture content in six different sampling sites)

Chemical Analysis-Table.1

Sl No.	RIVERS	TEXTURE	NITRATE	AMMONIUM	CALCIUM
1.	Ramamangalam(RR)	Sandy	low	low	low
2.	Kallur(KR)	Sandy	-----	------	low
3.	Chalakudy(CR)	Loamy	low	low	low
4.	Aluva(AR)	Loamy	low	low	high
5.	Manjaly (MR)	Sandy	low	low	low
6.	Muppathadam (MUR)	Clay	low	low	high

Table.1- results of chemical analysis conducted in six different soil samples.

By analysing the above results it is noted that only three river spots (RR,KR,MR) exhibit sandy texture of soil while the three other spots (CR,AR,MUR) shows loamy and clay soil (Table.1) which is not been observed as a quality of a healthy river soil. Among the sampling spots (showing loamy kind of soil) two spots such as AR and MUR shows presence of ammonium, nitrate and high amount of calcium when compared to the other sites. The samples collected from CR, AR, and MUR were found to be having foul smell and upon retaining the soil as such for two days, the foul smell was found to be intensified and formation of some worms were also found.

By analysing the figure 9 the Sample collected from MR shows high bulk density were as the sample collected from MUR shows low bulk density when compared to the other. Increase in bulk density restricts infiltration and make soil impermeable. Figure 10 shows the comparison of Specific Gravity of six sampling sites.MR shows high specific gravity followed by AR and RR and low specific gravity was observed for MUR. In contrast with the above two result MUR was found to be having high water holding capacity (96%) and there by high moisture content (graph.4) where as MR (59%) shows low water holding capacity (figure 11) and low moisture content.

Further sampling site wise analysis reveals the following results;

1. KR

The Kallur river site is the part of Chalakudy River and is not as polluted as the Chalakudy River. The texture of the river is sandy, which itself indicate that the presence of organic matter is low when compared to other sites. Anthropogenic disturbances are much less in this this area and there for less pollution.

2. CR

Chalakudy River or Chalakudy puzha is the fourth longest river in Kerala. The river flows through Palakkad, Thrissur and Ernakulum district of Kerala. It is also a home to large number of fish varieties. Studies have identified around 104 fish species from it. Considering the fish diversity supported by the river, the National Bureau of fish Genetics Resources, Lucknow has recommended that the upstream areas of the river should be declared as a fish sanctuary. It is estimated that ten lakh people directly depend on this river for various needs. Lift irrigation, ringing water schemes and dams have been constructed on this river system.

It has been observed that the density of the Chalakudy River is low and thus possessing high rate of water holding capacity. The earlier studies conducted in this area reveals that the river is dying. Low dissolved oxygen, abnormal colour and offensive odour were noted because of the discharge of effluents from nearby industrial units. Clay mining, transportation of mined clay and its processing near Chalakudy Bridge, presence of pesticides from Koodapuzha etc. are some of the signs of the slow death awaiting the river. In the soil presence trace of manganese, lead, nickel, zinc, copper, and cadmium were identified in earlier studies. The present study also supports these facts, because of the higher percentage of water holding capacity indicates that the river is in the stage of succession.

In a chemical analysis conducted, the presence of nitrate, ammonium and calcium were identified. The large amount of these components is from the discharge of chemicals from industries, farm lands nearby. The presence of these components in the soil indicates that it may be present in the river water also. Because from the river water only it get sediment in the soil. The presence of these chemicals will lead to pollution by eutrophication. The presence of nitrate in the soil may result in causing infant methaemoglobinemia (blue baby syndrome) due to the accumulation of nitrate in the tissues (through water, vegetable and fruits) and cause animal methaemoglobinemia.

3. AR

Aluva river site is a part of river Periyar. The texture of the soil was loamy. The present study indicates the high rate of pollution in this area. The water holding capacity is about 75% which indicate the presence of organic matter, high amount of calcium, presence of nitrate and ammonium.

4. MR

Manjaly rivers site is another part of Periyar River. It was observed that the numbers of industries are much lesser in this area when compared to other river spots. The anthropogenic disturbances were much lesser than all the other river spots and number of aquatic free floating plants was also less. Although in future there is a chance of degradation because of uncontrolled sand mining. The texture of soil as sandy and the presence of chemical components such as ammonia, nitrate and calcium was found to be less.

5. MUR

Muppathadam River site is another part of Periyar River. One of the interesting things noted in Muppathadam River is the low bulk density. It is below than one and the soil is much polluted with high amount of organic matter. Eutrophication were started in this area, the width of the river is decreasing and soil was noted and it possess high rate of water holding capacity enough to support the growth of the plants which indicate the chance for succession. The colour of the river were also changed due to the deposition of heavy metals from the effluents discharged from the nearby companies.

6. Ramamangalam

Ramamangalam is the river site through which Muvattupuzha river is flowing. This river is the least polluted one. The texture of the soil as found to be sandy.

Of the six sampling sites studied Mupathadam, Chalakudy and Aluva river site areas were found to be in serious threat of pollution and the rivers are in the treat of vanishing. The flow of the water had become less in these spots and the colour and the texture of the soil has been changing. Anthropogenic interventions in the form of land filling, blocking the natural flow of water by obstructing the interlinking channels , exploitation of plants for medicinal purposes, dumping of domestic, slaughter house and poultry wastes, coir retting ,sewage and plastics strewn all over the water body apart from encroachment and sand mining have reduced the aesthetic value of these water bodies. If adequate precautions are not taken, within a few years these rivers will get vanished. Vegetation stabilizes banks primarily by increasing shear strength of the soil (Thorne and Lewin 1979, Gray and Mac Donald 1989), reducing water velocity and armoring the bank (Thorne, 1982). Predicting bank erosion rates can be difficult because of the interaction of the many variables that influence the process. Bank erosion rates can vary according to the type of riparian vegetation that is present. Different vegetation life forms (e.g. herbaceous, woody shrub, tree) and species can have different root-shoot architectures and biomass—both above and below ground—which influence the ability of vegetation to stabilize banks of streams and rivers (Mallik and Rasid, 1993). The ability of vegetation to stabilize stream or river banks is partly dependent upon scale, with both the size of vegetation relative to the watercourse and absolute size of the vegetation being important. Vegetation stabilization tends to be most effective along relatively small water courses (Thorne 1982, Gatto 1984, Nanson and Hickin 1986, Davies-Colley 1997). On relatively large rivers, fluvial processes tend to dominate (Gatto 1984, Nanson and Hickin 1986). Large uprooted trees can serve to stabilize banks along large rivers, but on smaller streams those same trees may cause acceleration of water flow that result in local bank erosion (Thorne 1982). One must note, however, that local bank erosion may also result in the formation of scour pools and backwater areas that often are necessary for high quality fish habitat. Vegetation influences channel development and geometry through its influence on bank erosion processes. Narrow stable channels often are associated with relatively high levels of riparian vegetation, while wider, unstable channels are associated with relatively less riparian vegetation (Rowntree and Dollar 1999).

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