

**A PRELIMINARY STUDY OF SOIL ANALYSIS OF SONMIANI,
GADANI AND KUND MALIR COASTS OF DISTRICT LASBELA,
BALOCHISTAN, PAKISTAN**

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ABSTRACT: The purpose of the soil analysis is to study the beach characteristics of different coasts of Balochistan. Three sites Sonmiani, Gadani and Kund Malir were selected. The Gaddani coast is known as sandy cum rocky shore, Sonmiani as sandy cum muddy shore while Kund Malir is sandy. Three different stations were selected on each site for sampling. At each station, five different samples were collected. At all three sites, the amount of medium and fine sand showed greater amount and very fine sand depicted lesser. The results showed that soil samples collected from three coasts mostly have highest fraction of fine sand and lowest portions of very fine sand. At Sonmiani the soil composition is fine sand and very fine sand as compared to Gadani where the soil is of fine sand and medium sand and at Kund Malir the soil is of fine sand along with medium sand but very fine sand also present.

KEYWORDS: Sonmiani, Gadani, Kund Malir, soil analysis, Balochistan.

INTRODUCTION

Geographically Pakistan is located at 23.3° to 36.45° N latitude and 61° to 75.5° E longitude located in south Asia has a distinctive position (Salma *et al.*, 2012). The coastline of Pakistan borders the productive NE Arabian Sea well-known for its upwelling phenomenon (Banse, 1968, 1987; Haq and Milliman, 1985). Its Exclusive Economic Zone (EEZ) covers an area of 196,600 sq km and the territorial waters cover an area of 24,000 km² (Valencia, 2004; Khan and Rabbani, 2000). Coastal area of Pakistan extends 1050 km (650 mi) and is spread in two provinces that are Balochistan and Sindh in which Balochistan contains enough area as 65 % and remaining 33 % is in Sindh province (Ali *et al.*, 2003; Saifullah and Rasool, 2002). The coastal area of Balochistan lies in almost arid zone (little precipitation; 1-100 mm/ year) and is located in two districts Lasbela and Gwadar (Khattak, *et al.*, 2012; Burke *et al.*, 2005). The continental shelf of the Sindh coast extends to a distance of 150 km whereas, that of Balochistan only measures 15-40 km (Qureshi, 2011). The prevailing ocean current direction is clockwise during the southwest monsoon season and anti-clockwise during the northeast monsoon season. The salinity value is on average 36 ppt (Saifullah, and Rasool, 2002). Tides are neither very high nor very low, but intermediate; the mean average height is about 10-11 feet (Harrison *et al.*, 1997). Tides are higher on the eastern side and their velocity is in general between 1-2 knots but may increase to 4 knots in narrow creeks.

The Makran Coast Range forms a narrow strip of mountains along about 75% of the total coast length, or about 800 km (500 mi) (Rasool *et al.*, 2002). These steep mountains rise to an elevation of up to 1,500 m (5,000 ft). The majority of the coast is underdeveloped, with deserted beaches and only a few fishing villages. The coast is rocky and tectonic in origin as evidenced by the uplifted terraces, headlands and fluted beds. The mud volcanoes nearby the shores additional support this. The coastline is generally an exposed desert with distinctive landforms such as sandy beaches, mud flats, rocky cliffs, headlands, bays, deltas, and so forth (Sayied, 2007).

Soil is one of the chief and expensive possessions of the environment. The all living organisms directly or indirectly rely on soil. Soil has complex function which is helpful to human and other life form. Marine ecological condition such as temperature, pH, salinity, nutrients, sediments and soil texture discover composing the fauna and flora. Enhance temperature, low salinity sediment nutrients and accessibility of organic matter found to support the growth and distribution of microorganisms. Microbes like fungus, bacteria and other tiny life form existing surrounded by the soil are also significant and therefore soil is a vigorous medium made up of mineral deposits, macrobiotic matter, aquatic, atmosphere and microorganisms (Vijayakumar *et al.*, 2007).

Sediments consists of fine sorted grains contrasted with poorly sorted grains. Sorting express the distribution of grain sizes of sediments, either in unconsolidated deposits or in sedimentary rocks.

Soils are commonly made up of varying combination of three sizes of soil particles; sand, silt and clay, which are recognized as soil texture. In general, water retention is inversely related to permeability. Sandy soils have the poor water retention, followed by silt, and clay (Dexter, 2004).

