GEOGRAPHICAL ANALYSIS

RESEARCH ARTICLE

Assessment of Land use/Land Cover Change Detection using Geospatial Techniques in Mannur-1 Microwatershed of Afzalpur Taluk, Kalaburgi District, Karnataka

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Abstract

The study was undertaken with the use of remote sensing and GIS for delineating and planning. For land use/land cover (LULC) mapping, the standard procedure has been used and finally with the help of geospatial technology (ArcGIS10.2.2 software version) the mapping was done. The study area was classified into three land cover classes i.e., agriculture, built-up and water bodies. The majority of the area in the microwatershed was covered by agricultural land (83%) followed by water body (11%) and built up (6%) land. This classification and the land use map will be beneficial to the policy makers, farmers, NGO's and field agricultural officers for planning and development of this watershed. Also rainwater harvesting structures can be provided after estimating the runoff potential and accordingly rainwater conservation structures can be planned for sustainable LULC management.

Keywords: Remote Sensing; GIS; LULC; Geospatial; Agricultural; Water Body; Built Up

Introduction

Land use/land cover (LULC) in the form of maps and statistical data is very vital for spatial planning, management and utilization of land for agriculture, forestry, pasture, urban industrial, environmental studies, economic production etc.[1]. LULC change refers to (quantitative) changes in the areal extent (increases or decreases) of a given type of land use and land cover respectively[2]. According to Dimyati et al. (1996)[3] LULC is two separate terminologies which are often used interchangeably. Land use refers to the way in which land has been used by humans and their habitat, usually with accent on the functional role of land for economic activities (agriculture, urban development, grazing, logging and mining). While land cover refers to the physical characteristics of earth's surface, captured in the distribution of vegetation, water, soil and other physical features of the land, including those created solely by human activities (cropland, forests, wetlands, pasture, roads and settlements). The information on land use/land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare [(4)]. Patangray et al. (2017) [(2)] reported that, land cover changes may result either from land conversion or land modification or even maintenance of land in its current condition against agents of change. Land use changes on the other hand may involve either conversion from one type of use to another or modification of certain type of land use. LULC change is a widespread and accelerating process, mainly driven by natural phenomena and anthropogenic activities, which in turn drive changes that would impact natural ecosystem [(5,6)].

The information on LULC could be used by ecosystem, hydrological and climate modelling as well as by policy makers for assessing the impacts of LULC on regional climate, water resources and biogeochemical cycles in terrestrial ecosystems [(7)]. A complex set of interactions between biophysical and socioeconomic variables drive the LULC changes. These changes are known to impact ecology (forest services, biodiversity, climate, water quality, habitat of wildlife etc.), environment (carbon sequestration, oxygen levels), food security (crop production) and livelihood (source of living) of human population. The spatial analysis of land, with the support of Geographic Information System (GIS) and historical document is a very important tool for monitoring landscape diversity and for investigating changes in vegetation and landscape structure. The impact of land use change on the annual water balance was relatively small due to compensating effects in a complex catchment and the decrease of forest due to a grassland bonus amplifies the peak flow rate and thus increases the risk of flooding. Analyzing land use changes generally requires an integrated approach that considers multiple disciplines, data sources and methodological constructs [(8)]. Considering these facts, the study was conducted on Land use/Land cover change detection using geospatial techniques in Mannur-1 microwatershed of Afzalpur taluk, Kalaburgi district, Karnataka.

Material and Methods

The Mannur-1 microwatershed (Mannur subwatershed) is located in the northeastern part of Karnataka in Afzalpur Taluk, Kalaburagi District, Karnataka State (Figure 1). It lies between 17^0 17’ and 17^0 19’ north latitudes and 76^0 03’ and 76^0 06’ east longitudes and covers an area of 727.02 ha. It surrounded by Chikkamannur village on the south, Maharashtra state in the north, Karajgi on the east and Agarkhed village on the west side. Major rock formations observed in the microwatershed are basalt. The elevation ranges from 411 to 435 m above MSL. The climate is semiarid and categorized as drought-prone with an average annual rainfall of 680 mm and mean maximum temperature of 30^0C to 45^0C. Length of growing period (LGP) is 120 to 150 days. In this study image processing and visual interpretation techniques are carried out to LULC classification by using digital data and standard False Colour Composite (FCC) satellite image. The classification is adopted to prepare land use and land cover map. Standard FCC for satellite image LISS-IV is used for mapping LULC. The methodology followed was on-screen digitization using visual image interpretation elements like tone, texture, size, shape, pattern, association using ArcGIS10.2.2 software version [(4)]. The schematic diagram of the methodology followed was showed in Figure 2.

