SEDIMENT MOVEMENT ALONG HARWADA BEACH, UTTAR KANNADA, WEST COAST OF INDIA

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   Beach Profile, CM plot, Linear Discrimination Function

INTRODUCTION:
   Karnataka’s coastline extends over a length of 320 kilometers along the west coast of India from Mangalore to Karwar. The Karnataka coastal region lying between the edge of Western Ghats and the Arabian Sea covers Dakshina Kannada, Udupi and Uttara Kannada districts. It has difficult terrain full of rivers, creeks, cliffs, sand dunes, waterfalls, peaks, long beaches and hill ranges. The important estuaries in the area are Aghanashini, Gangavali and Kalinadi estuaries. Along the Karnataka coast 75% of the coastline is covered with sandy beaches (Kumar et al., 2006). The intertidal zone of sandy beaches is a highly dynamical zone caused by natural (tide, wave and wind) as well as human activities (Short and Hesp, 1982; Niederoda et al., 1984; Wright and Short, 1984; Larson et al., 2000; Capo et al., 2006; Scott et al., 2011; Van Rijn, 2011). Seasonal variations of beach erosion and/or accretion and also spatio-temporal evolution of beach profiles provides useful information for the scientific understanding of coastal processes and management (Andrade and Ferreira, 2006; Gujar et al., 2011).

The beach profile gets altered depending on the balance between physical agencies and the supply of material from the inland water. Large scale irreversible transformations, however, would lead to deformations in the shoreline configuration. Which give rise to the different geomorphic processes such as erosion, deposition, sedimentation, periodic storms, flooding and sea level changes etc. keeping this in mind following objectives are set for the present study.

1. To Understand the Direction and magnitude of littoral drift
2. Textural parameters of the sediment.
3. To understand the presence of heavy minerals.
4. Suggestion of Sea wall along most vulnerable location.
5. Impact of anthropogenic activities on beach morphology if any.
Before commencing the study, primary visit is conducted to fix up the stations points (Figure 1), while selecting the stations points care was taken that they should not be disturb for the study period. Beach profiles were measured using Auto level from reference points to low water line at selected stations representing entire beach, during low tide period. Survey is conducted for the period of five months during premonsoon period of 2016 (January to May) during first week of the every month. From the profile data, volume of sediment eroded or accreted at the five stations is computed by superimposed profile. Observations on waves (height and period) and longshore currents (speed and directions) were also made visually using a graduated pole, measuring tape and Rhodomine-B dye.

During the beach profile survey at every five meter, top 4cm sediment samples are collected are they are subjected to preliminary analysis (coning-quartering, washing, treated with chemicals to remove carbonate shells, iron coating and organic matter) and textural analysis (sieve analysis using Ro-Tap Sieve Shaker). The grain size data (weight %, Cum. weight %) obtained were then used in GRADISAT software for textural parameters (Mean size, standard deviation, skewness and Kurtosis) of Friedman (1961) and Folk and Ward (1957). These textural parameters were used for various univariate and bivariate plots to delineate the depositional environment and sediment movement along the stretch. Also using the application of remote sensing, erosion and deposition of the soil is determined by ERDAS software.

Form the various analysis and experiments, it has been revealed that the dominant process over the study area is erosion which is being prominent at station H, thus this station is considered as more affected station and we suggest the construction of seawall at this place. From the textural analysis, it reveals that the sediments follow the general trend of deposition and addition of fine sediments is taking place near to the shore line. Also it has been understood that mean size is decreasing towards the stations I and that of sorting increases, thus the sediment movement is towards the north portion of the beach i.e. Station I. (Figure 2). Also Heavy minerals are deposited at station G and H indicating the presence of high energy conditions at these points.

From CM plot (Figure 3), it reveals that sediments are transported under graded suspension and deposited under high energy conditions. Also linear discriminate function (Figure 4) explains that sediments are transported under Aeolian conditions and deposited under the
shallow agitated water supporting the results of CM plot.

From the remote sensing study it has been observed that erosion was the dominant process for the period of 2000 - 2005 while deposition for the period 2005 - 2010. (Figure 5) This change took place because of initiation taken by the port department to construct the seawall along the study area during 2005-06.

Present study is just an attempt to show the process of erosion and deposition along with a littoral and cross shore variations along the beach. Results presented in the report are for the period of four months (Preamonsson) which is generally considered as a period of erosion (Hanamgond, 1992). Thus, the detailed investigation throughout the year/s is required to conclude about the dominant process among erosion and deposition and direction, magnitude of littoral drift.

**Figure 2: Bivariant Plot of Mean Size Vs Sorting**

**Figure 3: CM Plot for beach sediments of the study area.**
Figure 4: Relation Between Discriminant Functions i) Y1 and Y2 ii) Y2 and Y3
2000 to 2005

Figure 5a: Figure showing the Erosional deposition change in the study area from 2000 to 2005.

Figure 5b: showing the Erosional depositional changes in the study area from 2005 to 2010.