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Mapping and Reclamation of Wastelands in Yelanduru Taluk of Chamarajanagara District, Karnataka, India Using Geo-Informatics Technique

Basavarajappa H. T, Pushpavathi K. N, Manjunatha M. C

Department of Studies in Earth Science, Centre for Advanced Studies in Precambrian Geology, University of Mysore, Manasagangothri, Mysore, India

ABSTRACT

Wastelands mapping and its reclamation analyses has been applied on Yelanduru taluk in Southern tip of Karnataka using high-tech tools of geoinformatics. With the increasing population the natural resources like forest, agricultural land etc., have been devastated and degraded to a great extent. Unscientific handling of land resources in a region causes ecological imbalance & vast stretches of wastelands. The present study aims to propose appropriate management strategies to reclaim the wastelands in the study area. Efforts have been made to evaluate the unutilized lands using Survey of India (SoI) topomap of 1:50,000 scale, IRS-1D PAN+LISS-III satellite and Google Earth images through GIS software's with limited Ground Truth Check (GTC). This reveals the spatial baseline information in distribution, extent and temporal behavior of each wasteland categories for better planning and developmental reclamation strategies. Major identifiable wasteland categories are barren rocky; land with scrub; mining wasteland and salt affected area. The final result specifies each wasteland categories in the study area using geoinformatics technique considering the environmental, biophysical and socio-economic factors.

Keywords: Reclamation; Wasteland; Yelanduru; Geo-Informatics.

I. INTRODUCTION

Wasteland was referred as the land narrowed to uncultivated non-forested land (Pushpavathi., 2009). The multiple meanings of the term wasteland can have numerous ramifications within any policy designed to "Rehabilitate wastelands", as is a policy goal in our country's effort to increase food security (Hoeschele., 2003). The variation in association, shape, size, pattern, shadow and texture were used to identify and delineate different wasteland categories on IRS-1D PAN+LISS-III satellite images and are physically verified through limited Ground Truth Check (GTC) using SoI topomap of 1:50,000 scale and updated the same on Google Earth Image (GEI) (Basavarajappa and Dinakar., 2005; NRSA., 1987). Ground truth verification forms an important and integral part of Visual Image Interpretation Techniques (VIIT) on Remotely Sensed data (Basavarajappa et al., 2012; Manjunatha et al., 2015). Diversity in physical landscape affects different types of land utilization due to increasing pressure on agricultural activities and rise in population (Pushpavathi., 2010).

Study Area

It lies in between 11^0 42' to 12^0 09' N latitudes and 76^0 57' to 77^0 09' E longitudes covering an area of 265 Km^2 with an average elevation of 555 m (1820 feet) (Fig.1) (Basavarajappa et al., 2012). The plain country forming the western portion made up of gneiss and the hilly terrain forming the eastern portion and is composed of Precambrian gneiss mixed with charnockite and granulitic rocks which are late intruded by variety of dyke rocks (Basavarajappa., 1992; Dinakar., 2005; Satish., 2002; Meenakshi., 2003; Pushpavathi., 2009). Suvarnavathi River flows from South-West to North-Eastern direction in the central part of the study area (CGWB., 2008). The Biligiri-Rangan hill is covered the thick forest with the height of 5,091 ft above MSL (Dinakar., 2005).

