Studies on addressing challenges and enhancing community engagement in REDD+ implementation in Nepal and India

（ネパールおよびインドにおける REDD+実施に関わる課題への取り組みとコミュニティ参画の強化に関する研究）

Ph.D. thesis submitted to the Graduate School of Environmental Science,
Hokkaido University, Sapporo, Japan

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In partial fulfillment of the requirements for the Degree of Doctor of Environmental Science

By

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Abstract

Reducing emission from deforestation and forest degradation (REDD) emerged in 2005 through the UNFCCC negotiation as a response to the recognition of the important role forests play in climate change mitigation. Its primary goal was to provide financial incentives in the form of result-based payment to developing nations for preserving forests and reducing carbon emissions from deforestation and degradation and enhancing carbon stocks through sustainable forest management. The Warsaw Framework for REDD+ established implementation guidelines, including emissions reduction monitoring, reporting and verification, along with safeguards for social and environmental co-benefits so that externalities are minimized. Since then, REDD+ has gained global traction with various initiatives, pilot projects, and investments aimed at forest preservation, carbon emissions reduction, and supporting forest-dependent communities.

Over a decade has passed since REDD+ inception, yet its success remains uncertain, sparking debates on its effectiveness. This study aimed to identify the REDD+ progress and challenges for the successful REDD+ implementation by taking two different study sites- Mamit of Mizoram, India, and Dhankuta, Nepal. These sites share similar geography and practice community-based forest management, making them ideal for testing as both the sites meet the criteria for REDD+ projects. Given the significance of community managed forests in carbon projects, this study identifies what are the actions on the ground for sustainable REDD+ projects. The study methodology relies on three approaches: 1. Participatory Rural Appraisal 2. Household surveys, and 3. Remote Sensing and Geographical Information System, analysis to fulfill its objectives.

The first step involved assessing the progress of REDD+ in both the countries. Indicator-based questionnaire survey was conducted in two rounds of consultation meetings in both sites, involving 63 respondents. The findings revealed that both countries are at similar stage all five criteria, with Nepal slightly ahead in terms of REDD+ readiness. Institutional readiness emerged as an area requiring more attention in both countries. While gaps in other readiness areas can be narrowed through capacity development, research, and awareness programs, addressing institutional readiness necessitates greater commitment from government bodies, a genuine interest in REDD+, and carbon finance.

The research also identified the key drivers of deforestation and forest degradation in both sites through multi-stakeholder consultations using problem and solution tree approach. Acknowledging that REDD+ alone cannot address all the drivers of deforestation and forest degradation, the study prioritized the most important ones. In Mamit, shifting cultivation and forest fires emerged as the primary causes for deforestation and forest degradation respectively. Similarly, in Dhankuta, fuelwood collection and forest fires were identified as the main drivers. To assess changes in forest cover, the study analyzed land use data from 2010 to 2021, revealing a 2% decrease in forested areas in Mamit due to shifting cultivation, and a remarkable 12% increase in Dhankuta, driven mainly by rural-to-urban migration. Both regions, particularly their remote areas, rely heavily on fuelwood for energy, with livelihoods closely tied to agriculture. Most households engaged in agriculture lack alternative income sources, rendering them highly dependent on forest resources. In Dhankuta, annual consumption of fuelwood results in an estimated loss of approximately USD 2 million in potential carbon finance from fuelwood burning. A similar scenario unfolds in Mamit, accounting for potential carbon funding loss of roughly USD 1.8 million due to burning of fuelwood. In both the areas Dhankuta and Mamit, in case of tapping this carbon credits it will increase approximately 1% and 2% of per capita income respectively. Fuelwood is one of the critical aspects for forest degradation and carbon emission where REDD+ must channel its efforts to address this pressing issue effectively.

Furthermore, both study areas face the risk of forest fires, as identified during stakeholder consultations. The year 2021 was particularly devastating, with Mamit experiencing 675 fire incidents and Dhankuta recording 42. These fires pose not only a risk to carbon finance but also to the environment and human health. During the same period, air pollution levels increased, with high Aerosol Optical Depth in Dhankuta and elevated Carbon Monoxide levels in Mamit. These trends were linked to higher temperatures and lower precipitation compared to average annual norms. Without a comprehensive strategy to minimize forest fires, REDD+ remains a risky business.

For the success of REDD+ projects in community managed forests, it's imperative to identify and encourage active participation from forest-dependent communities. This can be achieved by utilizing potential carbon finance through initiatives like promoting clean cookstoves, afforestation, and sustainable forest management practices. Developing a benefit- sharing plan is crucial to convert carbon finance into tangible incentives for local communities. REDD+ as a mechanism for Result Based Payment can reduce fuelwood consumption and support sustainable forest management practices, reducing carbon emissions, and making communities eligible for carbon payments. REDD+ approach ensures the long-term sustainability of these strategies while encouraging site specific development in an ecologically sensitive way.

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List of Acronyms

AOD	:	Aerosol optical depth
BURs	:	Biennial Update Reports
CAMS	:	Copernicus Atmosphere Monitoring Service
CALIOP	:	Cloud-Aerosol Lidar with Orthogonal Polarization
CALIPSO	:	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations
CBA	:	Cost Benefit Analysis
CERs	:	Certified Emission Reductions
CFUG	:	Community Forest User Group
CMF	:	Community Managed Forest
CO	:	Carbon Monoxide
CO_2	:	Carbon Dioxide
COP	:	Convention of parties
D&D	:	Deforestation and forest degradation
DBT	:	Direct Benefit Transfer
EDC	:	Eco-Development Committee
EIA	:	Environmental Impact Assessment
ERP	:	Emission Reductions Program
ERPA	:	Emissions Reduction Purchase Agreement
ERPD	:	Emissions Reduction Program Document
ESMF	:	Environmental and Social Management Framework
FCPF	:	Forest Carbon Partnership Facility
FDA	:	Forest Development Agencies
FFPP	:	Forest for Prosperity Project
FGD	:	Focus Group Discussions

FIP	:	Forest Investment Program
FMA	:	February, March and April
FPIC	:	Free Prior and Informed Consent
FREL	:	Forest Reference Emission Level
FRL	:	Forest Reference Level
FSI	:	Forest Survey of India
GCF	:	Green Climate Fund
GEE	:	Google Earth Engine
GHG	:	Greenhouse gas
GIS	:	Geographical Information System
GRM	:	Grievance Redress Mechanisms
HKH	:	Hindu Kush Himalaya
ICIMOD	:	International Centre for Integrated Mountain Development
JFM	:	Joint Forest Management
KII	:	Key Informants Interview
M&E	:	Monitoring and Evaluation
MAIAC	:	Multi-Angle Implementation of Atmospheric Correction
MODIS	:	Moderate Resolution Imaging Spectroradiometer
MRV	:	Measurement, Reporting and Verification
NAMAs	:	Nationally appropriate mitigation actions
NDCs	:	Nationally Determined Contributions
NFI	:	National Forest Inventory
NFMS	:	National Forest Monitoring Systems
NGO	:	Non-governmental organizations

NRP	:	National REDD+ Programme
NRS	:	National REDD+ Strategy
NTFPs	:	Non-timber forest products
PAMs	:	Policies and Measures
PLR	:	Policies, Laws and Regulations
RBPs	:	Results Based Payments
REDD+	:	Reducing Emissions from Deforestation and Forest Degradation
RLCMS	:	Regional Land Cover Monitoring System
RS	:	Remote Sensing
S&As	:	Strategies and Actions
SDGs	:	Sustainable Development Goals
SESA	:	Environmental and Social Assessment
SFDA	:	State Forest Development Agency
SIS	:	Safeguards Information System
SRAP	:	Sub-national REDD+ Action Plan
SoI	:	Summary of Information (on respect for safeguards)
tCO2e	:	Tons Carbon dioxide equivalent
TROPMI	:	Tropospheric Monitoring Instrument
UNFCCC	:	United Nations Framework Convention on Climate Change
VC	:	Village Council
VFDC	:	Village Forest Development Committee

Chapter 1: Introduction

Reducing Emissions from Deforestation and Forest Degradation (REDD+) is a framework within the United Nations Framework Convention on Climate Change (UNFCCC) that aims to reduce greenhouse gas (GHG) emissions from deforestation and forest degradation (D&D) in developing nations. The "+" in REDD+ stands for additional forest-related actions that preserve the climate, such as sustainable forest management and the conservation and augmentation of forest carbon stores. Forests have a significant role in the global climate system. They absorb and store carbon dioxide, a key greenhouse gas. REDD+ is intended to provide financial incentives for developing nations to reduce deforestation and forest degradation to mitigate the effects of climate change.

The implementation of REDD+ is entirely voluntary for developing countries. Many countries have expressed interest in taking part in REDD+, and various pilot programs have been launched. It is critical to recognize that REDD+ is a complicated and changing mechanism, and there are many unanswered concerns on how to best administer it and guarantee that it is effective and equitable. REDD+ is not a panacea for climate change because it is only one component of a larger effort to reduce GHGs and mitigate climate change. It represents a significant opportunity for developing countries to profit from climate change mitigation. However, it is critical that REDD+ is implemented in a way that protects the poor and vulnerable.

1.1. REDD+ in chronological order

With an increasing emphasis on environmental issues worldwide, the crucial role of forests in combating climate change has gained recognition, particularly between 2000 and 2005 (Goldberg et al., 2020). After the ratification of the Kyoto Protocol in 1997, there was a significant shift in attention towards Reducing Emissions from Deforestation (RED). Developing countries asserted their right to pursue economic and social development; however, this often resulted in the destruction of forests for infrastructure and industrial purposes. It became imperative to devise a balanced development plan for these nations to avoid repeating the mistakes of industrialized countries that preceded them. Addressing the complex issues surrounding land use, including forestry and agriculture, has been a central challenge for the Parties to the UNFCCC since its inception (La Viña et al., 2016). Forests occupy a critical position in global climate change discussions due to their pivotal role in mitigation and their inherent connection to human survival. Forests possess a unique ability to simultaneously reduce greenhouse gas emissions, capture, and store carbon, and enhance the resilience of both people and ecosystems in the face of climate change. Consequently, policymakers and the scientific community have increasingly directed their attention towards forests. Nevertheless, it is undeniable that the changing climate regime adversely affects the adaptive capacity of forests, keeping them more vulnerable (Bernstein et al., 2008). The potential of forests to contribute to large-scale reductions in GHGs and address deforestation and forest degradation has been projected as a cost-effective and efficient strategy to mitigate climate change when properly implemented (Sathaye et al., 2007). The publication on the economics of climate change explicitly stated that reducing deforestation presents the "single largest opportunity for cost-effective and immediate reductions of carbon emissions" (Stern, 2006).

In the discussions during a side event of the UNFCCC's Ninth Session of the Convention of the Parties (COP 9) in 2003, the concept of lowering emissions from deforestation in developing nations initiated. This section emphasized "Avoided Deforestation," "Compensated Reduction," and "RED." The agenda for REDD in international climate change negotiations was submitted for debate at the UNFCCC COP 11 in Montreal in 2005. However, as talks advanced, the REDD agenda came under debate for its narrow focus on decreasing deforestation and forest degradation. To correct the lopsided focus of REDD, India took the initiative, with backing from Nepal, and other like-minded countries (Rawat & Kishwan, 2008) progressing from REDD to REDD+. India's advocacy for including conservation and the enhancement of forest carbon stocks as a policy approach to combat deforestation emissions was ultimately acknowledged and incorporated into the Bali Action Plan. The plan's paragraph 1(b) (iii) specifically addressed "policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries." This paragraph, collectively referred to as "REDD-plus" or "REDD+," was established in 2008 (Figure 1) under the UNFCCC (Besten et al., 2014).

Figure 1: REDD+ development in chronological order

In Cancun, governments agreed to accelerate action to reduce emissions from deforestation and forest degradation in developing countries, with the necessary technological and financial support. Building upon the paragraph 1(b)(iii) of the Bali Action Plan, Parties agreed on the list of forestry activities that would qualify for positive incentives under REDD+. Decision 1/CP.16 of the Cancun Agreements, paragraph 70, describes the five REDD+ activities: (a) reducing emissions from deforestation, (b) reducing emissions from forest degradation, (c) conservation of forest carbon stocks, (d) sustainable forest management, and (e) enhancement of forest carbon stocks. The activities denoted at (c), (d), and (e) represent the "plus" aspect of REDD+. In the Bali Action Plan, paragraph 1(b)(iii), the activity at (c) is referred to as "the role of conservation." However, in the Cancun Agreements, this has been modified to the measurable activity of "conservation of forest carbon stocks." The REDD+ mechanism, agreed upon by Parties at COP 16 of the UNFCCC in Cancun (decision 1/CP.16), incorporates principles and clauses that ensure safeguards, including good forest governance, respect for the rights of indigenous peoples and local communities, and protection and conservation of biodiversity and ecosystem services. Countries implementing REDD+ are required to adhere to safeguards that guarantee the full participation of indigenous peoples, local communities, and other stakeholders (Jagger et al., 2012).

To address concerns, an additional text on safeguards has been included, stating that actions must be consistent with the conservation of natural forests and biodiversity. This ensures that REDD+ activities are not utilized for the conversion of natural forests but rather incentivize for their protection, conservation, and enhancement of social and environmental benefits. The Cancun Agreements also outline a system for providing information on how safeguards are being addressed and respected throughout the implementation of REDD+ activities, while respecting national sovereignty (Korwin & Rey, 2015).

REDD+ progress was observed at several COP meetings, starting with Durban COP 17. During the negotiations, the focus was on finance, safeguards, reference levels, and measuring carbon emissions from forest activities. A decision was reached on safeguards, requiring countries to provide information on how they address and respect these safeguards during the implementation of REDD+ activities. The issue of establishing a financing mechanism for REDD+ and the matter of measuring, reporting, and verifying (MRV) REDD+ actions were left unresolved in Durban (Rawat et al., 2020). Nationally appropriate mitigation actions (NAMAs), including REDD+, were accepted as eligible mechanisms for developing countries to achieve emission reduction goals. Work on methodological guidance for REDD+ activities, particularly MRV and national forest monitoring systems, was highlighted as a significant area requiring attention. However, no agreement was reached on MRV, and the issue of REDD+ finance remained undecided. Parties agreed to undertake a work program on results-based finance in 2013 to support the implementation of REDD+ activities.

In Doha COP 18, the work program aimed to scale up and improve the effectiveness of finance for REDD+ activities. The program considered various sources of finance, including payments for results-based actions, incentivizing non-carbon benefits, and improving coordination. At Warsaw COP 19, the Warsaw Framework for REDD+ was approved, addressing methodological guidance, institutional arrangements, and results-based finance. The framework included provisions for results-based finance from various sources, with developing countries required to provide information on safeguards in their implementation of REDD+ activities. National entities or focal points were to be designated for REDD+ finance, and guidance on MRV and technical assessment of forest reference emission levels/forest reference levels was provided. At Lima COP 20, negotiations focused on additional guidance for developing REDD+ safeguards information systems and non-market-based approaches. However, no agreement was reached on further guidance for safeguards information systems. Under the Paris Agreement, forests were recognized as important carbon sinks for mitigating climate change. Article 5 of the agreement emphasized the role of REDD+ and encouraged all countries to act, including through results-based payments, for REDD+ activities. The recognition of REDD+ under the agreement provided political support and confidence for developing countries to continue with REDD+ strategies and readiness activities (Rawat et al., 2020).

While broad rules and methodological guidance for REDD+ were already agreed upon, legitimizing, and regulating REDD+ activities under Article 5 of the Paris Agreement was a significant step. This recognition and the importance of adequate and predictable finance for REDD+ activities further strengthened the implementation of REDD+ actions in meeting the forest-based targets of developing countries' Nationally Determined Contributions (NDCs).

While the fundamental concept of REDD+ has shown great promise, its implementation has struggled to gain traction across many countries. Numerous studies indicate that while REDD+ holds the potential for mitigating deforestation-related socio-economic and environmental risks, it also presents challenges in terms of compatibility and reliability. Nevertheless, the initiative is anticipated to contribute to poverty reduction by offering alternative livelihood opportunities and fostering biodiversity co-benefits. A significant portion of the REDD+ funding, whether bilateral or multilateral, has been directed towards countries with a history of high deforestation rates. This impetus has propelled Nepal and India to make substantial strides in their efforts. Both nations have embarked on the development of documents, plans, and policies mandated by the UNFCCC so these countries can access the incentives through this mechanism. Both the countries witnessed an expansion of forest cover in recent years, which is attributed to the community managed forest (CMF) initiatives and governmental interventions.

CMF stands as a vital cornerstone for communities reliant on forests in both countries. In the Indian context, this approach is recognized as Joint Forest Management (JFM), while the term Van Panchayat is employed in certain Himalayan states. Especially in northeastern region of India the local communities are dependent on these CMFs (JFMs). Here, local communities engage in forest product harvesting, a practice extending beyond the purview of the core REDD+ mechanism. To enhance economic gains for user groups, there has been a notable trend of cultivating fast-growing, short-rotation timber species—often exotic—in CMFs. However, this practice has raised concerns as it involves monoculture plantations that can lead to the destruction of natural forests. The intention behind is to get benefits in a shorter period span.

In Nepal, CMF, also known as community forests, are registered under the Divisional Forest Office. The history of these forests spans a significant period, fundamentally altering Nepal's forest landscape since its inception. However, recent stringent regulations have led to a termination in forest product utilization, resulting in challenges in forest management.

Since 2014, the country also adopted scientific forest management practices to enhance forest quality and ensure sustainable utilization of resources. Despite these efforts, there has been a shift in focus towards selling high-value timber, such as Sal (*Shorea Robusta*), leading to a decline in biodiversity within specific forests. This change appears to be focused by vested interests from political parties, influencing community forest committees to pursue profitable financial gains. Consequently, this has degraded natural forests and disrupted wildlife habitats due to the emphasis on a single tree species.

1.2. Rationale and objectives

In the coming years, the implementation of REDD+ holds promising potential within the CMF areas of these nations. However, a notable gap in understanding persists regarding how CMF can effectively contribute to achieving the objectives of REDD+. Attaining the envisioned goals of REDD+ through community-managed forests appears to be a challenging feat, largely due to the existence of perverse incentives. For the successful execution of REDD+, it becomes imperative to grasp the intricacies of local socio-economic factors, land tenure dynamics, and forest governance within a broader context. This comprehensive understanding is essential to accurately identify the underlying drivers and formulate appropriate mechanisms. Given the limited availability of literature and dedicated research, there exists a pressing need to scientifically evaluate the effectiveness of implementing REDD+ within these forests.

Furthermore, a clear comprehension of benefit sharing aligned with local needs becomes crucial. Considering this, the current study examines the progress of various countries in relation to REDD+ across different sectors, followed by an identification of the drivers of D&D. This study not only sheds light on the advancements made by countries in the realm of REDD+ but also identifies the sectors in which local demand aligns with the prerequisites for the successful execution of carbon projects. This spotlight on the benefit-sharing aspect of REDD+ holds utmost importance in ensuring its effective implementation.

The primary goal of this study is to evaluate the factor contributing to the effectiveness and successful implementation of REDD+ at the local level.

The specific objectives are:

- To examine and assess the progress of REDD+ in both countries.
- To analyse land use changes, particularly focusing on forest class, and identify the drivers of deforestation and forest degradation.
- To investigate the challenges for implementing the REDD+ activities and draw conclusions to facilitate effective implementation.

1.3.Thesis structure

The thesis is organized into 7 chapters (Figure 2). Chapter 1 serves as an introduction to REDD+, while Chapter 2 covers the methodology and details about the study areas. Chapters 3 to 5 present the results, and Chapter 6 offers a comprehensive discussion of these findings. Lastly, Chapter 7 includes the conclusion and recommendations. Additionally, this thesis comprises an abstract, acknowledgments, references, and annexes.

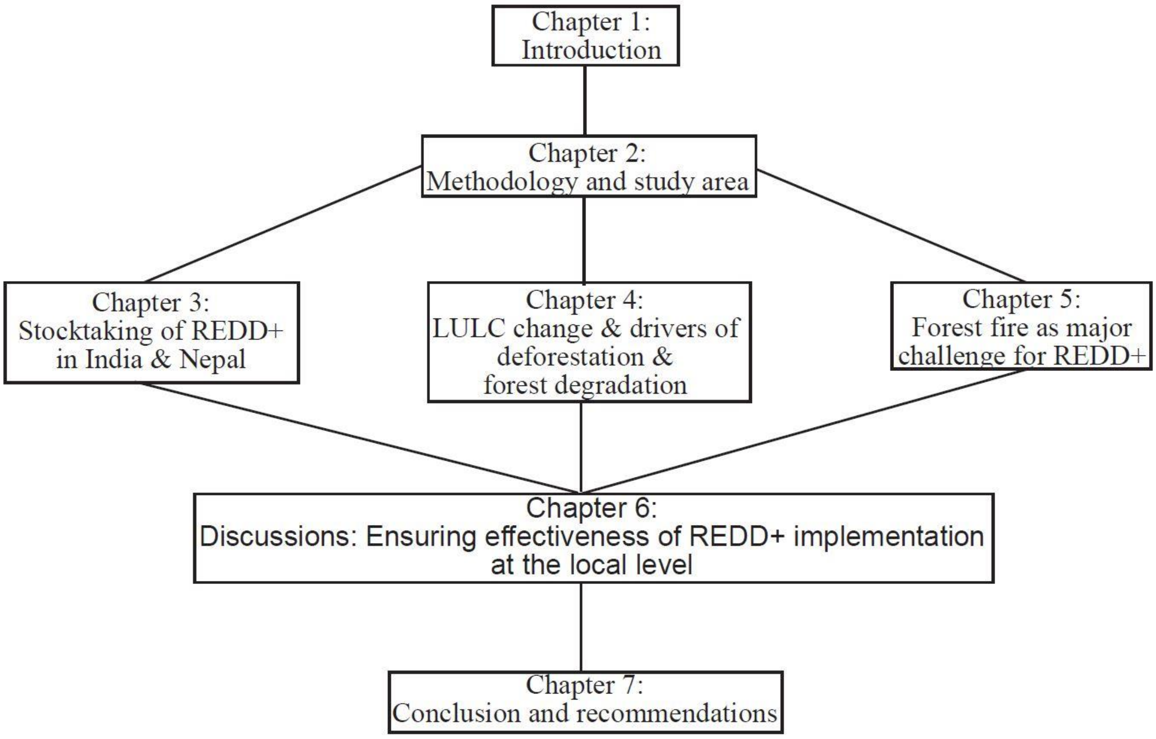


Figure 2: Structure of the thesis

Chapter 2: Methodology and Study Area

The choice of study sites depended on how feasible it was to put the REDD+ plan into action. The research needed to understand each country's progress in REDD+ before selecting or focusing on the locations. That's why, to achieve the study's first goal, the overall picture of REDD+ in both countries was assessed and then, the study delved into study sites, examining changes in land use and their causes (especially deforestation and forest degradation). This exploration also revealed challenges facing REDD+ implementation in these specific areas.

2.1. Selection of Study Area

As iterated, the study selected the study areas based on the progress of the REDD+ program, selecting Dhankuta in Nepal's Koshi Province and the Mamit district in India's Mizoram state (Figure 3). These places share similar mountainous terrain. Additionally, both districts have started initial REDD+ efforts, supported by the International Centre for Integrated Mountain Development (ICIMOD). Specifically, ICIMOD implemented the REDD+ Himalaya project, piloting the REDD+ program in two districts, including Mamit in Mizoram State. Dhankuta in Nepal attracted attention from private investors for its own REDD+ program. ICIMOD organized several consultations involving different stakeholders in Dhankuta to understand the potential for REDD+ implementation in the district. Importantly, both selected sites—Dhankuta and Mamit—practice community-based forest management. This similarity being the key for comparing and implementing the REDD+ activities effectively.

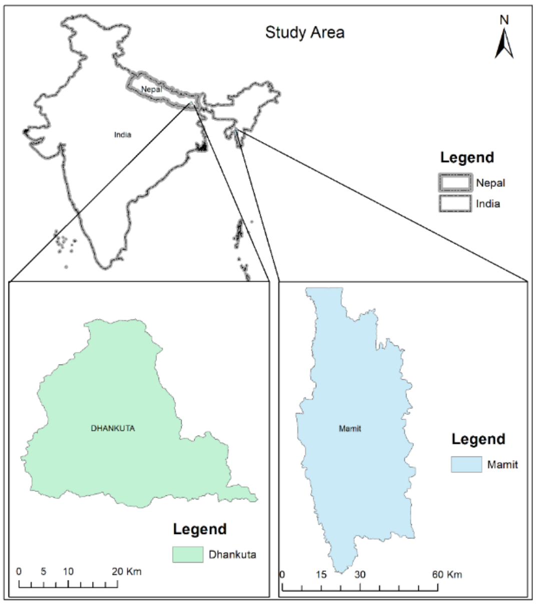


Figure 3: Study area map

2.1.1. Dhankuta District, Province 1, Nepal

Dhankuta, situated in the eastern part of Nepal within the Koshi Zone, is a district covering an area of 891 square kilometres. It is one of Nepal's seventy-seven districts, with its headquarters located in the largest city, Dhankuta. Geographically, it spans from 26°52' to 27°19' north latitude and 87°18' to 87°50' east longitude, bordered by Bhojpur to the east, Terhathum to the west, Morang and Jhapa to the south, and China to the north. The district is further divided into eight municipalities, comprising two sub-metropolitan cities, three urban municipalities, and three rural municipalities.

