

MAPPING OF MORNI SUBWATERSHED USING HIGH RESOLUTION SATELLITE DATA

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Abstract- Land use/land cover (LU/LC) mapping was done in Morni Subwatershed, Panchkula, of 2015-16 by using Geographical Information Systems (GISs) and remote sensing technology. These studies were employed by using the Survey of India topographic map 53F/03 and the remote sensing data of LISS IV and WORLDVIEW-2 with 8 band multispectral data. The study area was further classified into seven subwatershed on the basis of field study, geographical conditions, and remote sensing data. Scrub forest is the predominant land cover with in the classification of forest land, accounting about three fourth (77.23%) or 5059.76 ha of total geographical area. Terrace cultivation covered almost 16.26% of total area or 1065.38 ha.

1. INTRODUCTION

Land use/cover is two separate terminologies which are often used interchangeably (Dimiyati et al., 1996). 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 e.g., settlements. While 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. The land use/cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Information on land use/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. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population.

Land use affects land cover and changes in land cover affect land use. Changes in land cover by land use do not necessarily imply degradation of the land. However, many shifting land use patterns driven by a variety of social causes, result in land cover changes that affects biodiversity, water and radiation budgets, trace gas emissions and other processes that come together to affect climate and biosphere (Riebsame et al., 1994). Land use/cover change detection is very essential for better understanding of landscape dynamic during a known period of time having sustainable management. Land use/cover changes is a widespread and accelerating process, mainly driven by natural phenomena and anthropogenic activities, which in turn drive changes that would impact natural ecosystem (Ruiz-Luna and Berlanga-Robles, 2003; Turner and Ruscher, 2004). Understanding landscape patterns, changes and interactions between human activities and natural phenomenon are essential for proper land management and decision improvement. Today, earth resource satellites data are very applicable and useful for land use/cover change detection studies (Yuan et al., 2005; Brondizio et al., 1994).

1.1 Study Area

The present study was carried out for Morni sub-watershed in Panchkula district. It is located at latitude 30°40'17"-30°46'10"N and longitude 77°00'01"-77°09'52"E. It covers an area of about 6551.40 ha. The study area is divided in 7 micro-watersheds named as M1, M2, M3, M4, M5, M6 and M7.

The study area has climate having, hot summers, cool winters and good monsoon rainfall. It has great variation in temperature (-1 °C to 43 °C). The average annual rainfall of the area is 720.68 mm, out of which 80% of annual rainfall is received in June to September months. It also receives some rainfall in winter months due to western disturbances. Despite heavy rains in the area, water retention is very low because of steep slope which develops high surface runoff. Generally, the slope of the district is from north east to south west and most of the seasonal streams flow down and while spreading gravels/pebbles on its way. Morni hills constitute the highest point of Panchkula as well as of Haryana.

1.2 Data and Tools Used for LU/LC

Survey of India (SOI) Toposheet No. 53F/03 on 1:50,000 scale were used to delineate the study area. Very high resolution data from WORLDVIEW-2 satellite with 8 band multispectral capabilities of April 11, 2012, June 11,

2012 and June 12, 2012 on 1:2500 scale were used for digitization of land use/land cover map. Specification of satellite data is given in Table 1.1.

Table-1.1 Specification of Satellite Data

Satellite	Mode	Spectral Resolution (μm)	Spatial Resolution (m)	Path No.	Row No.
Worldview-2	Multispectral	Coastal band: 0.400 – 0.450 Blue: 0.450 – 0.510 Green: 0.510 – 0.580 Yellow: 0.585 – 0.625 Red: 0.630 – 0.690 Red-edge: 0.705 – 0.745 Near IR1: 0.770 – 0.895 Near IR 2: 0.860 – 1.040	1.84	95	49

2. MAPPING OF DIFFERENT FEATURES

2.1 Delineation of Study Area

The Survey of India Toposheet No. 53B/13, 53/14 and 53F/02 on 1:50,000 scale were used to delineate the study area.

