Mapping and Reclamation of Wastelands through Geomatics Technique in Precambrian Terrain of Mysuru District, Karnataka, India
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ABSTRACT

Wastelands are low-quality land from the agricultural point of view, often referred as degraded lands. The development of vast stretches of wastelands is caused by unscientific handling of land resources which causes ecological imbalance. The present work is undertaken to reclaim the wastelands of the study area through hi-tech tools of geomatics. This study aims to map and record the waste and unutilized lands using Survey of India (SoI) toposheets 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). The database provides spatial baseline information in distribution, extent and temporal behavior of wastelands in planning and implementation of developmental reclamation strategies. The final results highlight the specific wasteland categories in Mysuru district using geomatics technique considering the environmental, biophysical and socio-economical factors.

Keywords: Reclamation, Wastelands studies, Mysuru district, Geomatics.

1. Introduction

Wastelands are referred as degraded land and presently laying unutilized (except fallow land) due to inherent or imposed disabilities related to location, environment, soil as well as current financial constraint (NRSA., 1987). This becomes a major environmental issue posing threats to the existence of human being and surrounding environment. According to National Wastelands Development Board (NWDB., 1987) wasteland defined as "degraded land that can be brought under vegetative cover with reasonable effort and land which is deteriorating due to lack of appropriate water, soil management or on account of natural causes". Land has been turned into wasteland due to several natural and biotic factors like water logging, soil erosion, wind erosion/ deposition, salinity/alkalinity, floods and unscientific methods of cultivation (Pushpavathi and Basavarajappa., 2009; Azadhe and Basavarajappa., 2009). Geomatics technique provides alternative method of minimizing operational costs, digital data-bank information and fast evaluation for long-term monitoring on suitable land use category. Wasteland areas are mapped using geo-rectified SoI toposmap and updated on IRS satellite and Google Earth images to identify the change in their categories through GIS software’s (Pushpavathi and Basavarajappa., 2009). Remote Sensing technology with limited fieldwork provides an edge to characterize the specific land cover patterns through GIS analysis (Basavarajappa et al., 2013).

2. Study area

Mysuru district in Karnataka state of Southern Peninsular India consists of Precambrian rocks in Dharwar Craton (Srikantappa et al., 1992; Radhakrishna and Vaidyanadhan., 2011;
Basavarajappa et al., 2014c). It lies in between the 75° 59′- 79° 05′ E longitude and 11° 45′-12° 40′ N latitude with total extent of 6,847 km²; includes 7 taluks namely Hunasuru, Heggada Devana Kote, Krishna Raja Nagar, Mysuru, Nanjanagud, Piriyapatna and Tirumalakuduru Narasipura with general elevation of 700-800m above MSL (Figure 1) (Basavarajappa et al., 2014c). The study area endowed with perennial Rivers Cauvery, Kabini and other non-perennial rivers (Azadhe and Basavarajappa., 2011). Cauvery River drains major parts of the study area traversing the Mysuru plateau in northern parts from north west to east along with tributaries of Kabini, Suvarrnavathi, Nugu, Gundal and Laxmanathirtha. Temperature ranges from 11° to 34°C and may rise up to 39°C during summer with average annual rainfall of 776mm (2012). Relative humidity ranges from 21% to 84% and wind speed ranges from 3.9 to 14 Kmph (CGWB, 2012).

3 Methods and Materials

3.1 Methods

Geomatics technique is the advent high-tech tool in mapping, interpretation and integration of thematic maps in wasteland reclamation and sustainable development for future use (NRSA, 1995). Geomatics technique encompass Survey of India (SoI) toposheets, Remote Sensing (RS) Satellite image, Geographic Information Systems (GIS) and Global Positioning Systems (GPS) in mapping of lithology, geomorphology, soil types and land use/land cover pattern in assessing the wasteland reclamation and its management. Visual Image Interpretation Technique (VIIT) and Digital Image Processing (DIP) are carried out on False Color Composite (FCC) of IRS Satellite image (Figure 2). GIS software tools are adopted in analyzing, integrating the baseline information database to generate thematic maps. Variation in Association, Texture, Shape, Size, Shadow and Patterns are involved to identify and
delineate different wasteland categories. The final wasteland map is updated using Google Earth Image (Figure 3) (Basavarajappa and Manjunatha., 2014b).