Dhankuta boasts diverse topography, ranging from the lowlands of the Koshi river basin to the towering Himalayan mountains, with altitudes varying from 300 meters to 2500 meters above sea level. This shows that the vegetation zones in the district ranges from sub-tropical Sal Forest to temperate forests. The Mahabharat Range and Himalayan Range run parallel, separated by the Arun River. The climate varies with altitude, featuring tropical conditions with high temperatures and humidity in the lowlands, and cooler temperatures at higher elevations. The monsoon season, lasting from June to September, brings substantial rainfall to the district.

The predominantly rural population of Dhankuta engages in agriculture as the primary occupation, cultivating major crops such as rice, maize, wheat, and millet. The district is renowned for its production of avocados, oranges, and tea, earning it the title of the "capital of avocados." The major ethnic groups include Brahmin, Chhetri, Rai, Limbu, Tamang, and Newar. In terms of education, Dhankuta boasts a relatively high literacy rate compared to other districts in Nepal.

Known for its scenic beauty and cultural heritage, Dhankuta houses several temples, including the Bishnupaduka Temple, Chhintang Devi Temple, and Panchkanya Temple. The district offers various trekking trails, with the Makalu Base Camp trek standing out as one of Nepal's most popular treks. Overall, Dhankuta is a diverse and vibrant area with a rich cultural heritage and natural beauty, making it an intriguing study location for researchers across different fields. Its distinctive environmental conditions, climate, topography, and forest cover position it as a representative model for carbon projects in other hilly districts of Nepal.

2.1.2. Mamit District, Mizoram, India

Mamit District was established as a distinct entity from Aizawl District by the Mizoram Government on March 11, 1998. Covering an area of 3025 square kilometres, it is situated between 92°15'44.54” and 92°40'16.80”E longitude and 23°15'21.25” to 24°15'16.80”N latitude. Mamit stands as the least urbanized district in Mizoram, with only 17.25% of the total population residing in urban areas. Out of the total population of 86,364, only 14,899 people live in urban settings. Among the eight districts, Mamit has the second-lowest literacy rate at 84.9%. The tribal population constitutes 95.0% of the total, slightly higher than the 94.4% of scheduled tribes in the state.

The district experiences temperatures ranging from 9°C to 24°C in winter and 24°C to 36°C in summer. The monsoon season contributes abundant rainfall, maintaining a mild climate throughout the year. Mamit District shares borders with the Assamese district of Hailakandi to the north, the Tripuran district of North Tripura and Bangladesh to the west, the district of Lunglei to the south, and the districts of Kolasib and Aizawl to the east. The rivers predominantly flow south-north, except for Khawthlangtuipui, and the mountains align in a similar orientation. Key rivers in the area include Tlawng, Tut, Teirei, Langkaih, and Khawthlangtuipui. The forest cover type of Mamit district is primarily tropical wet evergreen forest coupled with moist deciduous forests and semi evergreen forest.

Agriculture forms the backbone of Mamit District's economy, with paddy being the primary crop and a staple food source. Jhum cultivation plays a crucial role in enhancing agricultural productivity. During the Rabbi season, cultivation focuses on significant crops like mustard, cabbage, radish, carrot, tomato, potato, and various pulses. Mamit is renowned for its oranges and Hatkora fruits. The district's flora encompasses diverse species, ranging from bamboo and cane to fuelwood and timber resources. Animal husbandry, particularly the rearing of pigs and poultry, serves as a prominent complementary activity.

Mamit District, with its distinctive characteristics, topography, and climate, presents an opportunity for showcasing carbon pilot projects related to shifting cultivation practices. The reduced enthusiasm for shifting cultivation among local inhabitants, when provided with alternative livelihood options, signifies a potential for sustainable development. Initiatives in this district could serve as models to be replicated in other northern Indian states.

2.2. Methodology

The study was conducted using three approaches. 1) Participatory rural appraisal techniques 2) GIS/ RS analysis 3) consultation workshops/meetings.

2.2.1. Stocktaking of REDD+

To commence, the research undertook initial assessments to determine the status of REDD+ implementation within the respective countries. This evaluation involved conducting a questionnaire-based survey with representatives from various sectors. A total of 63 questionnaires were completed in both countries: 36 in Nepal and 27 in India. We sought objective-oriented responses from respondents and visualized the progress of REDD+ in these countries through graphical representations.

The approach adopted in the study centered around utilizing multiple-choice questions for evaluating readiness progress. The research initiated the formulation of the questionnaire through informal discussions with REDD+ implementing agencies in both nations. Subsequently, we actively refined it through a thorough review of relevant literature, incorporating sources from the UN-REDD Programme, the Forest Carbon Partnership Facility (FCPF), the UNFCCC, and other credible references.(Casse et al., 2019; J. Chand et al., 2018; Poudel et al., 2020; Westholm et al., 2010). The questionnaire was structured to assess progress across five readiness dimensions:

- Strategy or policy readiness (covering National REDD+ Strategies and Policies as well as Measures),
- Institutional readiness, technical readiness (encompassing
- Forest Reference Emission Levels (FREL), National Forest Monitoring Systems (NFMS), and Monitoring, Reporting, and Verification (MRV)},
- Safeguards readiness, and
- Financing readiness, including the establishment of a benefit-sharing mechanism for distributing results-based payments (RBPs).

After piloting the initial version with a small group of experts in Nepal and incorporating their feedback, the questionnaire was finalized. In total, the questionnaire comprised 57 questions categorized across the five readiness components. Annex 3 provides an overview of the main indicators formulated in accordance with the REDD+ Warsaw framework. The survey unfolded in two rounds across the two countries, directing attention towards a diverse group of REDD+ stakeholders, including implementing agencies, non-governmental organizations (NGOs), private sector entities, and academics. The aim was to capture a broad perspective from these stakeholders. The research began by distributing the questionnaire to participants and collecting their responses. After observing consistent responses, the second round centred on collectively discussing and validating responses during plenary sessions.

Acknowledging the relatively small sample size, it is imperative to recognize that this research does not undertake a comprehensive analysis of readiness using an all-encompassing set of indicators. Instead, its objective is to provide a preliminary evaluation of REDD+ readiness status in these two countries up to 2021.

While ascending rankings were applied to most choices in the questionnaire to signify varying levels of readiness, certain responses were confined to "yes" or "no" or presented in an open-ended format. To facilitate basic qualitative analysis, radar charts were generated, the research translated responses into a 1-4 scaling system, assigning a score of 4 to indicate higher readiness and a score of 1 to indicate lower readiness. The scaling approach was uniformly applied to all questions within the questionnaire.

2.2.2. Assessing drivers of deforestation and forest degradation

Next, the study focused on examining the status of community-managed forests in the study sites. This involved reviewing secondary literature, conducting focus group discussions (FGDs), and key informant interviews (KIIs) to understand the drivers of deforestation and degradation in these areas. Additionally, land-use change cover from 2000-2021 was analyzed using satellite imagery and ArcGIS to track changes in forest and non-forest areas.

Land use change analysis

Primarily driven by human activities, changes in land cover have far-reaching consequences for ecosystems, biodiversity, and the dynamics of climate change. In fact, roughly 35% of the carbon emissions present in the atmosphere can be directly attributed to human actions since the industrial revolution (Houghton et al., 2000). Given this context, this study places significant importance on analyzing alterations in land cover, particularly focusing on shifts in forested areas in relation to carbon levels. To effectively monitor these transformations, the collaboration between ICIMOD and various partner organizations led to the creation of the Regional Land Cover Monitoring System (RLCMS). This innovative system brought together resources from SERVIR-Mekong at the Asian Disaster Preparedness Center, Afghanistan's Ministry of Agriculture, Irrigation and Livestock, and the Global Land Analysis and Discovery laboratory at the University of Maryland (ICIMOD, 2023). Powered by advanced remote sensing technology hosted on the Google Earth Engine platform and utilizing a standardized dataset, the RLCMS yields high-quality land cover data at both regional and national scales.

Especially, the RLCMS played an important role in generating extensive land cover maps for the Hindu Kush Himalaya (HKH) region, covering from 2000 to 2021 as a crucial side of ICIMOD's SERVIR-HKH Initiative. These maps, remarkable for their 30-meter resolution, effectively categorize land use into nine distinct classes. Upon determining the precise study area, the focus effortlessly transitioned to the analysis of land use changes, particularly the shifts between forested and non-forested domains. This was processed using ArcMap 10.8.1 software. By thoroughly cross-referencing established land use maps from both the years 2000 and 2010, the scope and extent of changes in land use were systematically computed. The identification of underlying trends in land cover changes is of utmost importance, as it provides critical information that is necessary for the effective planning and implementation of projects, including the critical REDD+ effort.

Drivers of deforestation and forest degradation

The research assessed the drivers responsible for D&D by employing a multi stakeholder participatory approach. In Mamit, the session convened with the participation of 25 individuals, while in Dhankuta, 31 participants attended. Within both gatherings, the attendees received a comprehensive briefing about the meeting's objective. They were provided with two distinct colors of meta cards to present the drivers of deforestation using one color and the drivers of forest degradation using another. This interactive process unfolded in two distinct groups, each group dedicated to exploring either deforestation or forest degradation drivers. Participants engaged in collaborative discussions to identify these drivers, ultimately generating a comprehensive list. Subsequently, these identified drivers were classified into two categories: direct drivers and indirect drivers. Recognizing that REDD or Carbon projects alone cannot effectively address the entirety of these drivers, a prioritization process was enacted. This prioritization adhered to the criteria specified in Table 1 (Richards et al., 2017), allowing for a methodical evaluation and ranking of these drivers.

Table 1: Scoring criteria for prioritizing the drivers of deforestation and forest degradation.

Direct driver	Location[s]	Future threat (1-5)	Future biomass impact (1-5)	Future forest area impacted (1-5)	Total score	Plenary scoring

2.2.3. Forest fire as major challenge for REDD+

To comprehend the challenges associated with the implementation of REDD+, the study conducted a comprehensive review of relevant literature and closely examined the prevailing forest fire trends, given its substantial impact. Forest fire occurrences have displayed a concerning escalation in both their intensity and frequency over the years. The study delved into the complex interplay between these incidents and factors such as precipitation, temperature, and air pollution. To gather data on forest fire incidents, precipitation, temperature, and air pollution, the study relied on Moderate Resolution Imaging Spectroradiometer (MODIS) satellite images, ERA-5 Landsat data and secondary information. Notably, forest fires emerged as primary drivers of degradation in both study sites. Recognizing the significant influence of forest fire incidents on air quality, the study undertaken to ascertain the extent to which forest fires contribute to air pollution within the study areas. The examination of the relationship between forest fires and air quality, temperature and precipitation were presented by line plots to show the areas and time having high pollution level and their impact on local air quality.

Forest fires

First and foremost, a review of secondary resources relating to forest fires in both the sites was carried out. These supplementary data sources played a crucial role in the analysis and assessment of the primary data derived from the MODIS instrument. The MODIS active fire products are recognized and used for their intricate fire detection abilities. These products capture snapshots of fire events during satellite passes over the Earth's surface. By employing detection algorithms, the MODIS system identifies pixels indicating active fires. Each of these active fire pixels corresponds to the central point of a 1x1 km area and represents one or more fire incidents that occurred within that specific km^2 (Giglio et al., 2003). Evaluating the brightness temperature of each potential fire pixel, the algorithm carefully examines and categorizes pixels into various classes such as missing data, cloud, water, non-fire, fire, or unknown. To procure the MODIS active fire data for this study, the resource https://firms.modaps.eosdis.nasa.gov/download/ was accessed. It's noteworthy that the MODIS active fire data comes with an associated confidence level spanning from 0% to 100%. To minimize the inclusion of false positive instances of active fires, this study exclusively opted for data points with a confidence level surpassing 50%.

Air pollution observed from space

MODIS information was used to identify the air pollution in the study sites. MODIS instruments aboard Terra and Aqua satellites capture radiance across 36 spectral channels, with spatial resolution ranging from 250 m to 1 km and a swath width of 2300 km. The Terra and Aqua satellites traverse the equator at 10:30 and 13:30 local solar time (LST) respectively (Levy et al., 2007). The effectiveness of Dark Target (DT) 10 km and 3 km aerosol products, as well as Deep Blue (DB) 10 km aerosol products, has been well-established and validated over time (Levy et al., 2007, 2013). A novel algorithm, the Multi-Angle Implementation of Atmospheric Correction (MAIAC), retrieves aerosol optical depth (AOD) with a heightened spatial resolution of 1 kilometer through MODIS measurements (Lyapustin et al., 2011). The MAIAC algorithm employs reflectance values from MODIS's blue, green, and shortwave infrared bands. Demonstrated by a higher correlation coefficient, a greater percentage of retrievals within expected errors, and lower root mean square errors, MAIAC AOD proves to be more accurate than DB and DT AOD specifically for South Asia (Mhawish et al., 2019). This study relies on the combined Terra and Aqua MAIAC product (MCD19A2v006), accessible via the Google Earth Engine (GEE) data platform.

TROPOMI, hosted on the Sentinel-5 Precursor (S5P) satellite by the European Space Agency, orbits the Earth in a sun-synchronous path at 824 kilometers altitude, crossing the equator at 13:30 LST (Landgraf et al., 2016). Operating with daily global coverage, TROPOMI provides a spatial resolution of 5.5 km × 7 km and swath width of 2600 km^2. The retrieval algorithm derives total column density of CO through measurement of Earth’s radiance spectra within the 2.3 μm spectral range of the shortwave infrared (SWIR) region (Landgraf et al., 2016). This study draws on the offline (OFFL) version of CO data available through GEE's data catalogue. GEE transforms the original S5P Level 2 (L2) data to Level 3 (L3) using the 'harpconvert' tool with the 'bin_spatial' operation. Initial validation demonstrates strong agreement between TROPOMI CO data and the Copernicus Atmosphere Monitoring Service (CAMS) dataset within the South Asian region (Borsdorff et al., 2018).

The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite carries the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) instrument, which acquires data on aerosol and cloud profiles. Following a sun-synchronous orbit and crossing the equator at 14:00 LST, CALIPSO operates with a 16-day orbit repeat cycle (Winker et al., 2013). In this study, the standard browse image version 4.11 of CALIOP data is utilized for identifying aerosol sub-types.

Precipitation and Temperature

The seasonal precipitation and temperature data for the selected regions during the reference period of 2010-2020 and for the year 2021 are obtained from the ERA5-Land dataset. Previous research in the Himalaya region has frequently utilized ERA datasets (Lutz et al., 2014; Wijngaard et al., 2017). ERA5-Land represents an enhanced iteration of the land component within the ERA5 climate reanalysis, boasting a resolution of 9 kilometers (Muñoz-Sabater et al., 2021). Monthly datasets were acquired and extracted for all the designated regions.

Limitation of the study

The study was subject to some constraints or limitations:

- The examination of the REDD+ stocktaking process highlights the involvement of a relatively narrow group of experts. It is important to recognize that variations in scoring might arise from different rounds of multi-stakeholder workshops conducted at diverse levels and across various states.
- Given these limitations, it is crucial to avoid asserting that this study represents a definitive assessment of readiness status based on an exhaustive array of indicators. Instead, its significance lies in offering an indicative overview of the progress made in REDD+ readiness within India and Nepal as of 2021.
- The analysis of land-use change might not provide precise figures due to the inherent limitations of low-resolution data, particularly in the case of RLCMS from ICIMOD. Therefore, it is strongly recommended to incorporate high-resolution satellite imagery, especially for the purpose of carbon monitoring and reporting.

- Regarding the fire data acquired through the MODIS satellite, it's important to note that the extent of forest fires cannot be precisely determined. The information presented solely represents detected fire points by the specific satellite. To gain a comprehensive understanding of the impacts, ground validation becomes imperative.
- The findings of this study are confined to mountainous regions in countries that primarily rely on fuelwood and possess community-managed forests; therefore, the applicability of these findings to urban areas of REDD+ participating countries may be limited.

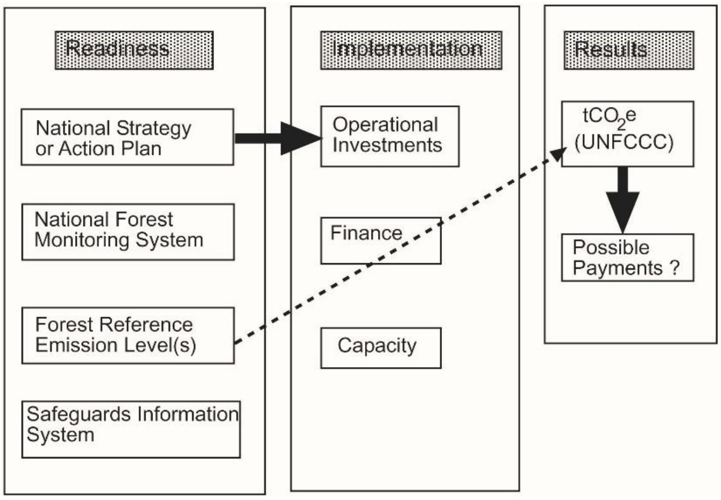
Chapter 3: Result 1 - Stocktaking of REDD+ in India and Nepal

3.1. Introduction

The REDD+ policy approach, which provides positive incentives to discourage D&D, has been in place for more than two decades. However, effectively addressing the ambitious goals outlined in the Paris Agreement under the UNFCCC will remain an unattainable feat unless significant efforts are made to reduce D&D, enhance forest restoration, and mitigate agricultural emissions. Recognizing this critical need, the UNFCCC has acknowledged the importance of offering RBPs to developing countries, contingent upon their ability to demonstrate emission reductions compared to their national emissions baseline. Activities eligible for the REDD+ process include the conservation of forest carbon stocks, sustainable forest management, and the increase of carbon stocks through natural forest restoration and the implementation of diverse tree plantation measures, typically involving reforestation, afforestation, or agroforestry systems. Ultimately, the primary objective of REDD+ is to encourage developing countries to actively contribute to climate change mitigation by reducing GHG emissions through the prevention, cessation, and reversal of forest loss and degradation, as well as by sequestering GHGs from the Earth's atmosphere through the conservation, management, and expansion of forests (Duchelle et al., 2018).

Many countries have therefore embarked on NRPs with the support of international development agencies, including the World Bank- Forest Carbon Partnership Facility (FCPF), the UN agencies via the UN-REDD Programme, and bilateral aid programmes of Norway, Germany, Japan, the USA and other countries. Based on UNFCCC guidance, an NRP can be divided into three phases: ‘Readiness’, ‘Implementation’ (or more accurately ‘early implementation) and “Payments for Results.” Furthermore, Figure 4, shows that the ‘Readiness’ phase has four main ‘components’:

- ✓ A NFMS, including a carbon MRV system;
- ✓ A baseline FRL/FREL;
- ✓ A Safeguards Information System (SIS) to protect or enhance the ‘Cancun’ social and biodiversity safeguards; and,
- ✓ A National REDD+ Strategy (NRS) or action plan, including a set of policies and measures (PAMs) or Strategies and Actions (S&As) in World Bank terminology, to counteract D&D.



Courtesy: (Le, 2017)

Figure 4: Showing different phases countries are required to transition before becoming eligible to receive REDD payment.

In accordance with the Cancun Agreement, the readiness phase of REDD+ implementation encompasses several key aspects that countries need to address in their preparation efforts. One crucial aspect involves the development of national strategies or action plans tailored to each country's specific circumstances, aiming to address drivers of D&D through policy reforms and interventions (Karki et al., 2018; MoEFCC, 2018; MoFE, 2018). These PAMs or strategies and actions (S&A) are designed to counteract the negative impacts of D&D. Additionally, countries must demonstrate the establishment of a NFMS to ensure the availability of reliable and accurate forest data, including functions related to MRV (Mora et al., 2013; Romijn et al., 2015). To demonstrate the additionality of REDD+ interventions, countries are required to establish FRL/FREL as baselines. These baselines serve as a foundation for quantifying emissions resulting from D&D, carbon stock enhancement, and removals through sustainable forest management (FCPF, 2022b). Furthermore, countries must adhere to the SIS, which aims to protect and enhance the social and biodiversity safeguards outlined in the "Cancun" agreement (Menton et al., 2014). Given that a significant portion of the population in developing countries relies on forests and their rights must be respected and addressed, the SIS ensures compliance with these safeguards. Similarly, biodiversity should not be adversely affected by REDD+ implementation, and the SIS establishes a compliance condition for countries.

This chapter provides the findings on assessing the progress of readiness in India, and Nepal within the context of their respective National REDD+ Programs (NRPs). The objective is to identify readiness gaps and provide a comparative evaluation of the preparedness levels of these countries. It is expected that the study's findings will be instrumental in determining the most suitable country for REDD+ implementation and identifying areas that require improvement to enhance their suitability.

3.2. Study Area

The study was conducted in both countries, choosing the entire country as the study sites, as depicted in Figure 5. The sites were selected based on the mandate of REDD+ mechanisms, which necessitates a comprehensive understanding of each country's scenario and progress in REDD+. By encompassing two districts in each country, the study aimed to capture a broader perspective and provide more accurate results and recommendations. Examining the entirety of the country allowed for a comprehensive assessment of the readiness levels and identified gaps in each country's REDD+ implementation efforts. Without considering the overall country scenario, it would have been challenging to provide meaningful and context-specific results and recommendations through this study.

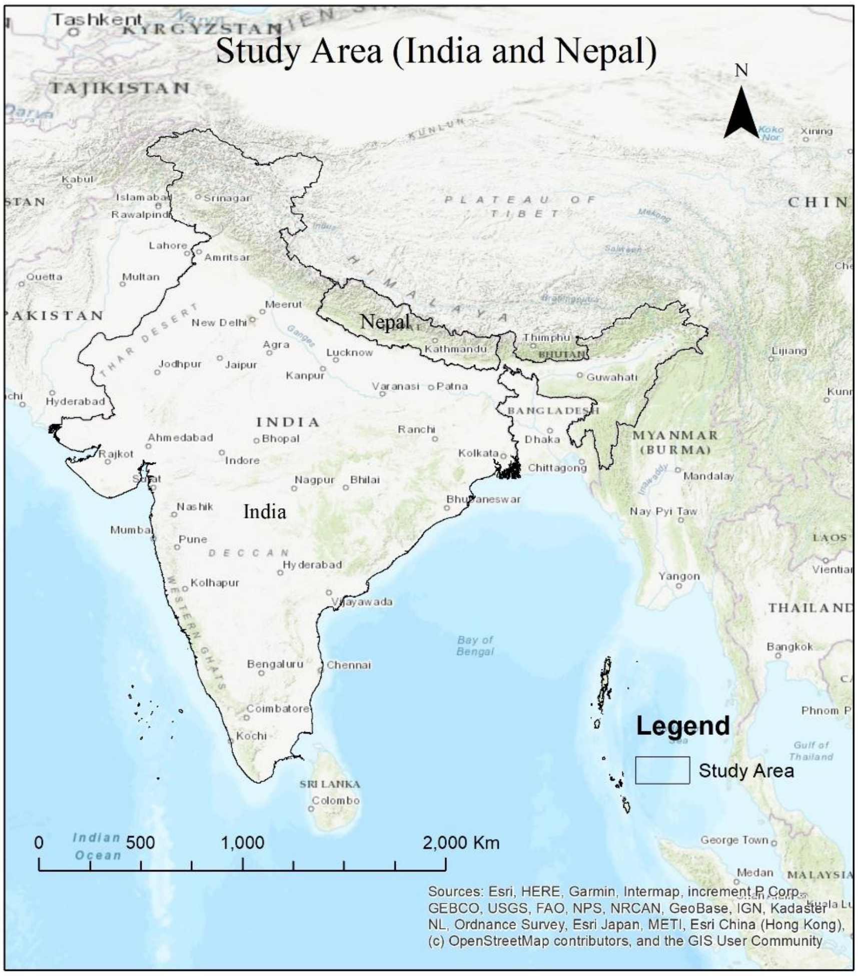


Figure 5:Map of study area-India and Nepal

3.3. Results

3.3.1. Strategy readiness

Thirteen indicators were used to assess the readiness of strategies and policies. The National REDD+ strategies of both countries have been ratified by their respective governments and are available on the website (MoEFCC, 2018; MoFE, 2018). To analyze the drivers of deforestation and forest degradation, both countries relied on secondary data, stakeholder workshops, and satellite imagery. India conducted a partial analysis of policies and laws (excluding PAMs), whereas Nepal conducted a comprehensive risks and benefits analysis, incorporating mitigation measures into their NRS. Notably, India has a higher proportion of 'extra-sectoral' PAMs, particularly in agriculture, infrastructure, and mining, compared to Nepal. India's higher rating reflects the use of current laws and policies as PAMs. Nepal has conducted some preliminary calculations and studies. Both countries have conducted a partial analysis of barriers, with comprehensive studies undertaken by India in 2013 and Nepal in 2010. This strong commitment includes India's goal of increasing the carbon sink by 2.5-3 billion tCO_2e through additional forest and tree cover by 2030 and Nepal's commitment to maintain 45% forest cover area and ensure 15% of total energy demand is supplied from clean energy sources by 2030 (GoN, 2020; MoEFCC, 2018; MoFE, 2018).

