Eco. Env. & Cons. 28 (1) : 2022; pp. (250-254)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i01.034

Ecological Study of Soil of Digha Coast, Digha, Purba Medinipur, West Bengal

Sunirmal Giri

Department of Zoology, Belda College, Belda, Paschim Medinipur 721 424, W.B., India

(Received 27 April, 2021; Accepted 21 June, 2021)

ABSTRACT

One of the important ecological resources that has important role on the life on Earth is soil. In this paper an attempt has been made to estimate the physico-chemical parameters of soil and to generate the Soil Quality Index (SQI) for Digha Coast, Digha, Purba Medinipur, West Bengal. Soil Quality Index (SQI) is calculated using five soil parameters such as Organic Matter (OM), Acidity (pH), Phosphorus (P), Potassium(K), and Electrical Conductivity(EC). Physico-Chemical properties of soil are estimated by conducting different experiments. The physico- chemical analysis and properties, and Soil Quality Index are helpful in concluding the quality of soil like as good, excellent, poor and very poor or unfit for ecological point of view.

Key words : *Physico-chemical parameters of soil, Soil Quality Index (SQI) etc.*

Introduction

Coastal environment plays a vital role in a nation's economy by virtue of their resources, productive habitats and rich biodiversity. Any human activities may causes a dramatic change in the ecology function coastal habitats, coastal development contributes to habitat loss in a number of ways-destruction of wetlands, sand dunes and other habitats and degradation of nearby areas (through erosion, siltation, dune migration changes in flow and current patterns and other physical factors) are the result of habitat conversion (for urbanization, settlement, agriculture expansion and shrimp farming) shoreline stabilization structures, dredging, filling and the dumping of the wastes (Cheshire and Sheppard, 2002). In Digha coast tourism and urban development, beach erosion and siltation etc. are all making this area increasingly vulnerable. The present work attempts to highlight the study of Soil Quality Index of Digha Coast, Digha, Purba Medinipur, West Bengal.

Materials and Methods

Digha is a seaside resort city in the state of West Bengal, India. It lies in Purba Midnapore district and at the northern end of the Bay of Bengal. It has a low gradient with a shallow sand beach with gentle waves extending up to 14km in length. Geographical location of Digha ranges from 21°36'50'' N, 87°29' E to 21°39'N, 87°37''.

During this study, six areas were considered according to the local name of those areas viz., Dighamohana (Study site -I), Old Dighaghat/Biswa Bangla (Study site -II), New Dighaghat/ Marine aquarium ghat/Hospital ghat (Study site -III), Science Centre ghat (Study site -IV); Udaypur (Study site -V) and Talsari (Study site -VI). Soil samples were collected in random selection process from 30 different places from the six study areas and conducted different tests like Organic Matter(OM), Acidity (pH), Phosphorus(P), Potassium(K), and Electrical Conductivity (EC) following standard literatures.A Soil Quality Index is an aggregate measurement of a soil's performance of critical ecological and agronomic functions. Values of physico-chemical properties of soil were analyzed, andestimation and evaluation of Soil Quality index (SQI) has been done following standard method of Brejda and Moorman, 2001.SQI = (DpH + DOM+ DP + DK +DEC) / 5. Where DpH=1 if pH>6.5 and 0 otherwise.; DOM=1 if OM>2 and 0 otherwise. ; Dp=1 if p>20 and 0 otherwise. ; Dk=1 if k>80 and 0 otherwise. ;DEC=1 if EC>2 and 0 otherwise.

S.No	Rage of values	Soil Quality Index Rating
1	0-0.4	Poor
2	0.5-0.7	Average
3	0.8-1.0	Good

Results

Soil pH (pH)

The pH value of soil of different study sites of Digha have been estimated which ranges from 6.5 to 8.6 (Table 1) and that the most of the soil of the study area are slightly alkaline in nature and few are acidic in certain time. Most horticultural crops will grow satisfactorily in soils having a pH between 6 (slightly acid) and 7.5 (slightly alkaline) and most organisms have a well defined range of pH tolerance.

Organic Carbon (OC%)

Soil biodiversity reflects the mix of living organisms in the soil. The distribution of soil organic matter in percentage has been estimated and it has been found that the percentage of the soil organic carbon in different study areas of Digha varies from 1.4% to 4.8 % (Table 1).

