

Use Of Geospatial Technology in Assessing Geodynamics of Gogababa Tekdi Chhatrapati Sambhajnagar, Maharashtra

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Abstract

This study investigates the geodynamics, geological characteristics, land use/land cover (LULC) changes, and groundwater recharge potential of Gogababa Tekdi and adjoining areas in Aurangabad, Maharashtra, using geospatial technologies. Remote Sensing, GIS, Cartosat DEM, LISS-IV satellite imagery, GPS observations, and field-based geological investigations were integrated to understand the area's geomorphology, lithology, and environmental changes. Field investigations identified compact, amygdaloidal, vesicular, moderately to highly weathered, and amethyst-bearing basalts, along with felsic veins and amygdals. Vesicular and highly weathered basalts were found to be more prone to erosion, while compact basalt forms the stable hill summit. LULC analysis from 2005 to 2019 shows a major increase in settlement area from 21% to 42% and a decline in vegetation cover from 59% to 38%, indicating rapid urban expansion and increasing pressure on natural resources. Watershed, drainage, slope, and contour analyses identified three potential groundwater recharge zones, with the first zone considered most suitable due to its moderate slope, limited settlement, and favourable catchment conditions. The study demonstrates the usefulness of geospatial techniques for geological assessment, environmental monitoring, watershed management, and sustainable land-use planning in basaltic terrains of the Deccan Volcanic Province.

Keywords: *Gogababa Tekdi Watershed, LULC, Groundwater Recharge, Change Detection, Deccan Volcanic Province.*

INTRODUCTION

The geological studies covering large areas calls; recognizing the discontinuities and determining the relationship between landform and lithological discrimination with well spreaded spatially all over the world. The remote sensing and GIS technology has capability to study diverse aspects of sciences. Recently, the launch of sophisticated remote sensors developed by National Aeronautics and Space Administration (NASA) and Indian Space Research Organization (ISRO) has created opportunities for improving the quality and reducing the cost of remote sensing data and make them open for research.

The integration of remote sensing and geological surveys has a potential to reveal useful information about attitudes and outcrops of the geological surfaces. The geological map derivation requires intersections between geological plane and topographic surface, which can reflect in points as well as attitude of the geological plane.

The present study area lies in the Chatrapati Sambhajnagar formerly Aurangabad, Maharashtra with coordinates 19°54'27.3348" and 75°18'13.1896". The following figure 1 shows the location map of the study area.

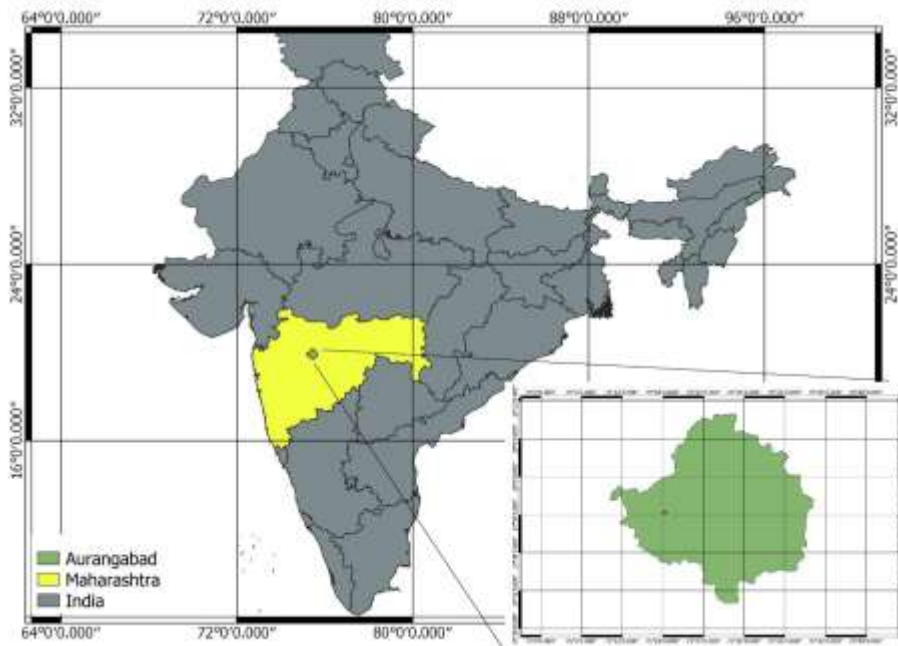


Fig. 1. Location map of study area

METHODOLOGY

Since last 50 years, the geoprocessing is a computerized processing of georeferenced data that uses computer software which enable the use of cartographic information in any form as maps, charts, or plans. The term geoprocessing denotes the use of mathematical and computational techniques that has ability to represent information in any form for decision makers. First the acquisition of the data enables the process of identification and collection of the necessary data. Subsequently the pre-processing involves the treatments of captured data in its different shapes to properly stored in digital format inside the computational database. The database manager regulates the creation and access to database information. In this, data entry, updation, deletion, storing the data is implemented. After this manipulation and analysis is performed. In this some new information get created. It had great analytical capabilities which enables individual to see coherence of information at one place. The geological and landform mapping is carried out using satellite imageries followed by detailed field investigation. The Cartosat DEM and LISS 4 satellite products are used on platform of Qgis Fig 2.

