

# Beach Morphology in Sindhudurg District, Maharashtra

Charlotte Maria Braganza\*

S K Somaiya College of Arts, Science and Commerce, Maharashtra, India

## ABSTRACT

The present study is an attempt to investigate the beach morphology in a section of the coast of Maharashtra. The coastline of Maharashtra extends over a length of 720 kms. From Dahanu in the north to Redi in the south along the Goa border. The present study confines attention to the extreme southern section of this coast. For the purpose of academic convenience the shores of the district of Sindhudurg forms the study area. The coast of the study area extends between 15°45' N latitude and 16°30' N latitude. It has a general orientation north-northwest to south-southeast. The coastline has a total length approximating to about 100 kms. The study area forms the talukas of Devgad, Malvan and Vengurla of the Sindhudurg district.

Beaches are composed of sediments derived from the disintegration of the land – sand and gravel eroded from terrestrial rocks. The composition of beach sediments reflects the nature of the source rocks and often can be used to assess relative contributions and transport paths from the sources to the beaches. Waves and nearshore currents continuously rework the accumulated beach sediment, rounding the particles and sorting them by size, shape and density. The beach takes on a form that reflects the totality of water and sediment movements.

The overall morphology of the beach reflects the composition of its sediments and the physical processes of waves, currents and sediment transport.

**Keywords:** Beach Morphology; Maharashtra; Sindhudurg

## BEACH MORPHOLOGY

A beach is an accumulation of loose sand and shingles at the upper end of the high tide zone, forming the margin of wave action (Figure 1). The basic character of the beach depends on:

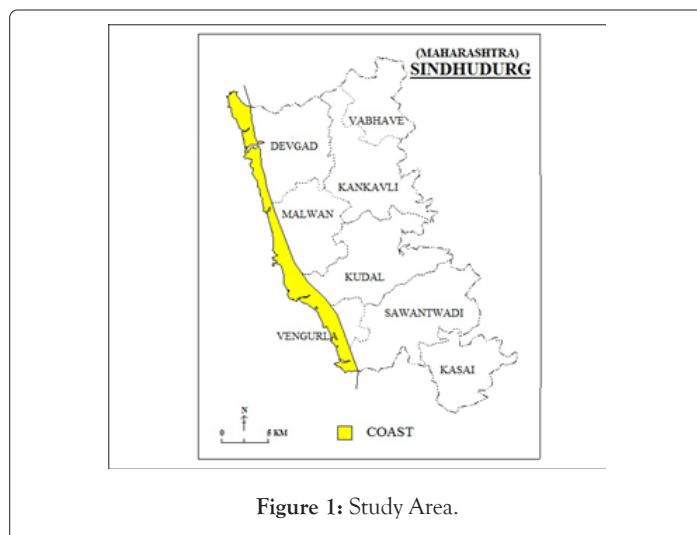


Figure 1: Study Area.

a) The nature of the land surface on which the sea comes to rest. If the land is low-lying the resulting beach will be straight. If the land is irregular or crenulated, the beach will tend to be irregular, discontinuous and in patches; and

b) The nature of the beach material-The final form of the beach is greatly influenced by the size and sorting of the beach material according to the texture. The beach gradient is also dependent on the grain size, the steeper the beach angle, thus determining the angle of rest of the slope. Coarser texture of the beach material is the result of strong swash and backwash, as well a lithology [1].

## BEACHES OF SINDHUDURG

The coast of Sindhudurg presents a hilly aspect with low lateritic plateaus and basaltic bluffs descending right into the sea, through steep slopes and cliff faces. There is a repeated alternation of bold headlands and sheltered coves and bays. This pattern of alternation of the shore features prevents the development of extensive and continuous beach development in long stretches further under the impact the swell waves of monsoons, the coast is mainly erosive in nature.

