Final Report

Analysis of Drivers of Deforestation and Forest Degradation in Shan State and Strategic Options to Address them

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Final Report

Analysis of Drivers of Deforestation and Forest Degradation in Shan State and Strategic Options to Address them

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> We cannot solve our problems with the same thinking we used when we created them.

— *Albert Einstein*

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Acronyms and Abbreviations

AAC	annual allowable cut
APFNet	Asia-Pacific Network for Sustainable Forest Management and Rehabilitation
ASMC	ASEAN Specialized Meteorological Centre
CCDAC	Central Committee for Drug Abuse Control
CFI	community forestry instruction
CNN	China National Narcotics Control Commission
CSO	civil society organization
D&FD	deforestation and forest degradation
DALMS	Department of Agriculture Land Management and Statistics
DGSE	geological survey and mineral exploration
DOA	Department of Agriculture
EAO	ethnic armed group/organization
ECD	Environmental Conservation Department (of MONREC)
EIA	environmental impact assessment
EU FLEGT	European Union Forest Law Enforcement, Governance and Trade
FAO	Food and Agriculture Organization of the United Nations
FRA	forest resources assessment
GAD	General Administrative Department
GIS	geographic information system
GIZ	German Society for International Cooperation
GMS	Greater Mekong Subregion
HDF	high-density forest
HDI	Human Development Index
ICIMOD	International Centre for Integrated Mountain Development
INDC	intended nationally determined contribution
INGO	international non-governmental organization
IRS	Indian Remote Sensing
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
LDF	low-density forest
LISS	linear integrated self-scanning
LULC	land use/land cover
MODIS	moderate resolution imaging spectroradiometer
MOM	Ministry of Mines
MONREC	Ministry of Natural Resources and Environmental Conservation
MSS	Myanmar Selection System
MTE	Myanmar Timber Enterprise
NCA	Nationwide Ceasefire Agreement
NDVI	normalized difference vegetation index
NGO	non-governmental organization
PFE	permanent forest estate
PPF	protected public forest
RECOFTC	Center for People and Forests
SAD	self-administration division
SAZ	self-administration zone
TCP	technical cooperation project
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNODC	United Nations Office on Drugs and Crime
VPA	voluntary partnership agreement
YRF	young regeneration forest

Executive Summary

This assignment is to contribute to Myanmar's REDD+ readiness programme. It is especially to identify, analyse, and document the drivers of deforestation and forest degradation in Shan State. Moreover, it is also need to determine co-relation between these drivers and also to assess strategic options for addressing deforestation and forest degradation.

During the study, stakeholder consultation, interviewing with local communities and government stakeholders including social economic surveys, and general observation were emphasized. Two sources (primary and secondary) of data collection were used. To know the history of forest cover change, spatial analysis using three sets of satellite remote sensing data (2005, 2010, and 2015) had been performed. As a countercheck, NDVI analysis and Hansen and Global Forest Watch data were also used. The strategic options for addressing deforestation and forest degradation were prioritized through stakeholder consultation and the validation workshop organized in Taunggyi, which can be seen in page 106. SWOT analysis of the priority options, which identified the various drivers related to deforestation and forest degradation, was also applied with the consent of the stakeholder consultation meeting. Socioeconomic survey was conducted only in nine villages of serious hotspot areas depending on available time, budget, and security conditions.

According to the spatial analysis of 2005, 2010, and 2015 Landsat images, forest cover of Shan State decreased from 52.38% in 2005 to 41.45% in 2010 then increased slightly to 48.14% in 2015, indicating an increase of 6.69% during the five-year period (2010 to 2015). The main drivers of deforestation and forest degradation in Shan State can be divided into two types, direct and indirect. Direct drivers are agricultural expansion, shifting cultivation, overexploitation of timber, fuelwood consumption (including charcoal), infrastructure development, mining, and forest fire. Indirect drivers include population growth, economic growth (international and national), weak law enforcement, poverty and subsistence, conflicting policy, language barriers, land tenure uncertainties, and inadequate natural resources planning and monitoring. In terms of carbon emission from deforestation and forest degradation, 6.86 million tons of carbons per year were emitted between 2005 and 2015 in Shan State.

The Government of Myanmar is trying to formulate a new land law to harmonize existing laws related to land. Under this law, a National Land Use Council will be set up. To overcome deforestation and forest degradation, MONREC has developed a 10-year Restoration and Rehabilitation Programme (2017–27) in cooperation with related stakeholders, building on past experiences and lessons learned.

