Abstract

Satellite remote sensing in conjunction with GIS provides a platform for landscape level characterisation. Information on land use or land cover allows a better understanding of the land utilization aspects like cropping patterns, fallow lands, forests, pasture lands, wastelands and surface water-bodies which are vital for development planning. Forests are important terrestrial ecosystems which provide a number of goods and services to the people. The dependency is very high especially amongst the rural people. Several international conventions and agreements have stressed the importance of the assessment of forest biodiversity. Retrieving information about forest resources is a process for obtaining information on the quality and quantity of forest resources and forms the foundation of forest planning and policy. Encroachment of forest land for cultivation and other purposes continues to be the most pernicious practice endangering forest resources. Encroachment leads to several ecological, economic and social effects. Landscape fragmentation has been identified as one of the fundamental cause for biodiversity loss. It is the process of breaking up of large expanses of continuous land cover into small discontinuous patches where native flora and fauna survives.

Jiribam is a Sub-Division of Imphal East District, Manipur State (India) and falls on the western side of the state bordering the Cachar district of Assam on the west, Tamenglong district of Manipur on the north and east and Churachandpur district of Manipur on the south. Jiri River and Barak River demarcate the boundary between Jiribam Sub-Division of Imphal East District and Lakhipur Sub-Division of Cachar District (Assam). It lies between 24°33´10´´- 24°51´25´´N latitude and 93°04´27´´- 93°14´25´´E longitude.

Jiribam Sub-Division is rich in natural resources and a large number of people depend on them in many ways. Being a sub-tropical type of climate, the vegetation of this region was different from other parts of Manipur except in Indo-Myanmar border. A lot of landscape changes have occurred due to developmental activities, increasing population, plantations etc. in recent years. Good patches of forest are left only in some parts of the study area. Very few work has been done in the forest of Jiribam Sub-Division. Little is known about NTFP collection, utilization, and marketing in Jiribam region despite their great economic potential for the local communities and households here.
The specific objectives of the study were to i) Preparation of landuse/landcover map using RS and GIS technique, ii) Quantitative analysis of vegetation and patterns of plant species diversity, iii) Analysis of spatial patterns of forest fragmentation and iv) Inventorisation of non-timber forest products and analysis of their utilization by local people.

Mapping has been carried out using high resolution IRS LISS IV data. Land use and land cover map of Jiribam Sub-Division was prepared using visual image interpretation technique supported by ground truth verification. ERDAS Imagine 9.1 and ArcGIS 9 software were used for image processing and mapping. The land cover/land use map depicted the state of the land features and land use of the study area. Ground truth verification was done by using GPS. Forests constitute the major proportion (62.55% of the total area) of Jiribam Sub-Division and the remaining areas were occupied by non-forest such as agriculture, wasteland and water bodies. Plantation occupied 2.30% and the non-forest categories occupied 35.07% of the total geographical area.

For the quantitative analysis of forest vegetation of Jiribam Sub-Division a forest cover map was prepared which included 3 forest classes. 2 classes i.e. dense forest and open forest classes were selected for quantitative vegetation analysis. A total of 113 species belonging to 90 genera and 45 families were recorded from 32 belt transects in dense and open forest class. The mean stand density recorded was 239 stems ha\(^{-1}\) (±45). Stem density was higher in dense forest (284 stems ha\(^{-1}\)) than the open forest (194 stems ha\(^{-1}\)). The average basal area was recorded as 11.4 m\(^2\)ha\(^{-1}\) (±2.8). The stand basal area was also higher in dense forest (14.2 m\(^2\)ha\(^{-1}\)) than the open forest (8.6 m\(^2\)ha\(^{-1}\)). The Shannon diversity index was observed as 3.9 in the dense forest and 3.7 in the open forest. Family Index Value of pooled data showed that Moraceae was the most dominant family (40.77) followed by Meliaceae (26.69), Mimosaceae (26.42) and Verbenaceae (24.38). In terms of IVI value in the entire forest, the dominant tree species were *Artocarpus chama* Buch.-Ham., *Toona ciliata* M Roem., *Duabanga sonneratioides* Ham., *Albizia stipulata* Boivin. etc. Analysis of Raunkiaer’s Frequency Classes showed that the dense forest class followed the normal Raunkiaer’s law of frequency but the open forest class did not follow it. The girth class distribution for different species in 2 forest classes showed the dominance of lower and middle girth classes. The stem count proportion decreased with increasing GBH class size.