The most important types of beach morphology observed in

**Correspondence to:** Dr. Charlotte Maria Braganza, S K Somaiya College of Arts, Science and Commerce, Maharashtra, India; E-mail: charlottecalypso@gmail.com

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Sindhudurg are:

i. Curving crescentic pocket beaches inside small coves and bays in between rocky headlands especially between Vijaydurg and Achra, and around Nivti. These pocket beaches vary in length and breadth and are crescentic in shape. They are barely 1 to 2 km. along the curving bay and barely ¼ to ½ km. wide.

ii. Fairly straight beaches, extending further southwards as splits into tidal creeks and estuarine entrances. These are particularly striking in development around Achra and Deubag which are respectively to the north and south of Malvan. The individual beach split zone that mainly occur between Achra and Vengurla is about 8 to 10 kms. And ½ km. wide. In addition, there are small spits barely a kilometer long across the smaller tidal inlet entrances [2].

## BEACH SAMPLES-TEXTURE ANALYSIS

To study the variations in beach morphology field work was carried out in October-November 1989 after the end of the monsoon season to collect sand samples for textural analysis and chemical analysis. It was found during the study that beach heights varied from 0.3 mts to 1 mt above the level of the intertidal zone. It was also found that even in hand samples most of the beaches had a greater proportion of sand compared to silt and clay. The pH values of the beach sand samples were also determined in the laboratory.

A study was also carried out to find out if there was any relationship between texture and angle of the beach. The gradients of individual beaches were measured with the help of the Abney level and the beach samples were collected from every site, the gradient was measured. Fourteen samples taken from different locations spread all over the shores of the study area. Figure 2 shows the location sites from which beach samples were collected.



Figure 2: Location sites.

The textural variations were studied through laboratory testing of the samples collected. The samples were first dried for about a fortnight. When they were completely dry, each sample was first measured and was then mechanically analysed for textural class grouping by sieving and sorting method. The textural classes that are identified are coarse sand, fine sand and silt and clay [3].

The results of the textural analysis of the 14 samples are tabulated and grouped area wise as shown in Percentagewise textural distribution of the sample are also shown in the table.

## BEACHES OF SINDHUDURG CLASSIFIED INTO TEXTURAL CLASSES

A triangular graph (Figure 3) was also plotted to classify the sample beach locations into textural classes. The sieved sand samples are grouped into three classes namely:

- Coarse sand+fine sand-sand
- Clay
- Silt

The triangular graph was later subdivided into critical limits namely:

- clay
- sandy clay
- sandy clay loam
- clay loam
- silty loam
- silty clay
- Loam
- silt loam
- silt
- sandy loam
- Loamy sand
- Sand

From a study of the triangular graph it can be seen that on the whole, the beaches of Sindhudurg show a greater accumulation of sand compared to clay and silt. A table is formed taking into consideration of the further subdivisions.

Most of the beaches reveal a fine sand proportion of a preponderant percentage ranging between 55% and 90%. It is noteworthy that beaches formed on quartzites and granite-gneisses have a large proportion of sands, while those on basalt as at Vijaydurg have a greater proportion of clay and silt.

It may also be mentioned that beach locations close to river entrances, especially on basalts, show a considerable content of iron and possibly titanium, because of their deposition from the river discharges [4].

## PH OF BEACH SAMPLES

The pH value of beach sands was also calculated and tabulated as shown in Table 1.

Table 1: pH value of Beach sand samples.

Sample No.	Location	pH value
1	Vijaydurg	7.3
2	Parweka Point	7
3	Mithmumbri	5.7
4	Kunkeshwar	5.7
5	Pirwadi	5.6
6	Kolamb	6.7
7	Rajkot	7.5
8	Dandi (Jetty)	7.5

10	Vayari	8
11	Kalethar	7.6
12	Deubag	7.5
13	Bhogia	6
14	Ubadanda	5.3

The alkalinity of the beach sediments are greatly influenced by sea-water and its pH value as well as the type of rock lithology from which the sediments are derived and possibly the nature of land use adjoining the beaches. Shores which are exposed to the direct action of the waves have a pH value inclined towards alkalinity these include the beaches of Malvan namely Rajkot, Dandi, Vayari and Kalethar. The more or less protected pocket beaches tend to show a lesser pH tending towards acidity for example beaches along Vijaydurg. This may also be possibly due to the lateritic uplands on which the beaches have formed.

Beaches which are in close proximity to and at the foot of the cliffs are generally found to be alkaline as for example Parweka Point, BHogia and Vijaydurg.