Electrical Conductivity (EC) (μmho/cm)

The Soil electrical conductivity (EC) of soil of different study sites of Digha have been estimated which ranges from 10.4 to 21.3 (μmho/cm) (Table 1). Soil electrical conductivity (EC) is an important indicator of soil health. Since water-holding capacity is intimately linked to crop yields, there is enormous potential to use soil electrical conductivity measurements to delineate areas with different yield potential.

Phosphorus(P) (mg/100 g)

It has been observed that the percentage of phosphorous in the surface soil of Digha coast varies from 1.01 ppm to 2.8 ppm (Table 1) which indicates that here phosphorous content in the surface soil is comparatively low due to high percentage of sand concentration.

Potassium (ppm)

It has been observed that the percentage of Potassium (ppm) in the surface soil of Digha coast varies from 0.28 ppm to 0.84 ppm (Table 1). Soil Potassium exists in four forms in soils: solution, exchangeable, fixed or non-exchangeable, and structural or mineral.

Soil Quality Index (SQI)

Based on above physico-chemical such as acidity (pH), Organic Matter (OM), Phosphorus (P), Potassium (K), and Electrical Conductivity (EC) the Soil Quality Index has been estimated. The Soil Quality Index values at 30 different samples show that most of the places the soil quality is in average condition as SQI values shows in between 0.5-0.7 and that for sevensamples the SQI value lie between 0-0.4 which conclude that soil is poor quality (Table 1).

Discussion and Conclusion

There can be three types of soil reaction, which are acidity, alkalinity and neutral. Soil reaction is measured by pH (Puissance de Hydrogen) of a suspension of soil in water. It represents concentration or activity of hydrogen ion. pH expresses the relationship between H^+ and OH^-. In the pH scale, the pH value ranges from 0-14, where pH, 0 represents the highest limit of active acidity and pH 14 the highest degree of alkalinity. Neutral represents pH 7. Soil acidity is common in regions where precipitation is high enough to leach an appreciable amount of exchangeable bases form the surface layer of the soil. So that the exchange complex is dominated by hydrogen ions on the contrary, alkali soils, occur where there is a comparatively high degree base saturation. Soil pH understood is to large extent of merely conventional significance and not absolute values.

The organic matter of the soil has its origin in the decay of dead plants and animal substances incorporated in various ways in the soil. Vascular plants represent the largest component of living biomass on Earth (Thomas and Bianchi, 2011). The decay the soil organic matter is further induced by the soil micro-organism and is called humification and more