1. Introduction

In December 2011, the Government of the Republic of the Union of Myanmar became a partner country of the UN-REDD Programme. The UN-REDD Programme is the United Nations collaborative programme on reducing emission from deforestation and forest degradation. The programme assists developing countries like Myanmar to build capacity to reduce emissions and to participate in a future REDD+ mechanism.

The Government of Myanmar developed a REDD+ Readiness Roadmap in July 2013 through a multi-stakeholder process with support from the Government of Norway. The REDD+ Readiness Roadmap has three phases and six components to implement REDD+ activities.

The implementation of the REDD+ Readiness Roadmap constitutes the initial stage of the REDD+ process which is divided into three phases:

Figure 1: **Three-phase approach to REDD+ under UNFCCC Framework**

Phase 1 and Phase 2 together comprise the REDD+ Readiness Phase, during which countries build capacity, develop strategies and action plans, and test different approaches to REDD+ implementation at demonstration-pilot sites and subsequently refine their approaches based on feedback. In practice, the three phases overlap to an extent. Myanmar is presently in Phase 1.

Phase 1 (Readiness): This phase involves carrying out activities in the Roadmap, during which Myanmar will put in place the necessary frameworks, capacities, and institutions to implement REDD+ at the national level. Phase 1 also includes the identification of the possible actions (or 'candidate strategies') that may achieve net emission reductions from the land use, land use change, and forestry sectors.

Phase 2 (Implementation): This phase will involve field testing of candidate strategies through demonstration activities to establish which of the strategies may achieve efficient and cost-effective results on a national scale without undermining any of the REDD+ safeguards. Demonstration activities may begin in some areas of the country before all Phase 1 activities are completed at the national level.

Phase 3 (Performance-based payments): Myanmar will implement REDD+ activities through a national system consistent with decisions taken by the UNFCCC. Phase 3 will lead to international results-based finance.

The Roadmap is a living document. It is not intended to be a fixed and unchangeable set of instructions for REDD+ Readiness activities. It would be reviewed and updated regularly to reflect the developing experiences and capacities within Myanmar and progression of REDD+ tools and approaches internationally.

For efficient implementation, the Myanmar REDD+ Roadmap is divided into six components.

Component 1: Management of REDD+ Readiness
Myanmar will establish the institutional structures to manage the REDD+ Readiness process. Under the overall guidance of the Ministry of Natural Resources and Environmental Conservation (MONREC), a REDD+ Task Force will manage and coordinate the Readiness process supported by a REDD+ Task Force Office, located at the premises of the Forest Research Institute of Myanmar and a system of technical working groups, which are composed of multiple governmental and non-governmental stakeholders and interest groups.

Component 2: Stakeholder consultation and participation
A stakeholder engagement structure with different levels of participation, which includes the technical working groups, the REDD+ Task Force, and a REDD+ stakeholder network as well as national and subnational consultation and participation processes, will ensure appropriate involvement of all relevant interest groups in REDD+. These include national, regional, and local governments; civil society organizations; the private sector; local communities; and women, youth, and ethnic groups.

Component 3: Development and selection of REDD+ strategies
Myanmar will assess, select, and pilot REDD+ strategies for the land use, land use change, and forestry sectors, based on a comprehensive analysis of present and future drivers of deforestation and forest degradation. A qualitative and quantitative assessment of carbon emissions from major drivers, including estimates of trends of future emissions for each of the main drivers identified, will help to identify appropriate policies and measures to reduce land use-related carbon emissions and increase carbon sequestration. The REDD+ strategy will be consistent with the general economic and social development plans and expectations of Myanmar and in line with international commitments ratified by the country.

Component 4: Implementation framework and safeguards
The institutional, legal, and financial frameworks for REDD+ implementation will be developed either by establishing new administrative or managerial mechanisms or consolidating existing ones. An intensive capacity building and training programme will be established. A safeguards information system will be set up, which is intended to monitor and ensure that potential REDD+ actions do not harm the livelihoods of forest dependent communities, or the biodiversity or conservation of natural forests, as well as to avoid the displacement of carbon emissions to other locations.

Component 5: National forest reference emissions level and/or forest reference level (FREL/FRL)
Myanmar will establish its forest (emissions) reference levels as a benchmark against which past and future forest carbon emissions and removals will be measured and reported. This component will focus on the collection and analysis of data on historical land use change, the projection of potential trends, and the analysis of relevant national circumstances which may introduce adjustment factors in the baseline definitions.