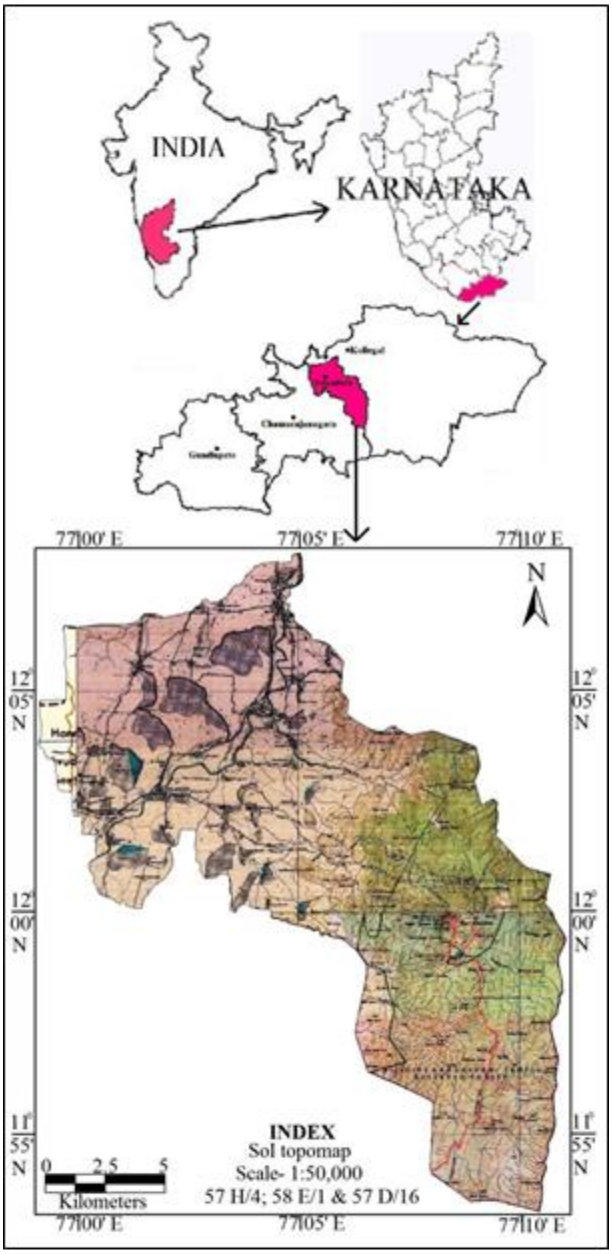

Figure 1. Location and Topomap of the study area

II. METHODS AND MATERIAL

i. Toposheet: 57D/16, 57H/4 and 58E/1 on 1:50,000 scale, *Source: Survey of India, Bengaluru.*

ii. Satellite images: IRS-1D, PAN+LISS-III (Band: 2, 3 & 4) of 2.3m Resolution (Fig.2); Google Earth image of >1m Resolution; year: Nov 2008 (Fig.3).

Source: Bhuvan-ISRO, NRSC-Hyderabad.

iii. GIS software's: ArcGIS v10; Erdas Imagine v2013.

iv. GPS: A handheld GPS (Garmin-12) has been used to record each wasteland categories in the study area through limited Ground Truth Check (GTC).