Figure 2: IRS-1D, LISS-III Satellite Image of the study area

Figure 3: Google Earth Image of the study area
3.2 Materials

1) Topomap: 48P/14, 15; 57D/2, 3, 4, 6, 7, 8, 11, 12, 15, 16; 57H/4; 58A/1, 5, 6, 9, 13.
   Sources of data: Survey of India (SoI) of 1:50,000 scale.
2) Satellite RS data: Indian Remote Sensing (IRS)-1D, LISS-III (year: 2010-11, Resolution: 23.5m), PAN (year: 2005-06, Resolution: 5.8m), Google Earth: 5th April-2011 with >5 meter resolution.
   Sources of data: NRSC, Hyderabad; Google Earth Software.
3) Software analysis: ArcGIS v10 and Erdas Imagine v2013.
4) GPS: Garmin-12 is used during field visits to check the exact locations and extent of specific wasteland categories.

3.3 Geology

Underlying lithological formations are basic factors for the constructional point of view such as dam, bridges, tunnels, roads, multi-storied buildings etc (Basavarajappa and Manjunatha., 2014b). The study area is traversed by 3 sets of joints trending in N-S, NE-SW and E-W direction and undergone F1, F2 and F3 folding. Geologically, the area is mainly composed of igneous and metamorphic rocks of Precambrian age either exposed at the surface or covered with a thin layer of residual and transported soils (Vaidyanadhan and Ramakrishnan., 2010). Various litho units such as charnockites, granites, gneisses, schist’s of Archeans age are mapped. Charnockite series, granitic gneiss and gneissic complex types of rock formations are encountered during field visits with common intrusions of pegmatite veins and dolerite dykes (Basavarajappa et al., 2013) (Figure 4). The intervening ground consists of granitic gneiss with thin beds, lenses of various hornblendic rocks, pyroxenites and dunites bearing chromite and magnesite. The flat and low-lying areas are covered by a thick mantle of fertile soil; while the elevated portions and hills are capped by laterite.

![Figure 4: Geology map of the study area](image-url)
Sargur schist belt in H.D. Kote taluk noticed to be extending about 40 Km from Sargur to Mysuru city commonly known as Sargur group of rocks (Basavarajappa et al., 2012). Sargur type of structure, deformational folds and joints formations are also observed during field visits. Geology map of the study area derived from Geological map of Karnataka (1:250,000 Scale) and digitized using satellite imagery represents largely of igneous and metamorphic rocks with gneisses, charnockite, amphibolites schist pink and grey granite, meta-ultramafites, hornblende schist, granodiorite, limestone and dolomite with younger Chamundi granite (Basavarajappa et al., 2014a).

### 3.4 Geomorphology

The study area divided into 3 physiographic units; a) northern to eastern riverine plains of Cauvery including south easterly flowing Kabini River which later conflicts at T. Narasipura; b) middle - eastern parts of Hunasuru, H.D Kote, K.R Nagara, Nanjanagudu includes gentle slopes and plains with both irrigated and dry seasonal crops; and c) the other belonging to parts of Western Ghats of Hunasuru and Piriyapatna with thick natural forest (Basavarajappa et al., 2012). Ridges and valleys are mainly restricted to the Nanjungud and H. D. Kote taluks and north western parts of the district. The general elevation of the district ranges from 700-800 m above MSL except for the denudational hills and ridges. South-western parts of the district fall under semi-malnad category with elevation ranging from 2200 to 3150 m. The Hekkan betta (3732 m) of the Naganpur Reserved Forest, the Shige betta (3724 m) of the Ainurmarigudi Reserved Forest and Jainbaribetta (3231 m) of the Bedrampadi reserved forest demark the water divide making the southern boundary of H.D. Kote taluk (Basavarajappa et al., 2014c; CGWB, 2012) (Figure 5).