Component 6: National forest monitoring system
Myanmar will develop a national forest monitoring system (NFMS) composed of a land monitoring system and a national forest inventory based on existing national capacities and improvement over time depending on national circumstances and decisions. The NFMS will serve multiple functions including the assessment of performance of REDD+ actions and the reporting requirements to national and international bodies, as well as general strategic decisions.

The major development partners in implementing these components are UNEP and UNDP for components 1 to 4 and FAO for components 5 and 6.

In December 2013, the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety agreed to fund the regional programme REDD+ Himalayas: Developing and Using Experience in Implementing REDD+ in the Himalayas. This capacity-building programme for REDD+ is jointly implemented by ICIMOD and GIZ in the four Hindu Kush Himalaya countries of Bhutan, India, Myanmar, and Nepal. Under this initiative, REDD+ activities have already been planned in all four countries through a consultative workshop held in each country. The duration of the project is March 2015 to December 2018. The project began in Myanmar on 29 March 2016 after signing of the MOU.

1.1 Objectives of the study

The broad objective of the study is to contribute to Myanmar's REDD+ readiness programme. The national consultant will identify the nature and extent of the drivers of deforestation and forest degradation, as well as the barriers to sustainable management, conservation, and enhancement — the "+" activities under REDD+ — and will explore the relevance of these drivers and barriers in policy development and implementation within all districts of Shan State.

The specific objectives of this study are to:

i. Thoroughly identify and analyse all critical (both direct and indirect/underlying) drivers and agents of deforestation and forest degradation, and assess the emissions contributed by each driver with reference to key forest types;
ii. Identify the barriers (and agents) to forest conservation, forest enhancement, and sustainable management, at the national and subnational levels;
iii. Identify and prioritize strategic options and key interventions (REDD+ policies and measures) to address these causes and barriers in close conjunction with UN-REDD and the national implementing entities;
iv. Evaluate the impact of drivers at the local level, looking beyond the forest sector and in particular at sectors that impact on forests such as agriculture, energy, infrastructure, and rapid urbanisation;
v. Estimate the magnitude of current and potential future consumption of wood products (timber and fuelwood); and
vi. Assess the potential for increased carbon removals through natural regeneration, forest conservation, sustainable forest management, and afforestation and reforestation.

1.2 Description of the study area

The study covers the whole of Shan State. The Shan Plateau in eastern Myanmar is an extensive, mountainous upland ranging in height from 1,000 metres to 2,300 m. The area is undulating and has been stripped of natural forests making it subject to severe erosion.

Shan State is the largest of the 14 regions and states in Myanmar, covering almost 23.2% of the country (approximately 155,800 km2). The state gets its name from the Shan people, one of several ethnic groups that inhabit the area. With 5.8 million people (census 2014), Shan ranks fifth in population amongst all states and regions, after Yangon, Mandalay, Ayeyarwady, and Sagaing regions. As such, Shan is an important player in the socio-political constellation of the country.

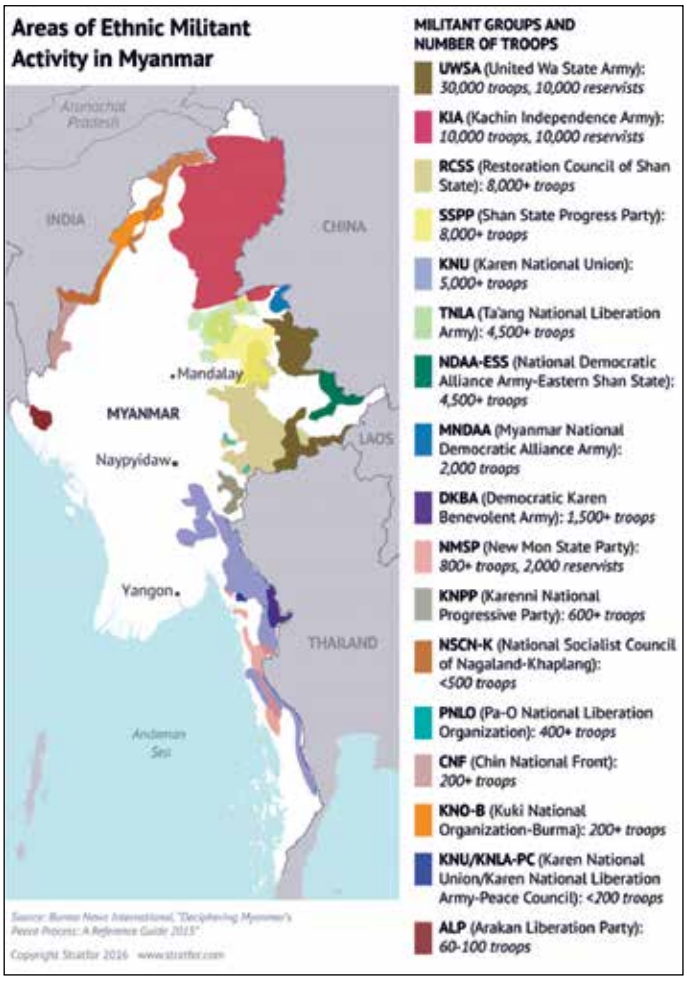
Shan State attracts local and international tourists, due to natural wonders such as Inle Lake, Goteik viaduct, Pintaya Cave, Ywangan blue lake, Mwetawkakku pagoda, Htantsan Cave, Phaungdaw-U pagoda, and Mongshu, a source of Myanmar ruby, sapphire, and gems.