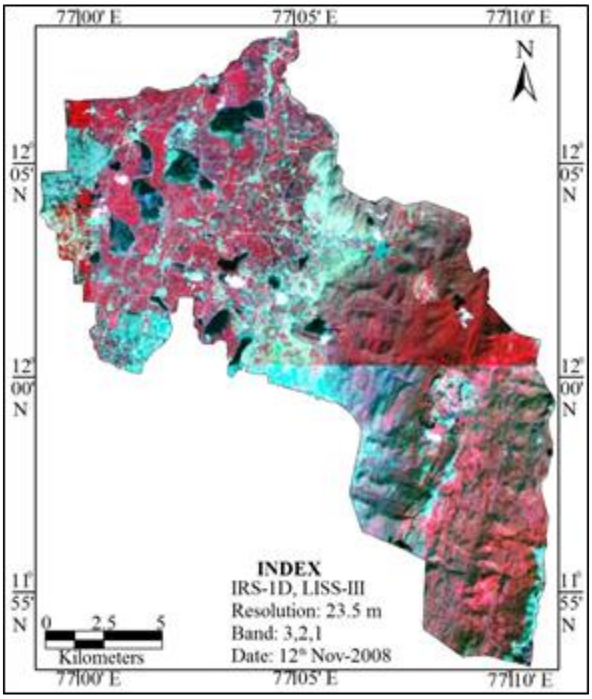

Figure 2. IRS-1D LISS-III Image of the Study Area

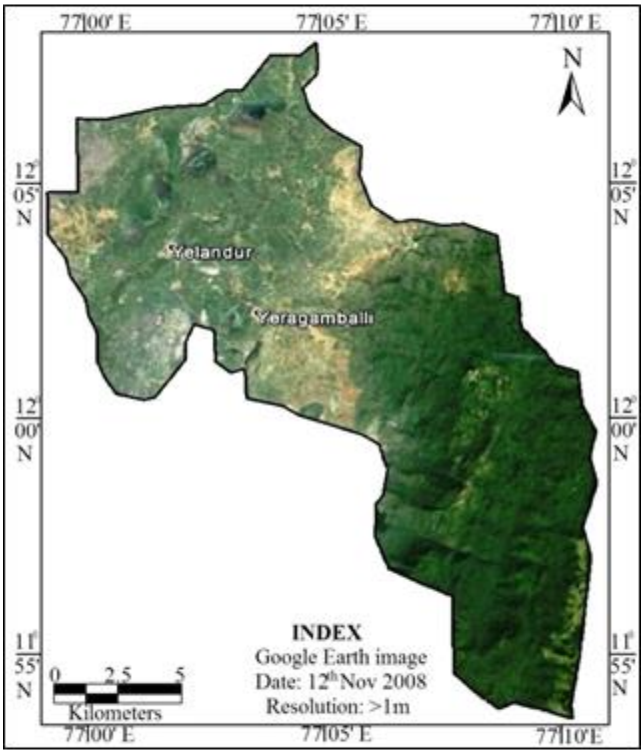

Figure 3. Google Earth Image of the study area

1. Lithology

Geologically, the terrain confirms to an ancient Archean complex (3.4 b.y old) (Srikantappa & Basavarajappa., 1997). Lithological map was derived from published Geological Map of Karnataka (GSI., 1981) and updated using satellite images (Fig.4) (Basavarajappa et al., 2012). The area consist of hard crystalline rocks mainly peninsular gneiss and charnockite of Archaean age (Basavarajappa and Srikantappa., 1999; Pushpavathi., 2009) and are intruded by dolerite dykes of Proterozoic age. Gneisses are observed as medium grained with varying color of grey and pink noticed in north-western parts with fractures, faults and joints (Dinakar., 2005; Basavarajappa and Srikantappa., 2014). Charnockite rocks occupy south-eastern parts forming the hill ranges. They are well defined joint system and are dissected by the number of intrusions. Both the formations and intruded by dykes of basic composition and the amphibolites occur as small and narrow lenticular patches in gneissic rocks (Pushpavathi., 2009).

