Reconnaissance using SRTM-DEM map and field survey of Indian States: With Special Reference to Kerala

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Abstract

Reconnaissance survey, field mapping and detailed sampling - The research assessed the amount and type of overlap between landform data derived from a SRTM DEM and aerial photographs and explored systematic mapping biases that may negatively affect data quality. Results indicate that the interpretation from 1:50 000 aerial photographs produced more detailed landform maps than that from the SRTM DEM. A consistent three-layer lithology is encountered along most part of the plain, especially along the central belt. The white-coloured glass- sand seen on the surface, continue down to a depth of 8-10m (Litho Unit 3) that is underlain by a 2 m thick layer of finer sand mixed with vegetal matter exhibiting a characteristic brownish-green appearance (LithoUnit 2), which is in turn underlain by a medium to coarse sand layer with occasional presence of thin clay lenses (Litho Unit 1)

Keywords: *Lithology, SRTM, Borehole, Litho Unit, Stratigraphical*

1. Introduction

The geological history and lithological characteristics of an area have distinct and definite bearings on the settlements and communication lines. Settlements occupy fixed and definite positions on the earth surface and they bear a definite relationship to space at large and the space involved in between various units of settlements. The stability of the region, building materials, foundation and durability of the buildings, mineral deposition, etc., all depend on geology and lithology. The same is the case with the development of communication lines.

The lithology of a stone unit is a depiction of its physical qualities unmistakable at outcrop, close by or center examples, or with low amplification microscopy. Physical attributes incorporate shading, surface, grain size, and composition.Lithology may allude to either a point by point portrayal of these qualities, or a synopsis of the gross physical character of a rock.Lithology is the premise of subdividing rock successions into individual lithostratigraphic units for the motivations behind mapping and connection between zones. In specific applications, for example, site examinations, lithology is depicted utilizing a standard wording, for example, in the European geotechnical standard Eurocode 7.

The translation of geophysical models inferred by reversal is a profoundly emotional piece of any geologic examination. Our inadequate information on the subsurface, the spatially-changing goals of the models, and the non-uniqueness of the geophysical opposite issue make it hard to dispassionately decipher physical property models as far as geologic structure in

Maharashtra, Andhra Pradesh etc. The issue is exacerbated by the many-to-many, or, best case scenario, many-to-one, connection between geologic units and their physical properties. It is along these lines typical to utilize various techniques to decide different physical properties over a territory of enthusiasm for request to segregate between the scope of conceivable geologic/lithologic structures.

The examination of such corresponding information, is once in a while taken past a subjective correlation. Endeavors at a quantitative correlation are, generally, focused upon constitutive or exact relations between physical properties, which will in general be restricted in scale and appropriateness.

2. Literature Review

David R. (2004) studied that field perceptions from western Washington and eastern Tibet show a solid lithologic effect on strath porch development and feature the reaction of bedrock channel width to spatial slopes in bedrock erodibility and additionally rock inspire rates. Estimations of nearby bedrock bed and bank disintegration rates together with perceptions of the job of enduring procedures on disintegration of siltstones and sandstones show a component that underlies a calculated model that predicts a solid lithological control on strath porch arrangement. Direct estimations of bedrock disintegration rates in lithologies vulnerable to quickened disintegration upon sub-ethereal introduction show that horizontal paces of bedrock bank disintegration can generously surpass vertical cut underneath the enduring stream level because of an asymmetry in erodibility between perpetually submerged stone and rock presented to cyclic wetting and drying on bedrock channel dividers.

Bedrosian et al. (2007) studied that magnetotelluric and seismic techniques give correlative data about the resistivity and speed structure of the subsurface on comparative scales and goals. No worldwide connection, nonetheless, exists between these parameters, and relationships are frequently substantial for just a restricted objective zone. Freely got opposite models from these strategies can be consolidated utilizing an arrangement way to deal with map geologic structure. The technique utilized depends entirely on the factual connection of physical properties in a joint parameter space and is autonomous of hypothetical or observational relations connecting electrical and seismic parameters. Areas of high connection (classes) among resistivity and speed can thusly be mapped back and rethought inside and out segment. The spatial dispersion of these classes, and the limits between them, give auxiliary data not clear in the individual models. This strategy is applied to a 10 km long profile crossing the Dead Sea Transform in Jordan. A few conspicuous classes are related to explicit lithologies as per nearby topography. An unexpected change in lithology over the shortcoming, together with vertical elevate of the storm cellar propose the deficiency is sub-vertical inside the elite.

