Implementing Statistical Tools to Assess the Sedimentation of the Entire Ozat Riverbed in Gujarat Through Physical and Chemical Examination

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Abstract

In this study, selected statistical tools (Discriminant analysis, ANOVA, and correlation analysis) were used to determine the physical-chemical analysis accumulation and its controlling factor and to identify the origin of these metals in soil samples collected from upstream, midstream, and downstream along the Ozat River. For this purpose, 72 topsoil samples were collected and the levels of electronic conductivity (EC), organic carbon (OC), nitrogen, potassium, calcium, and magnesium along with pH and organic matter content were determined in each sample. Discriminant analysis revealed that two investigated sites. The ANOVA and correlation analysis found that soil organic matter is the most important factor controlling the distribution of physical-chemical sub-tans. High parameter loading is suggested to result from wastewater irrigation upstream and downstream, probably due to the extensive use of organic fertilizers and solid manure. This study concludes that statistical analysis can provide a scientific basis for monitoring the physic-chemical parameters accumulation in soil and for controlling the future soil contamination posed by human activities.

Keyword; - Soil analysis, SPSS, physicochemical, ANOVA, standard error, standard deviation, Comparison

Introduction

Sediments have been studied for many years to characterize their nature and properties for different purposes. Many analytical methods used in the general characterization of bottom sediments in environmental studies have been derived from those used in soil and sediment analysis in mineral exploration. The understanding of the origin of bottom sediments, particularly the erosion, transport, and deposition of terrestrial soil particles into lakes and streams, led to the application of analytical methods for soil analysis in the characterization of bottom sediments. Also, some techniques used in the determination of physicochemical properties of soil, rocks, and sediments used in mineral exploration were adapted in the assessment of the quality of bottom sediments in environmental studies. In these early studies, analytical methods, developed in soil science for the determination of nutrients in soils, were used in the analysis of the sediments (Frink, 1969; Shukla et al., 1971).

The various physicochemical parameters such as pH, Electrical Conductivity, Calcium, Magnesium, Total Hardness, Potassium, Sodium, chloride, Texture, COD, BOD, DO, Total organic carbon TDS, TSS, and TS were analysed (Vyas et al 2018), Although soil science is relatively new compared to the older disciplines of mathematics, physics, chemistry, etc., methods for chemical analysis of soils are numerous and have been continuously improved and modified over many years. In addition to the methods for the general characterization of the physicochemical properties of soils, techniques for the quantitative determination of many elements and compounds have developed, particularly in studies of plant nutrition, essentiality and toxicity, and physiological substitutions. With the recognition that bottom sediments are generally derived from soils, the application of the methods used in soil analysis to the sediments was justified.

The development of the understanding of different biogeochemical processes in bottom sediments and their role in aquatic ecosystems, particularly under anoxic conditions, led to the design of different analytical techniques. Techniques for sediment sampling, sample storage, and preparation relevant to the studies of the biogeochemical processes and pathways of sediment contaminants were revised and improved (Mudroch and MacKnight, 1994; Mudroch and Azcue, 1995). The major objective was to preserve the conditions in sampled sediments similar to those on the bottom of the streams and lakes. New techniques for in situ samplings of sediment pore water and methods for the determination of chemical species in the sediments concerning its redox potential were developed (Hesslein, 1976; Tessier et al., 1979; Carignan et al., 1985). In addition, many methods for the quantitative determination of different organic contaminants were tested and applied in studies of sediment quality.

Sediment is an integral and dynamic part of aquatic systems and it plays a major role in the hydrological, geomorphological, and ecological functioning of river basins, defined here to include lakes, reservoirs, estuaries, and the coastal zone. In natural and agricultural systems, sediment originates from the weathering of rocks, the mobilization and erosion of soils and river banks, and mass movements such as landslides and debris flows. In most river basins there are also important contributions to the sediment load of organic-rich material from a range of sources such as riparian trees, macrophytes, and fish. This inorganic and organic material is susceptible to transportation downstream by flowing water, from headwaters and other source areas towards the outlet of the river basin.

Flow rates decline in lowland areas (and areas where the flow is reduced) where transported material settles in slack-zones and on the bed of the river, and river floodplains during overbank events. At the end of the River, much of the sediment is deposited in the estuary and on the seabed of the coastal zone.
For the duration of the study, it was detected that the main cause of deterioration in water superiority was due to the high anthropogenic activities, illegal discharge of sewage and industrial effluent, lack of proper cleanliness, unprotected river sites, and urban runoff. (Tank et al 2019)

The water and residue resolved to temperature and pH. Soil pH was dictated by embracing the strategy of Jackson (1958). Salinity and dissolved oxygen was estimated by the modified Winkler's method and inorganic nutrients were measured by adopting standard methods (Strickland and Parsons, 1972). Total organic carbon (TOC), and total phosphorus content of sediment samples were estimated by the methods of El Wakeel and Riley (1956) and Rochford (1951). The percentage composition of sand, silt, and clay in the sediment samples were determined by the combined sieving and pipette method of Krumbein and Petti john (1938). Simple correlation (r) was made for the statistical interpretation of the physicochemical characteristics and two-way analysis of variance (ANOVA) was employed to find out variations in all hydrographical parameters between stations and seasons.

