

**LAND COVER ANALYSIS OF MOUNTAINOUS HIMALAYAN SYSTEM
USING GEOSPATIAL TOOLS
A CASE STUDY OF SINDH VALLEY (KASHMIR)**

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ABSTRACT

Research area (Sindh Valley) is a typical environmentally fragile terrain undergoing tremendous pressure on its natural resources. Considering the watershed as basic resource unit, the impacts of development are noteworthy. Indian Remote Sensing Satellite (IRS LISS III) data have been used in this study along with other collateral information for deriving land cover classes. Interpretations have been done using optical bands of IRS/LISS III sensor with good spectral resolutions in visible to near infra-red range and spatial resolution of 23.5 meters. Ground-truth studies were done with suitable ground control points (GCPs). A total of eleven land cover classes were identified, ranging from dense forest to snow cover. Remote sensing technique have been found to be cost-effective, labour effective and time effective for such studies. A significant component of this research element involves improvements in data collection systems and data products. Research on current land cover will provide new information to enable the production of regular updates on the distribution of land cover at scales relevant for analysis and resource management decisions in a mountainous environment. Sustainable development and environmental conservation strategies are perceived to work out faster and precisely using this methodology for such inaccessible and difficult terrain.

INTRODUCTION

Mountain environments cover some twenty-seven percent of the world's land surface, and directly support the twenty-two percent of the world's population who live

within mountain environs. Lowland people also depend on mountain environments for a wide range of goods and services, including water, energy, timber, biodiversity maintenance, and opportunities for recreation and spiritual rejuvenation. There is pronounced variation in the nature of mountain environments despite their common basic physical conditions of elevation and slope. Much of this variation arises from differences in temperature and precipitation regimes associated with latitudinal position on the Earth's surface – whether high or low, deep within a continental landmass or under oceanic influence along the margins of a landmass.

The Himalayas are the youngest folded mountainous formations of India, and the youngest in world as well. The Aravallis, Nilgiris, and the Eastern Ghats are 1500 to 2500 million years old, and the Vindhya-chals around 1000 million years old (Swaminathan, 1992). By comparison the Himalayas date back to only 40-45 million years. They traverse an arc for about 2500 km between the Indus and the Brahmaputra. The average width of this

mountain range along the entire longitudinal extension ranges from 100 to 400 km. *Upadhyay* (1995) estimated that the Himalayas cover an area of 4.6 million sq. km. above 1500 m, 3.2 million sq. km. above 3000 m and 0.56 million sq. km. above 5400 m. The Himalayas extend from west to east, from the Pamir Knot in the northwest to the valley of the Brahmaputra River in the east. The range passes through Afghanistan, Pakistan, India (Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Sikkim, Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Darjeeling district of West Bengal), China, Nepal, Bhutan, Bangladesh and Myanmar. Being the world's highest mountain chain, the Himalayas are characterized by a complex geologic structure, snowcapped peaks, large valley glaciers, deep river gorges and rich vegetation. A complex interplay of climatic and geological processes, patterns of resource use and economic conditions have led to resource degradation and associated environmental consequences in the Himalayan ecosystem (*Jodha*, 2001).

The Himalayan mountainous belt is inhabited by 51 million people, covering 18 percent of the geographical area and 6 percent of population of India. The Himalayan states together account for one-third of the total forest cover in the country, with Arunachal Pradesh alone

contributing 10.8 percent of the total forest cover. Forests cover 40 percent of the geographical area in the Himalayan region and between the two assessment periods of 1997 and 1999, forest cover in the states of Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Tripura, Uttar Pradesh and West Bengal has increased (*FSI*, 2000). The Himalayas in India are the biodiversity hotspots, where flora and fauna vary extensively with climatic diversity from one region to the other.

An accelerated loss of primary ecosystems and associated biodiversity worldwide, mainly due to human activity, has led to an urgent need to identify areas of high biodiversity

("hotspots") in order to promote their priority for conservation (*Kati et al.*, 2004; *Garcy*, 2006). Land cover analysis plays a pivotal role in regional, social and economic development. It contributes significantly to Earth-atmosphere interactions and biodiversity loss is a major factor in sustainable development and human responses to global change, and is important in integrated modeling and assessment of environmental issues in general (*Chen*, 2002). Therefore, analysis of land-cover dynamics becomes a fundamental tool for adoption of conservation strategies within these hotspots. Land cover analysis has become a fundamental tool in assessing the environmental consequences of human activity (e.g., *Hunt and*

Ditzer, 2001; Veldkamp and Lambin, 2001; Brown, 2003; Dunn, 2004).