Regarding the implementation of REDD+ programs, Nepal received a significant rating due to high-level political support. However, concerns were raised about political support at the state level in India, which is crucial as REDD+ in India will primarily be implemented through State REDD+ Action Plans (MoEFCC, 2018). Currently, six states have already developed their plans and several are in the development phase. Incentives to change current practices were deemed "significant" in India (although less convincingly in the absence of PAMs) and "moderate" in Nepal. Experts expressed concern in Nepal that community forestry user groups (CFUGs) were not strongly motivated by REDD+ compared to their livelihood priorities. The forest law enforcement capacity and compliance in both countries received a strong rating. In terms of an effective and equitable judiciary system, it was rated as "strong" and equitable in India (despite controversy surrounding a proposed Supreme Court ruling on tribal forest peoples), and "significant" in Nepal, considering the multi-layered system following the recent federalization process. Figure 6 presents a composite strategy rating score for both countries, based on the indicators 'fact-based' indicators, Nepal is slightly ahead compared to India in overall strategy ratings.

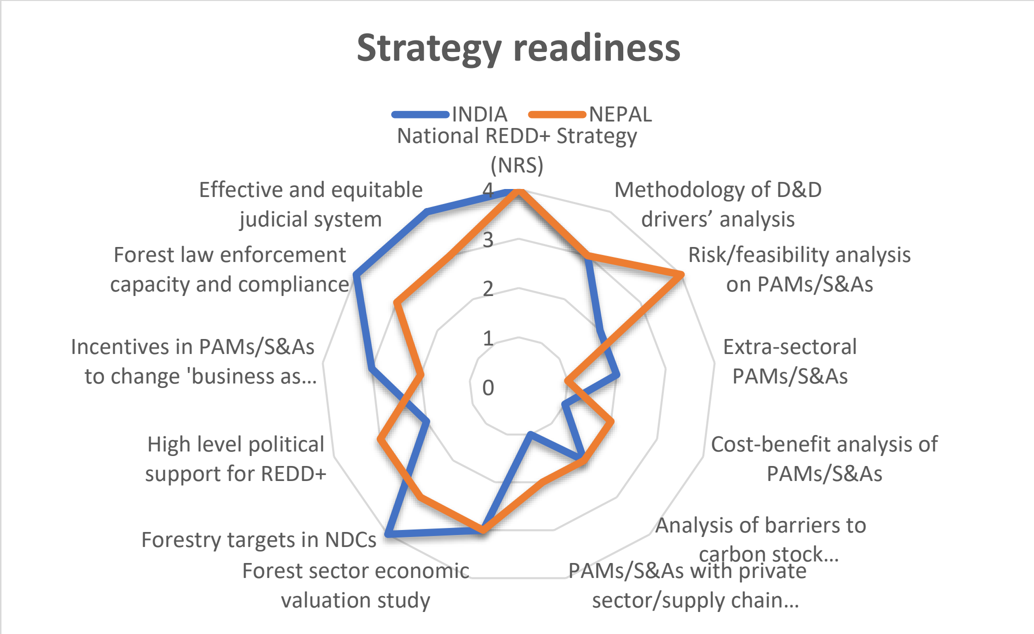


Figure 6: Graph showing the strategy readiness status of both the countries.

3.3.2. Institutional readiness

Based on the questionnaire responses, the current progress or achievement based on eight possible indicators of institutional readiness is summarized. The aim of the non-forest sector leadership of PAMs/S&As indicator was to assess the involvement of non-forest sector institutions in the NRPs. This involvement appeared to be more pronounced in India. India's high rating was based on the relevance of its existing policies and laws (considered as PAMs) to REDD+. On the other hand, Nepal received the highest rating due to its Steering Committee, which is mandated to report to the Planning Commission and the Prime Minister's Office. In India, the equivalent Steering Committee reports to the environment/forest sector ministry. Both countries have placed their Strategic Implementation Structures either directly under the Forest Department or within the forest ministry. The situation for the Monitoring and Evaluation (M&E) system was similar, as both countries will conduct M&E through a department in the forestry/environment ministry, indicating limited independence. However, both countries specified a specific section or department responsible for forest measurement and inventory work: the Forest Survey of India and the Forest Research and Training Centre for Nepal. This aspect is a crucial pillar of REDD (MRV/NFMS). In terms of implementing RBPs, both countries received low ratings due to the lack of ratified decisions regarding institutional responsibility for managing REDD+ implementation finance. India had made provisional decisions, while Nepal was yet to decide. In most cases, responsibility was likely to lie with the forestry ministry. Respondents predicted that coordination effectiveness in the implementation phase would be "quite effective" for both India and Nepal. However, considering the influence of ministries and lobbies involved in agriculture, infrastructure, and mining, along with political priorities centered around economic development, these ratings may appear overly optimistic. Figure 7 provides an overview of the overall institutional readiness in both countries, indicating that India is slightly ahead of Nepal in terms of overall readiness.

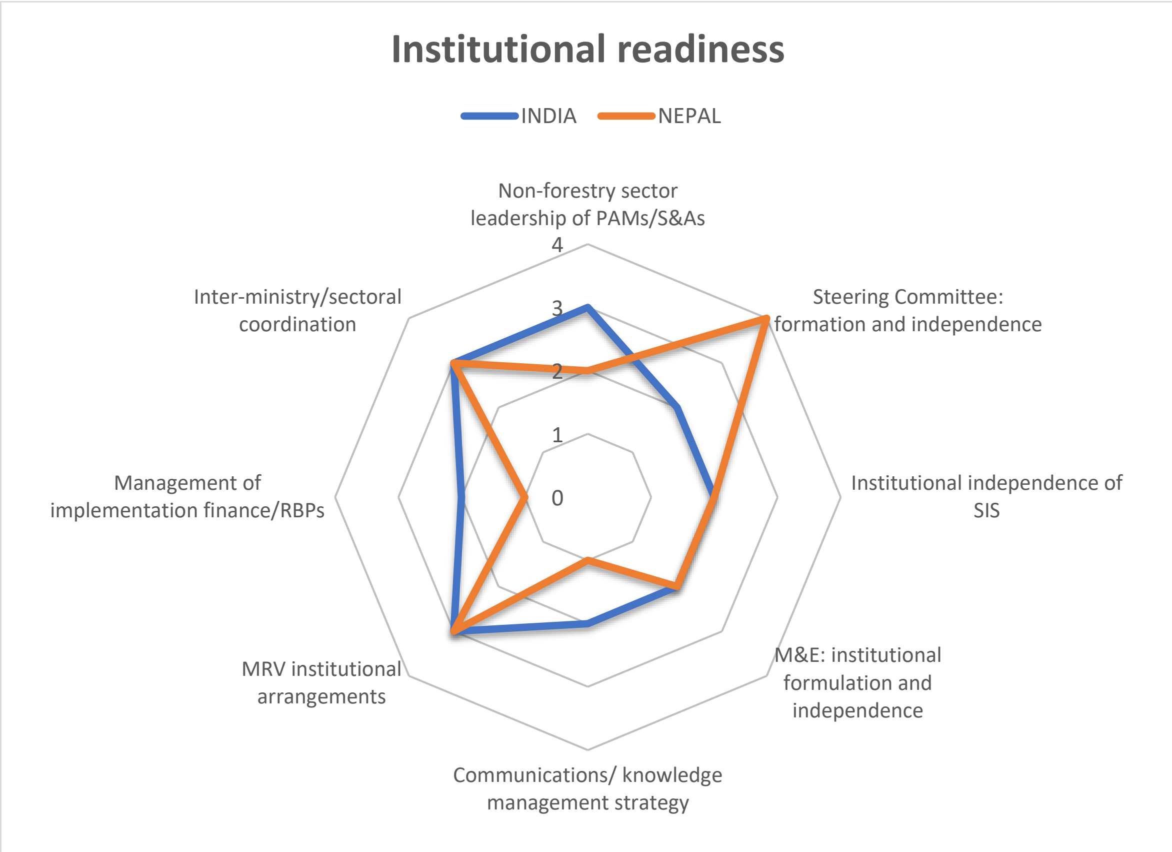


Figure 7: Institutional readiness of both the countries

3.3.3. Technical readiness

The progress and achievement of nine indicators of technical readiness, based on the questionnaire responses, are presented as follows. Both countries have submitted revised FRL/FRELs following the UNFCCC technical review. In India's FRL, five carbon pools (above and below ground biomass, deadwood, litter, and soil organic carbon) were included, while Nepal's FRL had two (above and below ground biomass). Nepal is still in the early stages of measuring forest degradation for inclusion in the FRL/FREL, whereas India has made significant progress and included forest degradation in its revised submission following the technical assessment. Both countries used a nationally derived Emissions Factor for calculating above ground biomass. Regarding the components of the NFMS, India is more advanced with its operational and publicly accessible satellite-based monitoring system and National Forest Inventory. In contrast, Nepal's NFMS is operational, but the web-based portal has not been finalized yet. Nepal has also made significant progress in developing a Carbon Registry based on the World Bank system, although it needs adaptation to the national context. India has an advantage in terms of accessibility to NFI data through the biennial India State of Forest Report and full website access. Nepal have provided some data electronically upon request. India has been able to utilize the 2019 map from the NFI produced by the Forest Survey of India, while Nepal has used 2015 satellite land use cover maps. However, Nepal's 2020 map is nearing completion. It's worth noting that, at the time of the survey, Nepal couldn't provide an updated forest cover map. Nevertheless, a forest cover map until 2021 is now publicly available (ICIMOD, 2023). Both countries have submitted Biennial Update Reports (BURs) to the UNFCCC. From Figure 8, it is evident that both countries are in an advanced stage of technical readiness. However, when comparing the overall readiness between the two, India is ahead of Nepal.

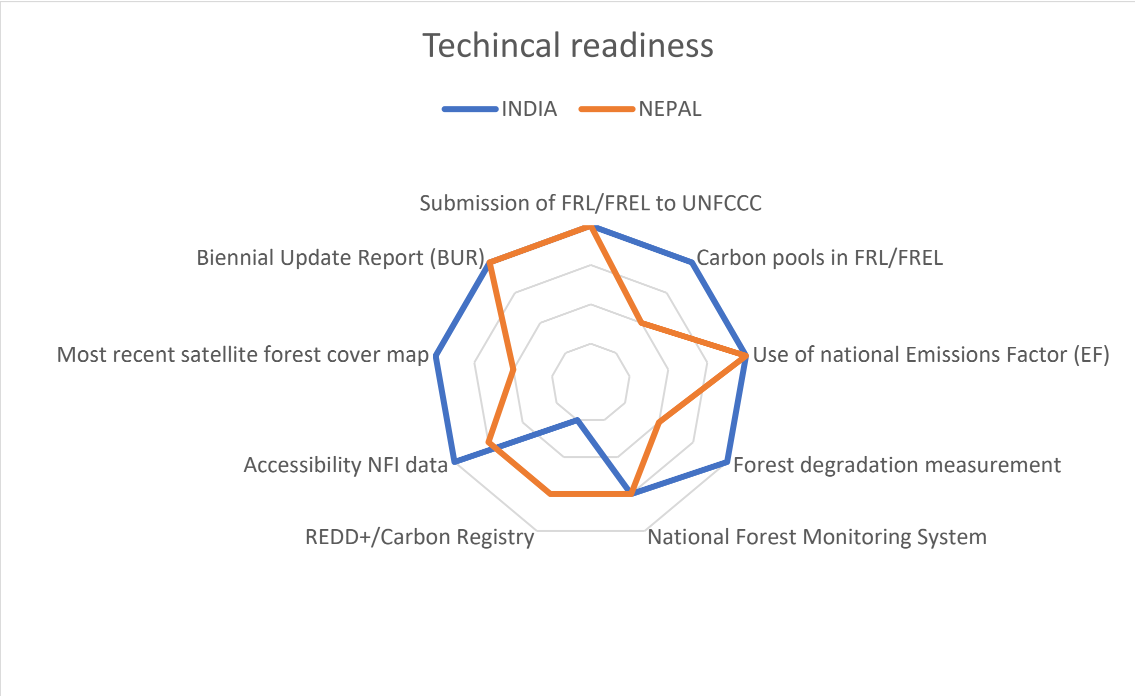


Figure 8: Technical readiness of both the countries as per the indicators

3.3.4. Safeguards' readiness

Based on the questionnaire responses, the status, or achievements of 17 indicators of safeguards' readiness can be identified as shown in Figure 9. Both countries have conducted comprehensive stakeholder analyses of social and governance risks, although India's analysis focused on current laws and policies rather than specifically defined PAMs. It was found that both countries are in the early stages of implementing the SIS, and there is a need to initiate a summary of information (SOI) on safeguards as no progress has been made yet. India has completed the analysis of policy, laws, and regulations (PLR) gaps associated with the SIS, while Nepal has started this step through a World Bank-supported study to identify policy gaps following the country's federalization process. Both countries were moving forward with the SIS, but the work has been delayed due to the COVID-19 pandemic. Nepal has conducted stakeholder consultation workshops for safeguard contextualization analysis, while India was planning to do so during the survey but has also conducted a few stakeholder consultation meetings since then. Nepal has well-established Grievance Redress Mechanisms (GRM) as part of their NRP, and their GRM, developed in 2015, has been widely disseminated for public awareness. India has outlined the GRMs but has not provided detailed information.

Nepal has conducted a comprehensive analysis of gender issues, including a workshop in February 2020. Both countries have web-based mechanisms (websites) for sharing forest management information, including logging data, which is freely available to the public. In terms of biodiversity risk analysis of PAMs, India has conducted a comprehensive risk analysis, but only focusing on current laws and policies. Nepal has conducted a partial analysis of biodiversity risks associated with the Safeguards and Safeguards Information Systems (S&As). Both countries have clear and well-implemented regulations prohibiting plantation crops on degraded forest land. In terms of biodiversity provisions in timber harvesting regulations, Indian respondents felt that these regulations were strong and well-implemented, while Nepalese respondents admitted that the regulations were insufficient and weakly implemented. In Nepal, there has been some analysis of emission reversal risks, particularly during the design of the Terai Arc project, but there has been no analysis conducted in India. Indian respondents felt that the current PLR is supportive of the property rights of forest-dependent communities and smallholders, including indigenous people. Nepal also has a reasonably good PLR basis, especially for the extensive community forestry system, but the protection of property rights was uneven. Both countries agreed that the Free Prior and Informed Consent (FPIC) had a strong PLR basis, but there were differences in implementation. In India, FPIC was rated as "strong" due to supportive village governance legislation (Panchayat Act) and institutions (Gram Sabha), while in Nepal, it was rated as "moderate." In terms of the legal basis for implementing Environmental Impact Assessments (EIA), Indian respondents stated that the EIA had a strong legal basis and was "very strictly implemented" in the forest sector. Nepal felt that the legal basis was good, but that implementation could be improved through the NRP. Similarly, both countries agreed that the biodiversity provisions in EIA regulations were strong on paper, and implementation was already good before the NRP. Based on the indicators, both the countries are progressing well where Nepal seems to be slight ahead.

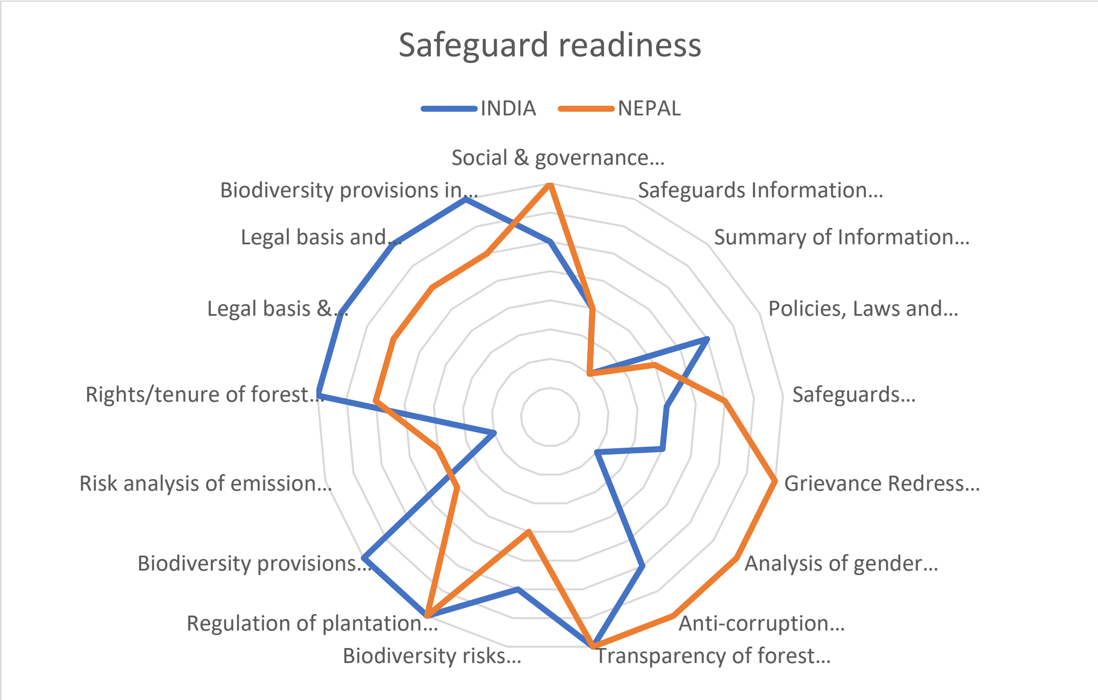


Figure 9: Safeguard readiness of both the countries

3.3.5. Financing readiness

Twelve indicators were used to assess the state of financing readiness, including the development of a benefit sharing mechanism. In terms of detailed investment plans, Nepal is more advanced with comprehensive draft plans, while India has an outline financing plan. Nepal has conducted basic costings of their PAMs/S&As, whereas India has not yet discussed this aspect. Preliminary discussions about nesting have taken place in Nepal, but India has not addressed this topic. Nepal has detailed benefit sharing plans for the World Bank's Emission Reductions Program Document (ERPD) in draft form, while India has an outline plan mandating State REDD+ cells to explore ways to facilitate benefit sharing. Nepal has an advantage with three ongoing projects that have significant REDD+ components: the Terai Arc Landscape Emissions Reductions Program (ERP), the Churia Region project funded by the Green Climate Fund (GCF), and the recently initiated World Bank Forestry for Prosperity Project (FFPP). On the other hand, India's Khasi Hills Community REDD+ project, established in 2011, has sold forest carbon credits on the voluntary carbon market with the support of Plan Vivo.

Regarding cash transfers or RBPs to rural households, there doesn't seem to be much experience with RBPs in either country. However, cash payments have been made to CFUGs in Nepal based on compliance with work plans. India, on the other hand, has extensive experience at the national and state level with the Direct Benefit Transfer (DBT) program, which provides financial assistance to poor households. Both countries have legislation in place mandating full disclosure of financial information. Additionally, both countries have approved REDD+ implementation projects or programs. India's domestic funding sources for REDD+ include the Green India Mission, the Compensatory Afforestation Fund, and the National Mission for Clean Ganga (Namani Gange) Program. Nepal is ahead due to the World Bank-supported Terai Arc ERP and the Forests for Prosperity Project funded under the World Bank's Forest Investment Program (FIP). Regarding the confidence level in managing RBPs, Indian respondents expressed high confidence due to their experience with the DBT Portal at the federal and state levels. Nepal expressed a reasonable level of confidence.

According to Figure 10, India is slightly behind Nepal in terms of financing readiness. This is mainly because India lacks a financing or investment plan, assured finance for REDD+ implementation, a pilot REDD+ project, and experience with cash transfers to households. Nepal, on the other hand, has an advantage in finance readiness, primarily due to the Terai Arc ERP and the support received from the World Bank. However, India, with its financial management experience, established systems like the DBT Portal, and assured domestic financing, is taking steps to become financially ready.

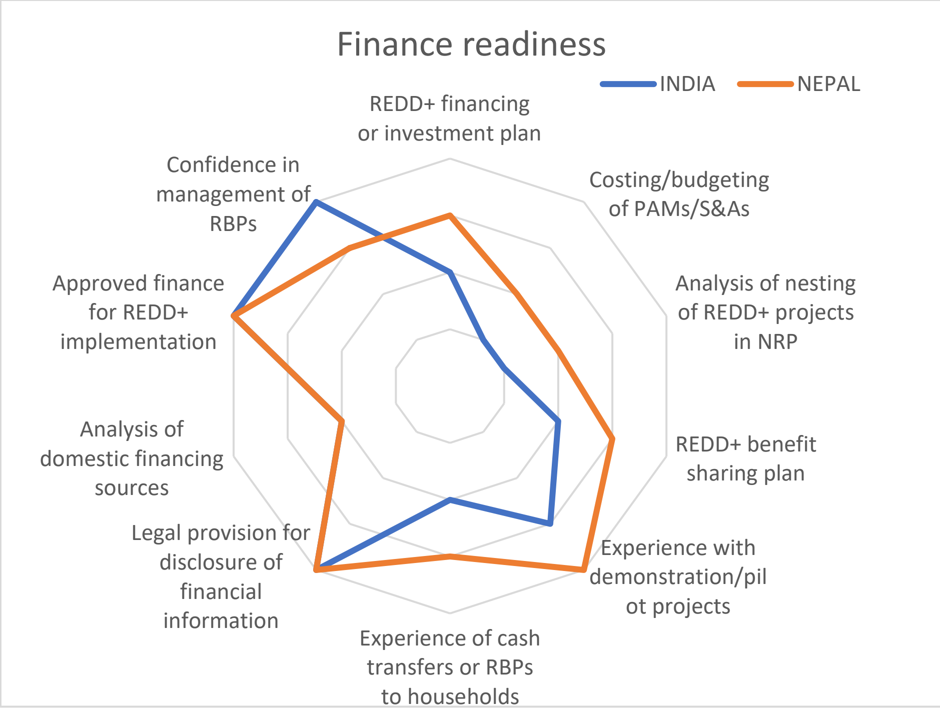


Figure 10: Financial readiness in both the countries

3.3.6. Capacity building needs

Both the countries requested capacity development through awareness programs, campaigns, or training. The responses are summarized in Table 2. It can be noted that some needs were listed by both the countries.

- ✓ Communications and knowledge management/methods. (India)
- ✓ Development of Carbon or REDD+ Registry (India, Nepal)
- ✓ Benefit sharing systems (Nepal, India)
- ✓ Economic or ecosystem valuation (India)
- ✓ Capacity building of local stakeholders, e.g., in implementing safeguards (India, Nepal)
- ✓ Subnational REDD+ planning and/or implementation (India)
- ✓ Various aspects of SIS in national or subnational REDD+ (India, Nepal).

Table 2. Outstanding capacity-building or training needs

Readiness area	India	Nepal
Strategy	Ecosystem valuation Community Based Assessment of PAMs	Studies of emissions from drivers
Institutional	Communication/knowledge management	Institutional continuity with forest management regimes
Technical	Registry	Registry Aligning MRV to international system
Safeguards	Gender mainstream. Environmental SIS	Stakeholder capacities to implement safeguards Safeguard audit and information systems
Finance	Finance mechanisms (benefit sharing) Nested projects	Fund management - ERP Benefit sharing system
Subnational REDD+	Planning/ implementing SRAPs; SIS including capacity building	Awareness of SIS/ESMF Identification of safeguard measures

This set of priorities can be compared to the capacity building priorities identified in the report by GCF (2019). This lists the "most frequent technical and financial areas of need and support identified by countries for REDD+" (GCF, 2019):

- ✓ Improvement of the NFMS
- ✓ Updating the FREL/FRL
- ✓ Establishment or improvement of the SIS, including an interface platform
- ✓ Preparation of the BUR
- ✓ Definition of high priority interventions and Implementation of the NRS
- ✓ Estimating uncertainty related to emissions under the FREL/FRL
- ✓ Enhancing private sector engagement in the NRP

3.3.7. Overall readiness assessment

The findings revealed that Nepal is slightly moving ahead in overall readiness compared to India. However, the overall average readiness scores were relatively similar for both the countries (Figure 11). Notably, Nepal received high ratings for safeguard and financing readiness, indicating significant progress in these areas. This achievement can be attributed to the support provided by the World Bank for the Terai Arc ERP. Furthermore, it reflects Nepal's longer engagement and experience in advancing their readiness efforts.