Materials and methods

The samples were carried out in Ozat River, Gujarat, India. It is the largest catchment area among the other entire watersheds within the Gujarat state. It originates from one of the village of Gorviyali in Visavadar taluka and discharges directly into the Arabian Sea near to the Pata Village Porbandar district. (Fig. 1) The study area extends between North latitudes 21˚10' to 22˚40' and East longitudes 69˚40' to 71˚00'. Agriculture is the main occupation in the area. Groundwater and river water is the main source of irrigation in the study area. The River consists of 4 tributaries: the left side of the river basin is connected through the Popatdi River and, the Ambakhoi River. While left side of the river basin connected through Uben and Utavadi River, travel towards Porbandar district where it discharges into the Arabian Sea. The large difference in the contour value is due to the Holy Girnar Mountain at Junagadh existing in the basin. The close spacing of the contour in middle reach of the basin indicated hilly ranges, while wider spacing in lower reaches of basin indicates flat topography. The holy Girnar Mountain is located in the upper reaches of the basin. The middle reach is having fine soils having a slope of around 1 percent and crops adopted are groundnut and cotton during monsoon; wheat, coriander, and gram during winter, and short-duration crops like groundnut during the summer season. The lower reach of the basin is having fine soils with a fairly flat slope of less than 1 percent. There are problems with water flooding in the lower reach of the basin during the monsoon season. Agriculture in the watershed is restricted to rainfed farming (groundnut, cotton, wheat, and barley), irrigated vegetable farming, orchard farming, greenhouse farming, and chicken farms. The groundwater level is very deeper somewhere it is found > 300 m so that major part of the basin depends upon rain-fed farming.

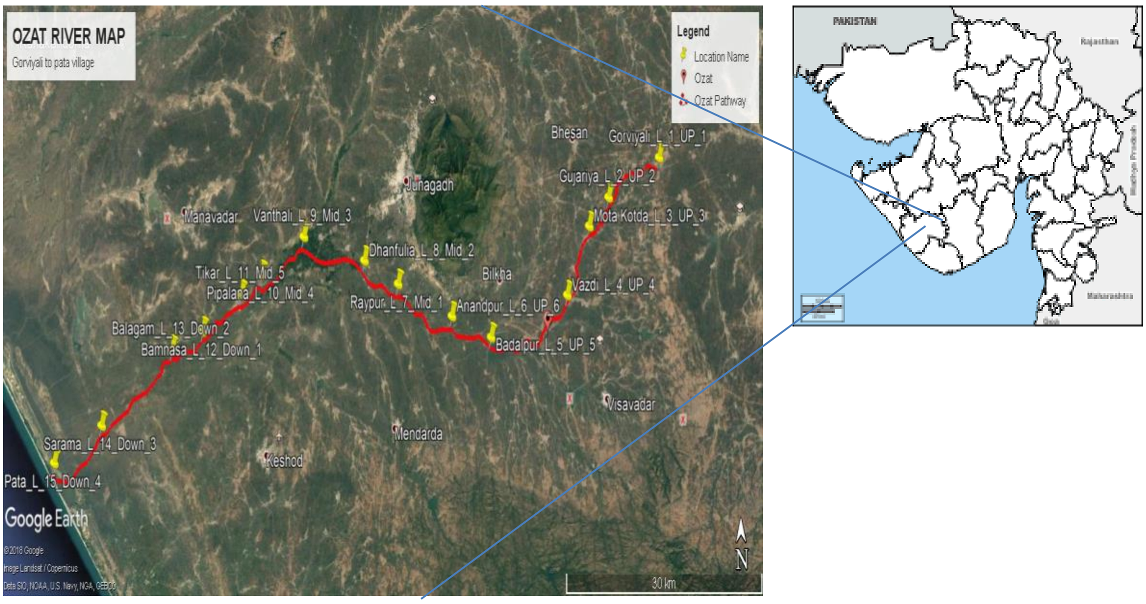

Fig. 1 Satellite view of Ozat River

Three streams were formed in the sampling of water and sediment taken from the river Hiran, in which the upper stream 6 location, midstream 5 locations, and downstream also 4 locations were arranged by GPS at a short distance from each stream, and triplicate samples were taken from each location loop, thus programming each stream-vice. On the go, there are nine locations across the river Hiran in the total of one season of water and Soil sample 51 From Gorviyali village to Pata village, near Madhavpur.