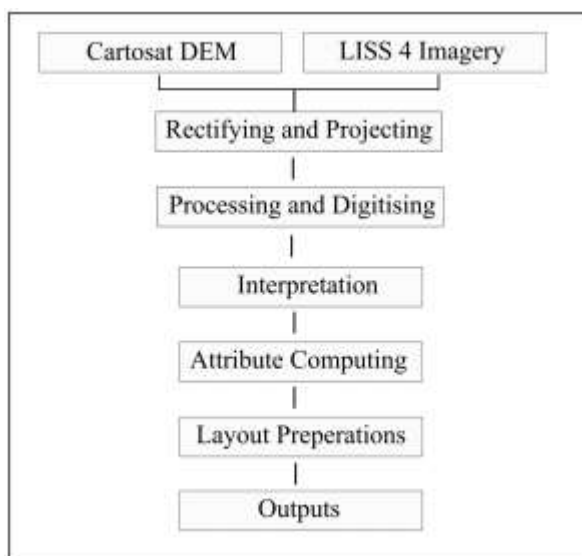


Fig.2. Geospatial methodology adopted

Projections:

Geographic Coordinate System (GCS) to Projected Coordinate System (PCS)

The World Geodetic System (WGS) is a standard used in nearly all navigation system in tracking the location of almost anything in the world. Is the reference used by Global Positioning System (GPS) in 0 – 180 degrees' longitude and 0 – 85 degrees latitude with intervals of 10 degrees. The WGS 84 assumes the earths center of mass which assumes prime meridian as Greenwich. This coordinate system is very well defined by Latitude and Longitude. The UTM divides the Earth in to 60 longitudinal numbering 1 to 60 and 20 latitudinal zones denoted by C to X omitted letter O which started at 180°W with intervals 6 and 8 degrees wide respectively.

Most of the part of the India lies in the zone of Universal Transverse Mercator zone 42 to 46. Used projection in the study area is GCS (WGS 84 4326) for projecting or registering the unknown raster with given coordinates associated with map. Then PCS (WGS 84 UTM 43 32643) Projected coordinate system is used to project and calculate the areas. All areas shown in this report is in meters.

Data Sets:

The Datasets, Software's, and Plugins used in QGIS and various S/W were used in the current study is as follows,

A) Datasets

1. Cartosat DEM (C1_DEM_16B_2006-2008_v1_75E19N_e43d)
2. LISS4 (LC08_L1TP_146046_20131223_20170427_01_T1)
3. GPS surveyed points

B) Softwares

1. Qgis V.3.6.3 and 2.6.1
2. SAGA GIS 2.3.2
3. Surfer 11
4. Google Earth

C) Plugins Qgis

1. Semi Automatic Classification
2. Quick OSM
3. SWAT plugin

D) XYZ Connection Tiles in Qgis

1. Google satellite Link:
<https://mt1.google.com/vt/lyrs=s&x=%7Bx%7D&y=%7By%7D&z=%7Bz%7D>
2. Open Street Maps: <http://a.tile.openstreetmap.org/{z}/{x}/{y}.png>
3. Esri Imagery:
https://server.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer/tile/%7Bz%7D/%7By%7D/%7Bx%7D

RESULT AND DISCUSSION

Total area 1261834.607 sq. m on considering centre point from Gogababa tekdi. The settlements in the year 2019 first 284190 sq. m as other settlements and 251628 sq. m for university campus. In the year 2005 other settlements are of 16039sq. m and university campus 251628sq. m. The total barren land was 240671 sq.m.

Table 1: Showing changed in settlement, vegetation and land.

Year	Settlements	%	Vegetation	%	Barren Land	%	Total
2005	267667	21	753496	59	240671	19	1261834
2019	535818	42	485345	38	240671	19	1261834

Table 2: showing attributes of photographs collected in field.