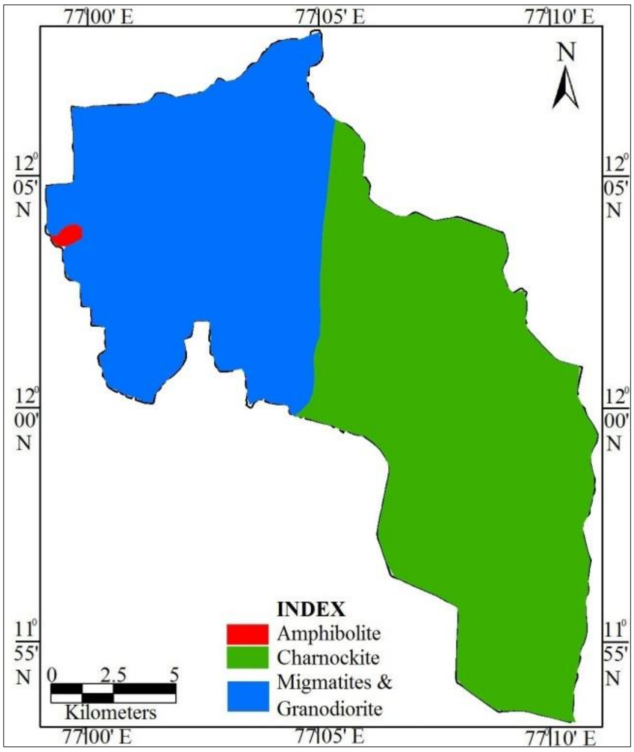

Figure 4. Geomorphology map of the study area

2. Geomorphology

Geomorphology is the scientific study of landforms on the earth surface that includes the study of topography, drainage pattern, geomorphic units etc (Miller., 1953). The landforms are delineated as denudational hills, plateaus, pediments, inselbergs, shallow & moderately weathered pediplains and valley (Fig.5) (Basavarajappa et al., 2012). Denudational hills are formed due to differential erosion, weathering acting more resistant and forming as mountains/ hills (Dinakar., 2005). Charnockite rocks occur as continuous range of varying height; while Pediments are rock floured plains in the uplands areas and adjacent to hills (Basavarajappa and Srikantappa., 1998). Inselbergs occurs in the form as residual isolated barren or rocky, smooth and small rounded hillocks (mostly conical) standing above ground level surrounded by pediplains (Satish et al., 2008). Moderately weathered pediplains is the flat surface with good weathered profile covering thick vegetation; while shallow weathered pediplains show weathered profile with sparse vegetation (Basavarajappa et al., 2012).

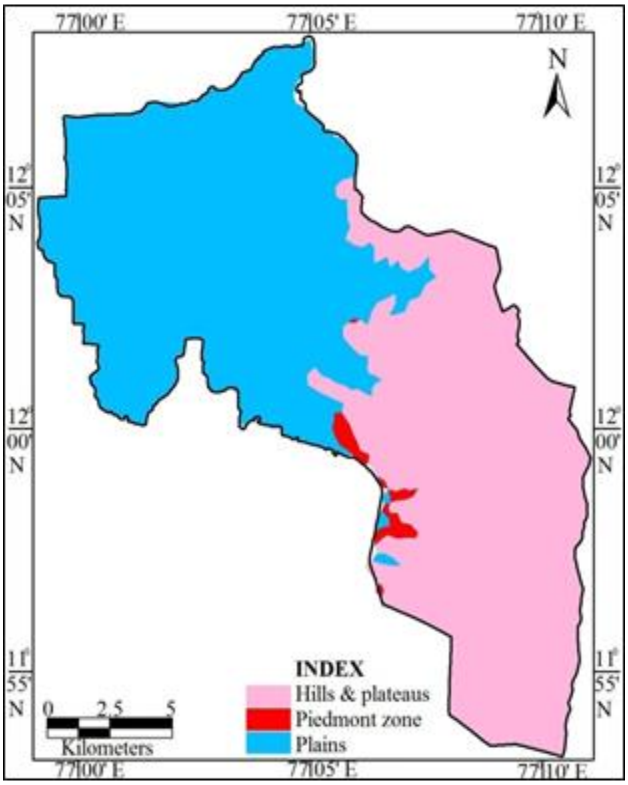

Figure 5. Geomorphology map of the study area

3. Soil

Different types of soil present in the study area are clayey, clayey mixed and clayey skeletal (Dinakar., 2005) derived from 1:250,000 scale Soil Map of Karnataka prepared by NBSS & LUP (Fig.6) (Pushpavathi., 2009). These are derived from granitic gneisses and charnockite rocks. Valley zones as well as stream courses are filled with highly porous and permeable alluvial/ colluvial material, sand and gravel. Soil depth shows wide variation in terms of image characteristics, nature & extent of different geomorphic units. The thickness of the soil especially clayey mixed varies from less than 1m to 6.5m which are black in color containing high moisture contents (Basavarajappa et al., 2012).