Arguably, Shan State has the largest ethnic diversity amongst its population of all 14 regions and states. On the list of 135 officially recognized ethnic groups in Myanmar, Shan (with 33 different groups) ranks second after Chin (with 55 ethnic groups). Linked to its ethnic diversity, another aspect that sets Shan State apart from the other regions and states is the number of constitutionally embedded self-administrative areas, such as Wa Self-Administration Division (SAD) in the north-east of Shan State; Self-Administration Zones (SAZs) of Kokang, north of Wa also bordering China, Palaung, also in the north; and Danu and Pa'O, the latter spread over two areas, in southern Shan.

Administratively, Shan State is composed of 55 townships, more than any other region or state. Because of its size, and certainly for the organizational arrangements of government departments, the area was in the past subdivided for administrative purposes into Shan South (where the state capital, Taunggyi, is located), Shan North (with Lashio as its centre), and Shan East (with Kengtung as its centre) (UNDP Myanmar 2015).

Figure 2: **Location of Shan State**

Figure 3: **Active areas of ethnic militants**



The state's geography and topography, armed conflict, and lack of state control have shaped its socioeconomic condition for centuries as well as the social and political organizations that have emerged. Agriculture plays an important role in the state economy. With various climate types, including more moderate temperatures, it has a large variety of crops. Main crops include rice, wheat and maize, ground nut, pulses and beans, fresh fruit, and vegetables. There are also cotton, coffee, tea, and thanapet (tobacco) plantations, and livestock breeding and freshwater fisheries are also significant.

Natural resource extraction has always played an important role in the state economy, and to this day Shan State is one of the major areas in Myanmar for mining (silver, lead, zinc, iron ore, coal, manganese, gold, rubies and gems), forestry (teak, hardwood, fuelwood, resin), and hydropower.

Its hilly and rugged terrain and the remoteness of some areas require a well-functioning roads and communications infrastructure for economic development. Unlike the large rivers of central Myanmar, the Thanlwin River is not suitable for navigation, due to numerous currents, rapids, and falls. Three railway lines operate in Shan State but the infrastructure is antiquated. As such, the state's transport and economic development depends on road infrastructure.

The major new oil and gas pipelines from Rakhine State to China pass through northern Shan State, which further confirms the state's strategic location as a gateway between China and the rest of Myanmar. Many people are active in trading activities, including cross-border trade with China and Thailand, with Muse and Tachileik being the most important trading centres.

Its remoteness, proximity to international trading routes, and long history of conflict and governance problems have also made Shan State one of the main areas of narcotics production and, increasingly, narcotics use.

1.2.1 Forest and Forest Cover Change

According to a forest resources assessment (FRA) conducted by FAO in 2015, 42.92% of Myanmar is still covered with forests (Table 3). Annual deforestation rates are 309,400 ha/year between 2005 and 2010, representing 0.9%, and 546,600 ha/year between 2010 and 2015, representing 1.7%.

Forest cover change in Myanmar is directly linked to the country's political economic history. Since 1856, the scientific management of natural forests in Myanmar was based upon the Brandis Selection System, following the German model. Over the next half-century the colonial forest management system transformed into the Burma (now Myanmar) Selection System (BSS, now MSS). The MSS was designed to maintain a high yield of quality timber and enhance the natural regeneration of commercially valuable trees. By the early 1920s MSS was internationally recognized as a world-class scientific forestry management model, for both theory and practice.

Another land management system development in Myanmar is the Taungya system, which is now a world-famous agroforestry method based upon agroforest intercropping. Although initial teak plantings in the mid-19th century were made coercively by the British in Karen-populated areas in the Tenasserim 66Hills (now Tanintharyi Division), they nonetheless represented the initial stages of a teak plantation management program in Myanmar. It wasn't until the 1970s that a systematic teak plantation development began, which continues to the present day.