Image id	Latitude (X)	Longitude (Y)	Height (Z)	Sample's
IMG_20190622_082620833	19°54'21.9458"	75°18'11.4468"	565m	Amethyst in basalt
IMG_20190622_082959536	19°54'0.1915"	75°18'21.781"		Amygdaloidal basalt
IMG_20190622_081658691	19°54'25.4501"	75°18'10.9599"	621m	Amygdaloidal basalt
IMG_20190622_062404930	19°54'19.841"	75°18'22.8673"	538m	Amygdaloidal basalt
IMG_20190618_062638194	19°54'18.2736"	75°18'19.7718"	545m	Amygdales
IMG_20190622_081909280	19°54'25.4501"	75°18'10.9599"	621m	Compact Basalt
IMG_20190622_080334464	19°54'25.2892"	75°18'13.5335"	655m	Compact Basalt
IMG_20190622_071230086	19°54'28.3464"	75°18'14.5513"	639m	Compact Basalt
IMG_20190622_064618241	19°54'23.4938"	75°18'20.4239"	582m	Compact Basalt
IMG_20190622_071623097	19°54'27.7489"	75°18'13.675"	645m	Felsic Vein in Basalt
IMG_20190622_083729353	19°54'18.0074"	75°18'19.2288"	534m	Highly weathered basalt
IMG_20190622_072559143	19°54'24.6266"	75°18'17.9868"	628m	Highly weathered basalt
IMG_20190622_070720034	19°54'27.782"	75°18'16.7533"	595m	Highly weathered basalt
IMG_20190618_064028869	19°54'21.4768"	75°18'16.5901"	648m	Highly weathered basalt
IMG_20190622_083336025	19°54'18.0054"	75°18'15.1745"	555m	Moderately weathered basalt
IMG_20190622_081301514	19°54'26.9705"	75°18'9.1029"	566m	Moderately weathered basalt
IMG_20190622_074028780	19°54'23.3145"	75°18'16.4696"	627m	Moderately weathered basalt
IMG_20190622_071911632	19°54'27.3348"	75°18'13.1896"	630m	Moderately weathered basalt
IMG_20190622_070158698	19°54'25.0857"	75°18'19.3877"	459m	Moderately weathered basalt
IMG_20190622_063537823	19°54'21.7489"	75°18'21.3021"	540m	Moderately weathered basalt
IMG_20190622_082338555	19°54'24.5061"	75°18'11.5104"	513m	Vesicular basalt
IMG_20190622_080659897	19°54'26.3514"	75°18'12.3881"	645m	Vesicular basalt
IMG_20190622_065126402	19°54'23.6267"	75°18'20.3487"	550m	Vesicular basalt
IMG_20190622_062806423	19°54'19.7739"	75°18'21.1067"	558m	Vesicular basalt

