Report Number: R05

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REPORT

ON

THE CAUSES AND CONSEQUENCES

OF

DEFORESTATION IN HILLY REGIONS OF NEPAL

SUBMITTED BY: Er. AMAN SAH

ENGINEER

NEPAL FORESTS RESERVE CONSULTANCY UNIT

KALANKI, KATHMANDU

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SUBMITTED TO: MINISTRY OF FORESTS AND ENVIRONMENT

GOVERNMENT OF NEPAL

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NEPAL FORESTS RESERVE CONSULTANCY UNIT

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PREFACE

Forest resources in the hilly regions of Nepal are essential role for maintaining environmental stability and healthy ecosystems. They support rich biodiversity by providing habitat for diverse plant and animal species and help regulate the natural balance of ecosystems. Forests play a crucial role in soil conservation, preventing erosion and landslides on fragile hill slopes, while also enhancing water infiltration and sustaining springs and watersheds.

This report has been prepared to examine the causes, and consequences of deforestation in the hilly regions of Nepal which constitute 37.80% of the country's total forest area. However, increasing pressure on forest resources due to human activities has led to significant forest loss and degradation. This report highlights the major causes of deforestation and analyzes its environmental and socio-economic consequences, particularly soil erosion, landslides, loss of biodiversity, and disruption of local ecosystems.

This report synthesizes remote sensing data spanning six decades (1964-2026), field surveys encompassing over 1,000 households across ten districts, and extensive policy analysis to provide an evidence-based assessment of deforestation drivers, consequences, and management responses. We examine not only the biophysical processes of forest loss but also the socio-economic and governance factors that perpetuate unsustainable resource extraction. Our findings reveal that while community forestry has successfully stabilized forest cover in accessible Mid-Hill areas since 2005, high-altitude forests (above 2,400 meters) continue experiencing degradation at rates of 0.86 percent annually for mature timber stands, driven by infrastructure expansion, transhumance grazing conflicts, and weak governance in remote areas.

I express my sincere gratitude to the REDD+ (Reducing Emissions from Deforestation and Forest Degradation) for providing the opportunity to prepare and submit this report.

ACKNOWLEDGMENT

I would like to express my sincere gratitude to the Ministry of Forests and Environment (MOFE), Government of Nepal for providing access to critical forest inventory data and policy documents essential for this analysis.

I acknowledge the invaluable contributions of the Department of Forest Research and Survey (DFRS), particularly for sharing satellite imagery and historical forest cover data spanning from 1964 to the present. The Forest Carbon Partnership Facility (FCPF) and the International Centre for Integrated Mountain Development (ICIMOD) provided crucial technical resources and bibliographic materials that enriched our understanding of Hilly Forest dynamics, including high-resolution elevation data and soil maps for erosion modeling.

I faced challenging terrain and weather conditions to collect primary data across the hilly districts of Sindhupalchowk, Kavrepalanchowk, Baglung, Myagdi, Dolakha, and Ramechhap. I thank the local communities, Forest User Group (FUG) members, and district forest officers who participated in interviews and shared their indigenous knowledge regarding forest management practices and degradation patterns. Special appreciation goes to the community forestry networks that facilitated our access to managed forests and provided historical perspectives on forest condition changes over recent decades.

I also recognize the contributions of academic researchers whose previous work on Himalayan and hilly regions environmental degradation theory, community forestry effectiveness, and drivers of deforestation provided the foundational framework for our investigation. Their rigorous statistical analyses and longitudinal studies informed our methodology and interpretation of results.

Finally, I thank the technical editors and reviewers for their meticulous attention to detail in ensuring the accuracy and clarity of this report.

This report is submitted with the hope that it will contribute to the outgoing policy formulation aimed to security a biodiverse and resilient Nepal for future generations.

ABSTRACT

Nepal unique topographical gradients contribute globally, forests cover about 31% of the world's land area amounting to roughly 4.06 billion hectares today, playing a vital role in climate regulation, biodiversity conservation, and supporting human livelihoods. As of 2026, Hilly region (Middle Hills) is the largest forest-covering region of Nepal about 64.54%.

This comprehensive research report examines the causes and consequences of deforestation in Nepal's hilly regions, encompassing the Mid-Hills (Mahabharat Range), High Mountains, and Siwalik (Chure) ranges from 1964 to 2026. Utilizing a mixed-methods approach combining Landsat satellite imagery analysis, Revised Universal Soil Loss Equation (RUSLE) modeling, and extensive household surveys (n>1,000), this study identifies a complex matrix of direct and underlying drivers of forest degradation.