![Figure 5: Geomorphology map of the study area](image-url)
3.5 Soil types

Soil is the surface material derived from underlying parent rocks due to weathering of rocks and minerals. Soil moisture consists of organic and inorganic materials, water and air (CGWB, 2009). Understanding the nature of lithology is useful in specific crop rotation analysis in most suitable lands to avoid wasteland encroachment (Basavarajappa and Manjunatha., 2014b). Soil map is extracted from satellite imagery and classified into three types namely, red sandy soils, red loamy soils and deep black soils (Figure 6). Most of the soil covered in the district is red sandy soil except a small parts of T. Narasipura taluk. The soils are having high permeability with pH of 7 (neutral) and varying thickness of 1 to 6 m. North-eastern part of T. Narasipura taluk comprises of red loamy soil characterized by clayey content mixed sand with less permeable compare to sandy soil. They show good moisture holding capacity, fertile in nature and varying thickness from less than 1 to 16 m (Basavarajappa et al., 2014c). South-western parts of T. Narasipura taluk shows dark brown, dark grayish brown to very dark grey with observed clayey texture throughout the profile (Basavarajappa et al., 2012).

![Figure 6: Soil map of the study area](image_url)

3.6 Land use/land cover

Land is one of the most important natural resource. Land use refers to man’s activities and the various uses which are carried on land. Land cover refers to natural vegetation i.e. water bodies, rock/soil, artificial cover and others resulting due to land transformations (Basavarajappa and Manjunatha., 2014b; Manjunatha et al., 2014). Although land use is generally inferred based on the cover, yet both are interchangeable. Land use pattern and its spatial distribution are the prime requisites for the preparation of an effective land use planning and management of any area. LU/LC map is digitized using satellite imagery in conjunction with collateral data such as topomaps (Basavarajappa and Dinakar, 2005;
This provides information on existing land use/land cover pattern and their spatial distribution (Figure 7). The following land use/land cover is delineated based on standardized classification system (Basavarajappa and Manjunatha., 2014b).

Figure 7: Land use/land cover map of the study area

### 3.6 Agricultural land

The land primarily used for farming, production of food, fiber and other commercial, horticultural crops including land under corps (irrigated and un-irrigated, fallow, plantations). Major parts of the study area represent rich agricultural lands with nearly level to very gentle sloping areas. Neam, Tamarind, Mango jack are observed to grown in major parts of thick natural forest cover of the district. Paddy, Ragi, Jowar, Sugarcane, Maize, Pulses, Oilseeds, Fruits and Vegetable, Tobacco, Cotton are the principle crops noticed in Hunasuru and Piriyapatna taluks. This category covers an area of 5,826.06 Km$^2$ (Figure 7) (CGWB., 2012).

### 3.7 Built-up land

The land defined as area of human habitation developed due to non-agricultural use and that which has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. Central part of Mysuru taluk shows high human habitation, building and transportation network (Figure 7).
3.8 Forest

The study area includes 3rd richest forest wealth in Karnataka state covering the area of approximately 34.52% and digitized using satellite imagery includes both moist deciduous and dry deciduous forests. Trees such as Teak, Honne, Rosewood, Eucalyptus and Evergreen forests are noticed all along the hill ranges in Western Ghats. The study area is a part of semi-malnad region covering the area of 694.2 Km\(^2\) (CGWB, 2012). Naganpur, Ainurmarigudi and Bedrampadi are the notified reserved forest observed in H.D Kote taluk, eastern parts of the Hunsur and Piriyapatna taluks (Figure 7) (CGWB, 2012).

3.9 Wastelands

Land described as degraded land which can be brought under vegetative cover with reasonable effort which is currently underutilized due to inherent/imposed constraints such as; by location, environment, chemical and physical properties of the soil or financial/management constraints (Basavarajappa and Manjunatha, 2014b). These include salt affected land, waterlogged areas, swampy land, sandy area, barren rocky/stony waste etc (Figure 7).

3.10 Water bodies

These are of impounded water area or in extent and often with a regulated flow of water. It includes man-made reservoirs/lakes/tanks/canals, besides natural lakes, rivers/streams. Cauvery, Kabini, Suvarnavathi, Nugu, Gundal and Laxmanathirtha drain major parts of study area covering an area of 429 Km\(^2\) (Figure 7).