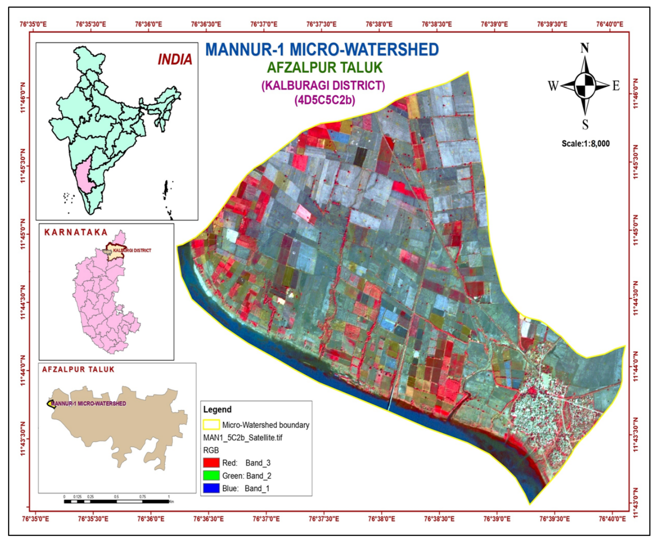

Fig. 1. Location map of Mannur-1 microwatershed

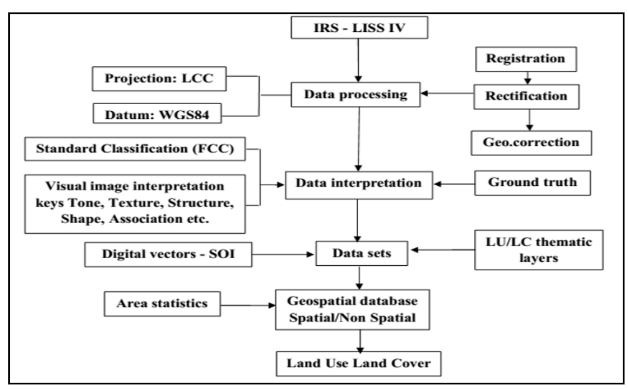

Fig. 2. Flow chart of Land UseLand Cover (LULC) mapping of Mannur-1 microwatershed

Field surveys

Field surveys were conducted within the study areas to determine the major types of land use and land cover. This data is used in two aspects of the mapping of land use and land cover. Firstly, it will aid in land use and land cover classification, by associating the ground features of a specific type of land use and land cover with the relevant imaging and spectral characteristics. Secondly, ground data will be used for accuracy assessment of the developed land use and land cover maps before final mapping [(4,9)].

Digitization

Digitization is a process of converting information into a digital format. In this format, information is organized into discrete units of data that can be separately addressed (usually in multiple bit groups called bytes) [(4,9)] shown in Figure 3 (Land use/Land cover map digitization. The LU/LC map were digitized in ArcGIS 10.2.2 Add the World view imagery and shapefile).

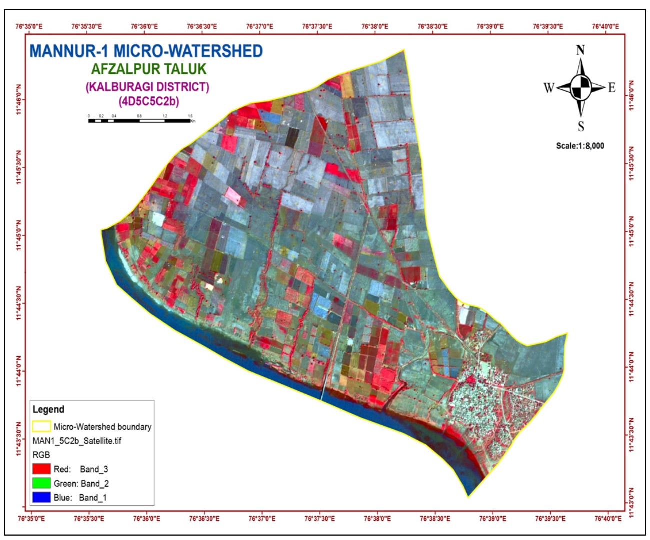

Fig. 3. Screen shot of LULC map digitization

Attributes

Geo-processing tools are used to create and build a land use dataset from satellite data. The tool import the land use feature classes into the file Geo-database and add the appropriate fields to these feature classes. The tools can also processes advanced logistics attribute from data vendors and model them as restrictions and attribute parameters in the land use dataset. Attribute data helps to perform spatial queries and analysis. When information in Geo-database or database changes, attributes can be updated had shown in Figures 4 and 5 (open the attribute tables-click option-add field-add the attribute name) [(4,9)].