Land cover map indicate only the location and type of vegetation. Further processing is needed to quantify and analyze forest fragmentation. Forest fragmentation analysis is an important part of
Landscape ecology. Forest fragmentation is the process of breaking up large patches of forest into smaller pieces. Different landscape indices have been calculated using geo-spatial tools. Patch size stratification was done to evaluate distribution of forests. Of the total 334 forest patches, 234 patches belonged to <25 ha patch size category. The patch class of >200 ha represented only 13 patches. The mean patch size of forest was estimated as 35.4 ha. The largest patch index for forest (7.4%) shows clear evidence of the increasing pattern of deforestation and forest degradation. The measured fractal dimension of 2.6 was very high and indicated extreme irregular topography. Landscape analysis indicated effect of anthropogenic impact on the naturalness of forest ecosystems through edge effect, patch isolation, invasive alien species, shifting cultivation and proximity to man-made land use categories.

Non-timber forest products (NTFPs) play a significant role in the life style of the people of Jiribam Sub-Division of Manipur. The dependency and utilization of NTFPs by the local people and the regional market information on NTFPs was studied. The study was based on extensive fieldwork using semi-structured questionnaires in 12 hill villages. Overall, 58 plant species with NTFP value was recorded belonging to 37 families and 51 genera. Rubber, bamboo, broom grass, betel leaf and rattan play a very important role in the socio-economic status of the region. Wild edible fruits like Artocarpus lacucha Buch.-Ham., Baccarae rambiflora Lour., Ficus racemosa L. etc and medicinal plants like Homalomena aromatica Schott., Oroxylum indicum Vent., Croton caudatus Geisel etc were collected from wild habitat. The high rate of extraction from forests is one of the reasons for the rapid deterioration of the forests in this region. The need of the hour is to conserve the fragmented repositories of natural forests by implementing stringent conservation measures such as scientific management and proper method of harvesting.

The present study can serve as baseline information and primary input for development and management planning activities and will helps in the management of forest, water, agriculture and other natural resources for the sustainable development of Jiribam Sub-Division. The forest type of Jiribam Sub-Division is majorly comprised of semi-evergreen forest. Quantitative evaluation using belt transects was carried out in two forest categories (open and dense). It was observed that the two forest categories did not vary too much in their composition. This was evidenced from the high similarity index (64.67%). However the other parameters such as frequency distribution, stem density, species diversity across GBH class, forest fragmentation etc. clearly depicted that
the open forests were under high anthropogenic pressure. The open forests were found to be continuously exploited by the local people to meet their daily requirements. This resulted in low species richness and low species density. The observed differences are extremely due to high degree of anthropogenic pressure in the open forest. This led to major decrease in canopy cover and has also altered the spectral reflectance of the open forest category. It can be concluded that if the present trend continues, then Jiribam will not have the characteristic semi-evergreen forest and the remnants of such forest will be found in a high degraded stage.

It was observed that the main anthropogenic pressure on forest were NTFPs collection, selective felling and forest encroachment. Shifting (Jhum) cultivation is the major factor of encroaching forest land. It is necessary to manage the jhum affected areas with modern scientific management of forest without neglecting the demands and needs of the farmers (Jhummiyas) and without sudden deviation from their traditional practices. A suitable agro-forestry model may be applied as an improved land use pattern. The immediate attention on people’s participation is most essential for effective conservation. New land use policies can be made according to the present different categories of LULC to preserve the environment by increasing forest cover, to provide alternative and better livelihood to rural people.