NATURAL RESOURCE CENSUS

Land Use / Land Cover Analysis- Third Cycle

Technical Document on –

Land Use / Land Cover Database for Dissemination through Bhuvan

Land Use & Cover Monitoring Division
LRUMG
Remote Sensing Applications Area
NATIONAL REMOTE SENSING CENTRE
(DEPT. OF SPACE, GOVT. OF INDIA)
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15.	**Abstract(with Keywords)**	The geo-spatial database on "Land Use/ Land Cover (Third Cycle) on 1:50,000 scale" is prepared using three season Resourcesat-2 ortho rectified LISS-III data of 2015-16. Entire database are prepared by NRSC, ISRO under Natural Resources Census (NRC) Project of National Natural Resources Repository (NRR) Programme with the participation of 29 State Remote Sensing Centers spread over entire country. Interpretation of satellite imagery is done using visual interpretation technique and individual classes were interpreted using their visual characteristics. The LULC database is prepared with 54 class LULC Classification Schema and are harmonized to 24 class for disseminating through Bhuvan, ISRO Geoportal by emphasing more on Land Cover. Output is in GIS vector file format, prepared using LCC projection and WGS84 as datum. This will serve the requirements of academia, researchers, planners etc.			

NATURAL RESOURCE CENSUS LAND USE LAND COVER DATABASE FOR DISSEMINATION THROUGH BHUVAN

INTRODUCTION

Earth observations from space platforms play a crucial role in generation and dissemination of information on LULC pattern in a timely and reliable manner providing vital inputs required for optimal land use planning. The evolution of Indian remote sensing program over the past two decades, providing a variety of remote sensing- based solutions for national development, is an apt and timely national initiative. Some of the important projects of ISRO/DOS under the theme of LULC are given in the Table – 1.

Table – 1: Major Land Use Land Cover Mapping Projects carried out by ISRO / DOS

S.NO.	PROJECT NAME	YEAR
1	Nationwide Wasteland Mapping	1985, 1986 – 1999, 2003, 2005-06, 2008-09, 2015-16
2	Land Use Land Cover Mapping for Planning based on Agro-Climatic Zone	1989 – 1990
3	Nationwide Wetland Mapping	1995
4	Urban Sprawl of Million Plus Cities	1988 – 1990
5	Land Use Land Cover Database for Zoning Atlas for siting of Industries	1999
6	Urban Information Systems (BMR; NCR; MMDA; AUDA, HUDA,NCRPB etc.	From 1990 onwards at different times
7	Land Use Land Cover Mapping using AWiFS data	2004 onwards at one year of interval
8	Integrated Mission for Sustainable Development	1992-1998
9	Integrated Resource Information for Desert Areas	2002
10	Land Use/Land Cover Mapping on 1 : 50,000 scale	2005-06, 2011-12

A project on National Land Use/ Land Cover Mapping on 1:50,000 scale (Second Cycle) using multi-temporal Resourcesat-2 terrain corrected Linear Imaging Self Scanning Sensor (LISS) -III data was taken up by DOS, under Natural Resources Census (NRC) Project of National Natural Resources Repository (NRR) Program. The project has been accomplished with the active participation of various state, central, universities and others partner institutes. The land use/land cover classification scheme of 1:50,000 scale consists of Level-I: 8 classes, Level-II: 31 classes and Level-III:
54 classes (NRSC, 2012). This classification was finalized after elaborate discussions within the DOS and various Central/State government departments/institutions. The project had been completed and atlas (NRSC, 2011) was released for the use of various departments central, state and others. LULC data is regrouped for web users with an emphasis on land cover classes as given in Table - 2. This has been undertaken keeping in view of volume of data, faster access to database and visualization.