Soil has three phases (Dexter and Czyz, 2000). The solid phase is mixture of minerals and organic matter. Soil particle pack loosely, forming a soil structure filled with voids. The solid phase occupies about half of the volume. The residual void space contains water (liquid) and air (gas). The quantity of water that a soil can hold is soil water holding capacity.

MATERIALS & METHODS

For the present study of soil analysis, three coastal sites were selected (Sonmiani, Gaddani and Kund Malir).

Site Description:

Sonmiani:

Sonmiani Dam coast area is located at latitude of $25^{\circ}23'49.39''$ N and at longitude of $66^{\circ}34'24.32''$ E. It is 45 km away from Uthal city. Sonmiani is a coastal town in the southeast of Balochistan province in Pakistan, approximately 80 kilometers northwest of Karachi (Saifullah and Rasool, 2002). The coast of Sonmiani is the northernmost point of the Arabian Sea. This area is generally known as muddy shore because there is a huge quantity of clay particles that makes the soil muddier in this region (Qureshi *et al.*, 2002). The area is rich in biodiversity like mudskippers and mud crabs (Ahmad, 1997). This area also contains estuarine region where mangrove plants are also present.



Fig. 1. Map showing the sites, Sonmiani, Gadani and KundMalir from where soil samples collected.

Gadani:

Gadani or Gadani is a small coastal city of Lasbela district located in the southern part of Balochistan alongside the Arabian Sea, Pakistan (Biagi *et al.*, 2013). Many prehistoric shell-midden sites were discovered along the shores of a small bay, near Gaddani. They are characterized of heaps of fragments of marine molluscan shells (Biagi *et al.*, 2103). The radiocarbon dating indicates that they result from the activity of people who settled along the coast during the seventh and the fifth millennia before (Biagi, 2004). The Gaddani beach is generally known as rocky and sandy beach the muddy shore occupies a very small space over there.

Kund Malir:

Kund Malir is a desert beach in Balochistan, Pakistan near Hingol, some 145 km from Zero-Point on Makran Coastal Highway (Khan *et al.*, 2010). The area is part of Hingol National Park which is the largest in Pakistan. Kund Malir beach is most commonly recognized as sandy beach (Kassi *et al.*, 2014). In this area, large sand dunes are also found and with the course of time they also formed sandy deserts. At one side of RCD road the Arabian Sea is located where as at the other side there is only different outcrops of diverse rock formations can be seen. There are thus several shrimps and lobsters breeding grounds are also found (Qureshi, 2011).

Data collection:

Three appropriate stations (A, B and C) were selected at each site for the collection of sand samples. At each station, 5 sub-stations were marked (e.g. A1, A2, A3, A4 & A5 and so on). Each sub-station was 6 meter apart from other. The sampling was done with the help of PVC pipe by pushing the pipe into the sand. Following the same procedure 15 samples were obtained from each site. The sand collected in the pipe was secured in plastic bags and brought to the laboratory for analysis.

Grain size analysis:

In the laboratory, each sample was weighed on an electronic balance to obtain the wet weight of soil. The soil was found to be 400 grams in weight. After weighing, the samples were then oven dried at 60°C for 24 hours. The aggregates of the dried samples were separated from each other gently and cooled up on room temperature. The weight of dried soil sample was recorded. Grain size was recognized by passing sample through sieves of different mesh sizes. The samples were placed in the sieve shaker with different sieves and left for 10 minutes at the speed of 100 amplitudes. The sieves were removed from the shaker and the retained soil was weighed. The segregated soil when weighed together was equivalent to the initial quantity of the soil sample. The percent contribution of each category according to the Wentworth scale of sediment.

RESULTS & DISCUSSION

The present investigation of soil analysis on three coasts of Balochistan (Sonmiani, Gadani and Kund Malir) (Fig. 1) was performed to determine the proportion of different grain sizes contained within the soil. The soil samples from coast of Sonmiani were observed to contain the very fine sand in the highest amount (Fig. 2) ranging from 41.5 g to 235.1g and that medium sand in the lowest amount ranging from 6.1g and 38.2 g at three stations (Fig. 2).