STUDY AREA

Sindh valley lies in the North Eastern part of Kashmir valley between 34° 6' to 34° 27' N latitude and 74° 40' – 75° 35' E longitude (Fig1.1), This valley being the largest side valley of Kashmir , possesses a varied

topography exhibiting altitudinal extremes of 1568m to 5236m above msl. A number of high altitude lakes like Gangbal, Nundkol and Harnag etc. are situated in this area.

This beautiful valley with high altitudinal variations is dominated by forests, meadows and glaciers.

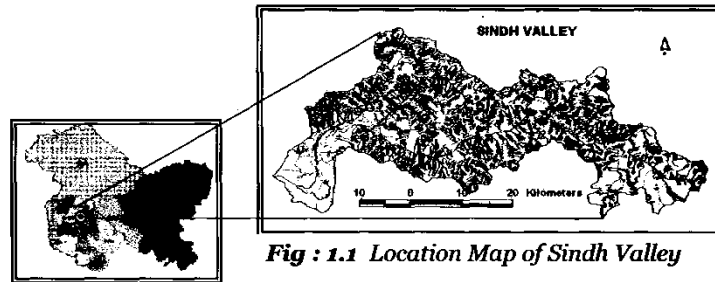
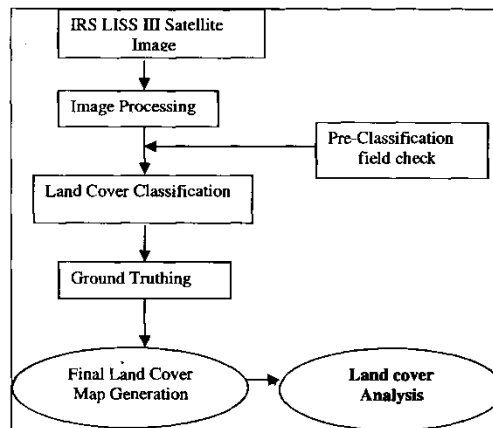


Fig : 1.1 Location Map of Sindh Valley

Data Source and Research Methods:

In the present study, varied data sets were employed to carry out the work including IRS LISS III image of 2005, besides the Ground truth data and other ancillary data from secondary sources.

The research applied an integrated approach using remote sensing, GIS and field data. The methodology adopted may be described by employing flow-chart as under:-



➤ Flow chart guiding through sequences involved in methodology for present paper

Results and Discussion:

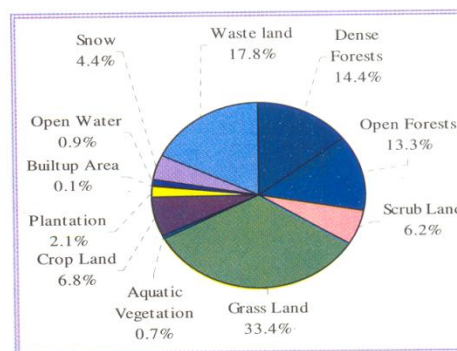
Land Cover Classification

There are numerous algorithms for classifying satellite images, however for the present study supervised classification algorithm was employed for achieving precise results.

Land cover Map:

Himalayas are truly one of the most outstanding yet fragile eco-systems on the surface of earth. In order to safeguard this blessing, an inventory of this resource region is the need of the hour. The land cover analysis of the study area revealed different land cover types, which were grouped in to eleven land cover classes (Fig 1.2, Map 1), the area of each land cover class were assessed. Out of those eleven classes, tree canopy covers almost thirty percent of the area (which includes area under Dense Forests, Open Forests and Plantation) this area may be termed as environmentally conserved. Although, as per the National Forest Policy, mountainous areas must have at least 66.6 percent of area under forests, the state of forests in Sindh valley provides a very grim picture, which is even less than the national average of 40 percent in Himalayan region. Even out of that thirty percent of tree cover, dense forests constitute just 14.4 percent of total

area. More than 30 percent of area in Sindh valley is under Pastures and meadows which in the present study have been grouped under grass lands. This area provides livelihood to a vast majority of people from different corners of the state who establish their temporary shelters during summer in this area to feed their cattle in these alpine grasslands. With the ever increasing number of cattles and introduction of High yielding varieties of cattle by Animal Husbandry department, the stress on these grass lands has increased tremendously.



