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学 位 論 文 内 容 の 要 旨/Dissertation Abstract

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学 位 論 文 題 名/Title of Dissertation

Assessing land use/land cover dynamics and community perceptions in Sagarmatha and Khaptad national parks: designing an integrated framework for national parks of Nepal
(サガルマータ国立公園とカプタード国立公園における土地被覆と土地利用の動態および地域社会認識の評価：ネパールにおける国立公園管理にむけた統合的フレームワークの設計)

The International Union for Conservation of Nature (IUCN) defines a protected area (PA) as a clearly defined geographical space, recognized and managed through legal or other effective means to conserve nature, ecosystem services and cultural values. Examples include national parks, conservation areas, wildlife reserves, sanctuaries and wilderness areas. PAs are therefore vital natural assets for conserving biodiversity and heritage, contributing to global conservation targets and the sustainable, equitable use of biological resources. According to the IPCC (2023), human activities are driving rapid and unprecedented landscape change, responsible for around 60% of global biodiversity loss and intensifying climate impacts. Understanding different land-cover types is essential because they regulate key ecological processes such as carbon sequestration, water filtration and biodiversity maintenance. Long-term assessments of land-cover dynamics help reveal how environmental change and human activities interact, allowing us to monitor trends, identify drivers and anticipate future trajectories. These dynamics are especially pronounced in mountainous regions, where pressures from population needs, infrastructure and tourism are growing, leading to the degradation of fragile ecosystems.

Nepal's diverse ecosystems—forests, grasslands, wetlands, rivers and glaciers—provide essential services for local livelihoods and global environmental health. However, they have undergone major change due to deforestation, agricultural expansion, urbanization and infrastructure development. Loss of forest cover has increased soil erosion, landslides and habitat loss, with cascading effects on ecological integrity and the socio-economic conditions of communities around PAs. In response, Nepal has promoted community forestry since the 1970s and is recognized globally for these restoration efforts, yet nearly two-thirds of the population still depends on forest products for subsistence, creating ongoing socio-ecological pressure. National parks are also under growing stress from domestic, religious and international tourism. Understanding how human activities, forest-cover change and policy interact is therefore critical for sustainable environmental management.

This study focuses on Sagarmatha National Park (SNP) and Khaptad National Park (KNP) to assess land use and land cover (LULC) change and community perceptions. Landsat data from the early 1990s to 2020 were classified using a Random Forest algorithm, with accuracy checked against PlanetScope and Google Earth imagery. Cellular Automata–Artificial Neural Network (CA–ANN) models were used to project future LULC.

Tourist and climate data were analyzed to examine their influence on LULC dynamics. From 1989 to 2021, SNP showed increases in bare land, grassland, shrubland, glacial lakes and water, alongside substantial decreases in snow/glacier (140.25 km²) and forest cover (15.36 km²). In KNP, grassland, agriculture, water bodies and bare land increased, while forest and shrubland decreased by 18.63 km² and 10.48 km², respectively. Forest loss in KNP's buffer zone (19.33 km²) exceeded that of SNP's buffer zone (13.45 km²). Built-up areas expanded in both parks (0.80 km² in SNP, 1.11 km² in KNP), indicating rising tourism and population pressure, and PlanetScope data show new roads in the KNP buffer moving towards the core boundary. These trends highlight mounting pressure on buffer zones and the potential spillover of deforestation into core areas, underscoring the need for a management framework to control forest loss in PAs.

Climate analysis shows that in SNP, mean annual precipitation has decreased while temperature has increased since the mid-1990s, whereas in KNP both precipitation and temperature show increasing trends. Under a business-as-usual scenario, projected forest loss by 2032 is 1.61 km² in SNP and 23.8 km² by 2030 in KNP, and SNP's core is expected to lose a further 22.84 km² of snow/glacier by 2032. Together, these results provide important baseline information on past and future LULC changes in both parks.

The study also examines links between agriculture, tourism and forest resources in these contrasting parks: SNP, with high-intensity foreign trekking tourism, and KNP, with mainly domestic religious visitors. Using a comparative case-study design and the Sustainable Tourism Attitude Scale (SUS-TAS), household surveys were combined with satellite-based LULC analysis. Results show a significant negative relationship between household tourism and forest cover in both parks. In SNP, higher agricultural productivity is strongly associated with forest loss, implying that cropland expansion is encroaching into forests and that tourism infrastructure increases resource demand. In KNP, forest dependency (use of fuelwood and fodder) is significantly and negatively related to forest cover, indicating that subsistence livelihoods are major drivers of deforestation. Ordinary Least Squares (OLS) regression identified key socio-economic drivers of perceived forest-cover change. In SNP, agricultural productivity and household tourism were significant predictors, while in KNP forest dependency was the main significant factor. Other variables, such as tourism satisfaction, gender and livestock dependence, had limited influence.

Overall, the study highlights the importance of community-based approaches to ensure fair resource distribution, promote sustainable practices and strengthen local ownership and accountability. Balancing economic development with environmental sustainability requires collaborative, participatory management and policies tailored to each park's specific context. Building on these findings, the thesis proposes the Integrated Land-Use and Community Adaptation Framework (ILCAF), an evidence-based framework that integrates cross-sector strategies, participatory governance and adaptive land-use planning for Nepal's protected areas. ILCAF is designed to be adaptable to different tourism intensities and ecological settings and emphasizes sector-specific indicators, eco-friendly practices and community-centered buffer-zone management and awareness programmed to address deforestation and other pressures.