2.2 Geo-referencing

Satellite data which is available in raster form needs to be geo-referenced to a map coordinate system so as to generate special information to be used subsequently in GIS environment. The process of geo-referencing spatial coordinate system WGS 1984 UTM zone 43N was assigned to raster image for the transformation of raster image to input coordinate system. All required images were rectified and then subjected to mosaicing and image enhancement.

3. GENERATION OF SUB-WATERSHED AND MICRO-WATERSHEDS BOUNDARIES

Boundary map of sub-watersheds (a) and micro-watersheds (b) was collected from department of Agricultural land, Haryana and then scanned. The scanned maps were rectified with already geo-referenced image of **LISS-IV satellite data**. Then, final boundaries of sub-watershed and micro-watersheds were digitized from rectified maps. The vector layers of these boundaries were overlaid on **WORLDVIEW-2** satellite image.

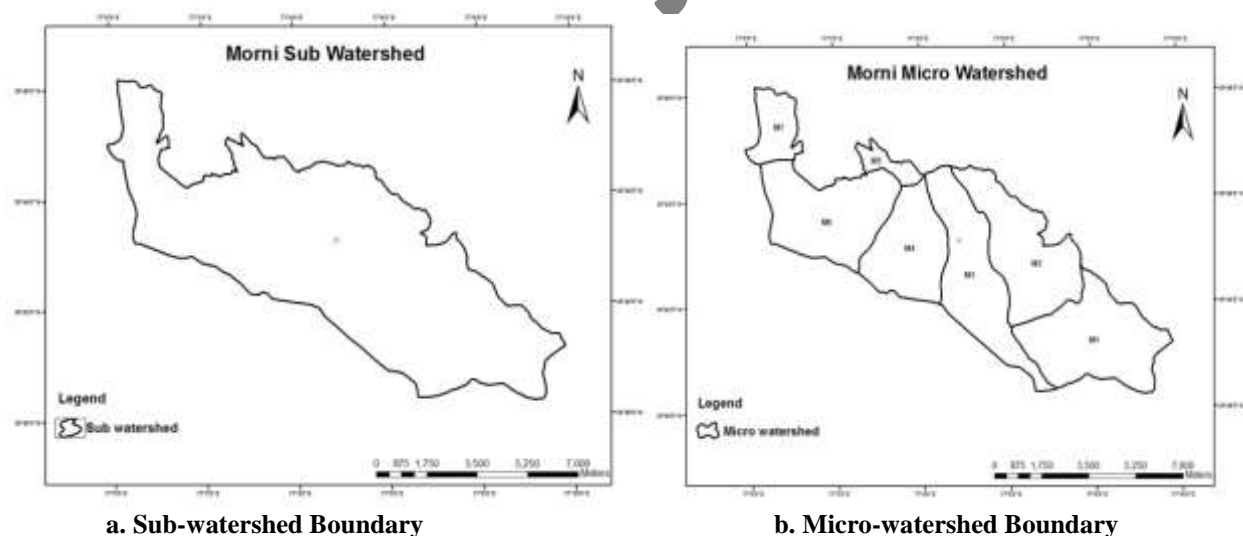


Fig. 3.1 Different Boundary Maps as Derived from SOI Toposheet

3.1 On Screen Digitization

On screen digitization was done on **WORLDVIEW-2** satellite data imagery on 1:2500 scale. The False Color Composite (FCC) (Blue, Green and Near IR1 band) of study area was prepared for preparation of land use/land cover maps. Land use/land cover was categorized in to different classes of built up area/settlement, agricultural land, wasteland, water bodies and forest. These areas were further sub-divided as shown in Table 3.1.