Methodology

Work on field sedimentation sample of Ozat River samples collection of winter November 2016 to October- 2018 from upstream, midstream, and downstream as location-wise every sampling point have connected through GPS with longitude and latitude, and all locations photograph available. The collection of soil samples on the field For the soil Sample have Three sampling points from one location and at each sampling point sample will be collected from a depth of 1(one) feet. Soil Sample 1 to 2 kg sample for the physicochemical parameter is estimated and collect at each sampling point. The container for Soil sample was collected in the plastic polythene from the selected sampling point, and soil samples were carried from the selected side to the laboratory as soon as possible. laboratory work different types of parameter was analyzed, total of 29 water parameter and the soil contain 25 parameters were analysed in the laboratory at the Department of Earth and Environmental, Kachchh University.

Result and Discussion

The time scales may vary from minutes to months. Measurements may be undertaken in the laboratory, on loose or repacked samples, on undisturbed cores, in plant containers or lysimeters, or as part of field experiments, trials, or larger, catchment scale, studies. The measurement precision and accuracy demanded varies widely and hence so does the sophistication of the methodology which must be employed.

As a result of this wide range of demands, no one method can satisfy all requirements. However, three methods are used for the vast majority of determinations today: the thermo-gravimetric method, neutron thermalization, and a group of techniques based on the measurement of soil dielectric properties

In this paper deals with, the concept of soil content, definitions of the water content of a block of soil, and the terminology and units used are described briefly. The relative merits of direct and indirect measurements and the spatial and temporal resolution that can be achieved by various methods are considered. The principles and practice of the three methods are then discussed in detail and applications of the neutron and dielectric methods are described.

Summary of the more common alternatives to the three major ground-based methods for soil water content measurement. Discussion about various parameters in the Ozat River sample location site in winter, summer, pre-monsoon, and post-monsoon in 2017-2018 data was recorded stream wise respectively.

Analysis of statistics Ozat river soil 2017 correlation of pH and Electrical conductivity this output of correlation 0.079, significant value 0.5838, according to 0.05 levels is a non-significant value. The pH and EC mean values are 7.674, 0.841, and Standard deviation is 0.211, 0.333, and the standard error is 1.085, 0.119. in the Organic matter and Organic carbon correlation output is 1.000** according to 0.01 significant level, a p-value is 0.000, in Organic matter and organic carbon mean were noted 0.122, 21.007, SD 0.041, 7.051 and the SE 0.017, 2.971 now Nitrogen, phosphorus and potassium it correlation data is Nitrogen – phosphorus 0.175 and significant value is 0.222, this value is non-significant as per the according to 0.05, Nitrogen–potassium correlation is 0.437** and significant value is 0.0015 level, it is a highly positive result, in nitrogen, phosphorus and potassium mean is 320.516, 1.599, 461.060 SD is 52.800, 0.330, 142.786 and SE is 45.328, 0.226, 65.204.

Calcium-magnesium correlation values are 0.186, significant result is non-significant according to 0.05 level, 0.1957, calcium magnesium mean values are 134.934, 5.698 and Standard deviation 38.750, 0.378 and Standard error were recorded 19.082, 0.806.

This is the correlation between two or three parameters and all parameters are significant and non-significant according to 0.05 and 0.01 level.

Ozat soil 17 Descriptive Statistics			
	Mean	Std. Deviation	S.ERR
pH	7.674	0.211	1.085
EC	0.841	0.333	0.119
OM	0.122	0.041	0.017
OC	21.007	7.051	2.971
Nitrogen	320.516	52.800	45.328
Phosphorus	1.599	0.330	0.226
Potassium	461.060	142.786	65.204
Calcium	134.934	38.750	19.082
Magnesium	5.698	0.378	0.806

Table 1: Statistical Analysis for the Year of 2017

Analysis of statistics Ozat river soil correlation of pH and Electrical conductivity this output of correlation 0.132, significant value 0.3616, according to 0.05 levels is non-significant value. The pH and EC mean values are 7.683, 0.846, and the Standard deviation is 0.210, 0.336, and the standard error is 1.087, 0.120. in the Organic matter and Organic carbon correlation output is 1.000** according to 0.01 significant level, p-value is 0.000, in Organic matter and organic carbon mean were noted 0.134, 23.147, SD 0.043, 7.431 and the SE 0.019, 3.273 now Nitrogen, phosphorus and potassium it correlation data is Nitrogen – phosphorus 0.337* and significant value is 0.0165, this value is significant as per the according 0.05 level, Nitrogen–potassium correlation is 0.409** and significant value is 0.0031, it is a highly positive result according to 0.01 level, in nitrogen, phosphorus and potassium mean is 350.115, 1.635, 456.405 SD is 64.898, 0.328, 139.525 and SE is 49.514, 0.231, 64.545.