Table – 2: Grouping of LULC classes of 3rd cycle

Sl.	Description-1	Description-2	Classes from NRC LULC50K Mapping Project
1	Builtup	Urban	Built up – Compact (Continuous), Built up – Sparse (Discontinuous), Built up – Vegetated / Open area, Industrial area, Ash / Cooling Pond / effluent and other waste
		Rural	Rural
		Mining	Mining – Active, Mining – Abandoned, Quarry
2	Agriculture	Crop land	Kharif, Rabi, Zaid, Cropped in 2 seasons, Cropped in more than 2 seasons
		Plantation	Agriculture Plantation
		Fallow	Fallow land
		Current Shifting cultivation	Shifting cultivation – Current
3	Forest	Evergreen / Semi evergreen	Dense / Closed and Open category of Evergreen / Semi evergreen
		Deciduous	Dense / Closed and Open category of Deciduous and Tree Clad Area
		Forest Plantation	Forest Plantation
		Scrub Forest	Scrub Forest, Shifting Cultivation – Abandoned
		Swamp / Mangroves	Dense / Closed & Open Mangrove
4	Grass/ Grazing	Grass/ Grazing	Grassland: Alpine / Sub-Alpine, Temperate / Sub Tropical, Tropical / Desertic
5	Barren/unculturable/Wastela	Salt Affected Land	Salt Affected Land
		Gullied / Ravinous Land	Gullied, Ravinous
		Scrub land	Dense / Closed and Open category of scrub land
		Sandy area	Desertic, Coastal, Riverine sandy area
		Barren rocky	Barren rocky
		Rann	Rann
6	Wetlands / Water Bodies	Inland Wetland	Wetland - Inland Natural (Ox-bow lake, cut off meander, waterlogged etc.), Inland Manmade (Water logged, saltpans etc.)
		Coastal Wetland	Wetland – Lagoon, creeks, mudflats, Saltpan etc.
		River / Stream / canals	Perennial & Non-Perennial River, Canal / Drain
		Water bodies	Aquaculture, Permanent & seasonal Lake/Ponds, Reservoir/Tanks
7		Snow	Snow

DESCRIPTION OF LAND USE AND LAND COVER CLASSES

LULC classification scheme and brief description of classes are as given hereunder:

Land Cover is defined as observed physical features on the Earth's Surface. When an economic function is added to it, it becomes Land Use. (FAO, 2005).

1.0 BUILT-UP LAND

It is an area of human habitation developed due to non-agricultural use and that has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. Web LULC map consists of 3 classes under built-up viz., urban, rural and mining.

1.1 Urban: Urban areas are non-linear built up areas covered by impervious structures adjacent to or connected by streets. This cover is related to centers of population. This class usually occurs in combination with, vegetated areas that are connected to buildings that show a regular pattern, such as vegetated areas, gardens etc. and industrial and/or other areas. (FAO, 2005).It includes residential areas, mixed built-up, recreational places, public / semi-public utilities, communications, public utilizes/facility, commercial areas, reclaimed areas, vegetated areas, transportation, industrial areas and their dumps, and ash/cooling ponds.

1.2 Rural: These are the lands used for human settlement of size comparatively less than the urban settlements of which the majority of population is involved in the primary activity of agriculture. These are the built-up areas, smaller in size, mainly associated with agriculture and allied sectors and non-commercial activities. They can be seen in clusters non- contiguous or scattered.

1.3 Mining: Mining areas encompass area under surface mining operations. The recognizable impacts of these activities on the landscape are unmistakable giant pit mines covering vast areas. The presence of water bodies does not necessarily imply inactive or unused extractive areas; ponds or lakes are often an integral part of an extractive operation. (USGS, 1999) It includes surface rocks and stone quarries, sand and gravel pits, brick kilns, etc. These are areas of stockpile of storage dump of industrial raw material or slag/effluents or waste material or quarried/mixed debris from earth's surface.

2.0 AGRICULTURAL LAND

These are the lands primarily used for farming and for production of food, fiber, and other commercial and horticultural crops. It consists of:

2.1 Cropland: These are the areas with standing crop as on the date of Satellite overpass. Cropped areas appear in bright red to red in color with varying shape and size in a contiguous to non- contiguous pattern. They are widely distributed indifferent terrains; prominently appear in the irrigated areas irrespective of the source of irrigation. It includes kharif, rabi and zaid crop lands along with areas under double or triple crops.