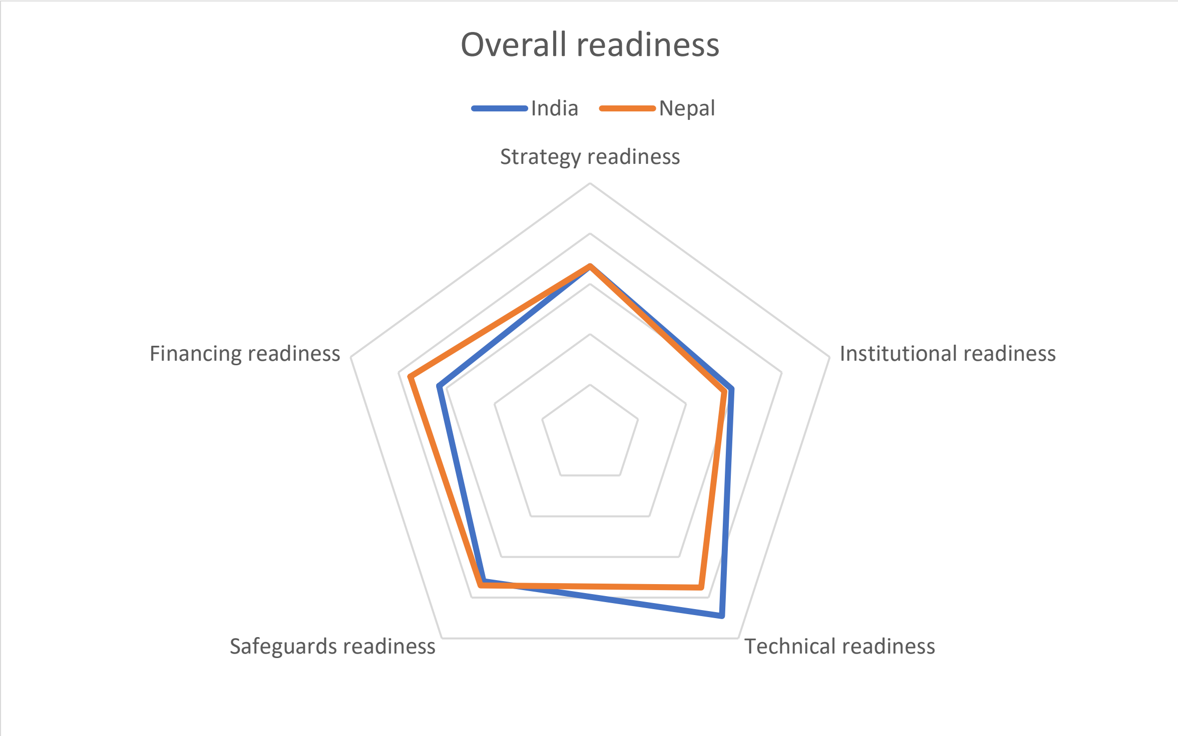


Figure 11: Overall REDD+ readiness of the both the countries

India scored high in technical readiness, largely due to the capabilities of the Forest Survey of India (FSI). However, India's strategy readiness rating was lower than the Nepal when considering all the indicators. This is because India does not have national-level PAMs that differ from existing laws and policies. Additionally, India's REDD+ implementation relies on the development of State REDD+ Action Plans, which are still in the early stages with the assistance of ICIMOD as shown in the below Photo 1.


Photo 1: Consultation meetings in India (left) and Nepal (right)

It is noteworthy that India's capacity building needs, include the development and implementation of State REDD+ Action Plans, as well as state-level support for MRV and the SIS. The Indian expert group also observed variations in political will for REDD+ across different states, suggesting potential unevenness in implementation and the possibility of leakage issues.

3.4. Conclusion

The study's findings indicate that Nepal is slightly ahead of India. Overall, the progress in readiness until the end of 2021 was positive for technical and safeguards readiness, satisfactory for strategy readiness, and India's financial readiness is modest compared to Nepal, which benefits from the World Bank program. Among the various readiness areas, institutional readiness received the lowest score and presented the greatest challenge. The dominance of the Forest Department (or equivalent) in leading the readiness process resulted in limited engagement from other sectors, hindering the establishment of a robust institutional foundation for effective cross-sectoral REDD+ coordination and implementation. Except for the challenging area of institutional readiness, most readiness gaps can be addressed through capacity building efforts. It is evident that capacity building and other readiness activities will continue well into the implementation phase. Access to finance for REDD+ implementation becomes crucial in maintaining the momentum gained from initiatives like the UN-REDD Programme and taking it forward by accessing more funds where possible.

Chapter 4: Result 2 - Assessing drivers of deforestation and forest degradation

4.1. Introduction

Communities, with the consent of the government, commonly manage, utilize, conserve, and control forests, referred to as community-managed forests. This approach aims to ensure the distribution of forest benefits, promote forest management, and involve local inhabitants in decision-making processes. Nepal and India have effectively adopted community-managed forest systems. Nepal stands out as a global pioneer in community forestry. In response to deforestation and degradation resulting from centralized forest management, Nepal formally embraced the concept of community forestry in the 1970s. The 1993 Forest Act established a legal framework for community-based forest management. Under this system, local communities formed user groups and are granted legal rights to manage and sustainably utilize forest resources. As a result, community forestry in Nepal has led to significant reforestation efforts, contributing to the conservation and regeneration of forests. Local communities actively engage in activities such as tree planting, forest fire management, and anti-poaching. To ensure the long-term sustainability of the forests, they have also devised rules and regulations governing the use of forest resources, including practices like rotational harvesting and grazing systems. The benefits of community-managed forests in Nepal are manifold. Local communities also enjoy increased access to forest resources for subsistence and income generation, leading to poverty reduction and improved livelihoods. Moreover, the participatory nature of decision-making has empowered marginalized groups, particularly women and indigenous tribes, enabling them to actively participate in forest management and benefit-sharing. Additionally, community-managed forests have played a crucial role in watershed management, soil conservation, and climate change mitigation efforts in Nepal.

Similarly, India boasts a rich history of community-managed forests, with diverse models and methodologies employed throughout the country. One noteworthy initiative is the JFM program, which emerged in the 1990s with the aim of involving local communities in the conservation and regeneration of degraded forests. The JFM program fostered collaboration between forest departments and local communities, granting communities rights and responsibilities in forest resource management. As part of the JFM initiative, local communities have been actively engaged in activities such as afforestation, protection against illegal logging, and forest fire prevention. They have also been granted rights to collect non-timber forest products (NTFPs), enabling them to derive income from the sustainable harvesting of forest resources. The program has resulted in increased forest cover, improved livelihoods, social empowerment, and enhanced biodiversity protection.

Several factors contribute to the success of community-managed forests in both Nepal and India. These include recognizing the rights and knowledge of local communities, decentralizing decision-making authority, implementing capacity building, and training programs, and establishing effective governance structures. Moreover, involving local communities in monitoring and enforcement procedures has led to greater compliance with sustainable forest management practices. However, challenges persist in both countries, including issues related to land tenure, conflicting interests, illegal logging, and inadequate financial and technical support. Nevertheless, the experiences of Nepal and India in community-managed forest systems offer valuable insights into the potential of local engagement and decentralized governance in promoting sustainable forest management, conservation, and livelihood improvement.

Deforestation and forest degradation

Understanding the D&D drivers is essential for developing certain climate change mitigation policies and measures, such as those included in national REDD+ programmes. The United Nations Framework Convention on Climate Change (UNFCCC) negotiation process has encouraged tropical or developing countries to identify land use, land use change, and forestry activities that address D&D drivers, and to assess their potential contribution to the mitigation of climate change (Hosonuma et al., 2012). A robust and empirically based understanding of the drivers of D&D is needed for three main reasons:

- ✓ To identify REDD+ policies and interventions: An analysis of the drivers of D&D is the foundation of any REDD+ programme or project;
- ✓ To help define the forest reference level: This should be based on a quantitative, historical analysis of context-specific drivers, and associated changes in forest carbon stocks (Hosonuma et al. 2012); and
- ✓ For REDD+ adaptive management: D&D drivers are constantly changing (for example, due to market forces, climate change, and other drivers) and therefore need to be carefully monitored over time so that REDD+ programmes and projects can adapt and continue to reduce emissions cost-effectively (Salvini et al. 2014).

4.2. Results

4.2.1. CMF status in Dhankuta, Nepal

The district boasts an impressive array of forest regimes, with most of its forested area falling within the realm of community forestry. The district's forested lands are classified into four distinct categories: 1) Government-managed forests, 2) Community forests, 3) Religious forests, and 4) Private forests. Among these categories, except for private forests, the management of the other three is facilitated through community-based forest management systems. From the totality of the district's forested area spanning 36,724 hectares, 8,518.59 hectares are designated as government-managed forests. In contrast, the community forests encompass 29,806.49 hectares. The category of religious forests encompasses a more modest area of 29.48 hectares, and the remaining 87.91 hectares are attributed to private forests. These statistics show a compelling narrative: over 80% of the district's forested landscape falls under the community forest management. Particularly, this district proudly hosts the country's second registered community forest, the renowned Sildhunga Community Forest, which extends over 26.66 hectares. A comprehensive tally reveals the existence of 387 registered community forests within this district, effectively catering to the well-being of 45,325 households. The influence of these forest resources resonates through the local population, with approximately 252,933 individuals acquiring the benefits. Table 3 below, which presents a breakdown of community forest users, households served, the associated population, and the respective land areas.

Table 3: Community forests under different sub-division forest office

Sub-division forest office	***Users***	***Households***	***Population***	***Area (ha)***
Rajarani	97	9,524	51,836	7,456
Bhedetar	56	6,139	34,982	5,683
Chinta	52	9,146	52,071	4,986
Nisandevi	62	8,136	44,275	3,651
Pakhribas	62	5,086	28,864	4,304
Jitpur	58	7,294	40,902	3,725
Total	**387**	**45,325**	**252,933**	**29,806.49**

4.2.2. JFM in Mamit, Mizoram, India

The people of Mamit hold forests in the highest regard, recognizing them as a crucial natural resource. In fact, a staggering 89.81% of the entire district's land area is blanketed by lush forests and tree cover, as evidenced by data from the FSI in 2019 (FSI, 2019). These forests carry even greater significance due to the communities' entitlement to utilize and cultivate the land bordering these woodlands, a privilege granted by the Village Council (VC).

The ISFR classification of 2019 sheds light on the distribution of forest types within Mamit. It reveals that 190,705 hectares are classified as open forests (70%), 75,780 hectares as moderately dense forests (28%), and 5,202 hectares as very dense forests (2%) (FSI, 2019). In 1998, this district pioneered the JFM initiative, a significant move after Mizoram state shifted towards involving its people in managing its forest wealth. The introduction of JFM established a new, mutually beneficial relationship between the forests, the local communities, and the State.

At present, the organizational structure for managing forests with active participation from residents comprises three levels in the State:

- State Forest Development Agency (SFDA) at the State level.
- Forest Development Agencies (FDAs) at the Divisional level.
- Village Forest Development Committees (VFDCs) at the village level.

Additionally, Eco-Development Committees (EDCs) have been established for villages situated near protected areas. The existing JFM guidelines encompass various aspects, including the procedures for constituting SFDA, FDAs, VFDCs/EDCs, their respective duties and responsibilities, the methodology for preparing micro-plans, effective implementation, timely monitoring, the flow of funds, and the utilization and sharing of forest produce benefits.

Within Mamit district, three distinct forest regimes exist:

1. Village Safety and Supply Reserve (managed under the JFM concept)
2. Private Forests
3. Protected Area Forests

According to respondents, the JFM approach is currently partially operational in the district, with forest management now falling under the jurisdiction of the Village Councils (VCs). These VCs, consisting of elected members serving five-year terms, are entrusted with the responsibility of formulating rules and regulations aimed at enhancing both forest conditions and community well-being. Remarkably, there are a total of 87 VCs within the district (GoM, 2023). Given the persistent practice of shifting cultivation in the area, VCs allocate forest land to families in need, whether for shifting or settled cultivation. The allocation is contingent on family size, with each family receiving a minimum of 0.5 hectares of land. A decade ago, JFM was a prevalent practice governed by government regulations, involving the formation of joint forest management committees. Currently, the government and forest department are planning to revitalize and fully activate JFM in line with the Green India Mission (GIM). This district encompasses one protected area known as the Dampa Tiger Reserve, which falls under the management of the forest department.

4.2.3. Drivers of deforestation and forest degradation, Dhankuta

Human activities and actions that directly lead to the loss of forest cover and carbon stocks are referred to as direct drivers of D&D. For identification of driver, the participants were divided into two groups and requested to note down the drivers for D&D. The identified drivers were prioritized based on their impact. The drivers for D&D are outlined in Table 4.

Table 4: Direct drivers and underlying causes identified in Dhankuta District, Nepal

	Deforestation	**Forest Degradation**
Direct drivers	Development activities; Natural disasters; Unsustainable fuelwood collection, Agricultural extension; and encroachment	Fuelwood collection, forest fire, Natural disasters; Haphazard grazing of livestock; Development activities and Encroachment
Underlying causes or indirect drivers	Income generation; Job opportunities; Political instability; Illegal trade	Poverty; Lack of awareness; Lack of alternative energy options; Population increase; Urbanization; Weak enforcement of rules and regulations

After identifying the direct drivers, the study recognized two significant challenges that were more prominent for D&D interventions. Recognizing that developmental activities are essential and acknowledging that REDD+ or carbon funds alone might not suffice to tackle them, stakeholders came to a consensus on addressing fuelwood collection as a driver of deforestation and forest degradation as shown in Photo 2.

Photo 2: Participants in Dhankuta identifying the drivers of D&D.

The process of prioritization and ranking culminated in the identification of two paramount challenges to serve as the primary drivers for D&D activities:

- Fuelwood Collection (Deforestation & Forest Degradation): This challenge involves the extraction of fuelwood, which contributes to both deforestation and forest degradation.
- Forest Fire (Forest Degradation): The threat of forest fires poses a significant risk, leading to forest degradation.

Mamit

Like in Dhankuta, the participants in Mamit also identified the drivers for D&D as outlined in Table 5.

Table 5: Direct and indirect drivers of deforestation and forest degradation

	Deforestation	**Forest Degradation**
Direct Drivers	Topographic factors, Traditional farming methods, limited livelihood options	Shifting cultivation, forest fire, firewood and NTFP collection
Underlying or indirect causes	Limited flat land, unavailability of irrigation, no alternative for shifting cultivation, Lack of income generation, food security, lifestyle of Mizo people, to meet domestic demand and lack of awareness.	Low socio-economic status, abiotic factors (soil, rainfall, temperature, topography, slope and terrain), remoteness, high livelihood dependency on forest resources, weak governance, land and revenue policies, traditional practices and lack of viable income opportunities

Photo 3: Instructing participant for prioratization of drivers (left) and consultation meeting in Mizoram (right)

The participants of the workshop identified (Photo 3) the following prioritized direct drivers of deforestation and forest degradation:

- Direct drivers of deforestation: topographic factors, traditional farming methods, and limited livelihood options.
- Direct drivers or causes for forest degradation: shifting cultivation, forest fire, and fuelwood and non-timber forest product (NTFP) collection.

As REDD+ funds will not be able to address all the drivers at once so, through participatory scoring system, the workshop attendees have chosen the following two key challenges as the highest priorities:

- Shifting cultivation: This practice acts as a direct driver for both deforestation and forest degradation.
- Forest fire: It has been acknowledged as a direct driver of forest degradation.

4.2.4. Land use change analysis from 2000-2021, Dhankuta

The examination of land use changes within the study area over the preceding two decades has unveiled substantial shifts in cropland dynamics, as depicted in Figures 12 & 13. Roughly 130 km^2 of cropland underwent a transformation, predominantly transitioning into forested regions. This shift has resulted in a notable 13% reduction in the expanse of cropland. Simultaneously, the forested area within the study sites was found to be increased 12.4% during the same timeframe. This expansion is primarily attributed to the conversion of cropland, with a minor contribution from the grassland as well.

Furthermore, alterations in grassland coverage across the district have been discerned, reflecting an overall 1.9% increase in grassland extent between 2000 and 2021, as demonstrated in Figure 12. This increment can be attributed to various factors, including the drying and shrinking of water bodies, as well as the conversion of cropland into barren terrain. These shifts have been particularly noticeable in the expansion of grassland cover within the study area.

The analysis of land use within the district has underscored three principal land classes—forest, cropland, and riverbed—which encountered the most profound changes throughout the study period. Remarkably, the conversion of forested areas into alternative land uses was most pronounced in urban enclaves and along riverbanks. Conversely, remote sectors of the district witnessed a surge in forest cover, largely attributed to migration patterns. While the primary focus of this investigation revolved around major shifts in land cover, it is imperative to acknowledge the subtle alterations within other land classes as well. Over the span of 21 years, water bodies dwindled by approximately one square kilometer, predominantly affecting grassland regions. Additionally, minor adjustments in the riverbed were observed, with conversions primarily involving croplands and grasslands. Although there was some expansion in the built-up area, the magnitude of this growth remained insubstantial.

A particularly interesting discovery lies in the significant expansion of forested areas within the district over the 21-year duration. The forested expanse expanded by an impressive 112 km^2, translating to a remarkable 12.5% surge in forest cover, as highlighted in Figure 13 and Table 6.

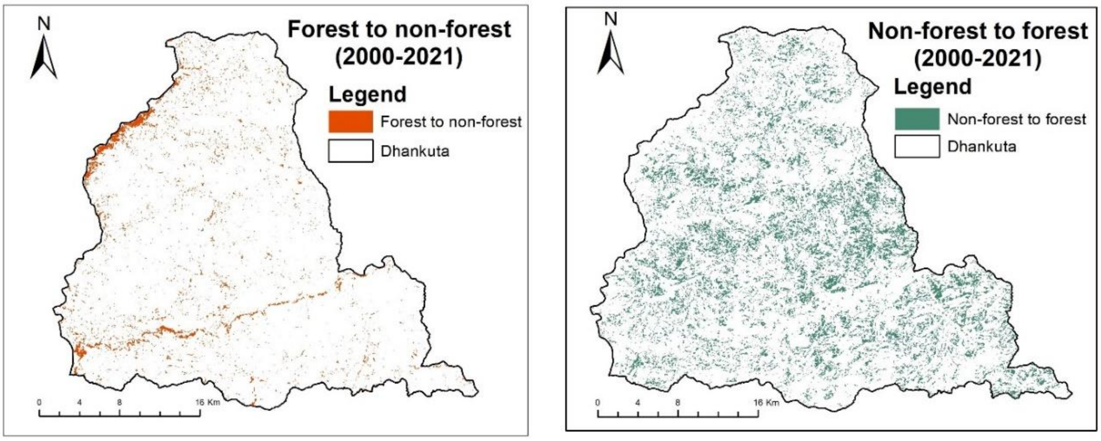


Figure 12. Map showing forest to non-forest and non-forest to forest locations.

The analysis of land use change in the study area over the past two decades has demonstrated significant transformations in cropland (Figure 9). Approximately 130 km^2 of cropland were converted, primarily into forested areas, resulting in a 13% decrease in cropland extent. Concurrently, the forest area in the study sites experienced an estimated increase of 12.4% during the same period. This increase can primarily be attributed to the conversion of cropland, with a minor contribution observed from grassland conversion. Furthermore, changes in grassland cover within the district were noted, indicating an overall increase of 1.9% in grassland extent between 2000 and 2021. These changes were particularly noticeable as grassland cover expanded within the study area.

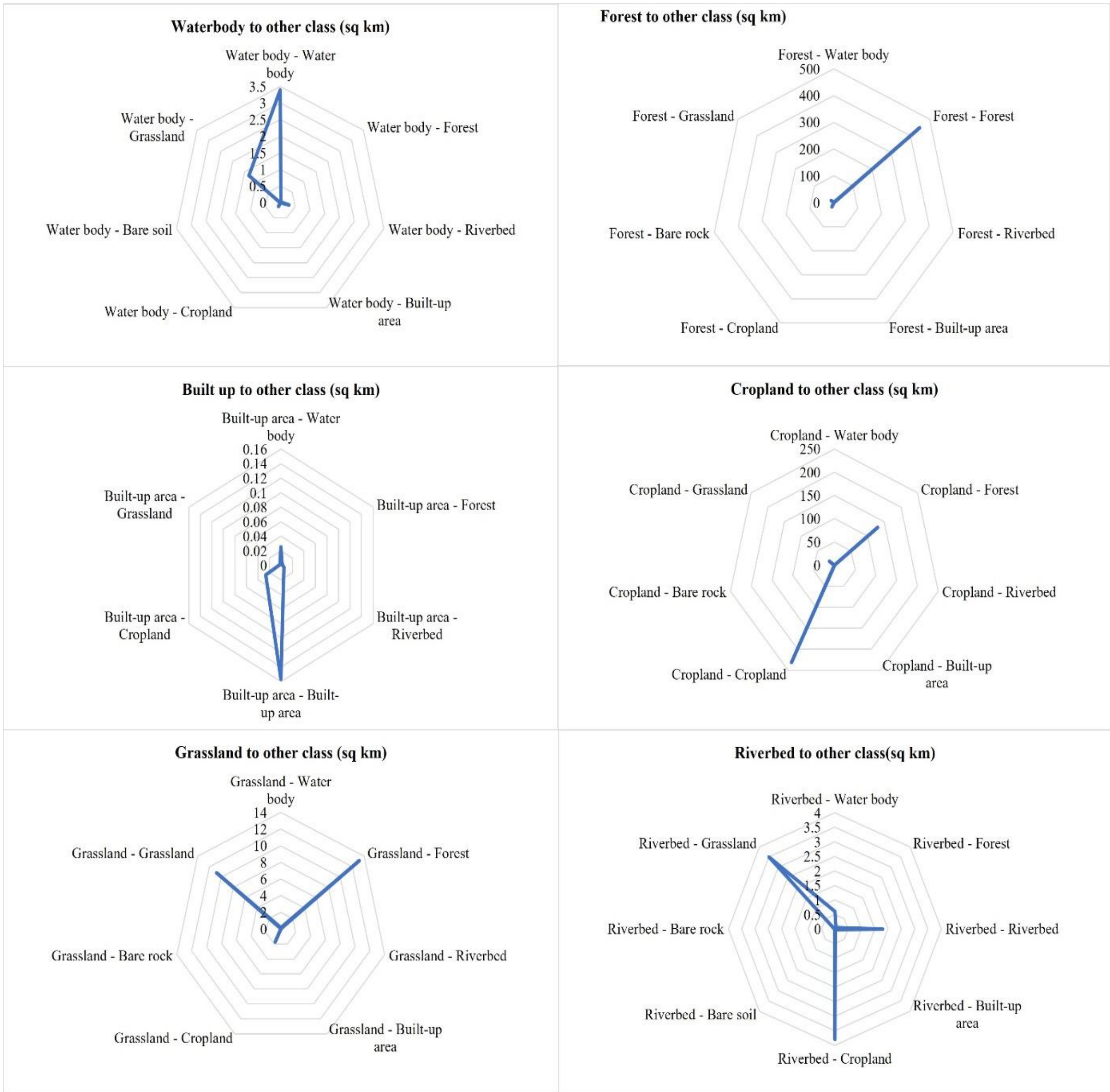


Figure 13: Land use change from 2000-2021, Dhankuta

Table 6. Change in forest to non-forest and non-forest to forest area (2000-2021)

Forest to non-forest		Non-forest to forest	
Class	**Area (km²)**	**Class**	**Area (km²)**
Forest - Water body	0.11	Water body - Forest	0.03
Forest - Riverbed	0.00	Riverbed - Forest	0.07
Forest - Built-up area	0.15	Built-up area - Forest	0.00
Forest - Cropland	17.85	Cropland - Forest	129.94
Forest - Grassland	13.29	Grassland - Forest	13.15
Total area	**31.40**	**Total area**	**143.19**

4.2.5. Land use change analysis from 2000-2021, Mamit

The analysis of land use changes over the span of two decades reveals a concerning trend wherein more than 25 km^2 of forested land has experienced a decline. This reduction in forest cover has predominantly occurred due to the conversion of these areas into grasslands and croplands. Within the same timeframe, the district has witnessed the loss of a substantial 58.43 km^2 of forested regions. However, it's striking that a positive development includes the conversion of 33.22 km^2 of non-forest land into forested areas. The figure below (Figure 14) depicts the areas where forests are lost, and new forests are grown.

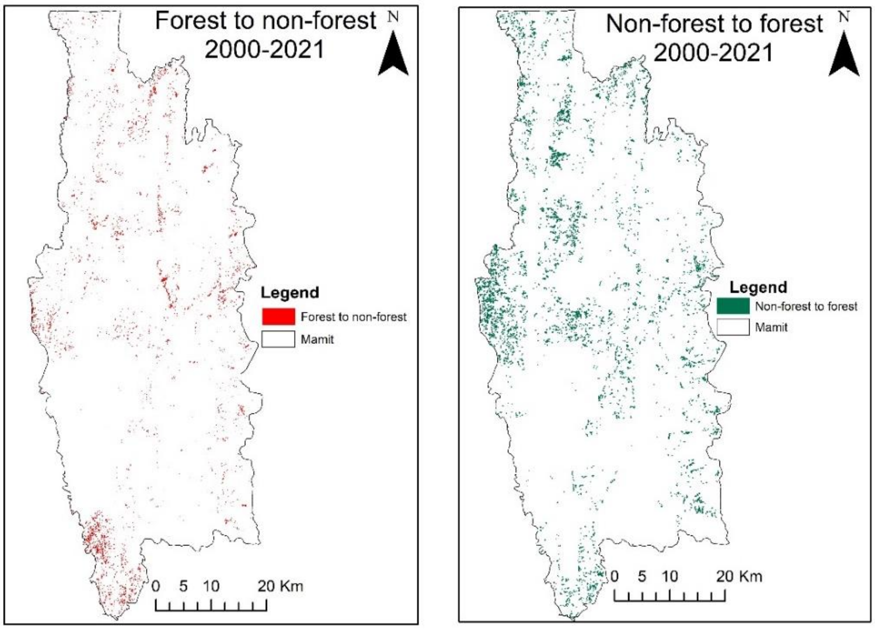


Figure 14: Forest to non-forest and vice versa from 2000-2021

Furthermore, this investigation brings to light another significant revelation: the diminishing extent of water bodies within the district. This variation in land use is evident as the areas previously occupied by water bodies are now converted into forested and cropland expanses. Reflecting the situation in Dhankuta, this district has also seen the conversion of croplands into forested terrain. Approximately, three square kilometers of cropland have changed into forested areas within this district over the course of two decades.