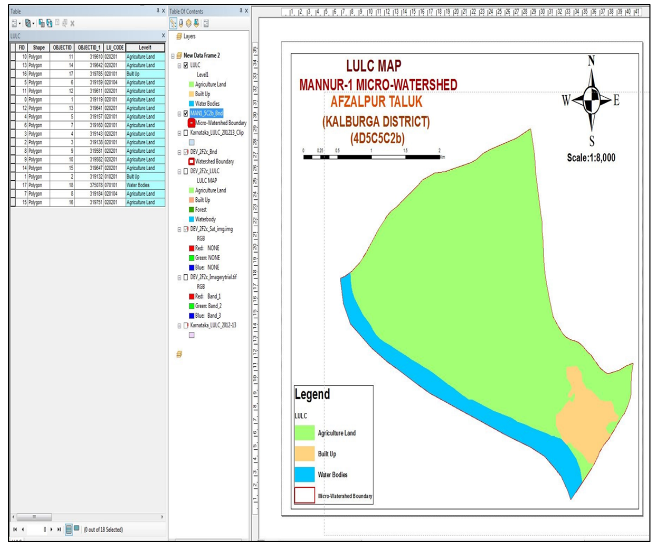

Fig. 4. Screenshot of adding the attribute information and add the label feature of Mannur-1 microwatershed

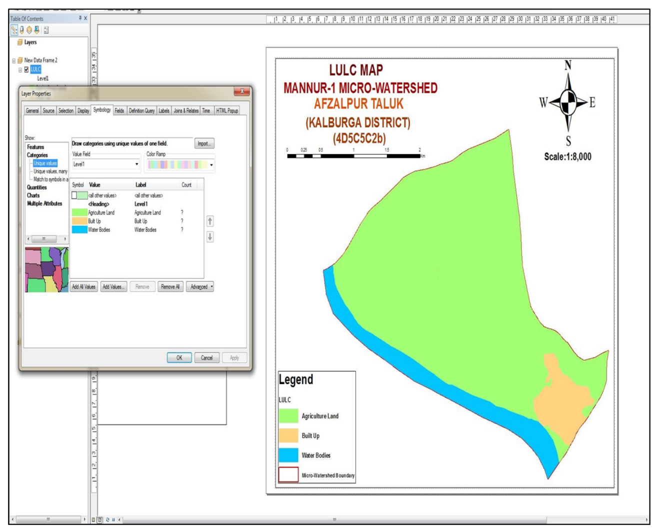

Fig. 5. Screenshot of adding symbol and colour to every LULC classes of Mannur-1 microwatershed

Results and Discussion

The better comprehensive development and management of the Mannur-1 microwatershed is needed to have proper information on LULC and the driving forces that affect the natural resources and also it is used as a primary input data source. IRS LISS-IV data of 1:8000 scales were visually interpreted for delineation of LU/LC categories of the study area. The various LU/LC classification levels based on visual interpretation, supervised classification in the study area includes agricultural land, built-up land and water bodies. The final map of LU/LC was generated by visual interpretation by using false colour composite satellite image from Landsat IRS LISS-IV and along with field verifications.

The registration and digitization of the watershed was done using ArcGIS10.2.2 software version to create land use coverage. The area and per cent distribution of land use/land cover classes of Mannur-1 microwatershed were depicted in Table 1. The land use/land cover maps of Mannur-1 microwatershed area were shown in Figures 6 and 7.

Table 1. Land use/Land Cover classification

S. No.	Land Use/Land Cover Clases	Area (ha)	Per centage (%)
1	Agriculture Land	606.26	83
2	Built Up	44.66	6
3	Water Bodies	76.10	11
Total		727.02	100