3.11 Others

It includes all those which can be treated as miscellaneous due to their specific nature of occurrence, physical appearance and other characteristics in integrated thematic layer (Figure 7).

4. Wastelands

Wastelands are the degraded lands that are currently underutilized, deteriorating due to lack of appropriate soil and water management or on account of natural causes. The final composite map is derived from 1:250,000 scale Wasteland map of Karnataka (2003) through ArcGIS v10 and Erdas Imagine v2013 (NRSC/ISRO, 2012). Geomatics technique plays a rapid role in the field of land resources, management and developmental strategic programs (Pushpavathi and Basavarajappa, 2009; Basavarajappa and Manjunatha, 2014b). Individual thematic maps are prepared and being overlaid one at a time such as geology, geomorphology, soil types and land use/land to generate final composite map with a particular set of information. The final wasteland map represents the digitized wasteland categories using SoI toponmap of 1:50,000 scale updated from IRS-1D, PAN+LISS III Satellite Image, Google Earth Image using GIS analysis (Figure 8; Table 1).

4.1 Barren/Rocky/Stony waste

The rock exposure of varying lithology often barren and devoid of soil and vegetation cover appears as isolated hill exposures on plateau and plains. They are located in steep isolated
hillocks /hill slopes, crests, plateau and eroded plains associated with barren and exposed rocky /stony wastes, mining and quarrying sites. These areas appear in light gray to black tone on standard FCC 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. These covers a total area of 5.98 Km\(^2\) (0.0873\%) observed in northern parts of Nanjanagudu taluk (Figure 8; Table.1).

4.2 Degraded Forest land

The lands within notified forest boundaries with less than 20% vegetative cover are classified as degraded/underutilized land. Degraded land under plantations are the thick growth of plantation crops located outside the notified forest areas that are better delineated using multi-season satellite data in conjunction with field verified data. These are small in shape exhibiting a regular pattern and scattered. Noticed in western parts of Piriyapatna taluk, Hunsur taluk; northern and southern parts of H.D Kote taluk. They appear as dark gray to light red tone on standard FCC during the maximum green period and tonal variations are mainly due to the type of season of data acquisition. They measure a total area of 46.35 Km\(^2\) (0.6769\%) and observed in eastern parts of Mysuru city (Chamundi hill) and small parts of Nanjanagudu taluk, T.Narasipura taluk (Figure 8; Table.1).

4.3 Gullied and Ravinous land

Gullies are localized surface run-off affecting the unconsolidated material resulting in the formation of perceptible channels causing undulating terrain. Gullies develop from rills which are tiny water channels with a few centimeters deep, formed as a resultant impact of heavy rainfall and weaving action of run-off generated. The word ‘ravine’ denotes gullied land containing systems of gullies running more or less parallel to each other and entering a nearby river flowing much lower than the surrounding table lands (Padmini Pani and Mohapatra., 2001). Ravines are basically an extensive systems of gullies developed along river courses. These cover a total area of 1.27 Km\(^2\) (0.0185\%) and observed in northern and eastern parts of H.D.Kote taluk; southern and central part of Hunasuru taluk; eastern parts of Mysuru taluk; Nanjanagudu taluk and T.Narasipura taluk (Figure 8; Table.1).

4.4 Salt affected area

Salt affected land is a major problem across many parts of the world (Crosbishley and Pearce D., 2007). Land is affected by salinity/alkalinity portray the qualities that have adverse effect on the growth of most plants due to action or presence of excess soluble salts (saline) or high exchangeable sodium. Salt affected lands appear in different tones of dull white to bright white on standard FCC. These are noticed in central parts of K.R. Nagara taluk and H.D. Kote taluk covering total area of 3.11 Km\(^2\) (0.0454\%) (Figure 8; Table.1).