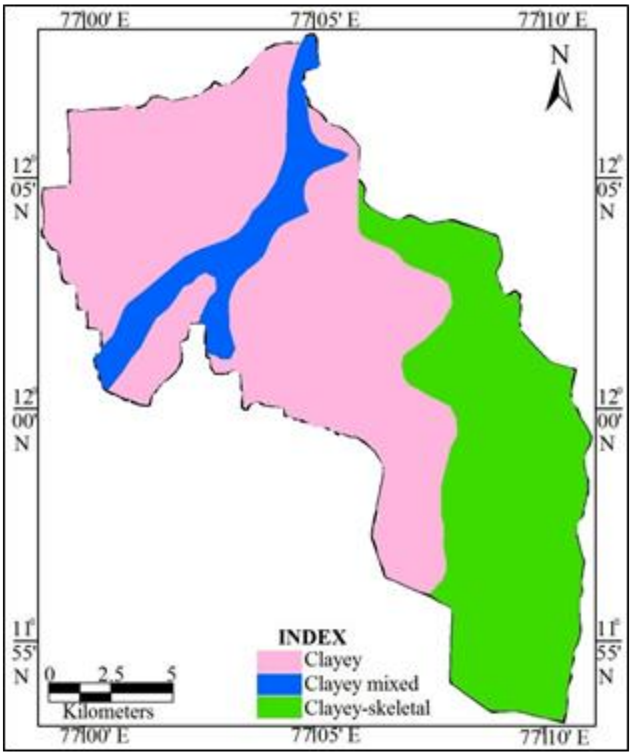

Figure 6. Soil map of the study area

4. Land use/land cover

Land is one of the non-renewable resources & its mapping is essential for planning and development of land and water resources in a region of engineering projects under progress (Fig.7) (Manjunatha et al., 2015). Land use refers to the utilization of land which are directly related by human's activities (Anderson et al., 1976). Land cover refers to natural vegetation, water bodies, soil, rocks, artificial cover and others resulting due to land transformation (NRSA., 1987). Visual Image Interpretation Techniques (VIIT) on IRS-1D LISS-III False Color Composite (FCC) of band 3,2,1 was well utilized in delineating various land use/cover categories of the study area (Basavarajappa et al., 2012). The land use/cover classes like agricultural land; built-up land; forest cover; grass/ grazing land, wasteland (salt-affected land, barren rock/stony waste) etc were identified and delineated (Fig.7). Water bodies were delineated based on the image characteristics like tone, texture, shape, association, background, etc. Forest area occupies the hilly terrain of south-eastern part, while agriculture land occupies the north-eastern part of low lying areas (Dinakar., 2007; Basavarajappa et al., 2012). Huge numbers of eucalyptus plantation were identified in the central part of the study area.