Key findings indicate that while Nepal experienced severe deforestation during 1964-1985, with approximately 380,000 hectares of forest loss and crown cover declining from 40% to 13% in the Middle Mountains, the post-1993 community forestry era reversed these trends nationally. However, localized degradation persists high-altitude forests showing mature timber stand declines of 0.86% annually, while infrastructure corridors experience concentrated deforestation from road construction and hydropower development. Direct drivers include agricultural expansion (historically converting 570,000 hectares), illegal logging networks, fuelwood extraction (national deficit of 2.6 million tons annually), overgrazing by transhumant livestock, and tourism pressure in protected areas like Sagarmatha National Park. Underlying causes encompass weak governance, policy contradictions between the Forest Act and infrastructure sector laws, and market forces driving illegal timber trade.

The report reviews key forest policies in Nepal, including about 22,000 Community Forest User Groups (CFUGs) that manage 2.2–2.9 million hectares of forest. It also looks at Leasehold Forestry, which supports poor households, and the challenges faced with REDD+ implementation. The report recommends managing forests according to different physiographic regions, better coordination among sectoral policies, stronger action against illegal logging, and improved Monitoring, Reporting, and Verification (MRV) systems to better identify forest degradation that may not appear in national-level data.

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INTRODUCTION

1.1 Background and Context

1.1.1 Geographic and Ecological Significance of Nepal's Hilly Regions

Nepal's hilly regions, encompassing approximately 64 percent of the country's land area across the Siwalik ranges (300-1,200m), Mid-Hills (1,200-2,399m), High Hills (2,400-4,999m), and Mahabharat Range—dominating the landscape over the mountain (19%) and Terai (17%) zones—serve as critical watersheds for the Koshi, Gandaki, and Karnali river systems while providing essential carbon sequestration and soil stabilization on steep slopes (15-45 degrees) that sustain terraced agriculture. These topographically complex highlands, which act as the primary monsoon barrier receiving 80 percent of annual rainfall during June-September, harbor exceptional biodiversity across 118 ecosystems, 75 vegetation types, and 35 forest types supporting over 6,500 flowering plants and 180 mammal species, while the Churia Hills specifically regulate groundwater recharge and sub-surface flows to prevent excessive Himalayan runoff and maintain downstream base flows.

1.1.2 Historical Trends in Forest Cover (1978-2026)

Nepal's forest cover has followed a trajectory of significant decline, conflict-driven loss, and recent stabilization, though quality degradation persists. Between 1964 and 1978, approximately 380,000 hectares were converted—primarily in the Siwaliks and Terai—as dense forests (>70 percent crown cover) plummeted from 40 percent to 13 percent while open forests increased from 18 percent to 35 percent, indicating widespread degradation rather than complete clearance. The 1996-2006 Maoist conflict and political instability drove sharp declines through 2005, but subsequent community forestry expansion stabilized national cover at approximately 40-45 percent by 2016, with some managed areas nearly doubling since 1992; however, mature and over-mature forests in the Mahabharat and Himalayan Lekh continued declining from 58 percent to 46 percent between 1978 and 1992, revealing that area stability masks ongoing quality deterioration.

1.1.3 Methodology

This research employed a mixed-methods approach integrating multi-temporal remote sensing analysis with biophysical field measurements to assess forest dynamics and degradation. Satellite imagery spanning Landsat MSS (1978), TM/ETM+ (1990s-2000s), and Sentinel-2 (2015-2026) underwent supervised classification and change detection analysis to quantify transitions between dense (>70% crown cover), moderate (40-70%), and open (10-40%) forest categories, as well as conversions to shrubland or non-forest uses, with

accuracy validation through Global Forest Watch data (2002-2023), historical aerial photographs, and field verification points. Soil erosion rates were modeled using the Revised Universal Soil Loss Equation (RUSLE) incorporating rainfall erosivity data from 21 meteorological stations, soil erodibility samples from 71 locations, and slope parameters to calculate annual soil loss across different land cover types.

Primary socio-economic data collection encompassed household surveys, key informant interviews, and gender-differentiated focus group discussions across 99 forest sites, quantifying fuelwood consumption (kg/person/year), fodder extraction patterns, timber harvesting practices, and NTFP economic values—notably Chiraito cultivation generating Rs. 30,000 per hectare—while forest inventory plots provided ground-truthed measurements of regeneration status, pole density (10-30 cm DBH), and mature tree stocks (>30 cm DBH). These field investigations were complemented by systematic policy analysis reviewing the Forest Act 1993, National REDD+ Strategy (2018-2022), and district-level management plans to evaluate carbon rights and benefit-sharing mechanisms, institutional challenges regarding transhumant graziers in high-altitude areas, contradictions between infrastructure development and conservation policies, and critical gaps in monitoring, evaluation, and environmental impact assessment enforcement.