Domenico (2004) examined in his study are previously published laboratory shear (S) and compressional (P) wave velocity measurements on water- saturated sandstone, calcareous sandstone, dolomite, and limestone cores, as well as laboratory porosity measurements on the sandstone and limestone cores. Sandstone and limestone porosities range from .092 to .299 and from .006 to .229, respectively. Differential pressure was varied from 500 to 6000 psi, corresponding to approximate burial depths from 290 to 3460 m, respectively. Sandstone, limestone, and dolomite are effectively separated by Poisson's ratio σ or, equivalently, by the ratio of P- to S-wave velocity. Separation of sandstone and limestone appears to result from the difference in σ of the matrix material, namely, quartz (.056) and calcite (.316), respectively.

Hans (2008) studied that a new digital map of the lithology of the continental surfaces is proposed in vector mode (n ≈ 8300, reaggregated at 0.5° × 0.5° resolution) for 15 rock types (plus water and ice) targeted to surficial Earth system analysis (chemical weathering, land erosion, carbon cycling, sediment formation, riverine fluxes, aquifer typology, coastal erosion). These types include acid (0.98% at global scale) and basic (5.75%) volcanics, acid (7.23%) and basic (0.20%) plutonics, Precambrian basement (11.52%) and metamorphic rocks (4.07%), consolidated siliciclastic rocks (16.28%), mixed sedimentary (7.75%), carbonates (10.40%), semi- to un- consolidated sedimentary rocks (10.05%), alluvial deposits (15.48%), loess (2.62%), dunes (1.54%) and evaporites (0.12%).

3. Methodology

Digital Elevation Model (DEM) is a quantitative model of part of the Earth's surface in computerized structure. Specifically, rise of a district in North India like (Delhi, Bihar, Haryana, Himachal Pradesh, Uttarakhand etc.). Commonly, a DEM comprises of a variety of consistently separated rise focuses in raster position. Landscape models are useful for earth researchers. Grabam (1974) first detailed that a topographic guide of the world's surface can be set up from stage contrasts recorded in the interferogram of a couple of Synthetic Aperture Radar (SAR) pictures. Polidori (1991) created DEM from SAR interferometry.

The Shuttle Radar Topography Mission (SRTM) has raised information on a close worldwide scale that could create high-goals advanced topographic database of Earth. SRTM-DEM has been utilized to think about the geography of the locale. Three particularly extraordinary landforms distinguished from the SRTM inferred guide of Indian beach front plain and adjoining territories. They are

(I) Swales spoke to by direct territories inside a height of 0 to 5m. Comprising of coast parallel stream channels, paleo-channels, bogs and tidal ponds,

(ii) Strand fields lying parallel to the present shoreline inside a height of 5 to lam. A portion of these happen as secluded sub-parallel sea shore edges and ridges and (iii) Lateritic slopes, from 10m or more statures, which adjoin into the plain, once in a while. The swales and strand plain (seen as blue and yellowish green tone in run parallel to the coast, while the lateritic slopes show dendritic mosaic, which doesn't demonstrate any relationship to the arrangement of the coast.

4. Result and Discussion

4.1. Reconnaissance and Field Surveys

The Shuttle Radar Topography Mission (SRTM) information of National Aeronautic and Space Agency (NASA) of USA gathered during 2005 was utilized for landscape observation.

The high-goals imaging radar framework produces 3-D topographic maps, computerized rise models and a 5rn form interim territory map. This photos the geography in reasonable scale. From SRTM information singular characters of the territory were brought out, as itemized underneath.

The field study in the present work involved three segments:

- A general advancement of surface highlights and determination of test locales.
- Systematic inspecting of surface residue.
- Subsurface inspecting for chosen areas.

Little sand hills, rises and water-logged miseries seen all around the focal segments of the investigation territory establish the run of the mill landforms experienced during the field work.

4.2. Surface and Sub Surface Sampling

Ordinary field methodology was received for surface examination, concentrating on direct field perceptions at each 100 m interim of the investigation region. Least upset examples were gathered from focuses among them. One meter channel was taken in such areas and dregs tests were gathered from that profundity. Eighty such examples were exposed to petrographic and geochemical examination to have a subjective evaluation of the silica sands spread over the zone of the present investigation.