The soil analysis of Gadani beach demonstrated that the fine sand was present in highest quantity ranging from 167.7g to 149.1g at station A, from 176.5g to 155.8g at station B and 193.3g to 175.9g at Station C (Fig. 3). The amount of very fine sand was displayed lowest in the samples which ranged between 29.7 g to 20.5g. (Fig. 3). The medium sand in the samples varied between 114.9g to 151.1g.

The coastal samples of Kund Malir contained a vast amount of medium sand in the soil and ranged from 145.3g to 84.0g (Fig. 3). The amount of fine sand varied in the samples from 137.2 g to 98.9g. The soil of Kund Malir beach had the smallest amount of very fine sand with maximum being 86.1g and minimum 50.2g (Fig. 4). The soil samples which retained highest moisture content were recorded from 22.54%, 18.57% & 22.50% at Sonmiani, Gadani and Kund Malir sites, respectively (Table 1).

Table 1. Highest moisture content % of Sonmiani, Gadani and Kund Malir sites.

Site	Moisture content %
Sonmiani	22.54
Gadani	18.57
Kund Malir sites	22.50

The present work is the preliminary report on the sand analysis of three different coasts of Balochistan. Sieving is a technique used to grading or separation of fine

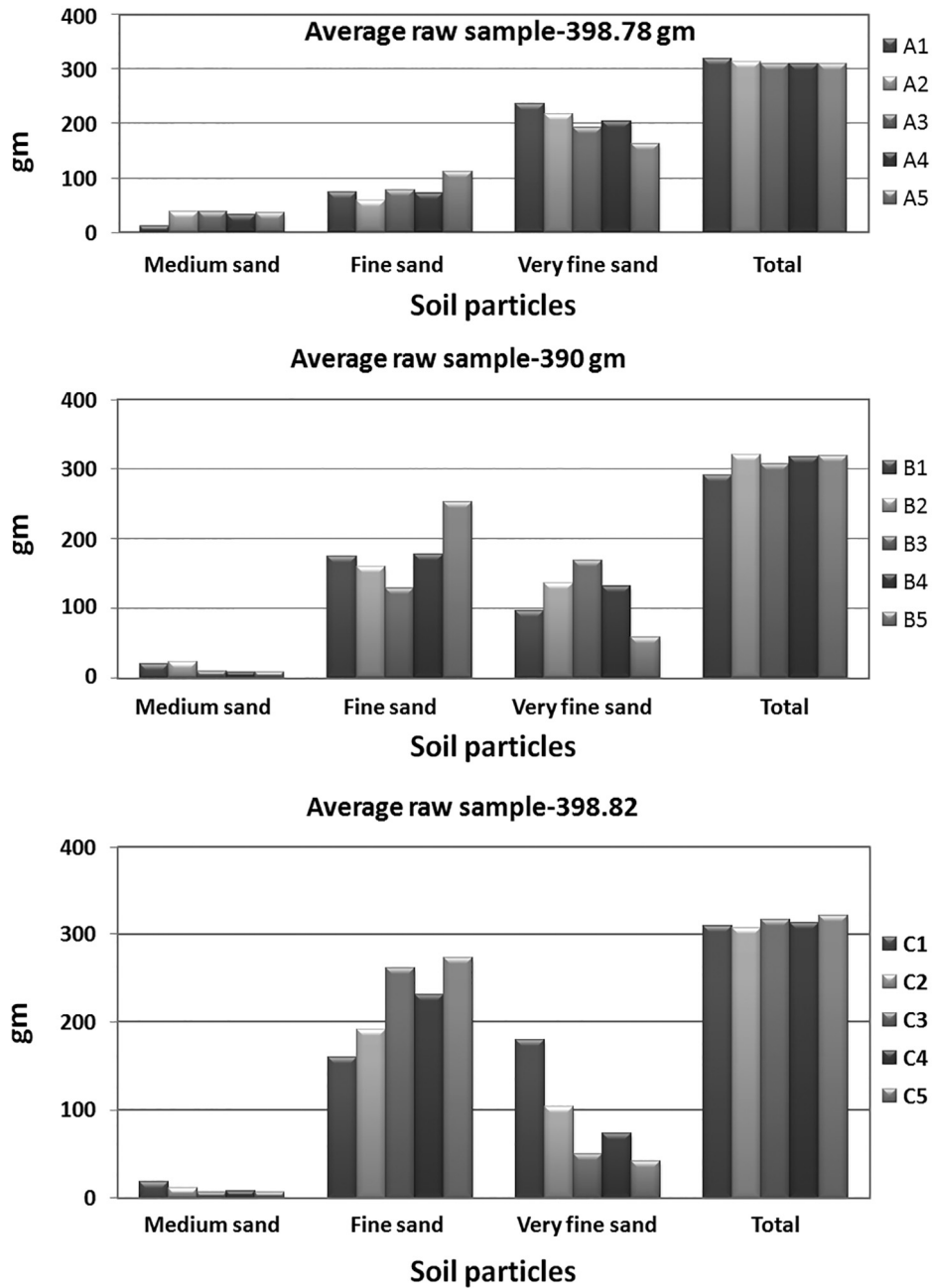


Fig. 2. Graph showing the various compositions of soil particles at Somiani Bay at stations A, B and C. The initial raw samples (15) from three field sites were average 395.86 gm.

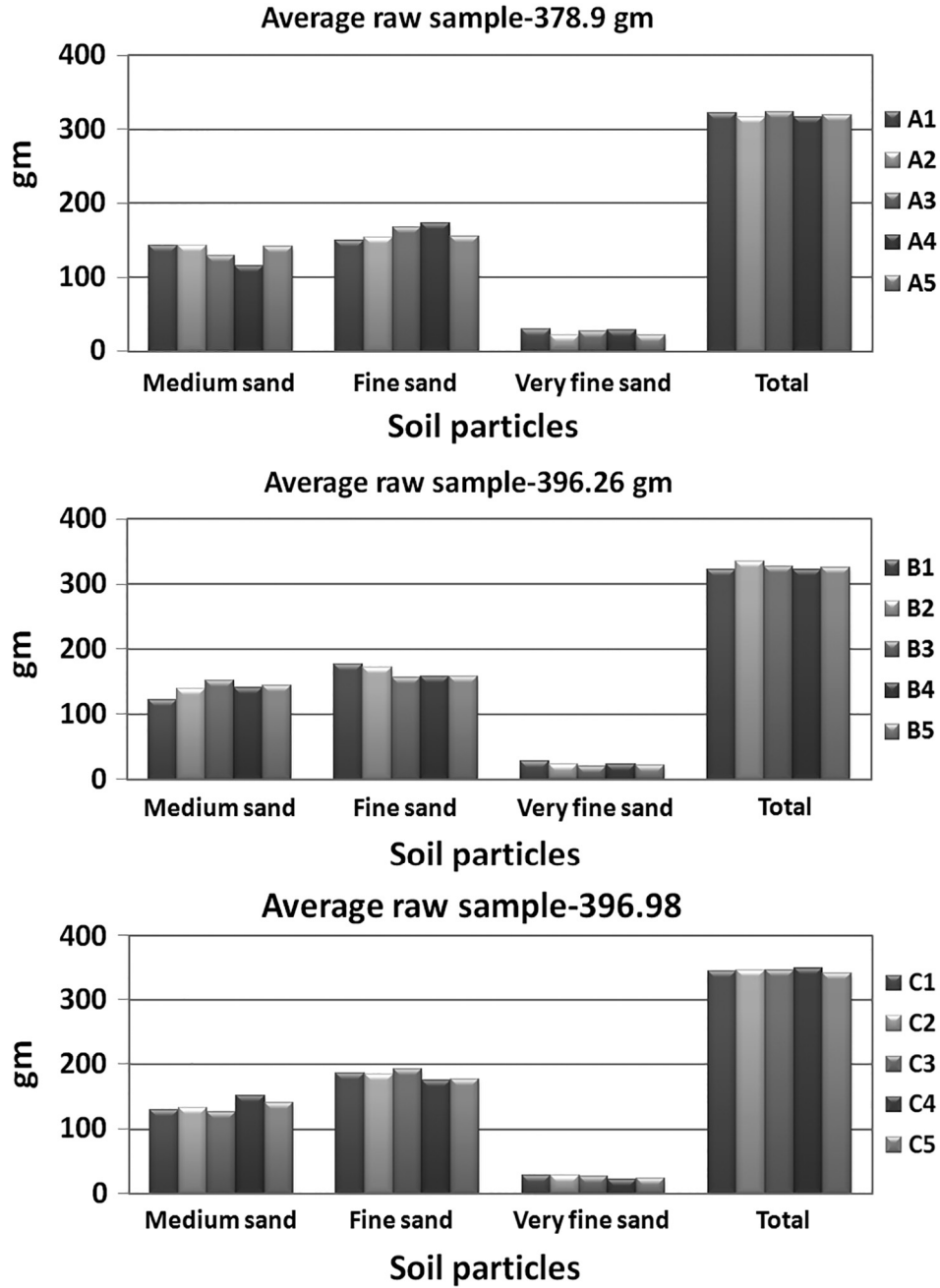


Fig. 3. Graph showing the various compositions of soil particles at Gadani beach at stations A, B and C. The initial raw samples (15) from three field sites were average 390.71 gm.