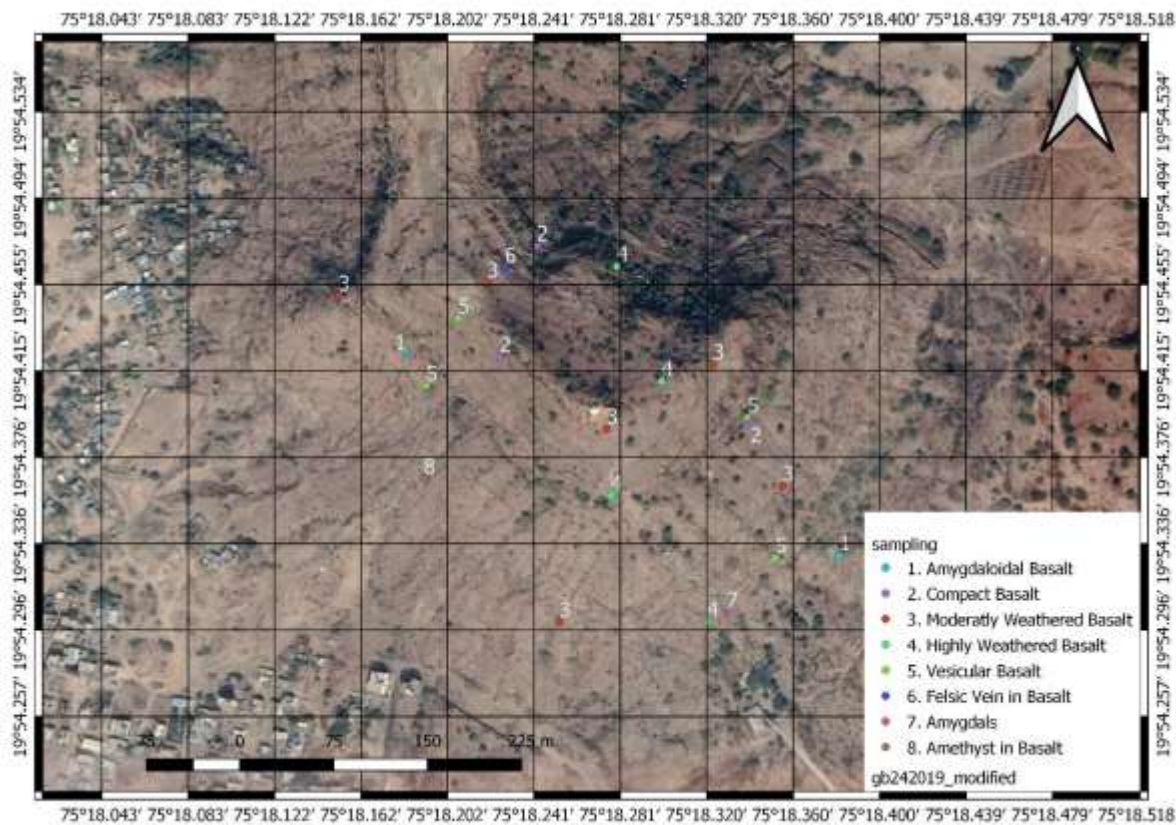


Fig. 3. Map showing surveyed location at Gogababa Tekdi

A variety of the basalts are showing in the fig.3, all of which are collected and surveyed by handheld mobile GPS. The outcrops are exposed all over the hill which is collected and reported here in consideration of the top of hill as a reference point (sample no 3 and one temple is nearby). The collection of sample 1 found at the two sides of the hill which is SE and NW direction of the hill. The sample 2 is found in the N, E and in the middle of the hill. The sample 3 found at top of the hill, middle of the hill, NE, NW, S, SE. The sample 4 found at SE, S, N, and NE. The sample 5 found at SW, SW, SE, SE. The sample 6 is found at NW. The sample 7 is found at SE. The sample 8 is found at SW.

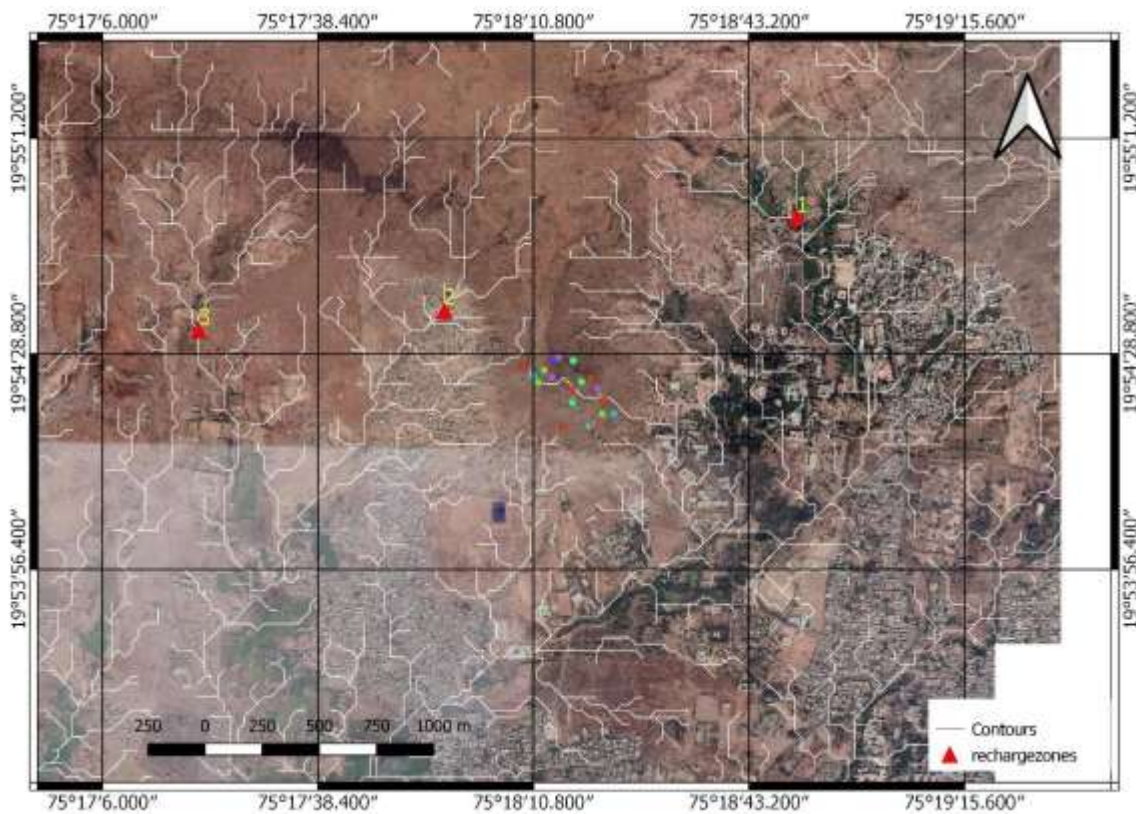


Fig. 4. Map showing recharge zones in the study area based on the watershed

The fig.4 shows drainage watershed with suggested recharge zones. There are total three points or zones suggested for groundwater recharge. At point 1 there is no settlement observed. At point 2 has maximum settlements which comes in the drainage network. At point 3 has least settlements. Based on the drainage network and area of the catchment zone one can draw high to low catchment points is from 3, 2 and 1.