Table 7: Forest to non-forest and non-forest to forest change area (2000-2021)

Non-forest to forest		Forest to non-forest	
Class	**Area (km^2)**	**Class**	**Area (km^2)**
Water body - Forest	0.11	Forest - Water body	0.38
Cropland - Forest	2.64	Forest - Cropland	10.48
Grassland - Forest	30.47	Forest - Grassland	47.57
Total change	**33.22**	**Total area**	**58.43**

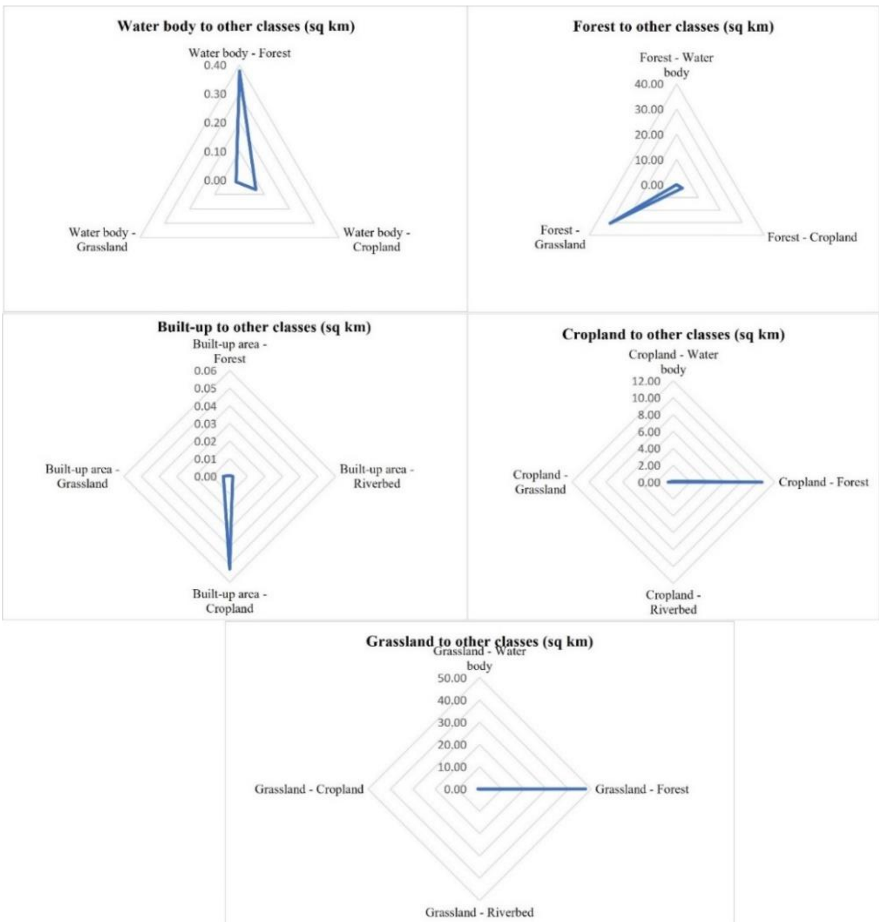


Figure 15:Changes in different land use from 2000-2021

Moreover, the analysis shows that roughly 30 km^2 of grassland have been converted into forest, while 0.67 km^2 of grassland have transitioned into cropland in the district as shown in Table 7 and Figure 15. A major portion of forest loss has occurred along roadsides, where clearing for settlement purposes has been prevalent. Conversely, the establishment of new forests is more conspicuous in remote regions lacking human settlements. However, it's important to note that a fraction of these new forests primarily consists of plantation forests, particularly featuring rubber, betel nuts and palm trees.

4.3. Conclusion

This chapter presents a comprehensive overview of community-managed forests within the study areas. Particularly, the nomenclature varies between Dhankuta, Nepal, where they are termed "Community Forests," and Mamit, India, where the concept is referred to as "Joint Forest Management." In both locations, the responsibility for forest management is with the local communities, facilitated through decision-making processes carried out by elected representatives. In Dhankuta, a thorough analysis identified five key drivers of deforestation and six drivers of forest degradation. Through a rigorous ranking process, two drivers emerged as the most significant and pressing concerns: fuelwood collection as the primary driver of deforestation and forest fires as the main contributor to forest degradation. Similarly, in Mamit, shifting cultivation was identified as the leading cause of deforestation, while forest fires were considered as the predominant driver of forest degradation.

In Dhankuta, the forest area experienced a noteworthy increase of 12.4% over the 21-year period, coinciding with a substantial 13% reduction in cropland. This transformation can be attributed to the phenomenon of rural-to-urban migration driven by opportunities in urban centers. Conversely, in Mamit, the forest area exhibited a decline of approximately 2%. Despite the broader state's reputation for being the second-largest contributor to forest cover in India, the study site witnessed a decrease primarily due to shifting cultivation. A fraction of this decrease could potentially be attributed to the inclusion of private plantations, such as rubber, betel nuts, and palm trees.

The study areas hold immense potential for the implementation of carbon-related projects, particularly due to the historical deforestation trends observed in Mamit. Such projects could offer local communities alternative livelihood options, thus incentivizing settled cultivation from shifting cultivation practices and promoting forest conservation. However, in

Dhankuta, the key lies in providing viable alternatives to fuelwood collection to ensure the sustainability of carbon projects. To ensure the success of carbon projects, it is crucial to address these drivers by providing incentives to the exact beneficiaries who depend on forest resources.

Chapter 5: Result 3 - Forest fire as major challenge for REDD+

5.1. Introduction

Forest fire is the term used for unwanted wildfires, which is one of the issues of the present world. A forest fire can shape the vegetation distribution, structure, and composition in many ecosystems. Although having this ability, these fires are also hazardous for human lives, their properties, and biodiversity. Globally, an area of more than 350 million hectares is estimated to be affected by forest fires each year (Amiro et al., 2001; Merino et al., 2004). Every year the montane forests are burnt by humans; most of the fire incidence in the forests of the Himalayas belt is human-induced (Giriraj et al., 2010) and not stemming from natural phenomena as in Australia or California (Helvarg, 2019, Tran et al., 2020). Each year 85% of the global surface area burnt lies in the tropical savannahs (Willis, 2017), which makes 19% of the total land cover (Global Forest Watch, 2021). In April 2020, the number of fire alerts across the globe was up by 13% compared to April 2019, which was the record year for forest fires (WWF, 2020). The top fifteen wildfires in the United States from 2000 to 2017 caused almost 1 billion USD worth of damage, which includes not only the loss of homes and infrastructures but also the procurement of equipment and logistics support for fire control/ firefighting (NOAA, 2021). The expenses increased from 2017 onwards, and the cost of 2017-2018 was more than 40 billion USD (NOAA, 2021). In 2019, wildfires caused an estimated loss of around 4.5 billion USD in California and Alaska (NOAA, 2021). In 2020, out of the six largest fires in California and Oregon, five fires saw historic levels of wildfire spread and damage. Wildfires across the West led to weeks-long periods of unhealthy air quality levels for millions of people (C2ES, 2021). Certainly, all these fire events increased the GHGs emissions (Ribeiro-Kumara et al., 2020). The projection reveals that at least 50 % of GHGs emissions will be increased by 2080 in Western North America, Southeast Asia, Africa, and Australia (Touma et al., 2021) from wild fires alone.

Forest fire is one of main drivers of forest degradation and depleting the productivity of forest ecosystem, forest biodiversity, forest carbon stocks, nutrient cycling and other ecosystem services (Amiro et al., 2000, 2001; Pérez-Cabello et al., 2012). Forest fires are becoming a serious ecological concern in the Hindu Kush Himalayan (HKH) countries due to changing in the climate and associated factors (Littell et al., 2016; Sannigrahi et al., 2020; Vachula et al., 2020; Zhang-Turpeinen et al., 2020), and becoming a major cause of forest degradation the HKH countries.

Frequent occurrence of forest fire in the summer season is a common phenomenon in the Western Himalaya due to high fuel load on the forest floor and low moisture content in the soil (Chandra and Bhardwaj, 2015). However, in the north-eastern region of India, forest fires are mainly associated with shifting cultivation (Puri et al., 2011). A total of 520,861 active forest fires were detected in India during 2003–2017, which are mainly concentrated over the dense evergreen and deciduous forests in the eastern Himalayan states (Sannigrahi et al., 2020). The Chir Pine forests distributed in the hilly Himalayan states are also found to be highly vulnerable to forest fires (Joseph et al., 2009). This relationship underscores the necessity for monitoring forest fires and accurate data on the emission of trace gases.

Forests are basic component of the global carbon cycle, and forest fires are a serious threat to the forest ecosystems that degrade net primary productivity, gross primary productivity and carbon sequestration services (Dixon et al., 1994). Forest is one of the major pools for sequestered carbon locked in terrestrial system, so will emit a vast amount of carbon into the atmosphere when burnt (Gibbs et al., 2007). Consequently forest fires are being recognized as an increasing prime concern of greenhouse gas (GHG) emissions and particulate matters in the HKH as in other regions like in Europe (Martinho, 2019). A recent study from the amazon forest shows that it emits more carbon dioxide due to intentional forest fires for clearing the land for beef and soy production (Carrington, 2021). This forest area which used to be a net carbon sink is now accelerating carbon emissions. Undeniably, forest fires develop a positive feedback loop as an increase in forest fires triggers the emission of GHGs that escalates climate change, while without fire, the carbon pool in forest landscape increases, thereby contributing to mitigating climate change.

Forest fires are one of the many topics of environmental concern in the HKH. Forest fire research is scarce in this region, and fire management has been one of the biggest challenges given the montane topography. Furthermore, transboundary fires and smoke pollution during the dry season are creating adverse effects on the wellbeing of humans and the ecosystems which needs to be addressed regionally (Cheong et al., 2019). This paper aims to show the linkage between temperature, precipitation, AOD and CO with forest fire. We reviewed 187 fire-related articles across the globe and more specifically on the HKH region. Those include scientific journals, technical reports, web sites, blogs, and news articles. Furthermore, we also explored the active fire incidences and their linkage with temperature and precipitation and impacts on the environment.

5.2. Results

5.2.1. Active Forest fires in Dhankuta and Mamit

During the period from January 2010 to May 2021, a comprehensive analysis using MODIS sensors (Figure 16) revealed over six thousand active fires in the study area, all with a confidence level of 50% or higher. Notably, these fires occurred exclusively during the summer season, specifically in February, March, and April. Among these three months, March experienced the highest number of fires, accounting for over 84% of all incidents. In March alone, there were 5,335 fire occurrences, followed by 578 incidents in April and 378 incidents in February.

Figure 16: Active fire locations in Dhankuta and Mamit from 2010-2021

In the months of March and April 2021, the MODIS sensor detected a total of 717 forest fires in the study sites. Dhankuta, one of the areas under analysis, recorded only 42 forest fire incidents, while Mamit faced a significantly higher number with 675 incidents during the same period. It is worth noting that Mamit had an even higher number of forest fires in 2010, reaching 1,068 incidents (Figure 17). Although the occurrence of forest fires in the area had been decreasing since then, 2021 witnessed a notable increase, albeit not as severe as in 2010.

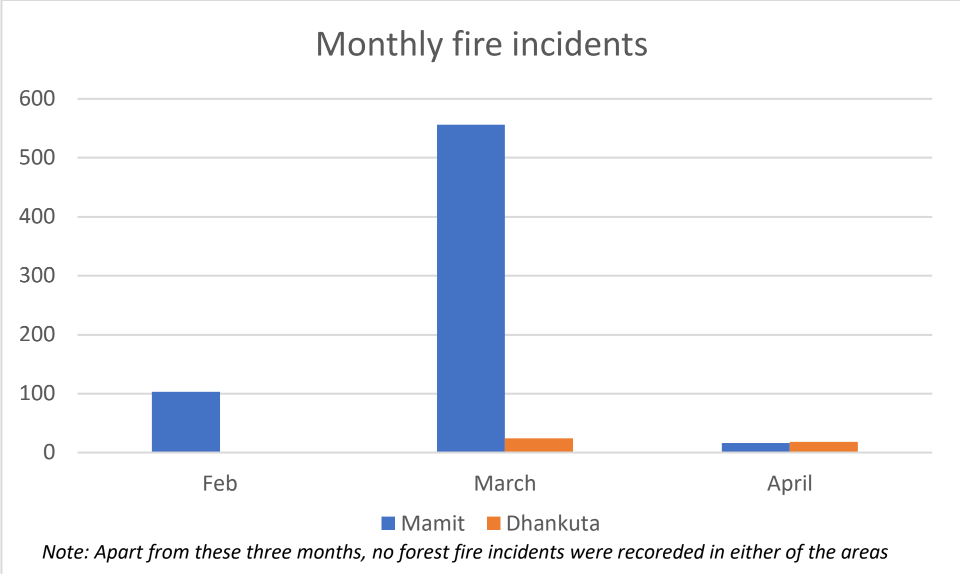


Figure 17: Monthly status of active fires in Dhankuta and Mamit for 2021

While it was not possible to obtain precise area-wise data, as it requires ground mapping and validation, the frequency of fire incidents is indeed alarming, excluding fires in agricultural lands. Some areas experienced fires that started as early as October 2020, which continued to rage until April 2021. Consequently, 2021 marked one of the worst forest fire seasons in recent years.

5.2.2. Temperature and precipitation and forest fire nexus

Table 8 displays the annual precipitation and precipitation for the months of February, March, and April (FMA) for the study sites during the reference period (2010-2020) and 2021. The table also presents the average temperature and the number of forest fires for the same periods as the precipitation data. The rainfall during the FMA months significantly affects the soil moisture condition, subsequently impacting the number of forest fires during that period. The analysis reveals that the annual precipitation in Dhankuta decreased in 2021 compared to the reference period. Conversely, in Mamit, the precipitation increased by approximately 80mm in 2021 compared to the reference period, and this pattern is consistent throughout the FMA months.

Table 8: Precipitation, temperature, and no. of forest fires for the month of Feb-Mar-Apr (mm) of the reference period (2010-2020) and 2021 for the Dhankuta and Mamit.

Period	Annual			Feb-Mar-Apr		
	Pp (mm)	Temp (°C)	No. of forest fires	Pp (mm)	Temp (°C)	No. of forest fires
Dhankuta						
2021	2446	19.2	42	174.3	17.9	42
RP	2535	19.3	13	198.8	17.9	11
Mamit						
2021	1881	22.6	675	252.2	22.4	675
RP	1802	22.9	497	203.4	22.7	495

Note: *Pp: Precipitation, Temp: Temperature and RP: Reference Period*

In terms of temperature, Dhankuta experienced a slight decrease of 0.10°C in annual temperature compared to the reference period. No significant change was observed during the FMA months. Similarly, Mamit's annual temperature also decreased by 0.30°C compared to the reference period, and this trend remained consistent during the FMA months. Despite Dhankuta having lower rainfall compared to the reference period, the number of active fires in 2021 was only 42, and these incidents occurred exclusively during the FMA months. Interestingly, Mamit experienced increased precipitation and decreased temperature, yet the number of fire incidents in 2021 and during the FMA months also increased. In 2021, a total of 675 fire incidents were recorded in Mamit, which is approximately 200 incidents higher than the reference period.

In both study sites, the FMA period demonstrates a consistent annual pattern, as the fire incidents were recorded exclusively during this time. For a visual representation of the temperature and precipitation relationship in the study sites, please refer to Figure 18. The linear regression of annual precipitation and FMA precipitation of Mamit shows a decreasing trend, but when compared with the reference period, the precipitation in 2021 has increased drastically. Similarly, while comparing with the reference period, there has been an increase in precipitation. However, if the comparison with the FMA time and annual precipitation, a clear decrease in precipitation is visible in Figure 18 (A). Similarly, the temperature trend for Mamit is increasing, with an increase of more than 2°C. The trend during the FMA period is similar, with a temperature increase of more than 2°C.

(A) Precipitation and Temperature trend of Mamit, Mizoram, India

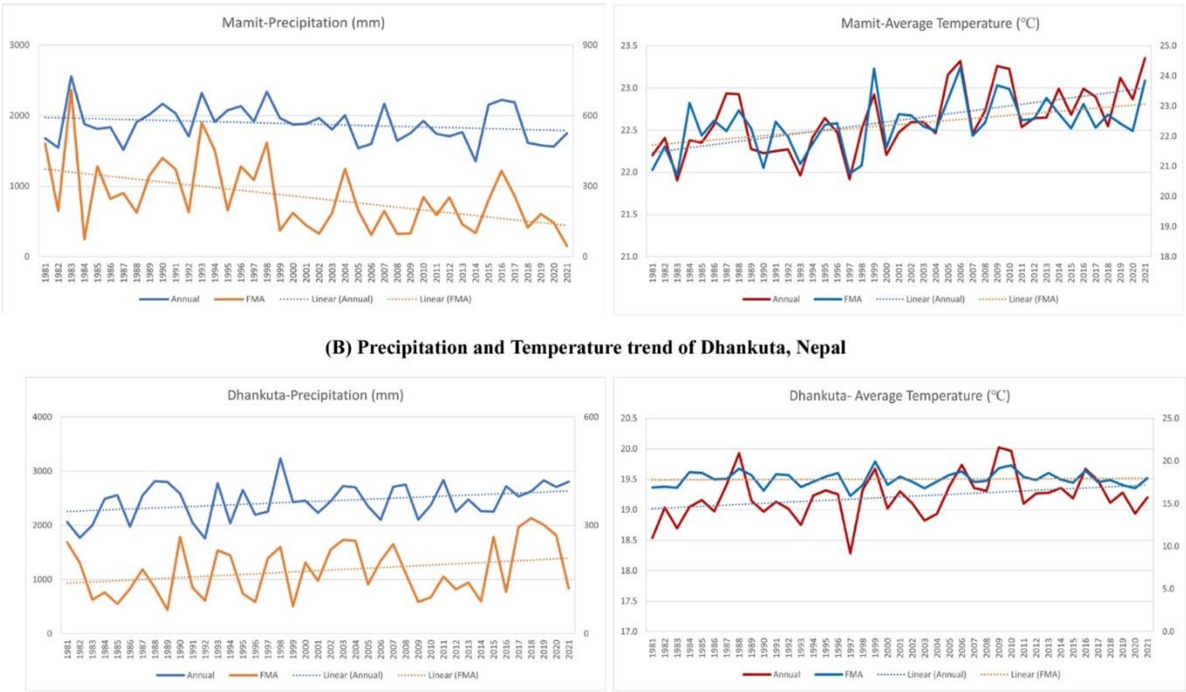


Figure 18: Precipitation and temperature trend of the study area

In Dhankuta, it is evident that precipitation has been slightly increasing over the past four decades, but this doesn't provide a clear picture of forest fire incidents. However, when the trend of precipitation during the FMA period is analyzed, significant fluctuations are visible. However, in 2021, there was a sharp decrease in rainfall. Temperature is also increasing without any surprise, but when evaluating the trend during the FMA period, the temperature remains in the same range. However, 2021 stands out as a particularly hot year after 2010, as shown in Figure 18 (B).

Most of the forest fires in the study area occur during the FMA months, as shown in Table 1. In fact, they accounted for 100% of all the forest fires in 2021 in both sites. When looking at the incidents over the decades, these three months constituted approximately 99% in Mamit and 93% in Dhankuta. The decrease in rainfall coupled with an increase in temperature during the FMA period has likely contributed to the higher number of forest fires during this time, as indicated in Table 15.

To examine the spatial variation in the change of FMA precipitation across Mizoram and Nepal, Figure 19 was created. The map for entire Mizoram State and Nepal was to show the change in the map. Since the desired site and time did not provide a clear spatial variation, a larger area was considered to observe the changes. The below figure illustrates that precipitation has generally decreased in most parts of the study areas. This suggests that areas experiencing a significant decrease in precipitation are more likely to face an increased risk of forest fires within the study areas.

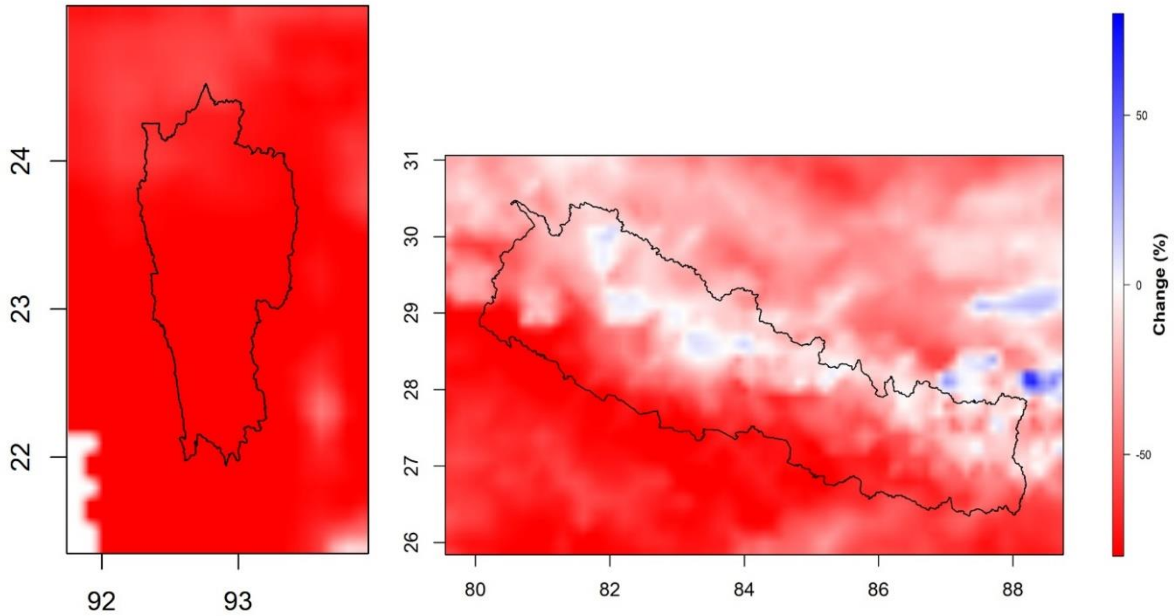


Figure 19: Spatial distribution of relative change in annual precipitation for the year 2021 with respect to the reference period of 2010-2020.

5.2.3. Air pollution induced by forest fires

Forest fire releases a vast volume of smoke, aerosols, and trace gases which tend to influence the atmospheric chemistry and impact air quality and human health. The dimensionless AOD value incorporates the Mie scattering of solar radiation by aerosols and gives information on the columnar load (Dahal et al., 2022), which is considered the proxy of $PM_{2.5}$. To see the changes in AOD and CO, multi-satellite observations were used. Figure 20 shows the columnar CO concentration during the intense haze episode of 2021 in the HKH region with the maximum number of fire counts. The Kathmandu region and its surroundings have a higher concentration of CO, unlike the Indo-Gangetic Plain in the vicinity, which is one of the most polluted regions in the world. Moreover, the north-western Indian region has a lower concentration of CO during the study period, which in the post-monsoon season is highly influenced by agricultural biomass burning emissions (Liu et al., 2018; Sarkar et al., 2018). In 2021, AOD values over Nepal show prominent peaks during the last week of March and the first week of April that coincide with the days with the maximum number of fire counts inferring the influence of forest fire on air quality. The CO values over Nepal and Mizoram during the forest fire episode in 2021 surges (as high as 0.06 mol/m^2) beyond the pre-episode values. The previous studies conducted in Uttarakhand (Shuchita & Senthil, 2020; Thakur et al., 2019) reported the increment in surface level CO, tropospheric NO_2, and AOD during widespread forest fire in 2016. Figure 22 shows the aerosol subtype for March 29, 2021, along a transect crossing the region near Bhutan, based on CALIPSO observation. Both study sites show the elevated level of CO and AOD during the third and fourth week of March (Figure 21). The elevated smoke is present near the altitude of 5 km that further corroborates the biomass burning emission.