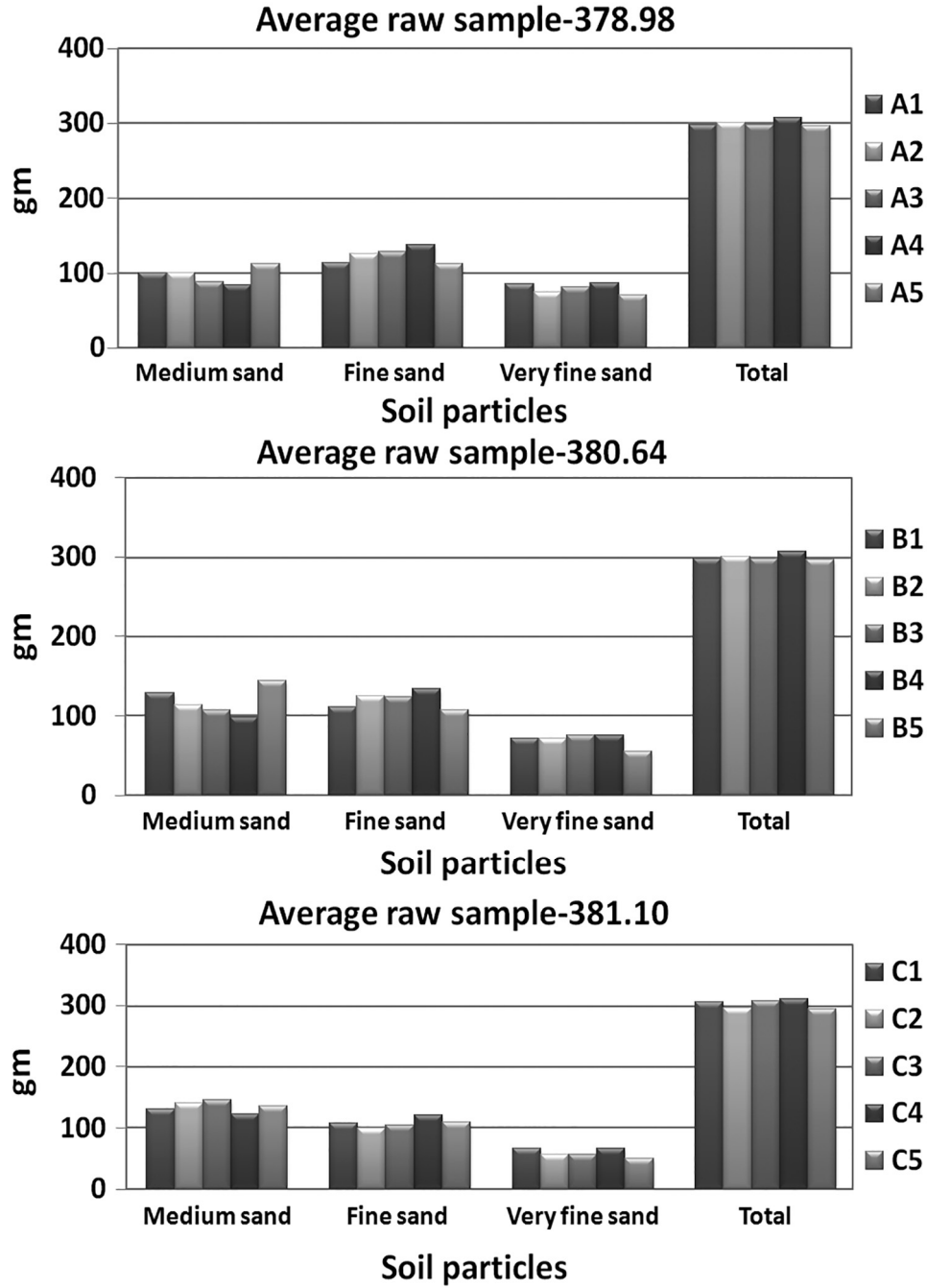


Fig. 4. Graph showing the various compositions of soil particles at KundMalir beach at stations A, B and C. The initial raw samples (15) from three field sites were average 380.21 gm.