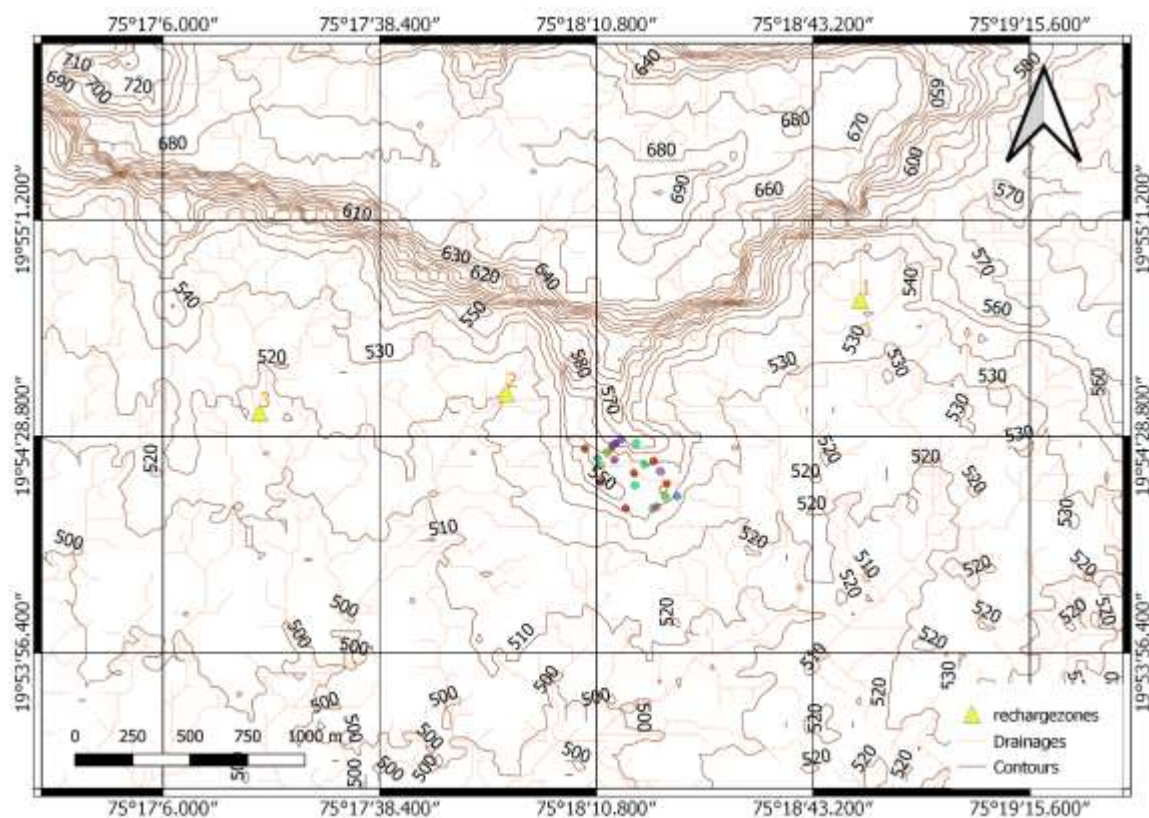


Fig. 5. Map showing contours at the area with draped drainages and proposed recharge points.

The fig.5 shows the contour elevations and drainage watershed is within the study area. The combination of watershed and slope suggest steepness and watershed collection points based on the drainage network. The map reveals gentle slope at point 1. At point 2 there is steep slope. At point 3 there is moderate slope. The maximum collection of water is decreasing from point 3, 2 and 1 respectively.