Table 1: Forest cover status of Myanmar in 2015 (as of FRA 2015)

Forest category	Area (,000 ha)	% of country area
Forest	29,041	42.92
Other wooded land	15,080	22.29
Other land	21,634	31.98
Inland water bodies	1,903	2.81
Total	**67,658**	**100.00**

FRA = forest resources assessment. Source: FAO 2015a.

Table 2: Forest cover status of Shan State, 2005 (Landsat TM, 2005 real time)

Forest category	Area (km^2)	% of total Shan State area
Closed forest	25,481.48	16.35
Open forest	56,131.15	36.03
Other wooded land	56,053.62	35.98
Other land	17,650.43	11.33
Water	488.04	0.31
Total	**155,804.72**	**100.00**

Source: Planning and Statistics Division, Forest Department.

Table 3: Forest cover status of Shan State, 2010 (IRS LISS III, 2010 real time)

Forest category	Area (km^2)	% of total Shan State area
Closed forest	16,891.29	10.84
Open forest	47,696.07	30.61
Other wooded land	39,792.04	25.54
Other land	50,819.66	32.62
Water	605.66	0.31
Total	**155,804.72**	**100.00**

Source: Planning and Statistics Division, Forest Department

Table 4: Forest cover status of Shan State, 2015 (Landsat 8, 2015 real time)

Forest category	Area (km^2)	% of total Shan State area
Closed forest	32,202.58	20.67
Open forest	42,807.15	27.47
Other wooded land	49,008.09	31.45
Other land	31,046.42	19.93
Water	740.48	0.48
Total	**155,804.72**	**100.00**

Source: Planning and Statistics Division, Forest Department.

The socialist era in Myanmar (1962–88) changed forest management considerably. Under the state-socialist system, growth-oriented targets without reference to local circumstances or edaphic qualities were put forth, with expected increases in annual export earnings. The centralization of the forestry management system in Myanmar had very negative effects on the MSS, where every divisional forestry department had to raise its timber production in order to reach allocated targets. Since the set targets were not based on the actual productivity of the forests as calculated under MSS, the forests were logged unsustainably, replacing the 30-year felling cycles with greatly shortened rotations.

At the end of the socialist governance system, in the 1970s, timber quickly became a principal source of national revenue. The State Timber Board (STB), the precursor of the Myanmar Timber Enterprise (MTE), became the only state agency authorized to extract and market timber. The STB (and now the MTE) thus directly challenged the institutional authority of the Forest Department, forcing foresters to permit overcutting to meet the government's need for foreign exchange. It was at this time that the establishment of forest plantations grew in popularity, supported by the FAO.

After the Myanmar government began to adopt a quasi-private market economy in 1988, major changes again swept through the forestry sector. In the 1990s Thai industry was heavily involved in the overexploitation of Myanmar forests along the Thai border. Heavy timber extraction shifted to the border with Yunnan Province (China) in the 2000s. Private sector involvement in the forestry sector, as well as shifts in regional politics and economics, has subsequently transformed forest management in Myanmar. In the past decade the Forest Department has responded to these new forces by advancing new policies and initiatives to attempt to protect and sustainably manage one of Asia's largest remaining expanses of tropical forests, as well as the world's most prized teak stands.

The northern forests along the China border were targeted by Chinese loggers and timber traders for their prized and valuable old-growth hardwoods in the late 1990s up to mid-2000s following cease-fire agreements along the Sino-Myanmar border (Global Witness 2005). In early 2006 the Chinese and Myanmar governments bilaterally agreed to stop illegal cross-border timber trafficking across their shared border — orchestrated to some degree by ethnic political groups. Immediately following the bilateral cross-border timber trade clamp-down, timber flows were reduced and currently remain under volumes previously exported across the border (upwards of 1 million cubic metres in the early 2000s), while cross-border timber trafficking continues, albeit at lower volumes (Global Witness 2009; EU FLEGT 2011).

For these reasons Myanmar's forest cover has been gradually decreased over several decades. It is obvious that Myanmar's annual deforestation rate is increasing, according to FAO FRA data.