Trap country beaches are associated with acidic reaction, while quartzites have comparatively higher pH value ranging between 6 and 8.

## BEACH GRADIENTS

Beach gradient as observed from site observations between 6° to 24° is shown in Table 1.

It is seen from the tabulation that the pocket beaches have generally steeper angles, possibly due to limited accumulation in restricted areas, and a more intense swash and backwash sorting [5].

## RELATIONSHIP BETWEEN GRADIENT AND BEACH SEDIMENT

An attempt was made to study the relationship between beach gradients and beach sediment textures. The 14 beach sample locations of beach gradients and corresponding beach texture (namely sand) were subjected to a regression analysis. The scatter reveals a mild relation between the two variables. The regression equation of the analysis (Figure2) is of the form  $y=7.16+0.09x$ , where  $y$  is the beach angle and  $x$  is the percentage of sand (coarse sand and fine sand together) in the beach material. The correlation coefficient worked out to be +0.48.

From the scattergram and trend of the regression line it is noted that there is a direct and positive relationship between the percentage of sand and the gradient angle of the beach (Table 2).

Table 2: pH value of Beach sand samples.

Sample No.	Location site	Beach gradient	Beach height (in mts)
1	Vijaydurg	20°	1
2	Parweka Point	7°	0.3
3	Mithmumbri	12°	0.5
4	Kunkeshwar	10°	0.4
5	Pirwadi	11°	0.4
6	Kolamb	10°	0.5
7	Rajkot	6°	0.3
8	Dandi (Jetty)	20°	1
9	Dandi	22°	0.9
10	Vayari	10°	0.4

11	Kalethar	8°	0.4
12	Deubag	10°	0.4
13	Bhogia	24°	0.7
14	Ubadanda	15°	0.6

## SAND DUNES OF SINDHUDURG

One of the most important processes associated with wind action on the coast is the formation of coastal sand dunes, provided adequate sand is freely available over a good stretch for wind play. The sand forming the dunes is derived from the foreshore where it is exposed to wind action at low tide, and from the backshore zone, in which the dunes form. Coastal dunes vary considerable in size and form, and also in occurrence (Figure 3).

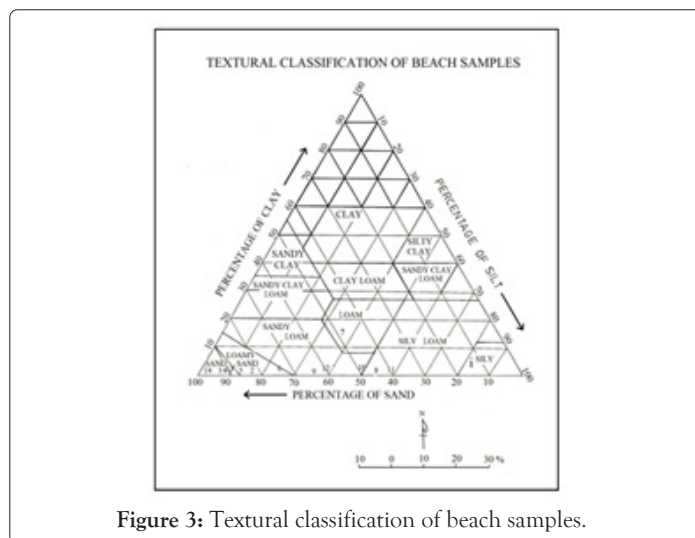


Figure 3: Textural classification of beach samples.

Table 3: Sand Dune Vegetation Types.