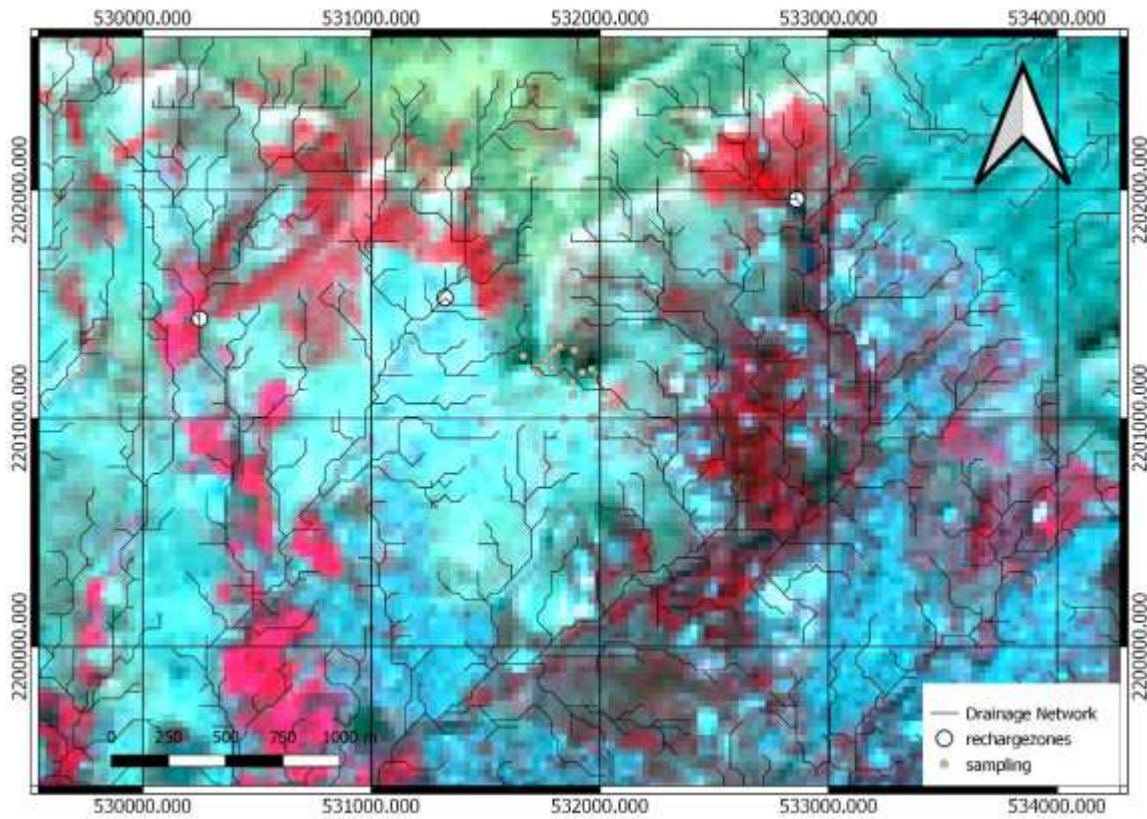


Fig. 6. FCC composite of the study area

The fig.6 shows settlements in whitish blue, vegetation in red, barren in green. Whereas all the points show no settlements in the proposed watershed recharge zones. This can be confirmed by clearer resolution images and also it calls for classification methods.

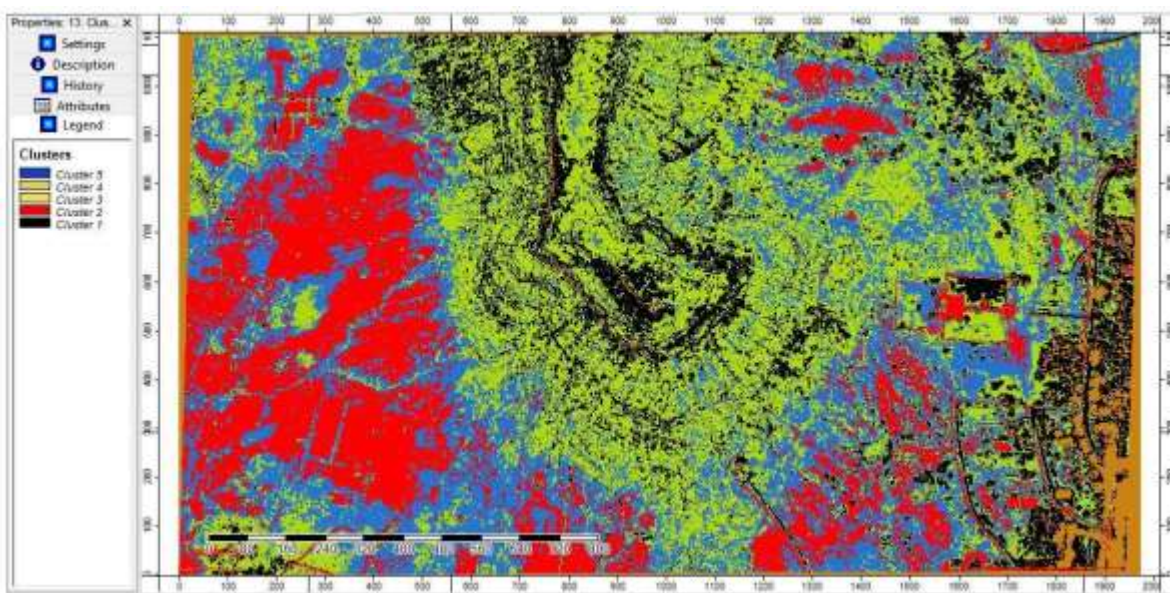


Fig. 7. LULC map for the year 2005

The fig.7 is unsupervised classified image of the study area for year 2005. The total classes are 5. At 2005, the green colour shows vegetation part which is well covered at the hill. The red colour shows barren land which covers most of its part towards west. The blue colour shows herbs on ground. Black colour shows settlements except mountain part.