Table-3.1 Land Use/Land Cover Classification

S. No.	Land use/land cover class	Subclass
1.	Built up area/settlement	1.1 Rural settlement 1.2 Urban settlement 1.3 Industry/Institute 1.4 Single building
2.	Agricultural land	2.1 Cropped land 2.2 Terrace cultivation 2.3 Old agricultural plantation 2.4 Young agricultural plantation
3.	Scrub (Wasteland)	3.1 Dense Scrub 3.2 Open scrub
4.	Water bodies	4.1 River course 4.2 Pond 4.2.1 Natural pond 4.2.2 Artificial pond
5.	Forest	5.1 Dense forest 5.2 Open forest 5.3 Scrub Forest

3.2 Interpretation of Data

On screen visual interpretation technique was used for the preparation of land use/land cover maps of study area. The interpretation used for identifying the classes was based on the standard visual interpretation elements such as shape, size, color, tone, texture and pattern. Interpretation key for each land use/land cover class is given in Table 3.2.

Table-3.2 Land Use/Land Cover Class Interpretation Key

Land use/land cover	Tone	Size	Shape	Texture	Association
Built-up area/settlements	Whitish	Varying	Definite	Coarse	Streets
Agricultural land					
➤ Cropped land	Greenish		Definite	Fine to medium	Outskirts of settlements
➤ Terrace cultivation	Greenish	Varying	Definite	Fine to medium	Foothill/Rocky slope
➤ Old agricultural plantation	Dark red Light red		Regular	Coarse with mottling	Agricultural land
➤ Young agricultural plantation			Regular	Coarse with mottling	Agricultural land
Scrub (Wasteland)	Brown/Dull red	Varying	Irregular	Coarse	River/Rocky area
Water bodies					
➤ River course	Dark blue		Irregular		Built up area/agricultural land/scrub/forest
➤ Pond		Varying		Smooth	
• Natural pond	Light blue		Irregular		
• Artificial pond	Light blue		Regular		Built up area
Forest					
➤ Dense forest	Bright red			Coarse with mottling	
➤ Open forest	Red	Varying	Irregular		Outskirt of agricultural land
➤ Scrub Forest	Dull red/Brown			Coarse with dark mottling Coarse with dark mottling	

3.3 Ground Truth Verification

Ground truth refers to information that is collected “on location”. It is important to relate image data with real features on ground. Collection of ground truth data enables calibration of remote sensing data, aids in interpretation and analysis of what is being sensed. The preliminary interpreted maps were taken to ground truth verification. Doubtful areas were checked in field and modifications were done as per ground verification. Various photographs of study area including land use/land cover features such as scrubland, agricultural land, forest land etc. were also taken.

4. RESULTS

Morni sub-watershed has a total geographical area of 6551.40 ha. It consists of 7 micro-watersheds. M1 is the biggest micro sub-watershed and M4 is the smallest micro sub-watershed. Scrub forest is the predominant land cover with in the classification of forest land, accounting about three fourth (77.23%) or 5059.76 ha of total geographical area. Terrace cultivation covered almost 16.26% of total area or 1065.38 ha. Symbols and area under different micro-watersheds is given in Table 4.1.

Table-4.1 Area Under Different Micro-Watersheds of Morni Sub-Watershed

Micro-watershed	Symbol	Area (ha)	Area in %
1	M1	1374.50	20.98
2	M2	1220.61	18.63
3	M3	1225.90	18.71
4	M4	164.84	2.52
5	M5	919.44	14.03
6	M6	1274.61	19.46
7	M7	371.50	5.67