The sub surface residue tests were gathered by a split spoon sampler, of measurement 108 cm length and 1.6 cm distance across connected to the base of a center barrel and brought down to the necessary profundity of concentrate by penetrating.

Split spoons are tubes developed of high quality compound steel with a tongue and section game plan running the length of the cylinder, enabling it to be part fifty-fifty. The two parts of the sampler are held together by a strung drive head gathering at the top, and a solidified shoe at the base, with a slanted cutting tip. The split spoon is strung onto the finish of the drill bar and brought down to the base of the drilling by a substantial steel link associated with the boring pole. The sampler is constrained into the soil by a drive weight that is dropped over and over onto the drive head situated at the highest point of the drill pole.

The sampler is crashed into the dirt to a profundity around six inches shorter than the length of the sampler itself. It is driven by 68 kg weight dropped through a 76 cm interim. At the point when the split spoon is brought to the surface, it is dismantled and the center is evacuated utilizing a center extruder.

4.3. General Description of Surface and Sub Surface Samples

The samples from eighty surface locations and thirty two boreholes were assessed to evaluate the lithology of the study area. The surface samples were named TC 1 to TC80 and subsurface sample points were marked T I to T8 (located at the eastern border of the southern part of the study region), PI to P6 (located adjacent to the eastern border of the southern part of the study region) and TRV1 to TRV10 (nearly along the central region of the study area) (Figures 1 and 2respectively).

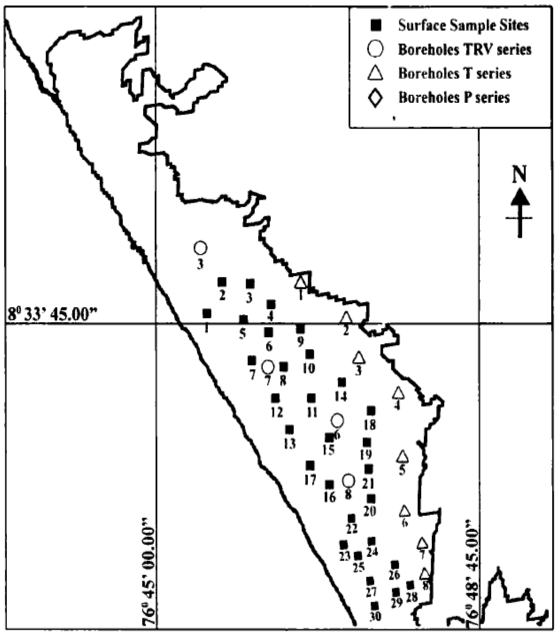

Figure 1: The map showing Sample Locations in the northern part of the study area

4.3.1. Surface Samples TC1- TC80

Surface example areas TC1 to TC80; fall in the white sandy level of Thiruvananthapuram waterfront plain. The examples were taken from a profundity of 1m from the surface. Common soil arrangement is uncommon in the locale, however in areas with landfills of earth squander or latcrite fillings comprises almost 99%, which gives it the trademark unadulterated white shading and a polished appearance. There is a slight fining of sand towards the hinterland close to the lake at Yeli.

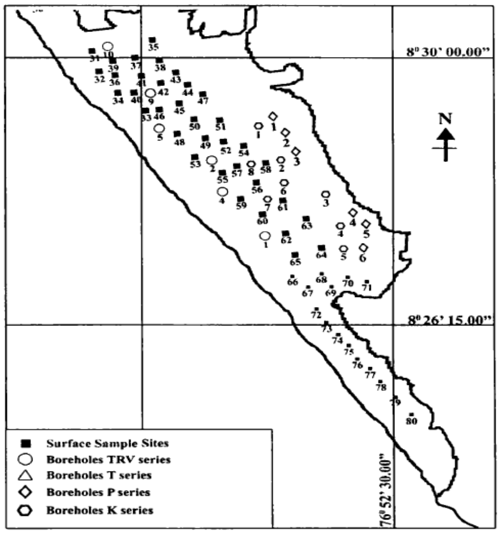

Figure 2: The map showing Sample Locations in the southern part of the study area