Table 1. Physico-Chemical Paramerters of the Soil of diffetent Study sites

Study sites	Sample No.	pH			OC (%)			EC (μmho/cm)			P (mg/100gm)			K (mg/100gm)			SQI	Rating
		MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG	MIN	MAX	AVG		
Study site-1	1	7.2	8.2	7.66	1.7	3.2	2.68	10.4	18.4	14.73	1.05	1.96	1.33	0.28	0.69	0.50	0.6	Average
	2	7.2	8.4	7.56	1.9	3.4	2.83	10.4	18.4	14.77	1.01	2.01	1.62	0.38	0.81	0.62	0.6	Average
	3	6.5	8.4	7.54	2.8	4.8	3.33	10.4	18.4	15.87	1.06	2.28	1.55	0.34	0.78	0.61	0.6	Average
	4	7.3	8.2	7.66	2.7	3.4	2.98	10.6	21.3	15.12	1.05	2.28	1.53	0.29	0.76	0.55	0.6	Average
	5	6.5	8.4	7.53	2.2	3.4	2.99	10.4	18.4	14.55	1.05	2.28	1.46	0.29	0.78	0.56	0.6	Average
Study site-2	6	7.2	7.9	7.51	1.6	2.9	1.93	10.7	17.5	14.15	1.11	2.28	1.60	0.34	0.74	0.56	0.4	Poor
	7	7.4	8.4	7.69	2.1	4.8	2.88	10.4	17.5	13.06	1.05	2.15	1.60	0.44	0.77	0.58	0.6	Average
	8	7.2	7.8	7.51	1.6	3.1	1.99	10.7	18.4	15.28	1.12	1.96	1.49	0.29	0.65	0.53	0.4	Poor
	9	7.4	7.9	7.61	1.7	3.1	1.97	10.6	18.4	15.04	1.23	2.28	1.69	0.29	0.78	0.58	0.4	Poor
	10	7.2	8.4	7.72	1.8	3.4	2.66	10.7	18.4	14.71	1.06	2.28	1.44	0.34	0.69	0.59	0.6	Average
Study site-3	11	7.4	7.9	7.61	1.7	3.4	2.72	10.4	17.4	14.69	1.05	2.28	1.70	0.34	0.78	0.61	0.6	Average
	12	6.9	8.2	7.62	1.9	3.4	2.68	10.7	18.4	14.38	1.12	2.01	1.65	0.47	0.84	0.64	0.6	Average
	13	7.3	7.9	7.60	1.7	3.4	1.98	10.6	17.5	14.06	1.05	2.28	1.49	0.29	0.78	0.56	0.4	Poor
	14	7.2	8.2	7.77	1.9	3.4	2.67	10.7	16.3	13.98	1.05	2.28	1.64	0.29	0.69	0.53	0.6	Average
	15	7.3	8.2	7.69	1.9	3.4	2.53	10.4	18.4	14.49	1.05	2.12	1.49	0.29	0.69	0.50	0.6	Average
Study site-4	16	7.2	7.9	7.45	1.9	3.4	2.57	12.4	17.5	14.23	1.12	2.28	1.64	0.29	0.78	0.58	0.6	Average
	17	6.9	8.1	7.54	1.8	3.4	2.88	10.4	18.4	14.81	1.22	2.01	1.51	0.29	0.78	0.52	0.6	Average
	18	7.4	7.9	7.64	1.5	2.9	1.93	10.4	18.4	15.60	1.05	2.28	1.40	0.29	0.74	0.54	0.4	Poor
	19	6.9	8.2	7.68	2.1	3.4	2.83	10.7	17.5	15.02	1.23	2.28	1.66	0.38	0.78	0.61	0.6	Average
	20	6.8	8.2	7.50	1.9	3.4	2.67	10.4	18.4	14.71	1.05	2.23	1.43	0.34	0.79	0.59	0.6	Average
Study site-5	21	7.2	8.1	7.66	1.9	3.4	2.79	12.5	18.4	14.96	1.01	2.28	1.51	0.55	0.78	0.67	0.6	Average
	22	7.1	8.2	7.52	1.8	3.1	2.58	12.6	18.4	15.43	1.05	2.28	1.50	0.34	0.78	0.58	0.6	Average
	23	7.2	7.7	7.38	1.7	3.4	2.60	10.4	18.4	14.71	1.2	2.28	1.71	0.44	0.74	0.58	0.6	Average
	24	6.8	8.1	7.57	1.8	3.2	2.53	10.4	18.4	14.04	1.01	2.28	1.55	0.29	0.69	0.57	0.6	Average
	25	7.4	8.2	7.72	1.5	2.8	1.92	10.6	18.4	14.21	1.12	2.28	1.52	0.38	0.75	0.60	0.4	Poor
Study site-6	26	6.8	7.9	7.43	1.8	3.2	2.76	10.4	16.3	13.19	1.05	2.28	1.60	0.29	0.69	0.56	0.6	Average
	27	7.2	8.6	7.67	1.7	3.4	3.01	11.4	18.4	14.61	1.08	2.12	1.56	0.44	0.78	0.61	0.6	Average
	28	6.9	8.5	7.56	1.9	3.4	2.80	11.9	17.2	14.12	1.05	2.28	1.60	0.29	0.69	0.49	0.6	Average
	29	6.9	8.2	7.52	1.4	3.4	2.73	12.6	18.4	16.03	1.08	2.8	2.10	0.29	0.74	0.58	0.6	Average
	30	6.5	8.1	7.38	1.4	2.9	1.97	12.6	18.4	15.05	1.05	2.28	1.60	0.38	0.78	0.63	0.4	Poor