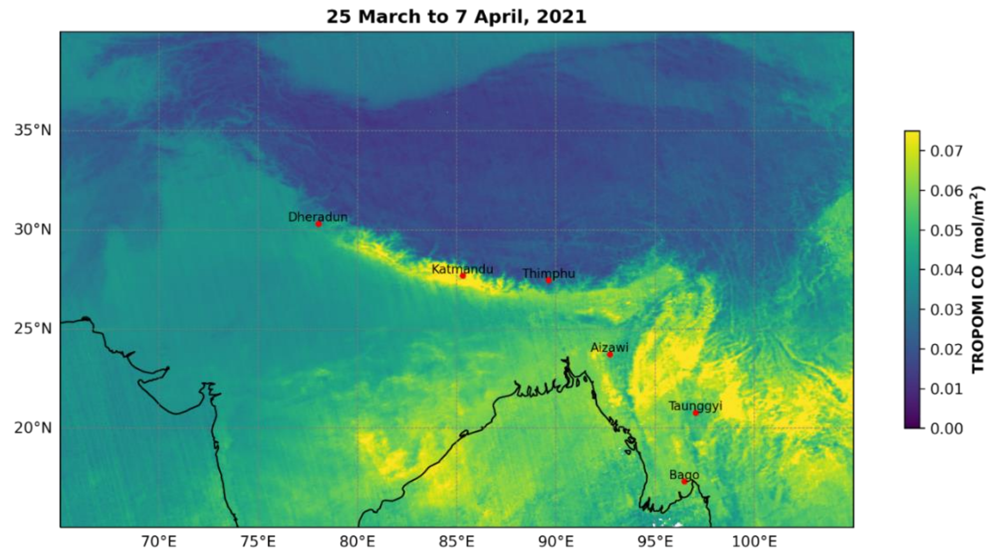


Figure 20: Spatial variation of columnar CO concentration in the HKH region

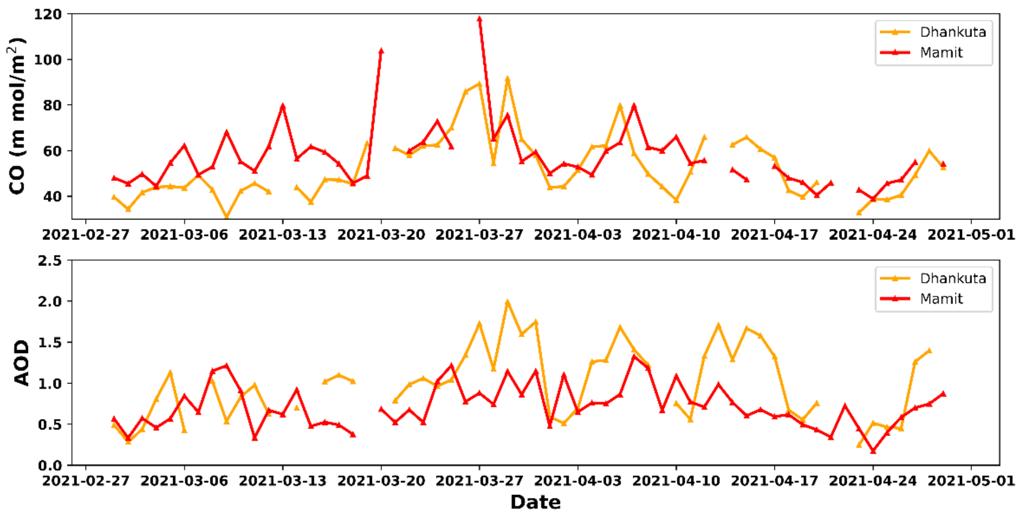


Figure 21: Temporal variation of MODIS AOD and fire counts, and TROPOMI CO

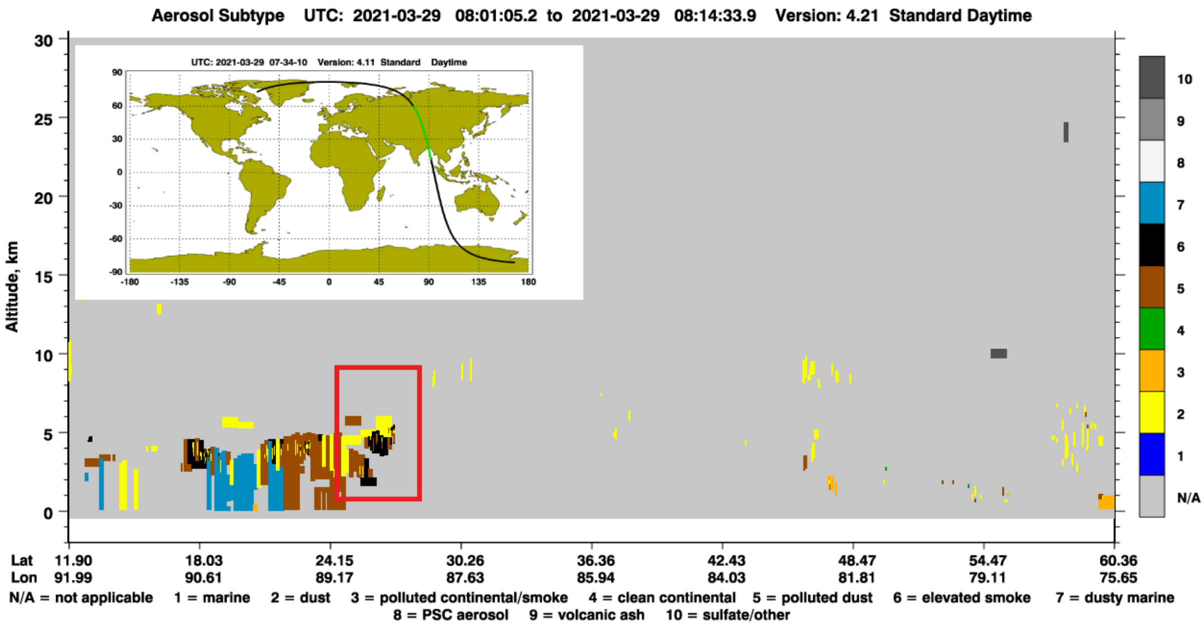


Figure 22: CALIPSO aerosol subtype over the Himalayan foothills

5.3. Conclusion

In both the sites, the main cause of forest fire is human carelessness. Except in the monsoon and winter seasons, the forests are susceptible to fires. Farmers use fire to clear undergrowth in the forest so that new forage can grow for livestock to graze or browse on. They also burn the agriculture field to remove crop stubble as it is the least labor-intensive method. And most of the protected areas in the plain areas undertake controlled burning to manage grasslands once a year, necessary for wildlife and for clearing the undergrowth in forests. Managed forest fires are beneficial and are part of the forest and grassland management practices, but wildfires are not. It may start as a small, controlled fire for agriculture land management. However, with prolonged drought conditions and increased fuel load, the fire transmits to forests developing into an uncontrolled wildfire that may last for days to months. The main drivers behind the increase in forest fire incidences are persistent hotter and drier weather because of climate change, as well as other human influences such as land conversion for agriculture and inadequate forest management. Forest fires can release millions of extra tons of carbon, decimate biodiversity, destroy vital ecosystems, impact economies and people, threaten property and livelihoods, and cause severe long-term health problems for millions of people in the HKH region and across the globe.

The haze episode of 2021 has highlighted how critical forest fires can be to the urban population and has underscored the necessity to promulgate local-level fire management plans.

The plan needs integration in all forestry-related programs such as restoration programmes, sub-national REDD+ action plans, adaptation plans, or nature-based solutions. A forest fire can only be managed and avoided with local community support. Although numerous initiatives on controlling forest fires have been identified, their execution is weak. There is a huge untapped potential to mobilize climate finance for fighting forest fires.

Chapter 6: Discussions-Ensuring the effectiveness of REDD+ implementation at the local level

To ensure the success and sustainability of REDD+ activities, it is imperative to incorporate the perspectives of local communities. Furthermore, the effectiveness of executing any REDD+ project hinges upon a comprehensive grasp of the procedural complexities, essential documentation, as well as the interests and demands of these local communities. In the context of this study, which aims to reveal the requisites for successful REDD+ activity implementation driven by local communities' needs, a multifaceted approach was adopted. The research focused on two distinct regions, namely the Dhankuta district in the Koshi province of Nepal and the Mamit district in the Mizoram State of India. The selection of these sites was based on the shared characteristics in forest management approaches, geographical features, and prior involvement in REDD+ either as pilot initiatives or through consultations (Bastakoti et al., 2015; Bhattarai et al., 2018) . Moreover, the implementation of the REDD+ program in both countries has predominantly occurred in lowland areas. Consequently, if these nations intend to replicate or expand projects in hills or mountain districts, it is crucial to recognize that strategies effective in lowland settings may not yield comparable results. This discrepancy is particularly noteworthy given that a significant portion of the local communities in these mountainous regions depend on forest resources for their livelihoods (Bhattarai et al., 2023; Mishra et al., 2019).

Firstly, to evaluate progress towards REDD+ readiness in both countries, we synthesized information from scholarly references and engaged in consultations with stakeholders. The initial step involved establishing a foundational understanding of REDD+ in both nations, followed by a detailed exploration of selected study areas. The research primarily focused on analyzing land cover change, specifically emphasizing forest cover change. This analysis was augmented by a comprehensive examination of the drivers of deforestation and forest degradation.

The research also facilitated the exploration of drivers for deforestation and forest degradation through a series of multi-stakeholder consultation meetings, targeting the identification of key factors contributing to carbon emissions. It further scrutinized resulting perceptions by examining the relationship between drivers of carbon emissions (deforestation and forest degradation) and local income levels. This not only validated our findings but also provided a platform for comparison with pertinent literature.

Ultimately, we thoroughly examined the connections or linkages between forest produce, drivers for deforestation and degradation, and income levels. This analysis paved the way for the effective implementation of REDD+ activities, aligning them with the interests and needs of the local communities involved.

6.1. REDD+ readiness in India and Nepal

The comparison between the REDD+ readiness indicators revealed many similarities for both the sites (countries). Overall, India's score was slightly lower as compared to Nepal due to predominant reliance on pre-existing legislations and policies to outline national-level PAMs. This contrasted with Nepal's approach, where PAMs were explicitly incorporated into their national REDD+ strategies (MoEFCC, 2018; MoFE, 2018). Nonetheless, within India, the states of Mizoram, Uttarakhand, Himachal, and Sikkim have successfully formulated distinct state-level PAMs, while Madhya Pradesh and Chhattisgarh are currently in the process of doing so (ICFRE, 2018a, 2018b, 2020b, 2020a).

Moreover, uncertainties arise concerning India's pursuit of "transformational change," particularly if connected to nationally defined PAMs. This uncertainty stems from India's National REDD+ Strategy (NRS) being rooted in existing policies, legal frameworks, and regulations, even encompassing older legislations like the 1988 National Forest Policy (GoI, 1988; Joshi et al., 2011). For both countries, the NRS has guided REDD+ activity implementation (MoEFCC, 2018; MoFE, 2018). India using its decentralized way of governance has given the responsibility to the state governments to execute REDD+ activities. Henceforth, separate State REDD cells have been developed within the State Forest Departments. (Bhattarai et al., 2023; Rawat et al., 2020). In contrast, Nepal's doesn't mandate states to create sub-national REDD+ plans; instead, REDD+ activities are executed through division forest offices within specific districts, under the purview of MoFE's REDD+ Implementing Centre (Poudel et al., 2022). But Nepal also developed two sub-national plans for the implementation of REDD+ which was for testing purpose, one was developed before the Nepal entered into the federal structure, so called as District REDD+ Action Plan and another after the federal structure given name as Local REDD+ Action Plan (REDDIC et al., 2017).

Technical proficiency stands as a critical factor influencing readiness. Several elements contribute, including limited capacity, inadequate technical support, and financial constraints (Banikoi et al., 2019; Yamasaki & Bhattarai, 2020), although India exhibits domestic financing capability (Borah et al., 2018; Chand et al., 2021) and in COP 28, Dubai, India also launched the Green Credit Programme where this mechanism is mainly for incentivizing the activity helping to achieve positive impact on the environment and also complements the domestic carbon market (Thaplyal et al., 2023). On the contrary, Nepal seems more financially poised for REDD+ initiatives, lifted by the FCPF-World Bank's ERP program and numerous smaller REDD+ projects across the country (Dhungana et al., 2018; GoN, 2023). Further, Nepal is ready to receive the REDD+ payment for the ERP program through the carbon trade. Initially it was expected to receive USD 45million by the end of 2024 (Aryal, 2022), this amount now requires verification to confirm Nepal eligibility. However, the positive aspect is, the country is accessing the REDD+ funds indicating the readiness level. Similarly, India is also set to access USD 1.5 billion funds from the world bank for the low-carbon energy, by enhancing renewable energy, developing green hydrogen and stimulating climate finance (The Word Bank, 2023). Further, government of India recently launched a new climate goal with updated carbon credit trading compliance. This programme include stringent regulations for the industrial emissions, setting a threshold level of carbon emissions and any industries surpassing that threshold is obligated to pay a carbon price (Anand, 2023).

Importantly, technical readiness represents just one feature of a nation's preparedness for a specific effort, with political economy and environmental governance playing crucial roles in determining implementation success (Andoh et al., 2022; Maniatis et al., 2019). In both countries, these factors seem less obstructive, with potential obstacles mitigated through strengthening institutional and policy-related capacities. For instance, India's improved technical readiness owes much to the strong institutional and technical proficiency of the FSI. Nepal's readiness received a significant support from the World Bank's Terai Arc Landscape Emissions Reduction Project (ERP)(FCPF, 2022a), a pioneering initiative in Nepal's REDD+ landscape.

Nepal's progress in safeguards readiness is notable, having developed an ESMF and a SESA. Additionally, the country established benefit-sharing mechanisms for the World Bank's ERP program across 14 Terai Arc Landscape districts (GoN, 2022). India's lower rating in this regard mainly stems from its departure from the standard national readiness route for safeguard readiness (Kishwan, 2023).

This assessment provides the baseline in five different sectors including benefit sharing mechanism for effective REDD+ implementation in both countries. Rawat et al. (2020) underscore various opportunities essential for REDD+, particularly the presence of active policies encouraging an enabling environment, the utilization of scientific forest management techniques for optimal conservation and sustainable utilization of forest resources, and the helpful setting for REDD+ implementation facilitated by existing JFM programs and major forestry initiatives. These components contribute to creating a conducive environment for accessing carbon payments. However, the presence of challenges remains, encompassing inadequate REDD+ targeted funds, difficulties in accessing and or securing private sector investments, the invasive plant species, and lack of high-quality seedlings. Alongside, Maraseni et al. (2020) present an intensive analysis of REDD+ projects in Nepal, placing the country at an advanced stage in South Asia, which is in line with this assessment. Furthermore, there are also challenges identified in Nepal include the lack of trust and coordination among central, federal, and local actors, limited engagement of national Civil Society Organizations and Indigenous Peoples in REDD+ committees, and conflicts stemming from regulatory frameworks governing forestry and land use (Maraseni et. al., 2020). This is also in line with the findings from these assessments as both the nations acknowledge the necessity of capacity development in critical areas such as knowledge management, establishing registries, enhancing stakeholder capacity for safeguard audits, implementing information systems, and devising effective benefit-sharing mechanisms. These priorities align closely with the defined objectives of the Green Carbon Fund (GCF, 2019) which was accessed by Nepal.

6.2. Changes in land use and land cover

The analysis of land use and cover in the study area showed different changes: while Dhankuta's forest cover is increasing, Mamit's is decreasing. Dhankuta's expanding forest cover is primarily linked to people moving to cities. These shifts in land use are attributed to migration patterns within and outside the country, influenced by both domestic movement and emigration (Acharya & León-González, 2019). This migration trend mostly focuses on urban centers in districts with better amenities. In places where water is scarce, locals often feel compelled to move away, leaving agricultural lands barren and behind. Furthermore, these abandoned lands then change into forests, shrubs, grasslands, or construction sites (Bhatta & Adhikari, 2022). Apart from migration, Government of Nepal has implemented measures contributing to the increase in forest cover, not just in Dhankuta but across Nepal. Initiatives like community managed forest program, which empowered local communities to manage nearby forests (Baral et al., 2019; Basnet et al., 2018). This resulted in the positive impact of community involvement in forest conservation efforts (Ghimire & Lamichhane, 2020). The most important aspect is the awareness and education about the importance of forests for ecological balance, livelihoods and biodiversity conservation might have led for better protection and afforestation efforts (Laudari et al., 2022). In 2019, a Forest Survey report showed that Dhankuta district has 60,631 hectares of forests, covering 55.9% of its land. Although there was a slight increase in forest cover from 2000 to 2016, growing at a rate of 0.16% annually, potential deforestation and forest degradation remain concerns (Bhattarai et al., 2023). Between 2000 and 2019, Nepal's forested area increased by 1.7% nationwide, while agricultural land decreased due to urban expansion (Shah et al., 2022). The conversion of agricultural land has become a nationwide concern, highlighted by national data showing a significant 2.1% decrease in cropland, equal to 8,053 hectares, between 2000 and 2019 (Pandey, 2022). Dhankuta also experienced a decrease in agricultural land which has implication not only with the availability of sources of water for irrigation plus not being able to get a good market for their produce. Further, farmers still face difficulties in the sector for instance in obtaining quality seeds, fertilizers, and finding dependable markets for their produce (Beshir et al., 2022). Making the situation more complicated, heavy reliance of agriculture on water for irrigation, combined with decreasing water supplies, has led to the transformation of farming lands into barren areas, construction sites, or forests (Azadi et al., 2018; Rachman et al., 2022). Population growth and increasing demands intensify these challenges. Family divisions often lead to either farmland or forests being used for building homes (Bhawana et al., 2017). In regions with severe water scarcity, residents near rivers expand their farmlands onto riverbeds to secure a reliable water source for irrigation (Kandel, 2013). These demands rise with population growth, intensifying challenges combined by the effects of climate change.

There are challenges but opportunities too, if tapped and effectively utilized, for eg. in Nepal, especially in the Hills and mountains, communities have long practiced agroforestry, using trees for daily needs (Bhattarai et al., 2016) where Dhankuta also a mountainous district. This needs to be promoted and converted into a carbon project. Agroforestry's ability to capture carbon has gained attention, especially since the Kyoto Protocol recognized it to mitigate greenhouse gases (Nair et al., 2009). Agroforestry systems can sequester carbon ranging from 12 to 228 tons per hectare, depending on the method, with an average of 95 tons per hectare (Bhattarai et al., 2016). Additionally, the district is known for *Alnus nepalensis*, a fast-growing species with good carbon sequestration capacity. A study in 2009 found carbon content in *Alnus nepalensis* stem, branches, leaves, and bark to be 40.52%, 33%, 9.56%, and 16.4%, respectively (Ranabhat et al., 2008). This can provide multiple benefits to the local communities. Households receiving remittances can now use market resources instead of relying solely on agriculture. This highlights the potential for carbon projects in Dhankuta district, Nepal, if tapped along with appropriate benefit sharing plans with the communities, such projects can bolster and diversify incomes in the district.

Mamit district, also mountainous in nature, can also tap the carbon projects for better livelihood option through managing the forest /natural resources. The district has experienced the decrease in forest cover where the primary cause of declining forest cover in the Mamit district of Mizoram can be attributed to the prevalent practice of shifting cultivation (Bhattarai et al., 2018), deeply ingrained as a traditional agricultural method throughout the entire district. This customary approach involves the systematic clearance of land through the cutting and controlled burning of vegetation. Subsequently, crops are cultivated on this prepared land for specific periods until the soil's fertility diminishes. At this juncture, the land is allowed to lie fallow, allowing natural processes to gradually restore its fertility. The fallow land often serves secondary purposes, such as grazing (Dasgupta et al., 2023). This practice also contributes to the reduction in forest quality for subsequent generations of plants. In recent years, driven by an expanding population and escalating demand, the cultivation cycles have been shortened (Bhattarai et al., 2019). This alteration has led to diminished soil fertility and heightened pressure on the forest ecosystem. While shifting cultivation sustains the livelihoods of 200–300 million individuals across 64 developing countries (Li et al., 2014), it simultaneously serves as a prominent driver of carbon emissions and biodiversity decline (Ding et al., 2012). The traditional fallow period, once spanning 20-30 years, has experienced a substantial reduction to as little as 3-5 years of rotation (Hnamte, 2016).

The region is undergoing significant changes affecting both soil and forest quality. Borah et al. (2018) highlighted the impact of a shortened fallow period on carbon emissions, with their study showing a depletion of 50%, 60%, and 83% of carbon stocks over 15, 10, and 5-year cycles, respectively. This not only suggests potential opportunities for initiatives like REDD+ or carbon finance but also emphasizes the urgent need for local communities to explore different ways of making a living.

Additionally, as communities learn more about climate change, they can consider transitioning to settled farming. This means focusing on crops that bring in money, like ginger (Bhattarai et al., 2018; Singson et al., 2017). The analysis also reveals the emergence of new forests in the region, influenced by both fallow periods and settled cultivation practices. Over 21 years, it's clear that these new forests result from both the regeneration of shifting cultivated areas and the longer rotation periods associated with them.

However, amidst this forest regeneration, Global Forest Watch data shows a significant loss of forested land from 2002 to 2022. For example, Mamit experienced a 7.9% decline in tree cover, losing 2.39 km^2 of humid primary forest during this period. Additionally, there was a noteworthy 10% decline (around 3 km^2) in tree cover between 2001 and 2022, leading to emissions equivalent to 16.2 million metric tons of CO_2 (GFW, 2023).

The analysis also highlights a decrease in water bodies, likely due to prevalent cultivation practices. The cultivation process, causing water infiltration into the soil, contributes to this decline. Communities strategically placing croplands near water bodies to ensure easy access to water further accelerates encroachment on wetlands or marshy areas, reflecting increasing human impact on these features (Cheng et al., 2022). The intricate relationship between land use changes, carbon dynamics, and environmental shifts in the region is evident in the interplay of these factors.

6.3. Fuelwood and shifting cultivation as major D&D drivers

The study identified two major drivers for D&D in the study areas. In Dhankuta, fuelwood collection emerged as a significant driver, while in Mamit, shifting cultivation was identified as a primary contributor. Specifically, in Dhankuta, the findings demonstrated the connection between people's jobs and the type of energy they use. The results revealed that most households primarily rely on fuelwood as their main energy source, aligning with previous studies in the district (Bhandari & Paudel, 2021; Pokharel, 2003). Despite a notable increase in the use of LPG gas for cooking over the past decade, over half of Nepali households still prefer firewood (NSO, 2023). According to a 2023 report from the National Statistical Office (NSO), 51% of the 6.66 million households in Nepal use firewood, while 44.3% use LPG in their kitchens. However, the burning of fuelwood contributes to air pollution, leading to various health issues (Bhattarai et al., 2022).

While the government of Nepal provides subsidies for LPG, concerns persist among people regarding its cost and accessibility. Consequently, many local communities continue relying on fuelwood, driven by the need for a strong fire for cooking large quantities of food, especially for livestock, and to ensure warmth during the winter season. However, this practice significantly contributes to the release of carbon emissions into the air, with negative consequences for the environment.

Similarly, in Mamit district, fuelwood is a major energy source, even though the district practices shifting cultivation. Shifting cultivation directly impacts the livelihoods of households in Mamit, particularly concerning the economic dynamics of the region. In a population of 86,364 individuals, with 71,465 residing in rural areas (DoFO, 2011), approximately 74.88% of rural households rely on fuelwood for cooking purposes. This reliance increases to 83.66% when focusing solely on rural areas (DoFO, 2011). This data underscores a concerning trend: the district contributes substantial CO_2 emissions through both fuelwood burning and the practice of shifting cultivation.

Families relying on shifting cultivation often experience lower income levels due to factors such as irregular harvest cycles and the necessity of fallow periods, limiting continuous crop production and income generation. This contrasts with modern agricultural practices that offer consistent yields and year-round income (Rasul & Thapa, 2003).

The widespread heavy reliance on fuelwood across numerous communities has far-reaching implications, including deforestation, forest degradation, and a significant contribution to carbon emissions. Addressing the resulting impact on climate change in the Dhankuta district requires immediate action. Introducing sustainable alternatives to fuelwood becomes a critical objective in facilitating carbon sequestration and alleviating the adverse consequences associated with deforestation. These insights align with earlier investigations emphasizing the complexities of forest preservation and management in the rural spheres of developing nations (Chaudhary et al., 2016; Fuwape & Onyekwelu, 2011; Gautam et al., 2009).

Mitigating dependence on fuelwood represents a critical stride towards realizing sustainable forest management within the district. Strategies promoting cleaner energy alternatives, such as electric cookstoves, biogas, and enhanced cookstoves, coupled with advocating for forest management practices benefiting local communities, emerge as potent avenues for advancing forest conservation and prudent utilization (Adhikari & Baral, 2022; Singh et al., 2021). Clean cookstoves hold the potential to reduce emissions (Piedrahita et al., 2020).

Findings from household surveys and consultation meetings underscore the relation between agricultural households, shifting cultivation, and a heavy reliance on fuelwood as a primary energy source. This further reiterates that these households often fall within the low-income bracket. This interrelation between shifting cultivation and limited-income livelihoods highlights the need to explore alternative economic opportunities. Dedicated efforts should be aimed at improving the financial well-being of these communities including strategies that diversify income sources beyond agriculture alone (Woodhill et al., 2022). This could involve promoting skill development, facilitating access to education, and encouraging engagement in non-farm activities like handicrafts, small-scale entrepreneurship, or service-based ventures. By addressing the income disparities associated with shifting cultivation, interventions have the potential to enhance the overall quality of life for families engaged in this traditional yet economically challenging practice. Most importantly, although if all the drivers are addressed by providing the abovementioned options, the risk remains if the forest can't be protected from forest fire.

6.4. Forest fire a risk for mitigation action and climate finance

Human activities are the predominant cause of forest fires in Nepal and India, rather than natural causes. While precautions are usually taken during shifting cultivation clearing activities, there are instances when these actions escalate into massive forest fires. Controlled forest fires, when managed carefully, play a crucial role in forest management. They help reduce the spread of wildfires by consuming natural fuels on the forest floor, control weed growth, and offer opportunities for emissions reduction and increased carbon sequestration. Additionally, controlled fires contribute positively by destroying diseases and providing nutrients for new growth. Even though controlled fires emit some greenhouse gases (GHGs), the emissions are significantly lower compared to uncontrolled wildfires, as controlled fires mainly target underbrush to protect larger trees (NSF, 2010). When left uncontrolled, however, these fires can rapidly transform into disasters (Valkó et al., 2014).