2.2 Plantations: These are the areas under agricultural tree crops planted adopting agricultural management techniques. Depending on the location, they are exhibit a dispersed or contiguous pattern. Use of multi-season data will enable their separation in a better way. It includes agricultural plantation (like tea, coffee, rubber etc.) horticultural plantation (like coconut, arecanut, citrus fruits, orchards, fruits, ornamental shrubs and trees, vegetable gardens etc.) and agro-horticultural plantation.

2.3 Fallow: An agricultural system with an alternation between a cropping period of several years and a fallow period. (Ruthenberg, 1980). In another terms these are the lands, which are taken up for cultivation but are temporarily allowed to rest, un-cropped for one or more season, but not less than one year.

2.4 Current Shifting Cultivation areas: This describes the growing of crops for a few years on selected and clear plots, alternating with a lengthy period of vegetative fallow when the soil is rested. The land is cultivated for less than 33 percent of the time (Ruthenberg, 1980). This cover is followed by the vegetative and / or bare cover of the fallow period that can last for several years (Shaneret. Al., 1982). These are the areas which are clearly perceptible on the satellite image that are in pre-burnt /post-burnt condition as bright white or with bluish small irregular patches amidst forest patches that are red in colour.

3.0 FOREST

The term forest is used to refer to land with a tree canopy cover of more than 10 percent and area of more than 0.5 ha. Forests are determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 m (MOEF, 2011). It consists of:

3.1 Evergreen/Semi-Evergreen: This term as such describes the phenology of perennial plants that are never entirely without green foliage (Ford-Robertson, 1971). This category comprises of tall trees, which are predominantly remain green throughout the year. It includes both coniferous and tropical broadleaved evergreen species. Semi- evergreen is a forest type that includes a combination of evergreen and deciduous species with the former dominating the canopy cover.

3.2 Deciduous: This applies to the phenology of perennial plants that are leafless for a certain period of the year (Ford-Robertson, 1971). The leaf shedding usually takes place simultaneously in connection with the unfavorable season (UNESCO, 1973).

These are the forest types that are predominantly composed of species, which shed their leaves once a year, especially during summer. It also includes tree clad area with tree cover lying outside the notified forest boundary areas that are herbaceous with a woody appearance (e.g. bamboos, palms, tree ferns etc.).

3.3. Forest Plantation: These are the areas of tree species of forestry importance, raised and managed especially in notified forest areas. The species mainly constitute teak, Sal, eucalyptus,

casuarina, bamboo etc.

3.4. Scrub Forest: These are the forest areas which are generally seen at the fringes of dense forest cover and settlements, where there is biotic and abiotic interference. Most times they are located closer to habitations. Forest blanks which are the openings amidst forest areas, devoid of tree cover, observed as openings of assorted size and shapes as manifested on the imagery are also included in this category.

3.5 Littoral/Swamp/Mangrove Forest: These are tropical and subtropical vegetation species that are densely colonized on coastal tidal flats, estuaries salt marshes etc. This category includes all the areas where the canopy cover/density is above10%.

4.0 GRASS / GRAZING LAND

These are the areas of natural grass along with other vegetation, predominantly grass-like plants (Monocots) and non-grass-like herbs (except Lantana species which are to be classified as scrub). It includes natural/semi-natural grass/ grazing lands of Alpine/Sub-Alpine or temperate or sub-tropical or tropical zones, desertic areas and manmade grasslands.

5.0 WASTELANDS

Described as degraded lands which can be brought under vegetative cover with reasonable effort and which is currently underutilized and land which is deteriorating for lack of appropriate water and soil management or on account of natural causes. It consists of:

5.1 Salt-Affected Land: Generally characterized as land that has excess salt in the soils with patchy growth of grasses.

5.2 Gullied / Ravinous Land: They are the resultant of terrain deformation due to water erosion which occurs widely in all agro-climatic zones. Gullies are formed as a result of localized surface run-off affecting the unconsolidated material resulting in the formation of perceptible channels causing undulating terrain. They are mostly associated with stream courses, sloping grounds with good rainfall regions and foothill regions. These are the first stage of excessive land dissection followed by their networking which leads to the development of ravinous land. Ravines are basically extensive systems of gullies developed along river courses.