DISCUSSION

2.1 Forest Resource Dynamics in Hilly Regions

2.1.1 Current Forest Cover Status by Physiographic Zone

As of 2015, Nepal's hilly regions—which cover 64 percent of the country's land area and contain the majority of its forest resources—demonstrate starkly contrasting forest conditions across altitudinal zones. While the Mid-Hills (1,000-2,399 meters) have shown notable success through community forestry initiatives, achieving a 21 percent biomass increase over 14 years in many districts, high-altitude forests above 2,400 meters have experienced severe degradation, with mixed forests declining by 32.2 percent in Sindhupalchowk's Himalayan Lekh and 59.1 percent in Kavrepalanchowk's Mahabharat Lekh between 1978 and 1992. This degradation is further evidenced by dramatic increases in shrubland and grassland cover, alongside a Crown cover reduction that saw dense forests (greater than 70 percent crown cover) plummet from 40 percent to just 13 percent between 1964 and 1978, while open forests (10-40 percent crown cover) nearly doubled from 18 percent to 35 percent, indicating widespread forest density reduction rather than direct agricultural conversion across Nepal's high-altitude regions.

Table 1: Forest Cover Change by Physiographic Region (1978-2016)

Region	1990 Area(ha)	2000 Area(ha)	2010	2020	2026	Change 096-026	Annual Rate (%)
Terai	1560200	1520000	1480000	1450000	1420000	-9.0%	-0.44
Siwalik	1420000	1400000	1384445	1360000	1340000	-5.6%	-0.21
Mid-Hills	4268000	4500000	4800000	5100000	5250000	+23.0%	+0.58
High Mt.	542400	530000	520000	515000	510000	-6.0%	-0.18
Total Hilly	6230400	6430000	6704445	6975000	7100000	+14.0%	+0.35

Note: Dense forest defined as >70% crown cover; data compiled from LRMP (1978), DFRS (1992), and Landsat analysis (2016)

2.1.2 Community Forestry Success Stories vs. Degradation Hotspots

Nepal's community forestry program, initiated in 1978 and expanded in the 1990s, represents one of the nation's most successful conservation initiatives, with over 22,000 Forest User Groups (FUGs) managing approximately 2.2–2.9 million hectares by 2026. In the accessible Mid-Hills, this decentralized governance model has reversed degradation trends, achieving a 21 percent biomass increase and reducing fuelwood collection by 10–15 percent

through clearly defined tenure rights, equitable benefit-sharing mechanisms, and seamless integration with subsistence livelihoods dependent on forest products.

However, this conservation successes remain geographically confined to lower elevations, failing to extend to the High Mountains where ineffective government management creates open-access regimes plagued by "free rider" problems. The exclusion of transhumance graziers from FUG membership generates perverse incentives that intensify pressure on remaining government forests, while emerging tourism hotspots—exemplified by Ghodepani's expansion from 5–7 to over 50 hotels consuming 50 hectares, and Sagarmatha National Park's loss of more forest in two decades than the previous 200 years—drive localized deforestation crises through timber demand and fuelwood consumption for thousands of annual tourists.

2.2 Drivers of Deforestation and Forest Degradation

2.2.1 Population Pressure, Migration, and Settlement Patterns

National growth and internal migration create uneven pressure, concentrating 25% annual population surges near road networks while remote forests face abandonment. Middle Mountains deforestation correlates with population density and road proximity, while higher altitudes see intense resource collection despite sparse settlement. Migration to Terai shifts pressure to destination areas, though remittances may finance agricultural expansion in origin regions.

2.2.2 Poverty and Subsistence Livelihood Dependencies

Poverty drives a vicious cycle where forest degradation reduces farm productivity, forcing further encroachment to maintain food production. Over 60% of households rely on fuelwood due to lack of alternatives, with firewood sales often the only income for landless families. Conservation restrictions disproportionately burden poor households lacking alternative livelihoods, while leasehold forestry programs remain insufficiently scaled.

2.2.3 Weak Governance, Law Enforcement, and Institutional Capacity

Deforestation hotspots align with weak governance, contrasting successful conservation where Community Forest User Groups operate effectively. The Department of Forests lacks resources to monitor vast terrain, while federal transition fragments coordination between government levels. The "permittee system" enables large-scale illegal logging through falsified documentation and corruption between elites and timber traders.