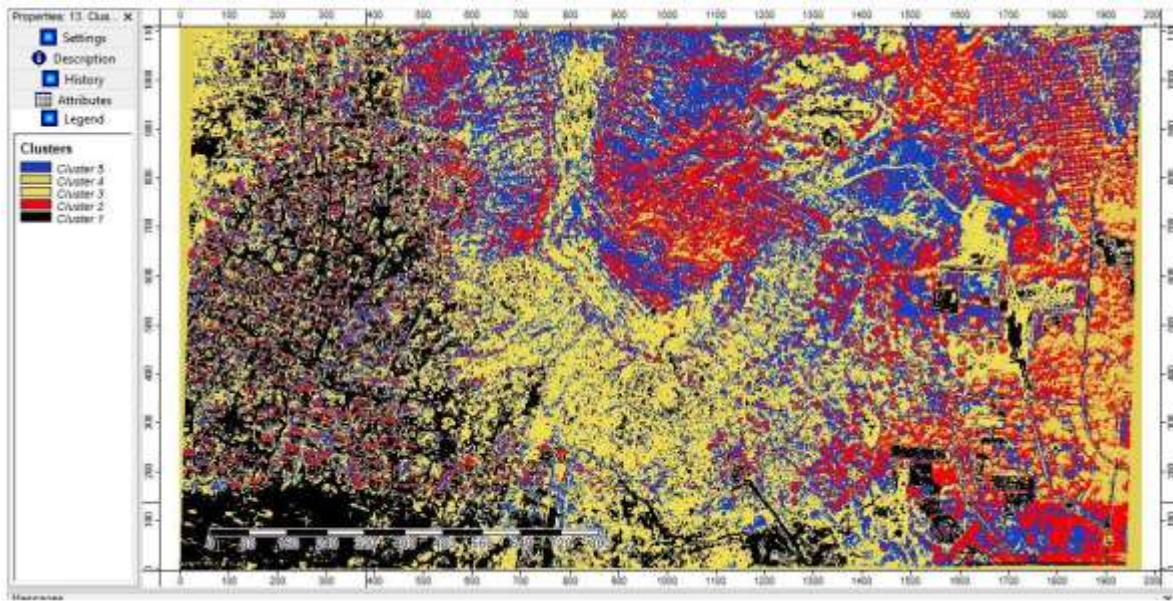


Fig. 8. LULC map for the year 2019

The fig.8 is unsupervised image of the year 2019 with total classes 5. Here blue colour shows herbs on ground. The red colour shows thick vegetation cover. The black colour shows settlements. The yellow colour shows barren land.



Photo1. Amygdaloidal Basalt, Photo2. Compact Basalt.

The total two samples are collected of amygdaloidal basalt shown in photo 1. The total four samples found and collected in the field.

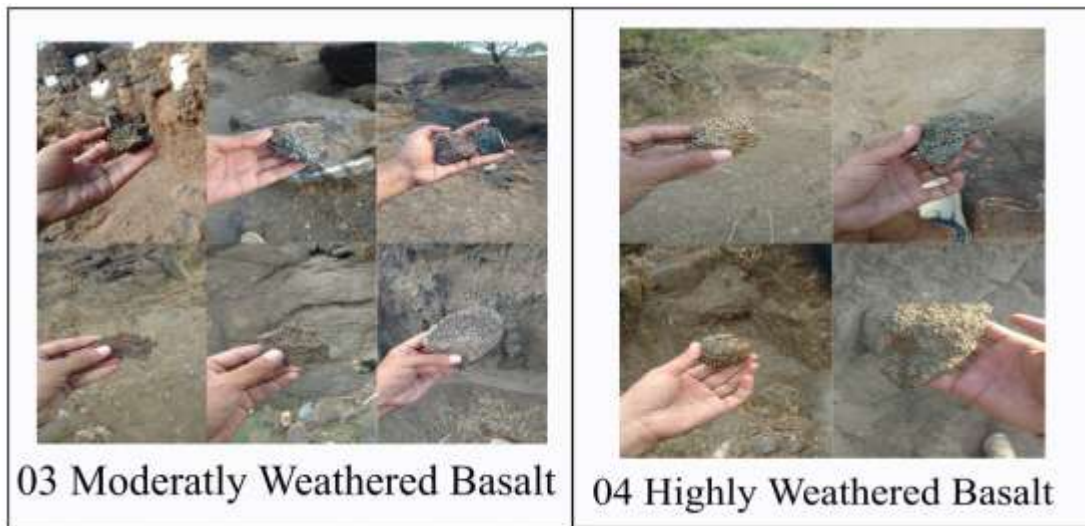


Photo3. Moderately weathered Basalt, Photo 4. Highly weathered Basalt.

The total 6 samples are collected of moderately weathered basalt. The total 4 samples of highly weathered basalts are collected.

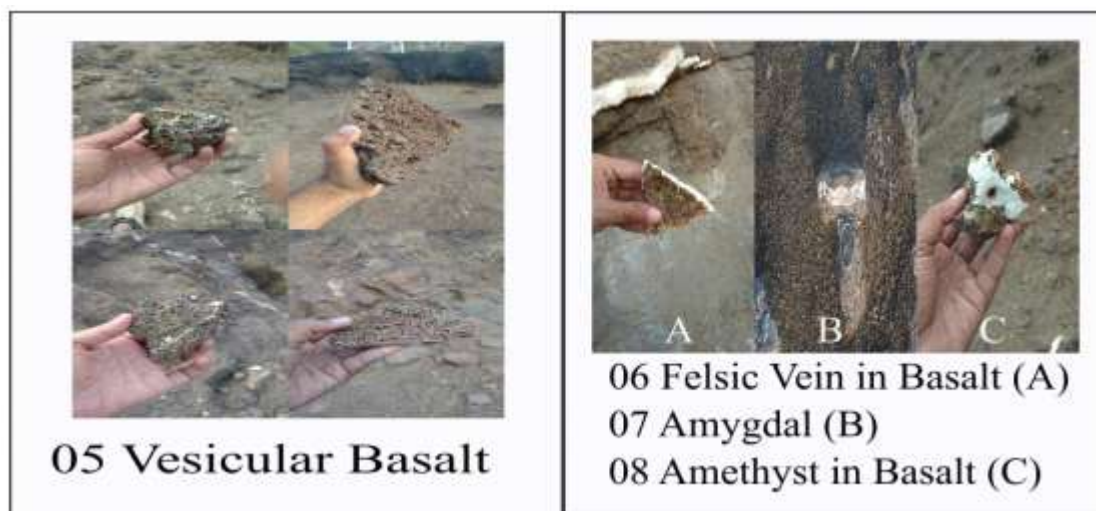


Photo4. Vesicular Basalt, Photo5. Felsic Vein in Basalt (A), 07 Amygdal (B), 08 Amethyst (C)