S. no.	Place	Vegetation type
1	Vijaydurg	Spinifexsquarrosus
2	Parweka Point	Spinifexsquarrosus
3	Mithmumbri	Grewiapolygama, Spinifexsquarrosus, Crotalaria auriculata.
4	Munkeshwar	Spinifexsquarrosus, crotalaria auriculata.
5	Pirwadi (Achara)	Ipomeapurpurea, Clerodendroninerma, Spinifexsquarrosus.
6	Kolamb	Ipomeapurpurea, Clerodendruminerm, CocciniaIndica, Grewiapolygama
7	Rajkot	Ipomeapurpurea.
8	Dandi (2)	Ipomeapurpurea, Clerodendruminerm, Lantana Gamara, CocciniaIndica.
9	Vayari	Ipomeapurpurea, Vitexnegundo, Crotalaria Auriculata, Spinifexsquarrosus.
10	Kelethar	Ipomeapurpurea, Crotalaria, auriculata, Spinifexsquarrosus.
11	Deubag	Spinifexsquarrosus.
12	Bhogia	Ipomeapurpurea, Spinifexsquarrosus.
13	Ubadanda	Ipomeapurpurea, CocciniaIndica, Spinifexsquarrosus.

## DUNE VEGETATION

Sand dunes are essentially found in straight long beaches and spits south of Achra. Vegetation plays a very important role in the stabilization of sand dunes along the coast of sindhudurg,

vegetation traps the movement of windblown sand beyond the beach zone by binding the roots, and by protecting the loose sands by the vegetal cover close to the ground.

The most important dune plants are the grasses which flourish in loose sand in this area include:

*Ipomea purpurea*

*Vitex negundo*

*Clerodendron inermis*

*Grewia polygama*

*Lantana camara*

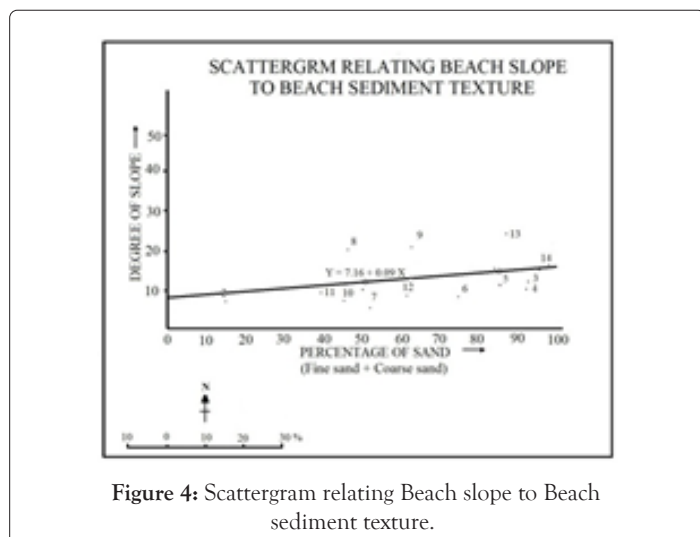
*Crotalaria auriculata*

*Coccinia indica*

*Spinifex squarrosus*

Most of these runners are psammophytes. The spinifex is strongly creeping and its long horizontal surface runners tend to promote more uniform accumulation of sand.

Vegetation samples were collected from each of the sand sample locations.



During the field observation the heights of the sand dunes were also estimated. It can be stated that the heights of sand dunes varied from 1 m to 2 m. near Dandi near Malvan to 5 to 10 around Deubag further south of Malvan. Along Achra right from Pirwadi to the north of Achraupto Talasil to the south of Achra which is a long grown spit, the height of the dune also varies from 3 mts. to 5 mts. in Talasil.

In some parts of Dhuriwada and Dandi, brick walls have also been built to protect the sand from being blown away. Coconut trees as well as casuarina trees which act as wind-breakers have been grown to protect sand from being blown away [6].

## CONCLUSION

Most of the beaches show a fine sand proportion of a high percentage ranging between 55% and 90%. This is due to geology of the area.

There is a direct and positive relationship between the percentage of sand and the gradient angle of the beach.

Vegetation along the Sindhudurg coast is important for the stabilization of dunes, which forms a valuable coastal defence.

Most of the beaches of Sindhudurg are short in length and narrow. Long straight beaches and spits are seen south of Achraupto Redi. The pocket beaches of the northern parts are sheltered in between rocky headlands. These beaches are curved and crescentic.

Beach slopes and beach texture are related positively to a moderate degree of correlation. Sand beaches are common but silty ones are found around estuarine mouths, and in the northern areas.

Psammophytic vegetation plays a very important role in stabilization of coastal dunes along Sindhudurg.

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