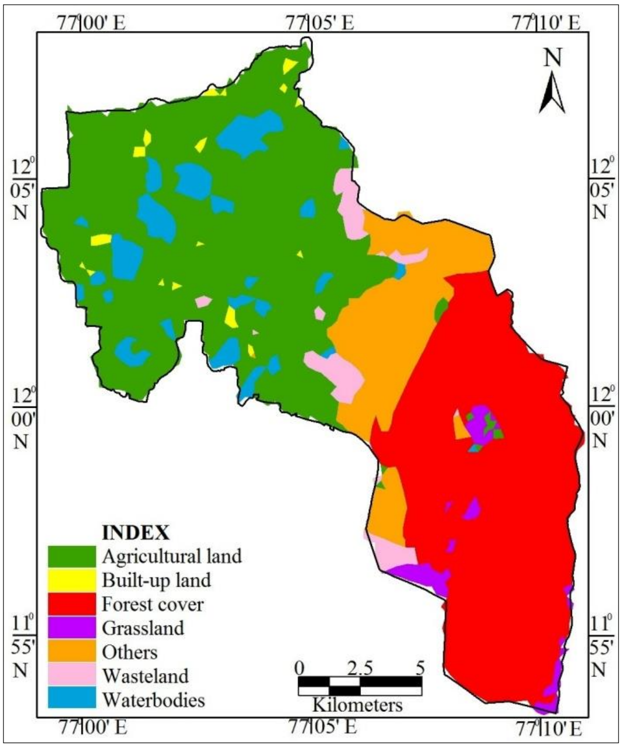

Figure 7. LU/LC map of the study area

5. Wasteland

Wastelands are deteriorating for lack of appropriate soil & water management or on account of natural causes that can be brought under vegetative cover with reasonable effort (Basavarajappa et al., 2015a). Wastelands develop naturally or due to influence of environment, chemical and physical properties of the soil, management constraints and due to mining activities for over demand of economic minerals (Basavarajappa et al., 2015b). The following wasteland categories are identified measuring an area of about 10.10 Km^2 (3.81%) using geo-informatics technique (Fig.8) (Dinakar., 2005; Basavarajappa et al., 2015c).

A. Barren/rocky/stony waste: The rock exposures of varying lithology often barren & vegetation cover appear as isolated hill exposures located in steep isolated hillocks/ hill slopes, crests, plateau & eroded plains associated with lateritic out-crops, mining, quarrying sites. These areas appear in light gray to black tone due to hill shadow on one side and light red on the other side due to vegetation and tonal variation subjected to degree of soil erosion (Basavarajappa et al., 2015a). This category covers an area of 0.5641 Km^2 (5.58%) (Fig.8; Table.1).

B. Land with scrub: These occupies relatively at high altitudes depicting shallow severely eroded skeletal soils over degradation period, extremes of slopes subjected to excessive aridity with scrubs dominating the landscape (Basavarajappa et al., 2015a). They have a tendency for intermixing with cropped areas. They appear in light yellowish brown to greenish blue depending on the surface moisture cover and vary in size from small to large either contiguous or dispersed pattern. It covers about 8.7993 Km^2 (87.06%) (Fig.8; Table.1).

C. Mining/ industrial wasteland: These occupies the large-scale mining operations, mine dumps and discharge of large scale industrial effluents causing land degradation (Basavarajappa et al., 2015b). The features exhibit dark gray to light bluish to black (iron ore waste) tone based on the color of the mine dump, small to medium in size, depending on the extent of mining area, irregular in shape with mottled texture, located at or near active mining areas and industrial complexes. This category covers an area of 0.3962 Km^2 (3.92%) (Fig.8; Table.1).

D. Salt affected area: These are salinity/ alkalinity affected areas that pose adverse impact on the growth of most plants due to action or presence of excess soluble salts (saline) or high exchangeable sodium (Basavarajappa et al., 2015b). They appear in different tones of dull white to bright white on satellite image in different geographical conditions. This land covers an area of 0.3479 Km^2 (3.44%) (Fig.8; Table.1).