aggregates/sand into particles of diverse size. (Day, 1965; Gee and Or, 2002). In practice, this is done by passing the materials through a set of sieves with openings of different diameter. The distribution of different grain sizes affects the engineering properties of soil. Grain size analysis provides the grain size distribution and it essential in categorizing the soil.

At Sonmiani the soil composition is fine sand and very fine sand as compared to Gadani where the soil is frequently found of fine sandy and at Kund Malir the soil is consisted of medium sand and fine sand but very fine sand is also present in large amount.

The Somiani Bay is considered as muddy cum sandy beach (Jahangir *et al.*, 2012) or sandy cum muddy beach (Qureshi, 2011) after analysis of soil sample of the coast where the amount of sand was greater in samples as compare to silt and clay. In our study, the very fine sand is more abundant at Sonmiani beach as compare to fine sand and medium sand.

While the analysis of samples from the Gadani beach it was also found as sandy beach (Snead and Frishman, 1968; Hedgpeth, 1957).

The clay soil has the maximum water holding capacity and the sand in the soil have the smallest amount; clay>silt>sand. Clay particles are so minute and have a lot of small pore spaces that make water travel slower (the upper most water holding capability) (Nimmo, 1997). Sandy soils have high-quality drainage but small water and nutrient holding capacities. The results showed that soil samples were collected from three coasts mostly have highest fraction of sand and lowest portions of clay, therefore water retention in these soil samples are very low Sandy soils have greater particles and big pores. Though, big pores do not have a great capability to hold water (Bruand and Tessier, 2000; Gee and Bauder, 1986).

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REFERENCES

- Ahmad, M., 1997. Natural and human threats to biodiversity in the marine ecosystem of coastal Pakistan. *In Coastal zone management imperative for maritime developing nations*. Springer Netherlands. 3: 319-332.
- Ali, Z., M. Arshad, and M. Akhtar. 2003. "Biological analysis of Makran coastal wetlands complex, Pakistan. " *Proc. Pakistan Congr. Zool.* 23: 99-140.
- Banse, K., 1968, February. Hydrography of the Arabian Sea shelf of India and Pakistan and effects on demersal fishes. *In: Deep sea research and oceanographic Abstracts* (Vol. 15, No. 1, pp. 45IN749-48IN1079). Elsevier.