or less dark-coloured products of this process is called humus. Humus is the world used when referring to organic matter that has undergone extensive decomposition and is resistant to further alteration. Humus is characterized by high Base Exchange capacity (Thomas and Bianchi, 2011). The soil organic matter plays an important role as the store house of plants nutrients. Recent researches on soil and plants have received considerable impetus in connection with the role of organic matter in regulating the growth of plants. But, it must be remembered that all organic matters are not beneficial to higher plants. Under certain conditions several organic components are found in soils that are known to be harmful. Rivers play a major role in exporting terrestrial organic carbon from the continents to the oceans. Bacterial diversity has been shown to decline with increased climatic severity, so many of the changes in the flux of terrestrial organic carbon to the ocean are also likely to be impacted by the changes in microbial communities Burdige, 2005). Soil biodiversity reflects the mix of living organisms in the soil.

These organisms interact with one another, as well as with plants and small animals, forming a web of biological activity. Soil electrical conductivity (EC) is a measure of the amount of salts in soil (salinity of soil). It should not be measured the electrical conductivity after applications of manure or bio-solids, since soil properties may be masked by excessive salts and electrical conductivity values obtained may be a reflection of the application rather than the actual soil conductivity. Soil electrical conductivity (EC) is an important indicator of soil health. Since water-holding capacity is intimately linked to crop yields, there is enormous potential to use soil electrical conductivity measurements to delineate areas with different yield potential. Soil electrical conductivity also can delineate differences in organic matter content and cation exchange capacity. Using soil electrical conductivity to create zones with different management strategies is becoming very popular. Areas are grouped by similar electrical conductivity values and may respond similarly to different management systems. Soil EC, much like pH, is a good overall indicator of soil fertility. It can be used to show the capacity of the soil to store nutrients, as an indicator of soil texture and as an indication of an excess of soil nutrients (e.g. excessive sodium levels leading to salinity). Good soil fertility management practices will contribute to maintaining optimal EC levels.

The relation of phosphorus in the soils and plants to animal health and extensive occurrence of phosphorus deficiency in grazing animal are well known. A level of Phosphorus is desirable for good yields of most crops. Phosphorus in the ocean promotes the production of microbes and tiny marine plants called phytoplankton, which compose the base of the marine food chain. Phosphorus often is the limiting nutrient for phytoplankton productivity in aquaculture ponds (Boyd, 1982). Rooted aquatic vegetation absorbs phosphorus (P) from mud and their growth increases in relation to the P content of mud Briston and White Combe, 1971; Chiou and Boyd, 1974).

Soil Potassium exists in four forms in soils: solution, exchangeable, fixed or non-exchangeable, and structural or mineral. Potassium might be considered to stand between nitrogen and phosphorus in its effects on plant growth. It tends to slow down the effects resulting from excessive nitrogen and to prevent the too rapid maturity often induced by too much available phosphorus.Potassium has a hydration energy of which indicates little ability to cause soil swelling (Helfferich, 1962).

A soil quality index (SQI) could be defined as a minimum set of parameters that provides numerical data concerning the capacity of a soil to carry out one or more functions (Garrigues *et al*., 2012). Based on above physico-chemical such as acidity (pH), Organic Matter (OM), Phosphorus (P), Potassium (K), and Electrical Conductivity (EC) the Soil Quality Index has been estimated.

These results have important guiding significance and practical value for the more objective and accurate evaluation of soil quality in coastal areas and the development and utilization of land resources. During the study, it has been found that exploitation of coastal resources has very abruptlyincreased in recent years. The knowledge of the chemical, physical and biological behavior of the soil was obtained mainly from the effort to provide an answer to the practical question for obtaining bigger and better yield. Significant variations in environmental parameters and nutrients were observed during the study period. The soil or sediment food web of any ecosystem is the place where organic and inorganic particles are eventually trapped, mineralized, or stored, and this has important consequences for the global carbon balance Wall, 2004,; Cole, 2007). The organisms in both soils and sediments interact in dynamic food webs, and the regulation of organisms by their consumers within the food web controls the fate of organic matter at local and global scales (deRuiter *et al*., 1995, Rooney *et al.*, 2006). Terrestrial, freshwater, and marine environments contrast in abiotic conditions such as oxygen availability and temperature fluctuation. However, indirect interactions, such as *bioturbation* (the biological reworking of soils and sediments by organisms including microbes, rooting plants, and burrowing animals (Meysman *et al*., 2006) and diseases caused by pathogens, or direct interactions, such as trophic effects caused by grazers, result in flows of organic matter through subsurface food webs that are remarkably similar in soils and sediments Rooney *et al.*, 2006).