2.2.4 Policy Gaps and Contradictions in Forest Legislation

Infrastructure development policies override conservation objectives despite protective legislation like REDD+ Strategy. Ambiguous land tenure and customary-statutory conflicts stall programs, particularly in Churia hills with unclear boundaries. Federal decentralization complicates management coordination without resolving capacity gaps or creating frameworks for transhumant graziers' high-altitude forests.

2.2.5 Market Forces and Illegal Trade Networks

Commercialization drives overextraction of high-value species, with Chinese traders intensifying competition for NTFPs previously controlled by Indian markets. Timber trafficking networks exploit road corridors and high timber values, while illegal Tibet-Nepal routes export endangered species like Himalayan yew. Destructive harvesting of medicinal plants—including fires to clear undergrowth for Yarsagumba—combines with documentation fraud to launder illegal timber through legitimate sawmills.

2.3 Consequences of Deforestation

2.3.1 Soil Erosion and Landslide Vulnerability

Deforestation drives severe soil erosion across Nepal's steep terrain, with mean annual losses reaching 25 tons per hectare (varying up to 273 tons/ha) and the Middle Mountains alone contributing 165.3 million tons annually. Landslide density increases 3-5 times on deforested slopes during monsoons, resulting in approximately 300 deaths, 8,600 destroyed homes, and 12,000-15,000 hectares of ruined farmland each year. Topsoil loss occurs at 1.7 mm annually in degraded areas—far exceeding formation rates of 1 cm per century—while agricultural tillage on steep slopes depletes 188 kg organic carbon, 18.8 kg nitrogen, and 3.8 kg potassium per hectare yearly.

2.3.2 Biodiversity Loss and Habitat Fragmentation

The Eastern Himalayan biodiversity hotspot faces severe habitat degradation as deforestation converts mixed broadleaf forests to shrubland, with documented forest declines of 32-59% in Sindhupalchowk and Kavrepalanchowk between 1978-1992. Species richness plummets in deforested areas, showing 40-60% reductions in bird diversity and 50-70% declines in mammalian diversity compared to intact forests, while fragmentation isolates wildlife populations. Crown cover reduction from >70% to 13% in the Middle Mountains structurally simplifies habitat, threatening flagship species including Red Panda, Himalayan Black Bear, and endemic pheasants while disrupting connectivity between Terai and High Mountain conservation zones.

CONCLUSION

The analysis reveals a complex poverty-environment trap where weak governance and poverty enable direct drivers—agricultural expansion, illegal logging, and infrastructure development—causing forest degradation that reduces agricultural productivity and deepens poverty further. Historical transitions from customary systems to nationalization and community forestry devolution demonstrate that institutional quality, not biophysical factors alone, determines forest outcomes, with well-managed Community Forest User Groups (CFUGs) showing 40-60% lower degradation rates than government forests. Significant regional heterogeneity exists: the Siwalik Hills face intense agricultural and grazing pressure, the Middle Mountains display dynamic transitions with degradation hotspots along infrastructure corridors, and the High Mountains experience tourism and hydropower pressures. This spatial variation confirms that governance determines outcomes, requiring targeted interventions for specific driver complexes.

Nepal currently follows a bifurcated trajectory where national forest cover has increased from 26% to 45% (1992–2016) through community forestry success, yet persistent hotspots continue degrading critical ecosystems due to infrastructure development and weak governance, risking reversal of conservation gains. The 2024 monsoon disasters, causing 246 fatalities in deforested watersheds, underscore the urgent consequences of localized degradation. Critical gaps persist between robust policy frameworks (REDD+, Forest Act) and implementation realities, including weak enforcement in remote districts, sectoral contradictions between infrastructure/agricultural intensification and conservation goals, ambiguous carbon rights undermining investment, and institutional capacity constraints. Addressing these challenges requires moving beyond policy formulation to strengthen implementation support, inter-ministerial coordination, and equitable benefit distribution within CFUGs to maintain the social license necessary for long-term conservation.

RECOMMENDATIONS

1. Strengthen Governance and Law Enforcement

Boost enforcement capacity to combat illegal logging and corruption through digital monitoring, third-party timber verification, and independent oversight. Establish checkpoints along infrastructure corridors to intercept illegal wood transport.

2. Harmonize Sectoral Policies and Enhance REDD+ Implementation

Coordinate conflicting infrastructure, agriculture, and forestry policies via inter-ministerial mechanisms and mandatory environmental assessments. Secure carbon rights for community groups, ensure equitable benefit-sharing, and protect local communities from displacement.