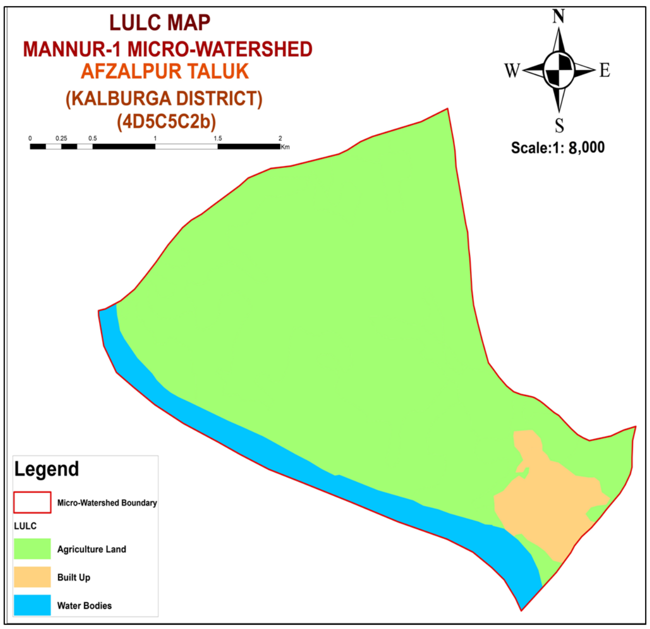

Fig. 6. LULC map of Mannur-1 microwatershed

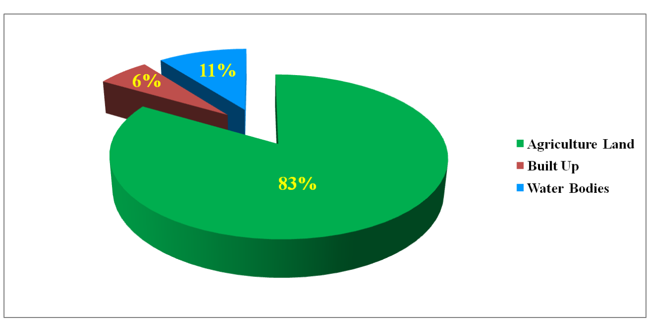

Fig. 7. Pie-chart of LULC classification of Mannur-1 microwatershed

Agricultural Land

Agricultural land is described as land primarily used for farming and for the production of crops to produce food, fiber and other commercial and horticultural crops for humans. This land includes cropland, pasture, orchards, vineyards, nurseries, ornamental horticultural areas and confined feeding areas. In the study area, agricultural land mostly includes crop lands.

The cultivated cropland comprises land in close grown crops and also other cultivated cropland (hay land or pasture land that is in a rotation with close grown crops). The crops can be either kharif or rabi or kharif-rabi seasons. In this study, the cropland occupies an extent of about 606.26 ha (83%). Dryland cultivation is the dominant land use category in the study area. Majorly sorghum, sunflower, redgram, bengal gram, cotton and other horticultural (brinjal, onion, bhendi, marigold, custard apple, lime etc.) crops are growing in this watershed. Similar results were also found by Mahender Reddy et al.[(9)] and Rajendra Hegde et al.[(4)].

Built up (Rural)

Built up area is a human settlement developed due to non-agricultural use and has a cover of buildings, transport and communications, utilities in association with water, vegetation and vacant lands. Cities, towns, villages, industrial and commercial complexes and institutions are included in this category. The rural area is characterized by built-up areas are smaller in size, mainly associated with agriculture and allied sectors and non-commercial activities. Most of the people are involved in the primary activity of agriculture. In this study, the built up area occupies an area of about 45 ha (6%). This may be due to gradual conversion of cultivable area into built-up area or human developmental area due to significant increase population. Similar findings were noticed by Praveen Kumar Mallupattu and Jayarama Reddy Sreenivasula Reddy[(10)] and Rajendra Hegde et al.[(4)].

Water bodies

A water body is any significant accumulation of water on the surface of Earth. The water bodies include both natural and manmade water features such as oceans, seas, rivers, streams, canals, lakes, ponds, tank, reservoirs and other geographical features where water moves from one place to another are also considered as bodies of water. In this study, the identified water bodies such as small tanks and natural ponds occur in an area of about 76 ha (11%). The available water body in the microwatershed may helpful to facilitate daily water requirement for the increasing population and it play a vital role in the areas of ecology, economy, transportation and general health of the system[(4)].

Conclusion

The using of geospatial technology represents most of the area in the microwatershed was covered by Agricultural land (83%) followed by water body (11%) and finally built up area (6%). This study is more important for knowing the land use and land cover area in the microwatershed. This study visibly shows the important effect of population, ecological and its growth activities on land use changes. This study proves that, integrated effort of geospatial technology is most effective methods for land use mapping with development, planning and management. The importance of land use mapping of microwatershed is most useful for environmental management groups, policymakers and for public to better understand the surrounding. Also based on the LULC pattern the runoff generation can be estimated with provision of rainwater harvesting structures.

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