- Banase, K., 1987. Seasonality of phytoplankton chlorophyll in the central and northern Arabian Sea. *Deep Sea Research Part A. Oceanographic Research Papers*, 34(5-6): 713-723.
- Biagi, P., 2004. New radiocarbon dates for the prehistory of the Arabian Sea coasts of Lower Sindh and Las Bela in Balochistan (Pakistan). *Rivista di Archeologia*. 28(28): 5-20.
- Biagi, P., R. Nisbet and A. Girod. 2013. The Archaeological Sites of Gadani and Phuari Headlands (Las Bela, Balochistan, Pakistan). *J. Ind. ocean archaeol.* no.: 9: p.75.
- Bruand, A. and D. Tessier. 2000. Water retention properties of the clay in soils developed on clayey sediments: Significance of parent material and soil history. *Euro. J. Soil Sci.* 51(4): 679-688.
- Burke F.A., S.N. Huda, S.A. Hamza and M.U. Azam. 2005. Disparities in agricultural productivity in Balochistan-A GIS perspective. *Pak. Geog. Rev.* 60(1): 27-34.
- Day, P.R., 1965. Particle Fractionation and Particle-Size Analysis. In: C. A. Black (ed) *Methods of Soil Analysis. Part I. Soil Sci. Soc. Amer.*
- Dexter, A.R. and E.A. Czyz. 2000. Soil physical quality and the effects of management practices. In: Wilson, M.J., Maliszewska-Kordybach, B. (Eds.). *Soil Quality, Sustainable Agriculture and Environmental Security in Central and Eastern Europe. NATO Science Series 2, Environmental Security, vol. 69. Kluwer Academic Publishers, Dordrecht*, pp. 153 – 165.
- Dexter, A.R., 2004. Soil physical quality: part I. Theory, effects of soil texture, density, and organic matter, and effects on root growth. *Geoderma*, 120(3): 201-214.
- Gee, G.W. and J.W. Bauder. 1986. Particle-size analysis. *Methods of soil analysis: Part 1—Physical and mineralogical methods, (methods of soil analysis)*. pp.383-411.
- Gee, G.W. and D. Or. 2002. 2.4 Particle-size analysis. *Methods of soil analysis. Part. 4(598)*: 255-293.
- Haq, B.U. and J.D. Milliman. 1985. *Marine geology and oceanography of Arabian Sea and Coastal Pakistan*.
- Harrison, P.J., N. Khan, K. Yin, M. Saleem, N. Bano, M. Nisa, S.I. Ahmed, N. Rizvi and F. Azam. 1997. Nutrient and phytoplankton dynamics in two mangrove tidal creeks of the Indus River delta, Pakistan. *Marine Ecology Progress Series*, 157: 13-19.
- Hedgpeth, J.W., 1957. Sandy beaches. *Geological Society of America Memoirs*, 67: 587-608.
- Jahangir, S., G. Siddiqui, M. Moazzam and Z. Ayub. 2012. Clams of the families Tellinidae and Veneridae and blood cockle of family Arcidae from Phitti Creek and Sonmiani along the Coast of Pakistan (Northern Arabian Sea). *Pak. J. Zool.* 44(1).
- Kassi, A.M., S.D. Khan, H. Bayraktar and A.K. Kasi. 2014. Newly discovered mud volcanoes in the Coastal Belt of Makran, Pakistan—tectonic implications. *Arab. J. Geosci.* 7(11): 4899-4909.
- Khan, M.Z., A. Zehra, S.A. Ghalib, S. Siddiqui and B. Hussain. 2010. Vertebrate biodiversity and key mammalian species status of Hingol National Park. *Can. J. Pure Appl. Sci.* 4(20): 1151-1162,
- Khan, T.M.A. and M.M. Rabbani. 2000. Sea level monitoring and study of sea level variations along Pakistan coast: A component of integrated coastal zone management. Karachi, Pakistan: National Institute of Oceanography. Pp.1-6.

- Khattak, M.I., M.I. Khattak and M. Mohibullah. 2012. Study of heavy metal pollution in mangrove sediments reference to marine environment along the coastal areas of Pakistan. *Pak. J. Bot.* 44(1): 373-378.
- Nimmo, J.R., 1997. Modeling structural influences on soil water retention. *Soil Science Soci. Ame. J.* 61(3): 712-719.
- Qureshi, M.T., 2011. Integrated Coastal Zone Management Plan For Pakistan. pp.1-63.
- Qureshi, R.M., A. Mashiatullah, M. Fazil, E. Ahmad, H.A. Khan and M.I. Sajjad. 2002. Seawater pollution studies of the Pakistan coast using stable carbon isotope technique. *Science Vision.* 7(3-4): 224-229.
- Rasool, F., S. Tunio, S. Hasnain and E. Ahmad. 2002. Mangrove conservation along the coast of Sonmiani, Balochistan, Pakistan. *Trees-Structure and Function.* 16(2): 213-217.
- Saifullah, S.M. and F. Rasool. 2002. Mangroves of MianiHor lagoon on the north Arabian Sea coast of Pakistan. *Pak. J. Bot.* 34(3): 303-310.
- Salma, S., S. Rehman and M.A. Shah. 2012. Rainfall trends in different climate zones of Pakistan. *Pak. J. Meteorol.* 9.
- Sayied, N., 2007. Environmental issues in coastal waters-Pakistan as a case study. Pp. 1-110.
- Snead, R.E. and S.A. Frishman. 1968. Origin of sands on the east side of the Las Bela Valley, West Pakistan. *Geol. Soci. Amer. Bull.* 79(11): 1671-1676.
- Valencia, M.J., 2004. Introduction. *Marine Policy.* 28(1): 3-5.
- Vijayakumar, R., C. Muthukumar, N. Thajuddin, A. Panneerselvam and R. Saravanamuthu. 2007. Studies on the diversity of actinomycetes in the Palk Strait region of Bay of Bengal, India. *Actinomycetologica.* 21(2): 59-65.