4.5 Scrub land

Scrub land occupies relatively high topographic locations (Ranade., 2007) having tendency for intermixing with cropped areas (ARD., 2009). They appear in light yellow to brown to greenish blue on standard FCC depending on the surface moisture cover and vary in size from small to large on either contiguous or dispersed pattern. These are noticed in northern parts of Piriyapatna taluk, Hunasuru taluk; north-western and south-eastern parts of Mysuru taluk and Nanjanagudu taluk and eastern parts of H.D.Kote taluk covering total area of 79.59 Km\(^2\) (1.1623\%) (Figure 8; Table.1).
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Figure 8: Wasteland map of the study area

![Wasteland map](image1)

Figure 9: Pie-chart depicting the wasteland categories of the study area

![Pie-chart](image2)

Table 1: Wasteland Categories of the study area

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Wasteland Category</th>
<th>Area (Km²)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Barren rocky/stony waste</td>
<td>5.98</td>
<td>0.0873</td>
</tr>
<tr>
<td>2.</td>
<td>Degraded forest land</td>
<td>46.35</td>
<td>0.6769</td>
</tr>
<tr>
<td>3.</td>
<td>Gullied/ravenous land</td>
<td>1.27</td>
<td>0.0185</td>
</tr>
<tr>
<td>4.</td>
<td>Land affected by salinity</td>
<td>3.11</td>
<td>0.0454</td>
</tr>
<tr>
<td>5.</td>
<td>Mining wastelands</td>
<td>0.05</td>
<td>0.0007</td>
</tr>
<tr>
<td>6.</td>
<td>Sands-riverine</td>
<td>1.13</td>
<td>0.0163</td>
</tr>
<tr>
<td>7.</td>
<td>Scrub land</td>
<td>79.59</td>
<td>1.1623</td>
</tr>
<tr>
<td>8.</td>
<td>Utilized land</td>
<td>6709.58</td>
<td>93.8929</td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>99.8954</strong></td>
</tr>
</tbody>
</table>

Total area of wastelands: 6843.06 km²
4.6 Mining/ industrial wasteland

These are the lands with large-scale mining operations, mine dumps and discharge of large scale industrial effluents causing land degradation. The features exhibit dark gray (coal mining areas) to light bluish to black (iron ore waste) tone on standard FCC based on the color of the mine dump, small to medium in size, irregular in shape with mottled texture, located at or near active mining areas and industrial complexes. These are observed in southern parts of Mysuru taluk; northern parts of Piriyapatna taluk; central part of K.R.Nagar taluk and eastern parts of T.Narasipura taluk measuring total area of 0.05Km² (0.0007%) (Figure 8; Table.1).

4.7 Sandy riverine

Sandy areas are developed in situ or transported by aeolian or fluvial processes. These occur as a sandy plain in the form of sand dunes and dune (windblown) sands. Patches of sand bars are noticed along the river Cauvery and meandering areas in the villages of Talakadu, Malangi and Hampapura measuring total area of 1.13Km² (0.0163%) (Figure 8; Table.1).

5. Conclusion

Out of 6,847 Km², 133.48 Km² (2%) of total wastelands are identified using geomatics technique. In the study area, rapid increase in population causing the over-exploitation of natural resources including depletion of soil fertility and degradation of utilized land resources. Main causes in wastelands are unskilled irrigation, over grazing, over-cultivation, deforestation and dumping/ mining wastes observed during field visits. Practices such as bundings, gully plugging, drip irrigation system, agro-forestry, soil, land and water conservation, long-term sustainable utilization of natural resources are noticed in few parts of Mysuru taluk in land reclamation. Growing of prosopis juliflora is very much necessary to reduce the salinity of the soils in problematic salt affected areas. With growing needs of development and exploding population in Mysuru city, urban sprawl is moving towards agricultural land and either sides of State, District and Taluk Highways. To compensate the arising issue, the final results show the availability of wastelands to convert them into agricultural fields with minimum efforts. The proper development and reclamation of wastelands need statistical databank information and consolidated maps of suitable scale to reveal the specific spatial distribution patterns. To prevent further land degradation, it needs appropriate management strategies for solving complex issues in understanding the potentiality of land resources.

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6. References

1. ARD, (2009), Agriculture and Rural Development-single Farm Payment - Claiming Land with Scrub.


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