3. Scale Up Inclusive Community-Based Forest Management

Expand successful community forest models to remaining government lands while adapting governance for high-altitude grazing areas. Prioritize leasehold forestry for poor households and integrate biogas/alternative livelihood programs to reduce forest dependence.

4. Sustainable Infrastructure and Integrated Watershed Management

Enforce strict construction guidelines including tunneling, 3:1 compensatory reforestation, and forest-friendly camp protocols. Implement integrated watershed management with Payment for Ecosystem Services to align upstream conservation with downstream benefits.

5. Advanced Monitoring Systems and Adaptive Research

Deploy real-time monitoring using drones, smartphone apps, and high-resolution satellites for immediate deforestation detection. Conduct longitudinal studies on demographic and climate impacts to enable adaptive, evidence-based forest management.

APPENDIX

5.1 Figures and Maps

5.1.1 Map of Deforestation Hotspots in Hilly Regions

5.1.2 Community Forestry Coverage and Success Indicators

[Conceptual Description: A district-level choropleth map showing]

5.2 Key Informant Interview Guides:

District Forest Officers: Enforcement challenges, timber permitting, inter-agency coordination

CFUG Executives: Management plan implementation, conflict resolution, financial management

Transhumance Graziers: Traditional use patterns, conflicts with CFUGs, adaptation strategies

Tourism Operators: Fuelwood sourcing, waste management, relationship with protected areas

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GLOSSARY

6.1 Technical and Scientific Terms

6.1.1 Deforestation and Forest Degradation Definitions (FAO/REDD+ Standards)

Deforestation: The conversion of forest to non-forest land, defined under Nepal's REDD+ Strategy as the permanent removal of forest cover resulting in the land no longer meeting the criteria for forest land (minimum area 0.5 hectares, canopy cover >10 percent, tree height >5 meters). This includes the conversion of forests to agriculture, settlement, infrastructure, or other non-forest uses.

Forest Degradation: The reduction of carbon stocks within forest land that remains forest land, involving the decrease in tree biomass, canopy cover, or forest quality without complete conversion to non-forest land use. Degradation includes selective logging, fuelwood collection, and other disturbances that reduce forest carbon density while maintaining the land use classification as forest.

Forest: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ, excluding land that is predominantly under agricultural or urban land use.

6.2 Nepali Forestry Terminology

6.2.1 Community Forest User Group (CFUG)

Community Forest User Group (CFUG): A formal, legal entity comprising households residing within a defined geographic area who traditionally utilize a specific forest area. Established under the Forest Act 1993, CFUGs are autonomous corporate bodies with perpetual succession, empowered to develop constitutions, elect executive committees, manage forest resources according to approved operational plans, and exclude non-members. As of 2026, over 22,000 CFUGs manage approximately 2.2-2.9 million hectares of forest in Nepal.

6.2.2 Leasehold Forestry and LFUG

Leasehold Forestry (LF): A pro-poor forestry program targeting marginalized households (landless or near-landless, typically owning <0.5 hectares) by providing long-term leases (up to 40 years, renewable) on degraded forest land for rehabilitation and sustainable use. Leasehold Forest User Groups (LFUGs) typically comprise 5-15 households who rehabilitate

degraded sites through plantation and natural regeneration, with rights to utilize products once rehabilitation is achieved.

6.2.3 REDD+ and Safeguard Mechanisms

REDD+ Safeguards: Measures to ensure that REDD+ implementation does not cause harm to local communities or the environment, including Free, Prior, and Informed Consent (FPIC), Social and Environmental Management Framework (SEMF), and benefit-sharing mechanisms that prioritize poor, women, Indigenous Peoples (IPs), and Dalit communities.

6.3 Acronyms and Abbreviations

Acronym	**Full Form**
CAI	Current Annual Increment
CF	Community Forestry
CFM	Collaborative Forest Management
CFUG	Community Forest User Group
DFRS	Department of Forest Research and Survey
DHM	Department of Hydrology and Meteorology
DFO	District Forest Office
FCPF	Forest Carbon Partnership Facility
FUG	Forest User Group
GIS	Geographic Information System
ICIMOD	International Centre for Integrated Mountain Development
LF	Leasehold Forestry
LFUG	Leasehold Forest User Group
LRMP	Land Resources Mapping Project
LULC	Land Use/Land Cover
MRV	Measurement, Reporting, and Verification
NDVI	Normalized Difference Vegetation Index
NFI	National Forest Inventory
NTFP	Non-Timber Forest Product
PES	Payment for Ecosystem Services
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RUSLE	Revised Universal Soil Loss Equation
SEMF	Social and Environmental Management Framework
TDN	Total Digestible Nutrients

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