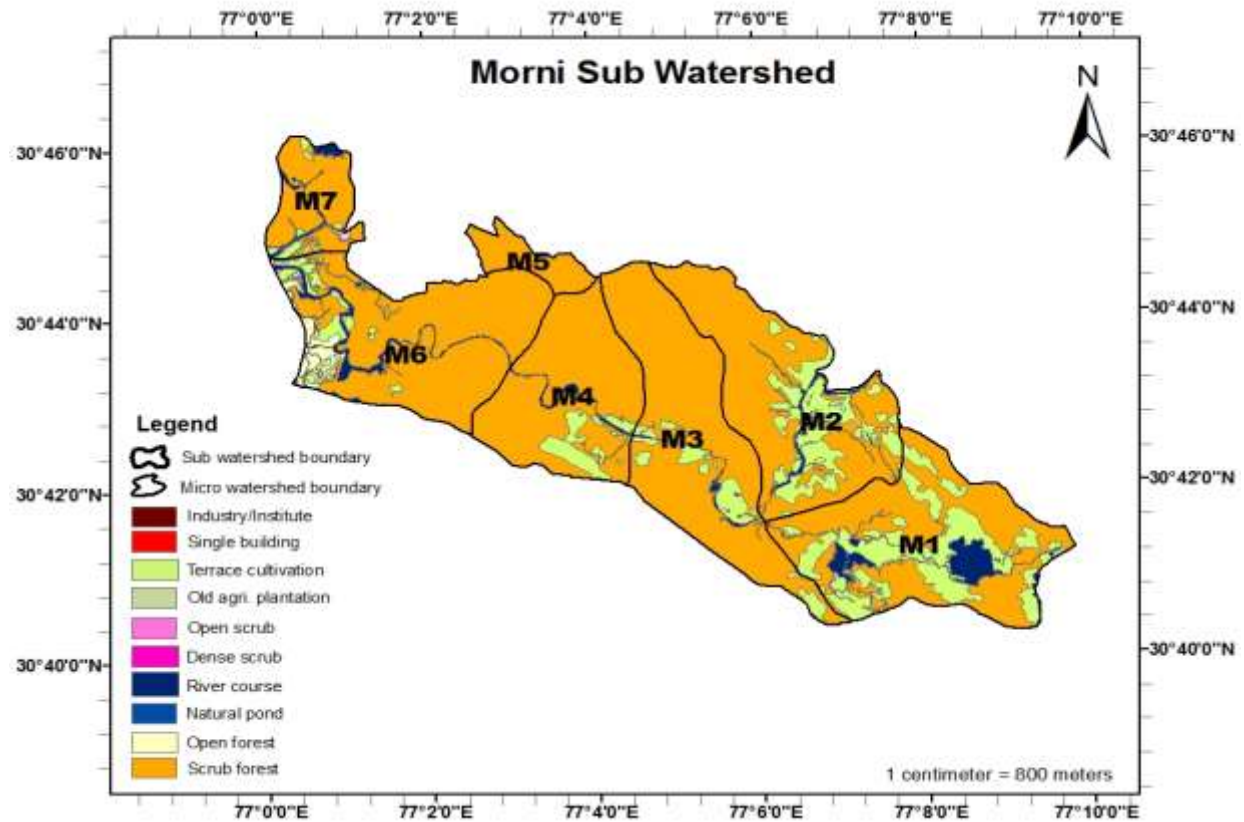


Fig. 4.1 Land Use/Land Cover Map of Morni Sub-Watershed

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Land use and land cover of Morni sub-watershed is given in Table 4.2 and Figure 4.1. Most of the area is covered by scrub forest land which was maximum in M3 (1083.62 ha) followed by M6 (1038.94 ha). Area under water bodies (river course) is greater in M1 (126.45 ha). Scrub land covers few area only in M6 (5.64 ha) and M7 (10.23 ha). Morni sub-watershed has 0.79 ha (0.01%) delineated area under natural water bodies (ponds) as two natural water bodies (ponds). Morni sub-watershed has an elevation variation ranges from 455 to 1453.43m. Most undulating sub-watershed of Panchkula district is Morni sub-watershed.

CONCLUSION

Forest land is the predominant land cover accounting for about three fourth part (78.18%) in the study area. About 5.21% area is occupied by water bodies and Only 2 natural ponds were observed in the study area. The baseline information generated on land use/land cover of the area would be of immense help in formulation of policies and programmes required for developmental planning. Successful application of remote sensing data to study Land Use and Land Cover, Topography, Groundwater Quality, Slope, Geology, Geomorphology, Flow Direction etc. shows that it is possible to use these techniques in combination to solve various issues.

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