Forest fires release various GHGs, including carbon dioxide, carbon monoxide, methane, nitrous oxide, and aerosols such as organic aerosols and black carbon (Pribadi & Kurata, 2017). The Paris Agreement recognizes the role of forests in carbon sequestration under the REDD+ framework, endorsed by Bhutan, India, and Nepal (Rawat et al., 2020). This framework links financial instruments to the carbon sequestered by countries through afforestation, reforestation, conservation, and forest management. While offering incentives for climate finance, forest fire incidents in 2021 could disqualify regions from such finance as the sequestered carbon is released back into the atmosphere. Furthermore, GHGs like methane and nitrous oxide, accumulated over decades in forests, can be rapidly emitted within hours due to forest fires. With methane having a global warming potential of 28 to 36 and nitrous oxide a potential of 298 over 100 years (US EPA, 2020), carbon credit trading from forestry becomes a risky initiative due to fire-related threats. This translates to higher insurance premiums for forest carbon projects, with up to 15 to 20% of carbon credit revenue being allocated as a buffer against forest fires in this region.

Despite the risks, post-fire activities present opportunities for restoring lost natural values, aligning with global agendas such as the UN Decade of Ecosystem Restoration. With approximately 2 billion hectares of land available for restoration activities worldwide (IUCN, 2014), controlled fires can eliminate invasive plant species and implement suitable ecological restoration models. This contributes not only to ecological restoration but also to the sustainable livelihoods of forest-dependent communities, considering future climatic conditions and ecosystem service improvements. Although forest fires are not explicitly mentioned in the Sustainable Development Goals (SDGs), they directly impact 8 out of 17 goals, as illustrated in Figure 23. Uncontrolled forest fires contribute to desertification and land degradation, impacting soil fertility and stability. Moreover, the resulting air pollution affects water quality, local livelihoods, and disrupts the sustainable harvesting of fuelwood. These fires also threaten life on land (SDG 15), damaging biodiversity and nearby settlements. With growing populations and communities encroaching upon forests, forest fire incidents not only result in tree and bush loss but also endanger structures and livelihoods. In Nepal's Dang district, over 460 households were at risk due to forest fires, leading to agricultural and livestock feed losses (THT, 2021).

1. Desertification and land degradation
2. Heating effects on soils, mainly effects on fertility, soil stability and water infiltration characteristics
3. Air quality, Combustion of vegetation and conversion to another, vegetation type, Damage to cultural artefacts
6. Post-water water quality, availability and treatability
7. Effects on sustainable firewood harvesting
13. Release of greenhouse gases and particulates, Changes in albedo, Changes in soil moisture retention capacity
14. Water quality, post fire runoff into water bodies
15. Combustion of vegetation and conversion to another, vegetation type and land use, Heating effects on soils, mainly effects on fertility, soil stability, water infiltration characteristics and soil moisture retention capacity

Figure 23:Forest fire impacts on SDGs

6.5. Making REDD+ work at the ground

In rural settings, such as Mamit and Dhankuta, local communities heavily rely on forest resources for their daily sustenance. The substantial dependence on fuelwood for cooking and heating in these communities not only leads to deforestation and forest degradation but also contributes significantly to carbon emissions, demanding urgent action. However, this reliance has led to significant disruptions in ongoing forest conservation and management efforts. The primary contributors to deforestation and forest degradation in the study areas include activities like shifting cultivation, illegal logging, fuelwood collection, unregulated extraction of non-timber forest products, and instances of forest fires. Effectively controlling illicit activities such as logging and hunting in the region is complicated by the challenging topography and terrain. To tackle these formidable challenges, various initiatives have been launched, including implementing community-based forest management, forest conservation measures, and sustainable livelihood programs. In both sites, several households depend on agricultural production, indicating a heavy reliance on fuelwood as an energy source.

In Mamit, the household survey revealed that household relying on fuelwood, practice shifting cultivation. A tradition that requires a subtle balance between subsistence needs and conservation efforts, while also considering traditional practices and modern demands, is of dominant importance for the region's environmental sustainability. Furthermore, household survey across three villages revealed that a significant 91% of households depended on agriculture, with shifting cultivation as the primary agricultural activity. Among these agriculturally dependent households, a noteworthy 84% did not engage in any secondary professions, as depicted in Figure 24. The findings in Mamit showed that, on average, 16kilogram of fuelwood is being used per day in a household. If this is extrapolated to all fuelwood-dependent households (i.e., 91% of the total households in the district), the quantity of CO_2e ranged between 0.16-0.18 million metric tons (Kaltimber, 2017).

Similarly, Dhankuta's local economy also predominantly relies on agriculture, with a significant portion of the community actively engaged in farming practices. The region is renowned for cultivating various crops, including paddy rice, maize, millet, vegetables, and fruits. This study, conducted on a representative sample of households, revealed that 46% of respondents identified agriculture as their primary profession. The survey encompassed individuals from various age groups, with approximately 15% of participants either unemployed or in the student phase of their lives, as illustrated in Figure 24. Within the Dhankuta District, the NSO identifies around 37,648 households (NSO, 2023). By calculating the average fuelwood consumption per family, an estimated annual usage of approximately 3,500 kilograms is determined. When extrapolated to cover the entire district, this cumulative average translates to an annual emission of CO_2 ranging between 217,417.2 to 237,182.4 metric tons, considering the collective output of all households. This amounts to an overall annual emission of approximately 0.217-0.237 million metric tons of CO_2 for the entire district. However, it is essential to note that these figures are approximations, as the precise quantity of CO_2 generated from fuelwood combustion is contingent upon variables such as wood composition, stove type, and related factors (Desta & Ambaye, 2020).

Burning 1 kilogram (kg) of fuelwood typically emits approximately 1.65 to 1.80 kgs of CO_2 gas (Kaltimber, 2017). If we calculate this at a rate of USD 10 per ton of carbon, the annual loss attributed to fuelwood burning in Mamit district equates to roughly 1.8 million USD. Although, this is a small amount but if the implementation is done for more fuel dependent communities, it not only provides income generation opportunities but also helps in minimizing the carbon emission. Similarly, in Dhankuta district, the estimated loss amounts to around 2 million USD annually. When compared to the country's per capita income, these losses represent approximately 2% and 1% respectively in support.

Households engaged in shifting cultivation or reliant on fuelwood as their primary energy source tend to have lower annual incomes. This trend directly correlates with income levels, as illustrated in Figure 26. In contrast, households with average to high annual incomes predominantly use LPG for cooking, and some even combine LPG with fuelwood. Interestingly, only one surveyed household reported using electricity for cooking purposes. This observation highlights the potential viability of the REDD+ mechanism, especially if incentivizing or benefiting shifting cultivation communities becomes a reality.

Interestingly, it was observed that most households whose primary profession was agriculture did not engage in a secondary profession. Nonetheless, a few respondents indicated simultaneous involvement in both agriculture and either business or service, implying concurrent engagement in multiple professions. This observation underscores the predominantly agricultural nature of the Dhankuta district. In urban areas, a significant number of respondents reported business or service as their primary profession while maintaining agriculture as a prominent secondary occupation. This finding emphasizes the enduring significance of agriculture, even in urban settings, as a supplementary source of livelihood for numerous individuals.

This study delves into the relationship between individuals' occupations and their energy sources. It was found that most households primarily rely on fuelwood as their main energy source. To further analyze the relationship between fuelwood usage, income, and occupation, the data were graphed. When employing the linear regression statistical model to assess the relationship between two variables, namely income and fuelwood usage, and examining the overall income class and fuelwood usage trend, a downward trajectory was observed, as illustrated in Figure 25A. However, a distinct pattern emerged when the data were stratified based on income levels—specifically, those below 300,000 and 500,000 or above. Figure 25B illustrates that households with annual incomes below USD 2,300 (Nepalese rupee 300,000) primarily rely on fuelwood as their primary energy source. In contrast, households with annual incomes exceeding USD 3,800 (Nepalese rupee 500,000) primarily utilize LPG as their main energy source (Figure 25C), with only a minority still using fuelwood and an even smaller fraction adopting clean cookstoves.

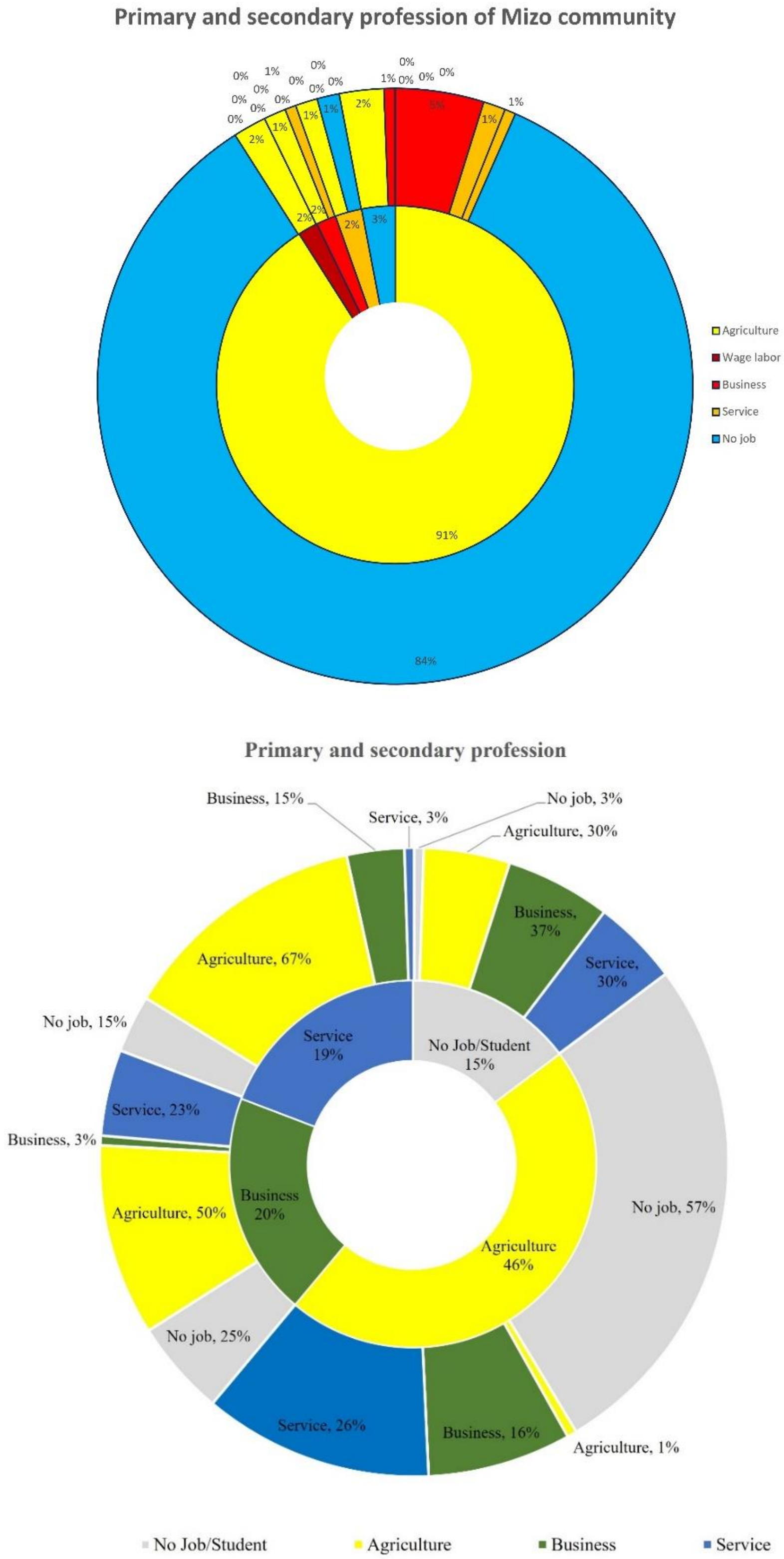


Figure 24: Primary and secondary profession relation in both Mamit (top) and Dhankuta (bottom).

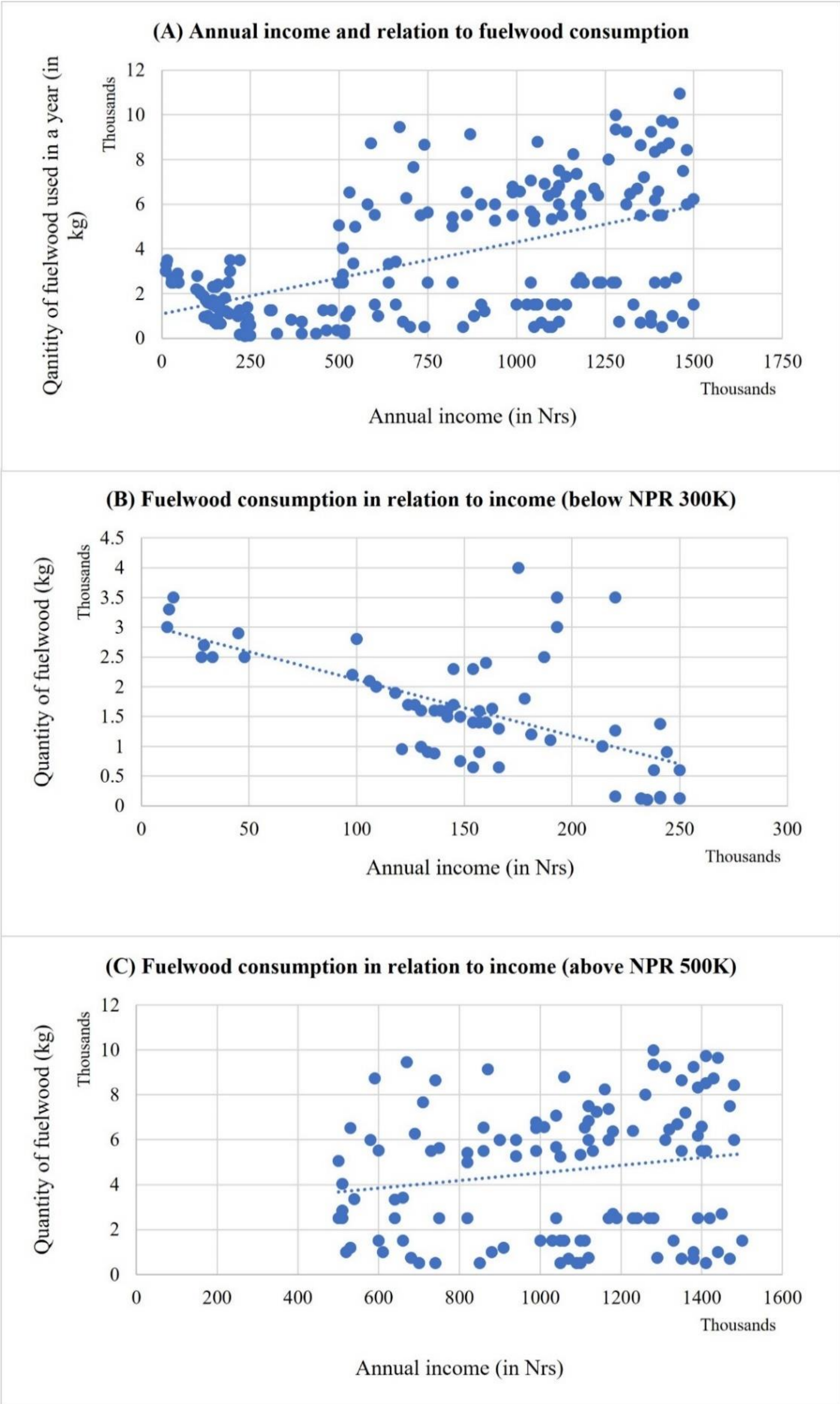


Figure 25: Linear regression between annual income and fuelwood usage

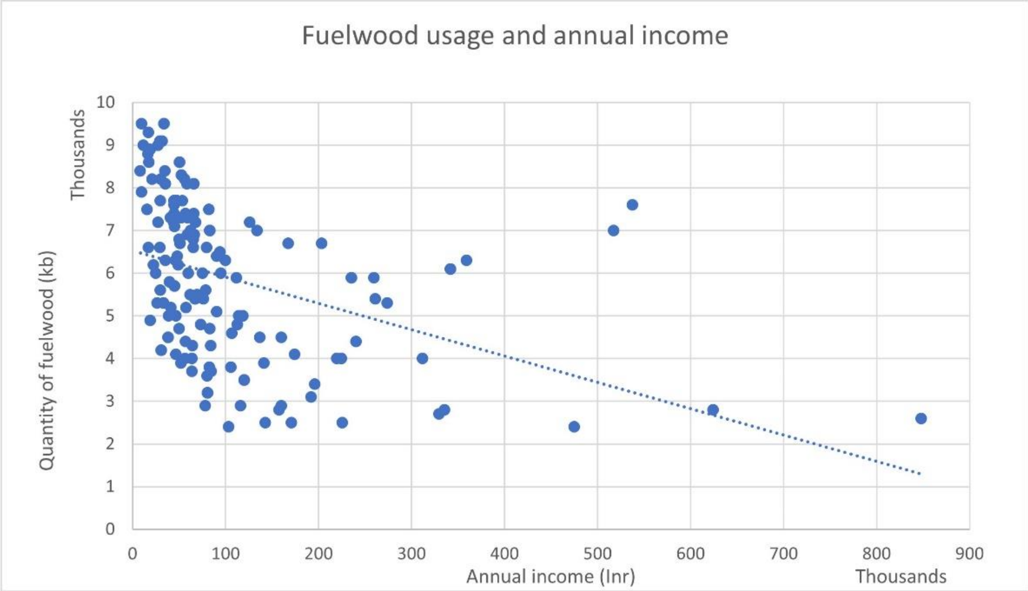


Figure 26: Fuelwood usage and its relationship with annual income

The REDD+ mechanism emerges as a promising solution for regions grappling with these intricate challenges. This mechanism offers incentives and support to communities engaged in expanding forested areas (Barrett, 2013). By promoting effective forest management and encouraging conservation practices, this approach contributes to heightened carbon sequestration efforts (Karky & Skutsch, 2010). Concerns have been raised regarding the success of REDD+ projects in various parts of the world, largely attributed to governance issues (Morita & Matsumoto, 2023). However, the situations in Nepal and India present distinct prospects as both countries is yet to implement the REDD+ projects but consist of a proven mechanisms for forest conservation in the form of registered management committees (Bhatia & Yousuf, 2023; Kimengsi & Bhusal, 2022). In Nepal, the Community Forest Management Committee operates in the form of registered body in divisional forest office, while in India, the Joint Forest Management Committee are also registered in respective forest departments. These committees bear responsibility for forest management activities, financial control and management, as well as organizing training and awareness programs (Bhatia & Yousuf, 2023; Kimengsi & Bhusal, 2022). This existing framework shows the potential value for any carbon-related projects where both financial and technical management capacity is already there with these committees, effectively adopting ownership and active involvement by local users.

Although, having such effective mechanisms, Mamit is experiencing a decrease in forest cover, and this is mainly linked with the income opportunities. The observed shifts in land use patterns underscore the complex interplay among socioeconomic factors, environmental challenges, and the pressing need for sustainable methodologies. Active engagement with relevant stakeholders and beneficiaries is imperative to skillfully address these concerns. This engagement not only advances a collaborative and comprehensive framework but also facilitates the provision of incentives to communities reliant on forests. In doing so, we can ensure the enduring sustainability of interventions over the long term.

Chapter 7: Conclusion and Recommendations

7.1. Conclusion

Humanity is facing the triple planetary crisis encompassing climate change, biodiversity loss, and air pollution, resulting in significant annual human casualties. The implementation of an effective REDD+ mechanism is an unique approach capable of addressing these crises. This study showed how REDD+ can effectively identify the challenges and address them at the local level. To accomplish this, the initial objective was to assess the progress of countries in aligning with UNFCCC guidelines for REDD+. This step was crucial in providing the base for the research. Subsequently, studying the direct causes of deforestation and forest degradation in two specific sites: Dhankuta in Nepal and Mamit in India. This was followed by a comprehensive analysis of land use and land cover changes from 2000 to 2021.

The research indicated that both countries are at a similar stage, with Nepal demonstrating slightly better readiness, while India showing a substantial advantage in technical readiness due to the capabilities of the Forest Survey of India. Although, both countries developed and submitted their NRS to UNFCCC in 2018, Nepal seems to be advancing more aggressively than India. Nepal stands out in terms of financial readiness, partly because the World Bank-FCPF has been involved in the country since the readiness phase and has implemented the ERP in the Terai Arc Landscape (TAL) area of Nepal. However, institutional readiness emerges as the most significant challenge among all aspects. The Forest Ministry, directing the readiness process, faces a lack of cross-sectoral support, hindering the establishment of a strong institutional foundation for coordinating REDD+ efforts. This reliance on political will for REDD+ also hampers responsiveness to international technical assistance. Most readiness gaps, except for institutional preparedness, can be successfully addressed through capacity-building activities and south-south exchange programs. Cooperation between nations with specialization in each field can promote mutual training and ensure a team effort to overcome these challenges. It is essential that these initiatives to increase capacity and preparation flow smoothly into the implementation stage.

For successfully implementing REDD+, countries must have essential funding access. This is especially true for initiatives like UN-REDD, which can combine preparation efforts with early implementation while encouraging a "learning by doing" philosophy. Adequate finances must be available for sustaining REDD+ activities over the long term and moving past the planning stage. Given that the drivers of deforestation and forest degradation differ significantly across specific sites due to factors such as diverse terrain, ecosystems, and demand, strategic funding allocation becomes critical to effectively address these unique challenges and drive progress within the sector.

In Dhankuta, the heavy dependence on fuelwood has exacerbated forest degradation and increased emissions. The unexpected growth in forest coverage can be attributed to shifts in land use and outmigration, with lower-income households and agricultural activities intensifying the degradation process. This context underscores the potential of carbon financing through interventions such as clean cookstoves and afforestation. The study found that stopping fuelwood burning in the district could allow for carbon projects generating over USD 2 million annually. However, in Nepal, many mountain districts heavily rely on fuelwood, and while implementing carbon projects focusing on afforestation and reforestation may not be the optimal solution, addressing the root cause of emissions, namely fuelwood burning, is critical. Furthermore, negligence has led to numerous fire incidents in both sites, posing a significant challenge to REDD+ projects. To mitigate this issue, there is a need for capacity development and the adoption of advanced technologies to minimize the occurrence of these destructive events.

In Mamit, heavy reliance on fuelwood for energy has led to a noticeable increase in carbon emissions. This is mainly due to the practice of shifting cultivation and the widespread daily use of fuelwood. Additionally, shifting cultivation contributes to forest fire incidents, posing a significant challenge for carbon-related projects.

However, carbon initiatives have the potential to play a crucial role in revitalizing lands affected by shifting cultivation. These projects can bring positive change by offering financial incentives to reduce cultivation areas and promote forest regeneration. The benefits extend to the ecosystem, biodiversity, and human health. Moreover, they provide an opportunity to create alternative livelihood options for communities heavily reliant on forest resources, potentially saving them around 1.8 million USD annually through carbon projects. This approach makes it possible to transform shifting cultivation areas into settled cultivation or facilitate their regeneration by incentivizing these communities. Such a strategic approach can significantly contribute to conservation efforts, particularly through initiatives like REDD+, by ultimately reducing emissions and enhancing forest carbon stocks.

To achieve this, the state government must prioritize the equitable distribution of benefits in any carbon-related project. Excluding these communities from the equation could significantly impede the success of carbon projects, not only in Mamit but also in other districts within the state. Therefore, their active inclusion and participation are essential for the effective implementation and success of such initiatives.

Furthermore, human-induced forest fires are a significant issue in the study sites and the broader HKH region, causing impacts on ecosystems, economies, and health. The year 2021 stands out as the worst in the past decade for forest fires. During this time, both the study areas and the lowlands and midhills of India and Nepal experienced widespread fires. The hottest months, from February to April, saw the highest number of fire incidents. Satellite data from MODIS revealed that between January 2010 and May 2021, there were over 6,000 active fires detected in the study area, with a confidence level of 50% or higher. Most of these fires occurred during the summer season, particularly during the FMA period, recording a total of 717 fire incidents. Mamit alone accounted for 675 incidents, while Dhankuta had only 42. During these months, temperatures rose, and precipitation decreased compared to the annual trend. The high incidence of fires also led to increased pollution levels. This analysis covered the entire regions of Mizoram and Nepal, as the results were not specific to individual sites. The observed aerosol subtype during this study extended into Bhutan based on CALIPSO observations. When comparing Mamit and Dhankuta, it was found that Dhankuta had higher AOD, while Mamit had higher CO levels. This difference was due to the higher number of fire incidents in Mamit, leading to increased CO emissions, whereas the elevated AOD levels in Dhankuta were a result of fires in the Terai area.

Persistently hotter and drier weather, attributed to climate change, along with inadequate forest management practices, contribute to forest fires. Implementing local-level fire management plans and integrating fire mitigation into broader programs are crucial for effective management, although they present certain challenges.

The occurrence of all these fire events in the region can provide valuable insights into the type of effective management strategies that should be adopted. Learning from these events is essential to understand what kind of support is necessary to protect our forests and homes. While it may not be possible to eliminate forest fires, it is of utmost importance for scientists, managers, policymakers, foresters, forest user groups, and all other stakeholders to seize the opportunity to reconsider forest management and promote more resilient landscapes in the aftermath of such events. Without effective management and mitigation of forest fires, achieving nationally determined contributions in the forestry sector and global agendas such as the SDGs, the United Nations Convention to Combat Desertification (UNCCD), and the United Nations Decade of Ecosystem Restoration becomes a challenging endeavor. Unfortunately, governments in these countries frequently allocate budgets for plantation efforts while overlooking the critical aspect of fire management. However, addressing this issue is just one part of the equation. Further, providing incentives is vital for the victims of forest fires, as it enables them to not only rebuild but also take proactive steps to manage and restore the landscape. Carbon finance holds great potential in this regard, but its success hinges on its transparent implementation.