1.2.2 National LULC categories and definitions

In terms of forest resource assessment (FRA), Myanmar's Forest Department normally used the FAO definition. Moreover, all of the FRA reports' source data were based on the prior two or three years of the assessment year, and then projected the data to the assessment year by using the annual deforestation rate of the respective country. That is why it is difficult to say those data will be represented for the respective year. To get more accurate data the consultant used the real time satellite data in spatial analysis: 2005 Landsat TM data for 2005 forest resource assessment, 2010 IRS LISS III data for 2010 forest cover assessment, and 2015 Landsat 8 data for 2015 forest resource assessment. The definitions of some land cover categories used in spatial analysis of satellite imageries of the country are shown in Table 5.

According to the FAO (2015b) Myanmar has around 29.0 million hectares of forested land, which constitutes to 44.2% of the total land area. The full 100% of the forest area is owned by the state, but certain management rights can be granted to communities or private companies. However, some forest areas (about 41,000 ha) are not under "state ownership", but are brought under community forests owned by the local people with long-term lease permission of the government. The annual rate of deforestation in Myanmar was 1.7% for the period 2010–15 (FAO 2015a) with rapid expansion of commercial agriculture, alongside legal and

Table 5: Definitions of some land cover categories

Category	Definition
Forest	Land spanning more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.
Closed forest	Under forestry or no land use, spanning more than 0.5 hectares; with trees higher than 5 metres and a canopy cover of more than 40 percent, or trees able to reach these threshold in situ.
Open forest	Under forestry or no land use, spanning more than 0.5 hectares; with trees higher than 5 metres and a canopy cover between 10 percent and 40 percent, or trees able to reach these thresholds in situ.
Other wooded land	Land not defined as "forest", spanning more than 0.5 hectares; with trees higher than 5 metres and a canopy cover of 5–10 percent, or trees able to reach these thresholds; or with a combined cover of shrubs, bushes, and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.
Other	All land that is not classified as forest or other wooded land.
Inland water bodies	Inland water bodies generally include major rivers, lakes, and water reservoirs.

illegal logging, and the clearance of forest areas for infrastructural projects being the main drivers (Woods 2015).

However, the trend of forest cover changes of Myanmar and Shan State according to the special analysis by using real time satellite imagery is as follows and percent numbers of total forest cover mean per cent of the geographical area of the country and Shan state, respectively.

As for Shan State, forest cover trend is as follows:

1.3 Expected Outputs

The main outputs of the study are as follows:

- Drivers of deforestation and forest degradation
- Co-relations between drivers (direct and indirect) and deforestation and forest degradation
- Strategic options for addressing deforestation and forest degradation

Figure 4: Forest cover changes in Myanmar according to FAO FRA data

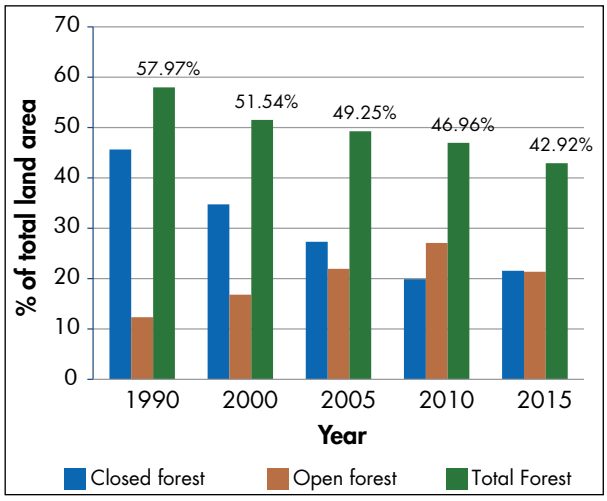


Figure 5: Forest cover changes in Myanmar

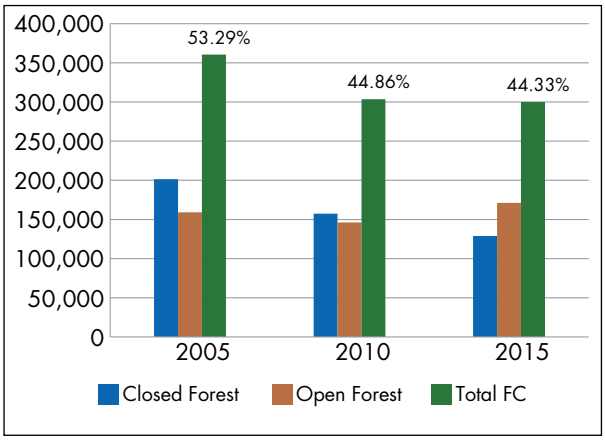
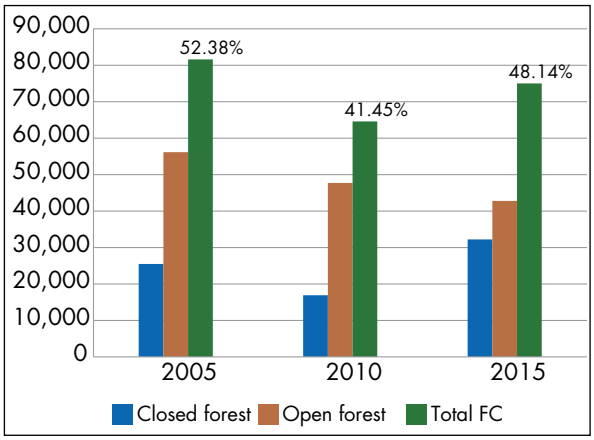