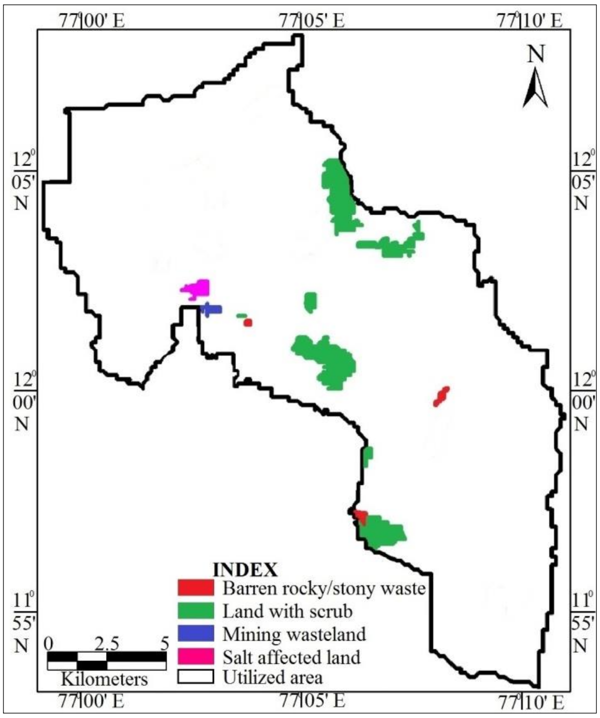

Figure 8. Wasteland map of the study area

Figure 9. Land with scrub near Yelanduru

Figure 10. Quarry waste area near Kothalvadi

Figure 11. Quarry waste area near Amble

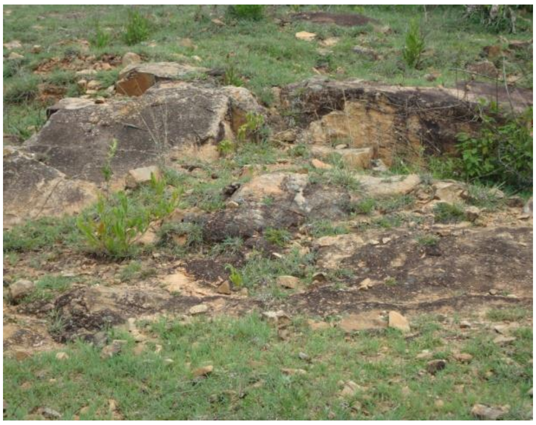

Figure 12. Rocky land near Malarpalya

III. RESULT AND DISCUSSION

Table 1. Wasteland Categories and Reclamation Measures for Suggested Land Use

Sl. No	Types of wasteland	Area in Km^2	Percent age (%)
1.	Barren Rocky/ Stony Waste/ Sheet Rock	0.5641	0.2128
2.	Land with scrub	8.7993	3.3204
3.	Mining/ Industrial waste	0.3962	0.1495
4.	Salt Affected Land	0.3479	0.1312
5.	Utilized land	254.8925	96.1858
	Total wastelands	***10.1075***	***3.8139***
	Total Geographical Area (TGA)	***265.0000***	***99.9997***

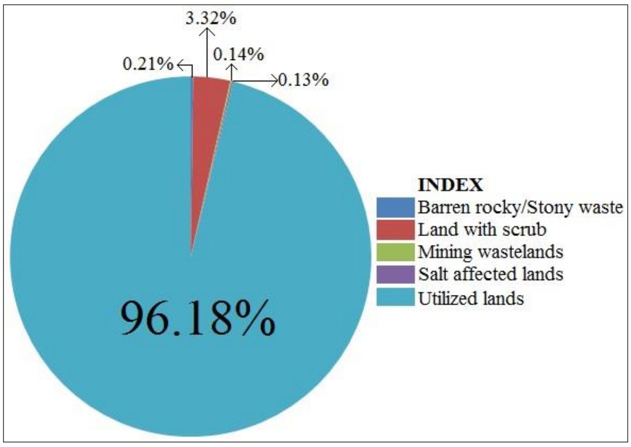

Figure 13. Pie chart depicting the percentage of each wasteland categories in the study area

IV. CONCLUSION

Wastelands in the study area covers an area of about 10.10 Km^2 (3.56%) comprising barren rock/ stony waste/ sheet rock; land with scrub; mining/industrial waste and salt affected areas. The different litho units encountered during field visits are charnockites, migmatites, amphibolites; are helpful in identifying the wasteland zones. Notified wasteland categories are observed in several villages such as Agara, Ambale, Devarahalli, Malarpalya, Shivakahalli, Vadagere, Yelandur etc. Rocky/stony waste areas should be channelized to regulate grazing activity and may use as building materials with proper channel. The formation of a gully is much easier than controlling it once it has formed; while incipient gullies become longer, larger and deeper if these are not stabilized over periodic management. All thematic layers are generated using SoI Topomap of 1:50,000 scale; IRS-1D, LISS-III satellite image through VIIT & DIP and updated on Google Earth image by Ground truth verifications for better land use developmental strategies.

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