Calcium-magnesium correlation values are 0.876**, and the significant result is 8.250E-17 this is high significant according to the 0.01 level, calcium magnesium mean values are 138.117, 6.270, and Standard deviation 41.191, 1.371 and Standard error were recorded 19.533, 0.887.

This is the correlation in between two or three parameters and also all parameters are significant and non-significant according to 0.05 and 0.01 level.

Ozat soil 18 Descriptive Statistics			
	Mean	Std. Deviation	S.ERR
pH	7.683	0.210	1.087
EC	0.846	0.336	0.120
OM	0.134	0.043	0.019
OC	23.147	7.431	3.273
Nitrogen	350.115	64.898	49.514
Phosphorus	1.635	0.328	0.231
Potassium	456.405	139.525	64.545
Calcium	138.117	41.191	19.533
Magnesium	6.270	1.371	0.887

Table 2: Statistical Analysis for year of 2018

Conclusion

The present study summarizes the variation of different physicochemical properties of riverbank soil along the Ozat River. The assessment of soil quality of the river indicates that up-stream, midstream, and downstream sampling locations of the river systems are affected by anthropogenic activities and also leaching of water from the agriculture field. The present study reveals that Ozat river bank soils from upstream Gorviyali village to downstream Pata village contain a very less amount of macronutrients i.e. Nitrogen, Phosphorus, and Potassium.

Downstream location shows comparative significant P values and non-significant values, During 2017-2018 the result was recorded of a physicochemical higher value of pH in 8.10 in Dhanfuliya a midstream location season of summer and 7.90 in Kotda in upstream, the season of post-monsoon and pata in downstream, the season of winter, EC 1.50 in Kotda an upstream location season of pre-monsoon and 1.71 in Kotda in upstream, the season of post-monsoon, OM 0.20 in vanthali midstream location season of post-monsoon and 0.23 in sarama in downstream, the season of post-monsoon, OC 37.07 in sarama downstream location season of post-monsoon and 39.03 in sarama in downstream, the season of post-monsoon, nitrogen 403.50 in pata a downstream location season of winter and 491.31 in kotda in upstream, the season of pre-monsoon, phosphorus 2.37 in pipalana a midstream location season of pre-monsoon and 2.32 in Kotda in upstream, the season of summer, potassium 783.33 in pata a downstream location season of post-monsoon and 574.43 in tikar in midstream, the season of winter, calcium in 234.65 in pata a downstream location season of post-monsoon and 241.94 in Kotda in upstream, the season of summer, magnesium 6.94 in pata downstream location season of winter and 9.50 in Kotda in upstream, the season of summer.

The present study will serve as a primary input to understand the soil pollution along the Ozat River and monitoring the riverbank soil health of the study area. Moreover, the data will be useful to environmentalists, conservation researchers, and scientists for the effective management of the Ozat River ecosystem.

This paper has the main objective of reviewing the most used statistical methods for appraising the spatial and temporal variability of soil properties. There is a large panoply of techniques and, as stated in the introduction, the choice of the adequate model will depend on the behavior of the phenomenon of interest (a priori knowledge), the objective of the analysis, and the nature of the available data.

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Correlations of Ozat River Soil - 2017

2017 Ozat Soil	**pH**	**EC**	**OM**	**OC**	**Nitrogen**	**P**	**K**	**Ca**	**Mg**
pH	1								
EC	.079	1							
OM	.142	.120	1						
OC	.142	.120	1.00**	1					
Nitrogen	.176	.599**	.366**	.366**	1				
P	.212	.252	.081	.081	.176	1			
K	-.141	.121	.543**	.543**	.437**	-.055	1		
Ca	.057	.787**	.234	.234	.662**	.171	.316*	1	
Mg	-.226	.010	.271	.271	.149	-.377**	.451**	.186	1
**. Correlation is significant at the 0.01 level (2-tailed).									
*. Correlation is significant at the 0.05 level (2-tailed).									

Correlations of Ozat River Soil - 2018

	pH	EC	OM	OC	Nitrogen	P	K	Ca	Mg
pH	1								
EC	.132	1							
OM	-.073	.156	1						
OC	-.073	.156	1.000**	1					
Nitrogen	.345*	.605**	.309*	.309*	1				
P	.077	.315*	.304*	.304*	.337*	1			
K	.092	.174	.610**	.610**	.409**	.044	1		
Ca+	.230	.815**	.225	.226	.653**	.360*	.309*	1	
Mg	.170	.818**	.299*	.298*	.640**	.365**	.392**	.876**	1
**. Correlation is significant at the 0.01 level (2-tailed).									
*. Correlation is significant at the 0.05 level (2-tailed).									