4.3.2. Boreholes Tl- T8

The boreholes Tt to T8 fall along the eastern margin of the northern part of the study area, north of Lake Veli and in contact with lateritic hills to the east. Here the coastal plain is broader than in the south. The Litho Units of TI to T8 are plotted in litholog (Figure 3).
Beneath the top soil/ land fill horizontal (thickness 1m to 2.5m). is a layer of brownish black silty clay (2.6m in TI, 1.2m in T2, 2.9m in T3, 2m in T4, 3.5m in T5. 2.7m in T6, 3m inT7 and 1.7m in T8) underlain by silty sand with slight clay (4.6m in TI, 2.6 in T2, 5m in T4, 3.5m in T5, 5.3rn in T6. 2.75 in T7 and 3.3 in T8) and laterite thereafter occur. At T3 no different Litho Unit is found beneath the sandy deposit till 13m depth. Except in T3, laterite is encountered at 7 -8m depth from present land surface.

4.3.3. Boreholes Pl- P6

The boreholes P I to P6 fall along the eastern margin of the southern part of the study area, south of Lake Veli, in contact with lateritic hills further east. Underlying the topsoil cover or landfill, there exists a layer of silty sand with slight clay (6m in PI, 3.5m in P2, 0.80m in P3, 4.5 m in P4, 2.25 m in P5 and 3.5 m in P6) and it overlies a layer of brownish black silty clay (1 m in PI, 0.5 m in P3, 2m in P4, 2.25 m in P5 and 2m in P6; this layer is absent in P2). The brownish black clay lies unconformably over laterite. In this region lateritic basement can be found at a depth of between 4rn and 7m.

4.3.4. Bore holes TRV 1 and TRV 4

In TRV I and TRV 4, the two most profound boreholes, which are 37 rn profound, there are three recognizable dregs layers. At a profundity of 8 m from the surface, the sand establishes practically 100%, of which quartz structure almost 99%. At a profundity of between 8 m and 10 m, the sand grains become exceptionally fine with fall in the amount of sand to 86%, residue gaining 8% and vegetal remains frames up to 6%, giving crisp green shading to the silt. Distinctively they fall in the class of natural rich sand. The sand grains are fine and made generally out of quartz followed by feldspar and heavies. Somewhere in the range of 7m and 8m, the shade of the dregs is somewhat dark colored, for what it's worth for the situation at a profundity of between 10 m and 11 m demonstrating skylines of change.

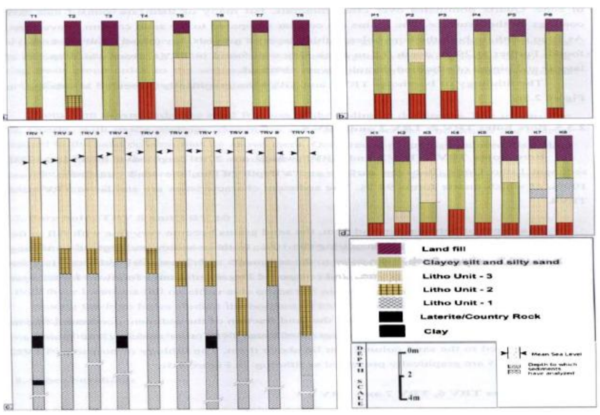

Figure 3:The lithologsof the study area developed from the borehole data

From 10 m downwards, the sand portion of the residue commands, as in the 0-8m zone. Quartz overwhelms over different minerals, however huge numbers of them are recolored and have coatings on their surface. The grains are coarser contrasted with the sand section above them.

At 20 m profundity, in both the drag gaps, a thick layer of grayish earth (about 0.5111 thickness) is found. Further at 29 m profundity 0.2 m thick dirt was found in TRVI, from which spots of laterite and bits of silicified rhyzolith were acquired. The lithology of boreholes TRV1 and TRV4 are graphically displayed as lithology Figure 2.3.

