

## Nature of Forest Fragmentation Owing to Human Population along Elevation Gradient in Different Countries in Hindu Kush Himalaya Mountains

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**Abstract :** Large numbers of people living in and around the Hindu Kush Himalaya (HKH) region, depends on this diverse mountainous region for ecosystem services. Following the global trend, this region also experiencing rapid population growth, and demand for timber and agriculture land. The eight countries sharing the HKH region have different forest resources utilization and conservation policies that exert varying forces in the forest ecosystem. This created a variable spatial as well altitudinal gradient in rate of deforestation and corresponding forest patch fragmentation. The quantitative relationship between fragmentation and demography has not been established before for HKH vis-à-vis along elevation gradient. This current study was carried out to attribute the overall and different nature in landscape fragmentations along the altitudinal gradient with the demography of each sharing countries. We have used the tree canopy cover data derived from Landsat data to analyze the deforestation and afforestation rate, and corresponding landscape fragmentation observed during 2000 - 2010. Area-weighted mean radius of gyration (AMN radius of gyration) was computed owing to its advantage as spatial indicator of fragmentation over non-spatial fragmentation indices. Using the subtraction method, the change in fragmentation was computed during 2000 - 2010. Using the tree canopy cover data as a surrogate of forest cover, highest forest loss was observed in Myanmar followed by China, India, Bangladesh, Nepal, Pakistan, Bhutan, and Afghanistan. However, the sequence of fragmentation was different after the maximum fragmentation observed in Myanmar followed by India, China, Bangladesh, and Bhutan; whereas increase in fragmentation was seen following the sequence of as Nepal, Pakistan, and Afghanistan. Using SRTM-derived DEM, we observed higher rate of fragmentation up to 2400m that corroborated with high human population for the year 2000 and 2010. To derive the nature of fragmentation along the altitudinal gradients, the Statistica software was used, where the user defined function was utilized for regression applying the Gauss-Newton estimation method with 50 iterations. We observed overall logarithmic decrease in fragmentation change (area-weighted mean radius of gyration), forest cover loss and population growth during 2000-2010 along the elevation gradient with very high R<sup>2</sup> values (i.e., 0.889, 0.895, 0.944 respectively). The observed negative logarithmic function with the major contribution in the initial elevation gradients suggest to gap filling afforestation in the lower altitudes to enhance the forest patch connectivity. Our finding on the pattern of forest fragmentation and human population across the elevation gradient in HKH region will have policy level implication for different nations and would help in characterizing hotspots of change. Availability of free satellite derived data products on forest cover and DEM, grid-data on demography, and utility of geospatial tools helped in quick evaluation of the forest fragmentation vis-a-vis human impact pattern along the elevation gradient in HKH.

**Keywords :** area-weighted mean radius of gyration, fragmentation, human impact, tree canopy cover

**Conference Title :** ICMSS 2018 : International Conference on Mountain Science and Sustainability

**Conference Location :** Zurich, Switzerland

**Conference Dates :** January 15-16, 2018