The total 4 samples are collected of Vesicular basalt. The best exposed felsic vein sample is collected in total 1. The total 1 sample is collected of amygdal from site. The total 1 sample is collected from site which is best exposed amethyst in basalt.

DISCUSSION

In the fig.3 sample no.1 (amygdaloidal basalt) is found at two diverse and distinct side of the hill. The specialty of this rock is found in the almost all vesicles. Whenever the gas bubble popped up forming vesicles in the hot lava, the remaining incompatible solids in the form of elements segregate in these vesicles and forming this type of basalt. This rock and its adjoining area is good for carving the any monuments.

The sample no.2 (compact basalt) is found almost middle of the hill. This invokes samples of compact basalts are least prone to weathering which successfully maintains the hilly portion and the top of the hill. The temple has its basemen on this rock only.

The sample no.3 (moderately weathered basalt; 6 samples) is widely spreaded all over the hill; which is at the center as

well as the corners of the hill. This samples were collected at the site which is at almost weathered condition. This rock and its adjoining are almost eroded and removed from top.

The sample no.4 (highly weathered basalt; total 4 samples) is found and collected almost at the footwalls of the hill. Which is found passing from almost middle of the hill. In due time this portion of the hill may get eroded. The curve in the northern side has outcrops of this rock. Based on this it is to be said that this part is highly eroded.

The sample no.5 (vesicular basalt; total four samples) is found almost all over the hill which is spreaded almost all sides as well as including the base of the hill. Whereas the all sampling sites are nearby in a linear fashion which is prominent at the west side of the hill. This side of the hill found comparatively highly weathered than sample no.3. Based on this it can be drawn that the vesical pipe may got developed at the western side of the hill which in due time is weathered and lowered the western part. The vesicals in basalt serves high corners or surface to be exposed to weathering. This can cause the weathering is to be acted rapidly.

The sample no.6, 7, 8 (felsic vein in basalt, amygdals, and amethyst in basalt; respectively) total one samples each are found and collected at outcrops. These are some special features which is generally found all over the hills. All these samples are found almost at the base and the corners of the hill.

The fig. 4 suggest the recharge zones in the study area. The sites are suggested based on the topography, settlements and watershed confluence area. At the point 1 has the longest watershed and has comparatively sparse settlements which is the area of the university. At the point 2 has the highest settlements in comparison for point 1 and point 2. The point 2 and 3 has the common confluence within the study area. The points 1 and 2 has same catchment area than point 3. The point 3 also has settlements at the suggested site.

The fig. 5 suggest comparatively moderate slope is good for watershed recharge. Whereas point 3 has a gentle slope, point 1 and 2 has moderate slope. Based on the settlements there is high no. of settlements found at the point 2 and least at point 3 which is exactly at the suggested site. Based on the fig 4 and 6, the point 1 has no settlement and can be taken in consideration for recharge zone.

The fig. 6 shows the vegetation cover with or around the suggested site. Whereas, point 3 has highest no. of vegetation, point 1 has moderate and point 2 has least cover of vegetation. The slope of the zones as suggested by fig 5 the point 3 has steep slope with highest vegetation cover and point 2 has highest settlements with least vegetation cover. At the point one has moderate vegetation cover; moderate slope and has no settlements at the suggested site.

The fig. 7 suggests land use land cover map of 2005. Based on this image it is found that vegetation part covers all over the hill. The barren land which is at the western part of the hill.

The fig. 8 suggest land use land cover map of 2019. Based on this image the barren land is utilized for settlements and the hill shows drastic change in vegetation in comparison with the fig. 7. In fig 7 of year 2005 shows well spread vegetation cover at the hill which is is highly affected till the 2019. The settlements have dramatically increased and vegetation cover has decreased from 2005 to 2019. Current study also calls detail field investigation for recharge zone and spatial relationship.

CONCLUSION

- The vesicular basalt is found and triggered rapid weathering in comparison to other rocks. The highly weathered basalt is found passing from middle of the hill can may get weathered in future.
- The settlements have increased from 21% to 42% and vegetation has decreased from 59% to 38%.
- 63% change is detected of settlements from year 2005 to 2019 from year 2005 to 2019 vegetation cover decreased and settlements has increased.
- The point 1 recharge zone is suggested for long term catchment of water.

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