Figure 6: Forest cover changes in Shan State



2. Methodology

This study was carried out during the first six months of 2017. During research and study, stakeholder consultation, interview participatory approach, and general observation technique were emphasized. Two main sources of data collection (secondary and primary) were focused upon to ensure that reliable and authentic data and information are available. In this context, the information from regional offices and other relevant documents developed by Forest Department and Government of Myanmar have been illustrated in the study.

2.1 Method for socioeconomic data collection and analysis

Quantitative socioeconomic survey was also conducted to measure rural livelihood strategies and to assess the potential for environmental conservation in the region. The results of the quantitative study will reveal the level of livelihood dependence on natural forest and the response of local villagers to their changing natural, social, and economic environment along with the expected impact of these changes on their livelihoods and well-being.

We also studied three different aspects of the relationship between local people and natural resources:

- Analysis of socioeconomic status, land use, and pattern of resources use by selected households in nine villages within the deforestation and forest degradation hotspot areas of Shan State
- Study of the impact of human harvesting on natural resources around them
- Assessment of the attitude of the local people towards conservation of natural resources and environment through people's perception

Socioeconomic study of nine villages, as seen in Table 6, in hotspot areas in Shan State was conducted 16–20 June 2017. Before interviewing with respondents of the villages, the survey team discussed with regional forest officers and some of village heads which villages can be accessed and suitable to interview among the random selected villages in hotspots areas. The following households were selected: 11 households of Kyaukkulay Village, Ywangan Township; 8 households of Wataya Village and 6 households of Shaukpin Village, Pindaya Township; 7 households of Kaungbo Village and 4 households of Ngapyawghin Village, Yarksauk Township; and 8 households of Kyauktan Village and 10 households of Sanphu Village, Hopong Township. 10 households of Ma Hlaing Kon Village and 8 households of Pyin La Ha Village, Mabein Township. Data on village profiles, households, and dependency of villages on forests were collected and analysed. Socioeconomic survey tools are designed to collect information as a means of improving understanding of local resource management systems, resource use, and the relative importance of resources for households and villages. Survey also provides information on community perceptions of trends and priority issues. They are also used to quantify the levels of awareness and support for the existing forest regulations and levels of knowledge about the biological importance of forest in the villages.

In fact, the present study was carried out on the socioeconomic status of villages in Shan State to understand their dependency on forests for livelihood. The study reveals that the hotspot village dwellers depend on forest for fuelwood, fodder, and other non-timber forest products (NTFPs).

Table 6: Names and locations of selected villages in hotspot area field visit sites

Sr.	District	Township	Village	Latitude/ Longitude
1	Taunggyi	Hopong	Kyauk Tan	20.91243/97.3053
2	Taunggyi	Hopong	San Phu	20.67648/97.30283
3	Taunggyi	Pindaya	WaTaYa	20.832/96.716
4	Taunggyi	Pindaya	Shauk Pin	20.84583/96.71301
5	Taunggyi	Ywangan	Kyaukkulay	20.99834/96.52825
6	Taunggyi	Yarksauk	Kaungbo	21.14287/96.68472
7	Taunggyi	Yarksauk	Nga Pyaw Gyin	21.166/96.658
8	Kyaukme	Ma Bein	Ma Hlaing Kon	23.40152/96.56564
9	Kyaukme	Ma Bein	Pyin La Ha	23.50651/96.5899

2.2 Method for data collection and analysis of direct and indirect drivers of deforestation

First, the definition of deforestation and forest degradation should be clear. In scientific literature, 'deforestation' generally denotes the (complete) removal of trees and the conversion from forest into other land uses such as agricultural, mining, etc., with the assumption that forest vegetation is not expected to naturally regrow in that area. 'Forest degradation' denotes thinning of the canopy and loss of carbon in remaining forests, where damage is not associated with a change in land use and where, if not hindered, the forest is expected to regrow.