5.3 Scrub Land: These areas possess shallow and skeletal soils, at times chemically degraded extremes of slopes, severely eroded or subjected to excessive aridity with scrubs dominating the landscape.

5.4 Sandy Area: These can occur in coastal, Riverine or inland areas. Desertic sands are characterized by accumulation of sand developed in situ or transported by Aeolian processes. Coastal sands are the sands that are accumulated as a strip along the sea-coast. Riverine sands are those that are seen as accumulations in the flood plain as sheets which are the resultant phenomena of river flooding.

5.5. Barren Rocky/Stony Waste: These are rock exposures of varying lithology often barren and devoid of soil and vegetation cover.

5.6 Rann Area: An extensive salt marsh of western India between the Gulf of Kutch and the Indus River delta.

6.0 WETLAND / WATER BODIES

All submerged or water-saturated lands, natural or man-made, inland or coastal, permanent or temporary, static or dynamic, vegetated or non-vegetated, which necessarily have a land-water interface, are defined as wetlands. It consists of:

6.1 Inland Wetlands: These are the areas that include ox-bow lakes, cut-off meanders, playas, marsh, etc. which are seasonal as well as permanent in nature. It also includes manmade wetlands like waterlogged areas (seasonal and perennial).

6.2 Coastal Wetland: These include estuaries, lagoons, creek, backwater, bay, tidal flat/mud flat, sand/beach, rocky coast, mangrove, salt marsh/marsh vegetation and other hydrophytic vegetation and saltpans.

6.3 River /Stream / Canals: Rivers/streams are natural course of water flowing on the land surface along a definite channel/slope regularly or intermittently towards a sea in most cases or in to a lake or an inland basin in desert areas or a marsh or another river. Canals are artificial water course constructed for irrigation, navigation or to drain out excess water from agricultural lands.

6.4 Water Bodies: This category comprises areas with surface water in the form of ponds, lakes, tanks and reservoirs.

7.0 SNOW AND GLACIERS

These are the areas under snow cover confined to the Himalayan region. They are mostly located in mountain peaks and steep slopes/high relief areas. These are the areas which remain under snow either on temporary or permanent basis. These are the areas under perpetual snow cover throughout the year. They are the origins of most of Himalayan river systems.

METHODOLOGY

On-screen visual interpretation was used in the current exercise wherein the GIS LULC vector layer created during the first cycle was overlaid on to the terrain corrected Resourcesat 2 LISS III imagery acquired during 2015-16. The methodology essentially is based on editing the above vector layer for the changed areas thereby creating the new LULC vector layer for 2015-16.

DATASETS

Resourcesat-2 terrain corrected data from LISSIII sensor of 3 seasons pertaining to 2015-16 and LULC Vector of 2011-12 are used in this study.

Monsoon Season – Kharif	: August - October
Post-Monsoon – Rabi	: December - March
Pre-Monsoon – Zaid	: April – May

The specific path and row of the satellite data along with date of pass will be displayed when the user is querying the map.

SUGGESTED USE:

The LULC maps should be used at broad level for the following purposes:

- Scientific research involving carbon cycle, hydrologic cycle, energy budget studies, weather / climate prediction etc.;
- Siting of industries, SEZs etc.;
- Land improvement programmes;
- Watershed management;
- Coastal zone management;
- Agricultural productivity improvement and

DISCLAIMER

- Different land use and land cover classes accuracies are subjected availability of appropriate biological windows of satellite data.
- Data cannot be used for any legal purpose.
- User shall exercise reasonable skill, care and diligence while using the information and will keep indemnified NRSC/ISRO in respect of any loss, damage or claim howsoever arising out of use of this information.

USER RESTRICTION

I. Database should be used at scales smaller than 1:100,000
II. User of this data/information will consult NRSC to commercially exploit / use the intellectual property generated in the Projects.

CONTRIBUTORS

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Annexure – I

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