To bridge this gap effectively, there is a need to establish a benefit-sharing plan that transforms carbon finance into local incentives, thereby strengthening the overall effectiveness of REDD+ initiatives. Future research should explore interventions for reducing fuelwood consumption, analyzing the role of local institutions, and understanding demographic impacts on land use and forest coverage. Harmonizing emissions reduction, land management, and local livelihoods is crucial for sustainable development and aligns with holistic land management trends. To enact change, identifying households heavily reliant on fuelwood and those practicing shifting cultivation is crucial. The REDD+ mechanism should target beneficiaries engaged in both deforestation and conservation efforts, incentivizing forest users through rewards, incentives, and capacity building for effective conservation and management. These results underscore the importance of considering local customs, ecosystem well-being, and sustainable energy sources in carbon emissions reduction and land management. This approach ensures long-term viability and promotes holistic development, aligning with global trends advocating for comprehensive land management practices.

In conclusion, the success of REDD+ projects depend on effectively sharing benefits and providing meaningful incentives to the right communities with transparent governance mechanism. REDD is based on the RBP mechanism, and if forest-dependent communities don't feel adequate incentives, REDD won't work as intended. Transparent discussions about project benefits and fair distribution agreements are crucial to gaining ownership and support from project proponents and stakeholders affected by the project. Furthermore, benefit-sharing agreements should be set up before project implementation, encouraging positive actions and discouraging poor performance so that result-based payment can work and, at the same time, foster a sense of ownership and responsibility. Additionally, maintaining transparency and equity in benefit-sharing, along with ensuring projects have enough resources for proper investment and maintenance, prevents excessive value extraction.

On the ground i.e. on both sites, the success of REDD+ is closely tied to motivating local communities' green demands since their dependence on forests is central. Without proper motivation, improving greenery and carbon sequestration in forest areas remains challenging.

The communities' willingness to engage in carbon projects for improved livelihoods and well-being is evident, indicating a positive outlook for successful and sustainable carbon projects.

7.2. Recommendations

- REDD+ initiatives should prioritize the establishment and implementation of strong social and environmental safeguards. This involves thorough engagement with local communities, indigenous groups, and stakeholders to ensure their rights, livelihoods, and cultural integrity are protected. Additionally, stringent environmental impact assessments and compliance mechanisms should be in place to prevent adverse ecological effects.
- To guarantee transparency and accuracy, third-party entities should conduct the baseline calculation and ongoing evaluation for REDD+ projects. This independent assessment ensures impartiality, credibility, and adherence to standardized methodologies, reducing the risk of biases or inaccuracies.
- It is essential to ensure the precise measurement of forest carbon stocks without any inflation. Utilizing advanced technologies like LiDAR, remote sensing, and ground-based assessments with scientifically validated protocols can enhance accuracy. Rigorous validation and verification processes are essential to maintain data integrity and reliability.
- Implementing REDD+ initiatives should focus on incentivizing sustainable forest management practices, especially for forest-dependent communities. Providing economic incentives, capacity-building programs, and alternative livelihood opportunities can encourage these communities to actively participate in conservation efforts while meeting their socio-economic needs.
- There is a high scope for integrating Gender equity, disability, and social inclusion in the REDD+ initiatives. Involving marginalised groups into decision making processes aids in overall development of the communities that are often closely associated and are dependent on these forest resources. The women led households in the sites can diversify their incomes by employing carbon credit mechanisms through hand-holding and policy support.
- Detailed and comprehensive plans incorporating Mean Annual Increment (MAI) and Annual Allowable Cut (AAC) are necessary for effective forest management. These

plans should encompass sustainable harvesting practices, biodiversity conservation strategies, reforestation plans, and clear guidelines for forest utilization to ensure long-term ecological balance.

- Introducing proactive pre-fire management strategies is critical to minimize forest fire risks. This includes technological advancements in fire detection and suppression, the creation of fire breaks, controlled burning practices, and the establishment of water harvesting ponds strategically placed to aid firefighting efforts. These measures aim to mitigate the devastating impact of forest fires on carbon stocks and ecosystem integrity.

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Annexure

Annex 1. Questionnaire for REDD+ readiness survey

1. Strategy and policy readiness indicators (NRS and PAMs/S&As*)

No.	Question/s	Responses
1.1	What are the main methodological basis for analysing the drivers of deforestation and forests degradation (D&D)?	1. Literature review only 2. Also based on stakeholder opinion/workshops 3. Satellite land use change data also used 4. Statistical analysis of causes of D&D used
1.2	Has cost-benefit analysis (CBA) of the PAMs/S&As, including emission calculations, been undertaken?	1. No 2. Yes, If yes, please explain-
1.3	Has an analysis of the barriers to forest carbon stock enhancement been undertaken?	1. No 2. Yes, If Yes, Please explain.
1.4	In your opinion, how strong are the forestry targets in the Nationally Determined Contributions (NDCs)?	1. No forestry targets in NDCs 2. Weak forestry targets in NDCs 3. Significant forestry targets in NDCs 4. Strong forestry targets in NDCs
1.5	What is the strength (in your opinion) of high- level political support for REDD+ compared to the country's other development priorities?	1. Very weak high-level political support 2. Moderate high-level political support 3. Significant high-level political support 4. Strong high-level political support
1.6	How strong (in your opinion) are the measures or incentives* in the PAMs or S&As to change "business as usual" behaviour of resource users, managers and decision-makers?	1. Very weak incentives 2. Moderate incentives 3. Significant incentives 4. Strong incentives
1.7	In your opinion, how strong is forests law enforcement capacity and compliance?	1. Very weak 2. Moderate strength 3. Significant strength 4. Strong or very strong
1.8	Has the country undertaken sub-national REDD+ planning, or does it plan to do so?	1. Yes 2. No If yes, please explain.
1.9	Are there any training necessity to support policy/strategy readiness? If yes, list up to 3 in order of priority.	National level: Sub-national level:

2. Institutional readiness

No.	Indicator/question	Reply options
2.1	What % of REDD+ SC (or equivalent) members are non-state actors, as set out in NRS?	
2.2	Is the institutional home of the Safeguards Information System (SIS) separate to the FD?	1. SIS is housed in FD

		2. Not housed in FD, but in same Ministry. 3. Not housed in FD, but reports to FD or same Ministry 4. Housed in, and reports to, a different Ministry
2.3	Is the monitoring and evaluation (M&E) system for the NRP, as set out in the NRS, independent from the FD?	1. M&E system led by FD 2. Not led by FD but under same Ministry 3. Not led by same Ministry, but reports to it 4. Led by, and reports to, separate Ministry to FD
2.4	Is a communications or knowledge management strategy for REDD+ implementation set out in the NRS?	1. No communications/knowledge management strategy 2. Strategy in draft form 3. Strategy is summarised in NRS 4. Detailed strategy set out in NRS
2.5	How effective (in your opinion) will be the inter-ministry/sectoral coordination mechanisms for REDD+ planning and implementation set out in the NRS?	1. Very weak 2. Modestly effective 3. Quite effective 4. Strongly effective
2.6	Are there any vital remaining training or capacity building needs related to institutional readiness? If yes list up to 3 in order of priority.	National level

3. Technical readiness

No.	Indicator/question	Reply options
3.1	Is the Above Ground Biomass carbon pool in the FRL/FREL based on a nationally determined Emission Factor (EF) (rather than IPCC default EF)?	1. No 2. Yes
3.2	How many national forest inventories (NFIs) have been undertaken incorporating methodology prescribed in the NRP or NRS?	Number: What year was last one:
3.3	Is the NFI data electronically stored and publicly accessible?	1. Not electronically stored 2. Electronically stored but no access to public 3. Electronically stored and some access to public 4. Electronically stored and fully accessible
3.4	Is there a satellite-based national map showing changes in forest cover over time, and when was the latest map produced?	1. No 2. Yes but over 5 years old 3. Yes within last 2-5 years 4. Yes within the last 2 years

3.5	Is a geo-referenced REDD+ or Carbon Registry or equivalent information system operational and publicly accessible?	1. No system planned 2. System in process of development 3. System operational but not accessible to general public 4. System operational and accessible to general public
3.6	How comprehensive is the information in the Carbon or REDD+ Registry (or equivalent)? e.g., carbon accounting and ownership data, financial flows to REDD+ projects /programmes?	1. Not developed or no information 2. Limited amount of information 3. Significant level of information but incomplete 4. Comprehensive
3.7	Is there a dedicated institution, body or department responsible for MRV of carbon emissions from land use and land use change?	1. No 2. Department (of an institution) undertaking MRV also has other functions/work 3. Department is specifically for MRV, but is part of an institution with broader functions/work 4. Separate institution specifically for MRV only
3.8	What progress has been made towards measuring forests degradation and deforestation and developing a revised FRL/FREL?	1. Not stated 2. Started but still at an early stage 3. Well advanced 4. Revised FRL/FREL has been drafted or submitted
3.9	Are there any vital remaining training or capacity building needs related to technical readiness? If yes, list up to 3 in order of priority.	National level

4. Social and governance safeguard readiness

No.	Indicator/question	Reply options
4.1	Has a systematic and multi-stakeholder analysis of social and governance risks and benefits of each PAM or S&A been undertaken, and risk reduction measures and benefit enhancement measures identified?	1. No 2. Partial or rapid analysis of risks and benefits of PAMs/S&As 3. Comprehensive analysis but with limited stakeholder involvement 4. Comprehensive multiple stakeholder analysis of social and governance risks and benefits of each PAM/S&A
4.2	What is the current status of the Safeguards Information System (SIS)?	1.Not started 2. SIS at early stage or draft form 3. SIS designed and the process is nearing completion

		4. SIS process completed and documented
4.3	Has a first Summary of Information (SoI) on compliance with the safeguards been drafted or submitted to the UNFCCC?	1. No 2. Draft version of SoI started 3. final version of SoI 4. SoI submitted to UNFCCC
4.4	Has a "gaps analysis" been undertaken among the existing policies, laws and regulations (PLR) and the Cancun safeguards?	1. No 2. Partial analysis or in process 3. Comprehensive analysis 4. Comprehensive analysis and separate report on website
4.5	Has there been a multiple stakeholder national "clarification" or contextualization of the Cancun safeguards?	1. No 2. Partial analysis or in process 3. Partial analysis involving multiple stakeholders 4. Comprehensive multiple stakeholder analysis
4.6	Is there any Grievance Redress Mechanism (GRM) for REDD+?	1. No GRM for REDD+ 2. Outline or brief description of GRM developed 3. Full description of GRM, but low public awareness 4. Full description of GRM widely disseminated and easily accessed by public
4.7	Has there been a separate study of the gender impacts of the PAMs/S&As, including how to mitigate potential gender inequity impacts and/or enhance gender equity?	1. No analysis of gender equity impacts of PAMs/S&As 2. Partial analysis, e.g., undertaken as part of the general risks & benefits analysis of the PAMs 3. Separate study on potential gender equity impacts of PAMs/S&As, but risk reduction and equity enhancement measures are not in NRP 4. Separate study, gender equity risk mitigation and equity enhancement actions included in NRP
4.8	Has a REDD+ Consultation and Participation Plan for REDD+ implementation been developed?	1. No 2. Draft or outline plan 3. Detailed plan 4. Detailed plan included in the NRS
4.9	To what extent do existing policies, laws and regulations in the country recognise and protect forest ownership and access of rights of forest dependent communities and farmers, including indigenous or ethnic groups?	1. Very weak on paper and in practice 2. Some policies, laws and regulations are good, but weak implementation 3. Policies and laws and good, but protection is uneven and improvements are needed 4. Good protection from appropriate laws and policies
4.10	With the Cancun safeguards and SIS, do you think customary or traditional rights of forest dependent communities will be respected and upheld in REDD+?	1. Very weak respect and protection likely 2. Should be some improvement under REDD+ 3. Significant improvement expected with REDD+ 4. Likely to be well respected and protection
4.11	How strong (in your view) are national regulations and procedures for FPIC, and the likely implementation of them?	1. Weak on paper and in implementation 2. Good on paper, but weak implementation 3. Good on paper, moderate on implementation 4. Good on paper and strong likely implementation
4.12	Do the FPIC regulations and procedures include a sufficiently elaborated and strong grievance redress mechanism (GRM)?	1. No GRM mechanism in FPIC regulations and procedures 2. GRM mechanism in FPIC lacks detail or weak 3. Strong GRM in FPIC, but weak implementation is likely

		4. Strong GRM in FPIC with good implementation
4.1 3	How available and accessible is forest management information (e.g., on concessions, licences) to the general public, e.g., on a government website?	1. No information accessible to public 2. Low level of information and accessibility 3. Significant information, but not on website 4. Significant information on website
4.1 4	How many members in the REDD+ Steering Committee?	Male: Female: Total:
4.1 5	Is there a currently operating CSO or multiple stakeholder REDD+ platform or network with good CSO participation and sustainability?	1. No operational CSO/multiple stakeholder platform/network 2. It exists but CSO participation has been limited 3. Good participation level, but network does not seem sustainable 4. Good participation level and likely sustainability
4.1 6	Are there any vital remaining needs for training or capacity building related to social safeguards readiness? If yes, list up to 3 in order of priority	National level:

5. Environmental safeguard readiness

No.	Indicator/question	Reply options
5.1	Has a systematic analysis of the biodiversity risks and benefits of each PAM or S&A been undertaken, and risk reduction and benefit enhancement measures identified?	1. No 2. Partial or rapid analysis of biodiversity risks and benefits of PAMs/S&As 3. Comprehensive analysis of biodiversity risks and benefits of each PAM/S&A 4. Comprehensive analysis and risk reduction measures included in NRS
5.2	Are you aware whether the EIA Act and Regulation endorsed in your country?	• Yes (please kindly provide the name of the Act and Regulation) • No
5.3	In your opinion how strong are the biodiversity provisions in the EIA regulations and implementation?	1. Weak or absent biodiversity provisions in EIA 2. Good biodiversity provisions in EIA, but weak implementation 3. EIA biodiversity provisions and implementation are likely to be much better in the NRS 4. Biodiversity provisions in EIA and implementation were already good (before NRP)
5.4	Is there a clear regulation preventing the establishment of plantation crops on degraded forest land?	1. No regulation 2. Regulation exists but is weak or unclear 3. Regulation is clear but weakly implemented 4. Regulation is clear and strongly implemented
5.5	Are there sufficient biodiversity provisions in the timber harvesting regulations?	1. No provision 2. Biodiversity provisions exist but are insufficient 3. Biodiversity provisions are sufficient, but weakly implemented

		4. Biodiversity provisions are clear and strongly implemented
5.6	Has a study of the risk of forest carbon emission reversals been undertaken, and have risk reduction measures been incorporated into the NRS?	1. No study undertaken 2. Partial or limited analysis of emissions reversal risks 3. Full study undertaken, but risk reduction measures are not in NRS 4. Study undertaken and risk reduction measures are in NRS
5.7	Has a study of leakage risks been undertaken, and have leakage risk reduction measures been included in the NRS?	1. No study undertaken 2. Partial or limited analysis of leakage risks 3. Full study undertaken, but leakage risk reduction measures are not in NRS 4. Study undertaken and leakage risk reduction measures are in NRS
5.8	Are there any vital remaining training or capacity building needs related to environmental safeguard readiness? If yes list up to 3 in order of priority.	National level

6. Financial readiness, including benefit sharing

No.	Indicator	Reply options
6.1	What is your view of the likely effectiveness, including avoiding corruption, of the institutional arrangements for managing REDD+ money, including RBPs?	1. Low confidence 2. Moderate or limited confidence 3. Reasonable confidence level 4. High level of confidence
6.2	Is there a REDD+ financing or investment plan either in the NRS or as a separate document?	1. No 2. Partial or outline financing/investment plan 3. Detailed financing/investment plan in draft 4. Detailed financing/investment plan finalised
6.3	Are the PAMs or S&As separately costed out or budgeted?	1. No 2. PAMs/S&As are partly budgeted, e.g., summary of costs 3. Detailed budget of each PAMs/S&As in draft form 4. Detailed budget of each PAM/S&A finalised
6.4	Has there been an analysis of how individual REDD+ projects can be included as “nested” projects in the NRP?	1. Not discussed or analysed 2. Preliminary discussions but not yet on paper 3. Preliminary plan for including projects in NRP 4. Elaborated plan for including projects in NRP
6.5	Has a REDD+ benefit sharing or distribution system been explained and planned, either in the NRS or other report?	1. No 2. Partial or summary level analysis of options 3. Detailed benefit-sharing system in draft form 4. Detailed benefit-sharing system finalised
6.6	Are there any proposed, approved or on-going ERPA, GCF, FIP or other multilateral or bilateral financed REDD+ demonstration/pilot projects or programmes?	1. Not yet drafted 2. Only in draft form 3. At least 1 proposal submitted

		4. At least 1 project approved
6.7	Is there a government agency with experience of making cash transfers to rural households or with the distribution of performance-based payments or benefits?	1. No 2. Experience with cash transfers to rural households 3. Experience with performance-based benefits, but not part of a REDD+ project 4. Experience with performance-based payments or benefits as part of a REDD+ project
6.8	Has a pilot project that includes a REDD+ benefit-sharing mechanism been proposed or implemented?	1. No 2. Project proposed 3. Project implemented or on-going 4. Benefit-sharing system of an implemented or on-going project has been evaluated
6.9	Is there experience of managing multi-sectoral funds, including involvement of NGOs/CSOs, whether in the forest sector or not?	1. No 2. Experience of managing multi-sectoral funds, but not with NGOs/CSOs 3. Experience including NGOs/CSOs, but not in the forest sector 4. Experience including NGOs/CSOs in forest sector
6.10	In your opinion, how strong are the carbon rights of local forest users in the main potential areas for REDD+ (i.e., areas with high deforestation rates)?	1. Very weak 2. Moderate 3. Significant 4. Strong
6.11	Is there a legal provision for disclosure of financial information on government funds and financial arrangements?	1. No 2. Partial disclosure - for limited financial information 3. Partial disclosure - most financial information 4. Full disclosure
6.12	Has an analysis been undertaken of potential domestic financing sources (innovative and existing mechanisms), or how to increase current domestic financing of the NRP?	1. No 2. Short outline report with limited detail 3. Detailed study in draft form 4. Detailed report completed
6.13	What have been your main sources of funding for REDD+ readiness and early implementation? Please list 5 main sources, including World Bank loans or ERPA-related finance (over last decade)	
6.14	Where will your future REDD+ finance come from? Please list approved or proposed sources of funding, including domestic finance sources.	
6.15	Are there plans to generate Certified Emission Reductions (CERs)? If yes: (a) What is the time frame? (b) Any data on investors/users of CERs?	

6.16	Are there any vital remaining training or capacity building needs related to financing or benefit sharing readiness? If yes, list up to 3 in order of priority.	
	National Forest Monitoring System (NFMS)	

Annex 2: Questionnaire for understanding and exploring the REDD+ mechanism in CBFM

Questionnaire No:…………. Date:………………………………………….

Geographical information of the place

Q1. Name of the place:

Q2. GPS location: Latitude:………………………………………Longitude:…………………………………………………

Q3. Altitude:……………………….(m) asml

Socio-Demographic profile of Household

Q4. Name of the respondent:………………………………………………………………………………

Q5. Age:……………………Years

Q6. Sex: M / F

Q8. Education: Illiterate………Primary………….High School………..Intermediate…………Bachelors & above…….

Q9. Age wise distribution of household members:

Gender	Below 8 years	Between 8-18 years	Above 18 years
Male			
Female			

Q10. Family Education status

Educational level	Illiterate	Primary	High School	Intermediate	Bachelors	Above Bachelors
Male						
Female						

Q11. Profession:

Primary Profession:

Agriculture……..Service……..Self-employed…..labour……Any other……………….

Secondary Profession:

Agriculture……..Service……..Self-employed…..labour……Any other……………….

Approximate Annual Income (Rs):……………………………………

Q12. What you use for cooking food?:

Purpose	Kerosene	Fuelwood	Dung cakes	LPG	Bio Gas	Electricity	Crop Residue
Cooking							
Heating							

Q13. What you use for livestock cooking and heating?

Purpose	Kerosene	Fuelwood	Dung cakes	LPG	Bio Gas	Electricity	Crop Residue
Cooking							
Heating							

Q14. How much units of electricity is consumed in your house?

……………..units (Monthly/Annually).

Dependency on Forest Resources

Q15. Fuel wood collection

Collection	Winter	Summer	All year
Quantity of collection(kg/day)			
Own field (kg/day)			
Government Forest (kg/day)			

Community Managed Forest (kg/day)			
Any other (kg/day)			
Major fuelwood sps			

Q16. Fodder collection:

Collection	Winter	Summer	All year
Quantity of collection(kg/day)			
Own field (kg/day)			
Government Forest (kg/day)			
Community Managed Forest (kg/day)			
Any other (kg/day)			
Major fuelwood sps			
Fodder cultivation at farm	Yes	No	

Q17. Grazing

Livestock feeding practiced: Stall fed: Yes/No Grazing: Yes/No

Time of grazing (hrs/day):

Place of grazing: Own field……..Forest……..CMF…………Others…………..

Q18. Leaf litter/Understory collection for manure and bedding:

Collection	Winter	Summer	All year
Quantity of collection(kg/day)			
Own field (kg/day)			
Government Forest (kg/day)			
Community Managed Forest (kg/day)			
Any other (kg/day)			
Major plant sps			

Q19. Timber logging:

Source to timber: Forest………CMF…………Own land………..

Amount of timber logged annually:………………………..

Use of timber extracted, if any……………………………

Q20. What are the other benefits you are taking from the forest?

…………………………………………………………………………………..

Q21. What was the condition of the forest before 10 years?

- Increase
- Decrease
- No change

…………………………………………………

Q22. Your opinion on causes of deforestation and forest degradation in your forest.

……………………………

Key Questions for FGDs and KIIs (Benefit sharing, risk minimization mechanism, safeguards)

- Role of community in forest management?
- How often do you the CMF management committee change?
- What is the procedure of selecting the CMF management committee?
- How you are making the CMF committee and activities socially inclusive?
- Are there any mechanisms fines or penalties?
- What is the process of benefit sharing? Fodder, Timber, NTFPs and others.
- What is the coordination mechanism in your CMF? How can you improve the coordination mechanism?
- How do you ensure the equal representation and participation of all the stakeholders?
- Any knowledge in REDD+ mechanism? Progress in Nepal/ India?

Annex 3: List of indicators by readiness area

Readiness category	***Indicators***
Strategy readiness	National REDD+ Strategy (NRS)
	Methodology of D&D drivers' analysis
	Risk/feasibility analysis on PAMs/S&As
	Extra-sectoral PAMs/S&As
	Cost-benefit analysis of PAMs/S&As
	Analysis of barriers to carbon stock enhancement
	PAMs/S&As with private sector/supply chain focus
	Forest sector economic valuation study
	Forestry targets in NDCs
	High level political support for REDD+
	Incentives in PAMs/S&As to change 'business as usual'
	Forest law enforcement capacity and compliance
	Effective and equitable judicial system
Institutional readiness	Non-forestry sector leadership of PAMs/S&As
	Steering Committee: formation and independence
	Institutional independence of SIS
	M&E: institutional formulation and independence
	Communications/ knowledge management strategy
	MRV institutional arrangements
	Management of implementation finance/RBPs
	Inter-ministry/sectoral coordination
Technical readiness	Submission of FRL/FREL to UNFCCC
	Carbon pools in FRL/FREL
	Use of national Emissions Factor (EF)
	Forest degradation measurement
	National Forest Monitoring System
	REDD+/Carbon Registry
	Accessibility National Forest Inventory (NFI) data
	Most recent satellite forest cover map
	Biennial Update Report (BUR)
Safeguards readiness	Social & governance risks analysis of PAMs/S&As
	Safeguards Information System (SIS) progress
	Summary of Information (SoI)
	Policies, Laws and Regulations (PLR) gaps analysis
	Safeguards contextualization analysis
	Grievance Redress Mechanism (GRM) for REDD+
	Analysis of gender equity impacts of PAMs/S&As
	Anti-corruption commission or equivalent
	Transparency of forest management data
	Biodiversity risks analysis of PAMs/S&As
	Regulation of plantation crops on degraded forest land
	Biodiversity provisions of timber harvesting regulations
	Risk analysis of emission reversals
	Rights/tenure of forest dependent groups/smallholders
	Legal basis & implementation of FPIC
	Legal basis and implementation of EIA

	Biodiversity provisions in EIA regulations
Financing readiness	REDD+ financing or investment plan
	Costing/budgeting of PAMs/S&As
	Analysis of nesting of REDD+ projects in NRP
	REDD+ benefit sharing plan
	Experience with demonstration/pilot projects
	Experience of cash transfers or RBPs to households
	Legal provision for disclosure of financial information
	Analysis of domestic financing sources
	Approved finance for REDD+ implementation
	Confidence in management of RBPs