(Fig 1.2: Showing %age areas under different Land cover Classes)

Agriculture is the main source of employment for more than 30 percent of working population in Sindh valley. This sector accounts for almost 10 percent of the study area and has been classified under plantation (2.1Percent) and

Crop land (6.7 percent). Crop land is mainly devoted for paddy cultivation in flood plains and maize in kandi belts of side valleys of main Sindh valley. Flood plains are highly productive in terms of rice cultivation as in these areas, rice production ranges between 70 – 80 quintals per hectare.

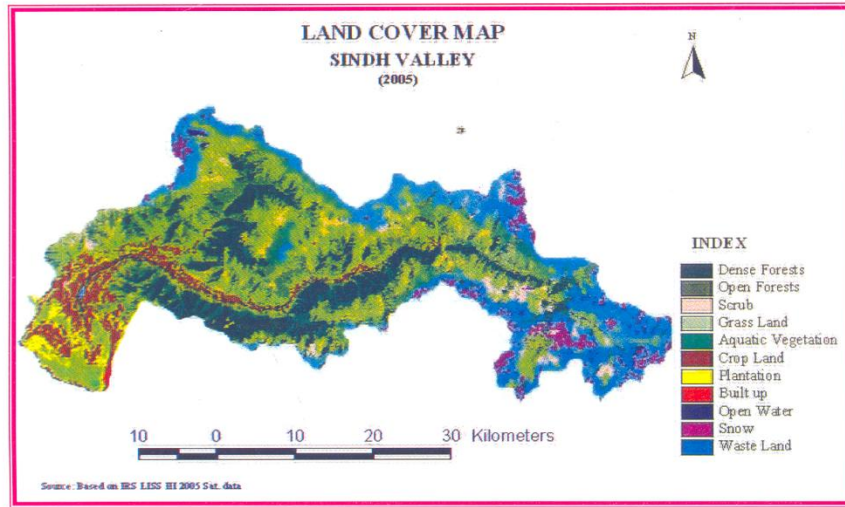
However in Kandi belts, the productivity of rice is much lower and people prefer plantation of maize over rice. Though these regions are backward and have not been benefited by the schemes of government to increase their per hectare yield, the easy option for them to feed their ever increasing population is to encroach upon the forest land which is evident from the land cover map which shows croplands at some locations have intruded deep in the forest area.

Waste land class which accounts for 17.8 percent of the total geographical area of Sindh is actually the land which remains under the cover of snow for major part of the year. So in total, snow covers more than 22 percent of the area for major part of the year. Though this category which has been classified as waste land as per

the Waste Land Atlas of India prepared by NRSA, Hyderabad is of vital importance for the sustenance of agriculture in the region and it is because of this class, the total hydropower generation capacity of Sindh has been estimated to be almost 400 MWs. As a result, this class may be identified as a resource class rather than mere waste land.

Aquatic vegetation and water jointly account for mere 1.5 percent of total area, which is negligible keeping in view the Landscape of the area. This region encompasses two giant high altitude lake and one valley lake. Although, high altitude lakes are more or less in their original form spatially, the valley floor lake has deteriorated because of continuous sedimentation from the Catchment which speaks volumes about the status of environment in this region.

Built up area constitutes mere 0.1 percent of study area and is predominantly confined to the lower plains of valley. The increase in its spatial extent is mainly reflected in the agricultural area of valley floor.



Map 1: Land cover status of Sindh Valley (Kashmir)

CONCLUSION

The National Research Council recently identified Land cover Dynamics as one of the grand challenges for environmental research (NRC, 2001). The present study was aimed to provide accurate assessment of land cover using remote sensing and GIS environments, which provide new types of data, information and improved scientific basis for decision making. With the current range of satellite sensing systems and archived data sets available to the research community, studies at the large spatial scales needed to depict land cover and management changes have been initiated. While considerable progress has been made so far in mapping land cover characteristics, the ability to

accurately map the wide range of landscape attributes, including land cover and biomass, require a considerable research effort. The present study attempts to provide an insight into the state of environment prevailing in this part of Himalayas and depicts the vulnerable and deplorable condition of these precious natural resources, as is evident by the discussion sited above regarding the canopy cover of the region and other land cover classes.

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