Understanding soil quality is important to improving sustainable land use management (McGrath and Zhang, 2003). It can be concluded the synergistic impacts of other anthropogenic stressors provide great potential for widespread changes to marine ecosystems.A great emphasis should be given on the utilization of soil. A fundamental knowledge of the soil as regard its origin and development, its nature and composition, characteristics, and the part it plays in the nutrition of plants and animals is very essential for the proper understanding and development of the science of agriculture.

The conservation policy should promote the management practices that maintain integrity of aquatic ecosystems, prevent endangerment and enhance recovery of the threatened species. For the proper management of soil and its properties in the coastal areas, a better knowledge is necessary to know the coastal environment entirely and attempt has been made to study how the coastal region alters in response to natural hazard and human interference and to suggest proper and efficient guidelines for management of it. So, proper use of soil is very important for life supporting systems of mankind and socio-economic development of any region.

Acknowledgment

I convey my sincere thanks to the Principal, Belda College for laboratory and library facilities. Author is thankful to the other faculties and staff members also for their co-operation.

References

Boyd, C.E. 1982. *Water Quality Management for Pond Fish Culture*. Elsevier Sci. Publ. Co., Amsterdam, 318 pp.

Brejda, J. J. and Moorman, T.B. 2001. Identification and Interpretation of Regional Soil Quality Factors for the Central High Plains of the Midwestern USA. Sustaining the Global Farm, Selected Papers from the *10th International Soil Conservation Organization Meeting*, p. 535-540.

Briston, J.M. and White Combe, M. 1971. The role of roots in the nutrition of aquatic vascular plants. *Amer J. Bot*. 58 : 8-13.

Burdige, D.J. 2005. The burial of terrestrial organic carbon in marine sediments: A reassessment. *Global Biogeochem Cycles.* 10.1029/2004GB002368.

Cheshire, P. and Sheppard, S. 2002. The welfare economics of land use planning. *Journal of Urban Economics.* 52 : 242–69.

Chiou, C. and Boyd, C.E. 1974. The utilization of phosphorus from muds by the Phytoplankton, *Scenedesmusdirnorphus* and the significance of these findings on the practice of pond fertilisation. *Hydrobiologia.* 45 : 345-355.

Cole, JJ. 2007. Plumbing the global carbon cycle: Integrating inland waters into the terrestrial carbon budget. *Ecosystems.* 10 : 171–184.

Garrigues, E., Corson, M.S., Angers, D.A., van der Werf, H.M.G. and Walter, C. 2012. Soil quality in Life Cycle Assessment: Towards development of an indicator. *Ecol. Indic*. 18 : 434-442.

Helfferich, F. 1962. Ion exchange.McGraw-Hill Book Co., New York, NY., Huang, P.M., Crossan, L.S. and Rennie, D.A. 1968.Chemical dynamics of K-release from potassium minerals common in soils. *Transactions of 9th International Congress of Soil Science*. 2 : 705-712.

McGrath, D. and Zhang, C. 2003. Spatial distribution of soil organic carbon concentrations in grassland of Ireland .*Appl. Geochem.* 18 : 1629–1639.

Meysman, F.J.R., Middelburg, J.J. and Heip, C.H.R. 2006. Bioturbation: A fresh look at Darwin's last idea. *Trends in Ecology and Evolution*. 21: 688–695.

Rooney, N., McCann, K., Gellner, G. and Moore, J.C. 2006. Structural asymmetry and the stability of diverse food webs. *Nature*. 442 : 265–269

Thomas S. Bianchi, 2011 The role of terrestrially derived organic carbon in the coastal ocean: A changing paradigm and the priming effect. *Proceedings of the National Academy of Sciences.*108 (49) : 19473-19481; https://doi.org/10.1073/pnas.1017982108.

Wall, D.H. 2004. *Sustaining Biodiversity and Ecosystem Services in Soils and Sediments*. Island Press.