4.3.5. Bore holes TRV 2, TRV 3 and TRV 5

Drill openings TRV2, TRV3 and TRV5 which are 27m profound, have three perceptible dregs Litho Units. Among surface and a profundity of 9m, the sand comprises practically 100%, of which quartz structures 98 %. The silt qualities are like TRV 1 and TRV4. At a profundity of somewhere in the range of 9m and 11 m, the sand grains become fine with fall in the amount of sand to 85% and sediment obtaining the 10%. In these silt, natural residual structures up to 5%, giving crisp green shading to the dregs as in past boreholes.
Here too the sand grains are exceptionally fine grained and made to a great extent out of quartz followed by feldspar and heavies. From a profundity of 11 m downwards, the sand division of the dregs overwhelms, as in Om 9m zone. Quartz, with oxide coatings, commands over other mineral. The grains are coarser contrasted with the sand segment that lie above them. The lithology of boreholes TRV2, TRV3 and TRVS are graphically exhibited as lithology in Figure 3.

4.3.6. Bore holes TRV 6, TRV 7 and TRV 9

In drill gaps TRV6, TRV7 and TRV9 which are 30 m, 26 m and 29 m profound individually from the surface and at a profundity of 10 m, sand comprises 100% sand of the residue. of which quartz structures 6% of the mineral populace. The grains are sub rakish and most of them are grained. The silt qualities are like TRY I, TRV2, TRY3, TRY4 and TRYS.
At a profundity of between 10 m and 12 5 m. the sand grains, establishing 86% become fine with residue securing 10%. In these silt, natural outstanding structures up to 4% giving new green shading to the dregs. The sand grains are very fine and made to a great extent out of quartz followed by feldspar and heavies. From 13m downwards, the sand division of the dregs rules, as in 0m-10m zone. Quartz, with oxide coatings, rules over different minerals. The grains are coarser contrasted with the sand section that lie above them. Event of greyish shaded mud the same in TRV I and TRY 4 is there in TRY 7 at a profundity of 21 m. The lithology of boreholes TRV6, TRV7 and TRY9 are graphically exhibited as lithology in Figure 3.

4.3.7. Bore holes TRY 8 and TRY 10

The silt qualities down center of TRV8 and TRV 1 0 are like that of the rest of the drag gaps (Figure 3). The profundity of events of the natural rich green hued layer here falls in the interim of 13m and 15m in TRV 8 and 12m and 16m in TRV 10. Both these areas fall on either side of the slope distending into the seaside plain at Veli.

Among the drag gaps examined the borehole TRV I 0 bears the most profound and the thickest natural rich sand. The lithology of boreholes TRV8 and TRV I 0 are graphically exhibited as lithology in Figure 2.3.

5. Conclusion

Sand is commonly circulated in riverbeds, rises and beach front stores on an enormous scale. Closer to modem coast it is found in close relationship with estuaries, flood fields and wetlands. Stratigraphical groupings of seaside sand could fill in as records for remaking paleoenvironments for wetland coast. To make stratigraphy, the litho coherent qualities should be represented with further confirmations. A lithological spatial course of action is inferred at. Figure 2.4 portrays the surface lithostratigraphy of the examination zone when all is said in done from the information drawn from agent boreholes. Every one of the eighty areas, falling in sandy fields, from where the examples are gathered single strata, perpetually. The equivalent lithological unit is experienced at a profundity of somewhere in the range of 8m and 12m profundity in all the ten diverse drill gaps examined in the examination region. Towards the eastern piece of the investigation territory, where the plain adjoins into the lateritic hillocks, a similar sand body weakens to a profundity of 4 to 5m underneath the top soil/land fill. In specific areas along the eastern side of the investigation zone the top layer of silica rich sand is missing and is subbed by laterites, tanish soil and silty sand.

In short the sand that is experienced superficially stretches out down to a profundity of 8m (TRV1 and TRV4) to 12m (TRV10) absent a lot of progress in its physical properties including constituents, shading and regular appearances. This consistency prompts the end that from surface to a profundity of 8 to 12m, the sand body can be considered as a solitary litho intelligent unit, that is, the top most units. The 12 boreholes spread along the southern, focal and northern district of the focal piece of the examination zone bears a silt layer which is strikingly unique in relation to the top most layers in light of its earthy green shading. The lithological unit contains exceptionally fine sand and the shading is credited to the natural substance, looking like present day neckron mud. One striking trademark displayed by these residue at the hour of assortment was its 'shading blurring'. Thesesilts existing under serious lessening conditions once presented to air, for an hour or somewhere in the vicinity, blur into darker shading, demonstrating the occasions of brisk oxidation.

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