The consultant identified and performed a desk review (study) of available relevant literature on deforestation and forest degradation and biomass/inventory reports and studies for forests of Myanmar and Shan State and also studies of comparable forest types and similar conditions of the countries around Myanmar. The book, *Myanmar REDD+ Readiness Roadmap*, helped us to identify and analyse important issues regarding the practical implications and effectiveness of tackling deforestation and forest degradation in Myanmar and Shan State.

While the consultant was using secondary information from existing documents and reports, primary information were collected from satellite images (2005 Landsat 5 images, 2010 IRS LISS-III images, and 2015 Landsat 8 images of the whole country), field visits, data from regional offices and HQ office of Forest Department, expert interviews, and consultation workshop to accomplish the tasks. The stakeholder consultation meeting was conducted in Taunggyi to get knowledge of deforestation and forest degradation of project relevant area and to identify the possible future implementation of REDD+ activities.

Taking into consideration the diversity and unique features of forest conditions, carbon density, degree of deforestation, carbon stock degradation threats, socioeconomic conditions, means of livelihood, population size, timber extraction conditions, main drivers of deforestation, watershed protection service, biodiversity conservation values, potential community benefits, presence of potential partners, and levels of local community organizations (community forestry groups, governance), detailed review and group discussions with local stakeholders were conducted to seek the correlation of land use change and specific drivers of deforestation and forest degradation in Shan State. Field visits were then made to deforestation and forest degradation hotspot areas to verify information obtained from primary and secondary sources and group consultations. The output results on specific drivers of deforestation and forest degradation shall be further verified by experts at the validation workshop. Targeted multi-stakeholder consultations were conducted throughout the study.

In terms of spatial analysis, three sets of remote sensing data were used for this study — Landsat 5-TM (2005), IRS LISS-III (2010), and Landsat 8 (2015) — as well as topographic UTM maps (2005). These years had the best coverage of the entire study area with the least cloud cover, allowing for a relatively consistent wall-to-wall comparison. In order to improve the classification, secondary data were used as a reference, such as Google Earth images and NDVI (normalized different vegetation index) composite maps. The details of the data used are given in Table 7.

ENVI, Erdas Imagine, and ArcGIS software were used in this study. Based on satellite imagery, the forest and vegetation covers obtained were **closed forest, open forest, mangrove, other wooded land, other land, snow, and water**. From these three periods of LULC historical data, the consultant can make spatial analysis of land

Figure 7: **Socioeconomic survey at Kyaukkulay Village, YwaNgan Township**

use change in Shan State and can produce change maps, deforestation and forest degradation hotspots, and seek to correlate land use change to specific drivers of deforestation and forest degradation and their socioeconomic context.

Table 7: Data used in the present study

Data source	Scale/ Resolution (m)	Year
Landsat 5-TM	30.0 m	2005
IRS LISS-III	23.5 m	2010
Landsat 8	30.0 m	2015

Spatial analysis of proximate and underlying causes of deforestation and forest degradation in Myanmar and Shan State were conducted. Spatial analysis of previous RS/GIS layers and LULC map time series analysis of Forest Department GIS section were very useful in this study. First, it is important that definitions of forest, deforestation, and forest degradation and regeneration (afforestation/reforestation) are clear. Here we also used the existing national definition of the country which was used in FAO FRA reports.

The following reference data were available for the spatial analysis:

- The three digital forest cover maps of Myanmar for 2005, 2010, and 2015. We modified those data for Shan State cover maps of 2005, 2010, and 2015, respectively.
- The output map of FAO project, TCP/MYA/3501, is very useful for 2015 real-time forest cover map of Myanmar.
- The NDVI (normalized different vegetation index) composite maps for 2005 and 2015 were used to confirm the result of spatial analysis.
- Global Forest Watch data were used to compare with international data.

The methodology applied in the FAO TCP project is especially useful in this assignment. These methodologies were also used for the change assessment of Shan State area.

2.2.1 Determining co-relations between proximate/direct drivers and underlying/ indirect drivers

National, international, and even subnational assessments of drivers are important for designing and implementing REDD+ strategies or action plans, particularly as a basis for engaging different (non-forest) sectors impacting forests. That is why direct/proximate drivers and indirect/ underlying drivers need to be understood.

Direct/proximate drivers are human activities or immediate actions that directly impact forest cover and loss of carbon. These causes can be grouped into categories such as agriculture expansion (both commercial and subsistence), infrastructure extension, and wood extraction.

Indirect/underlying drivers are complex interactions of fundamental social, political, cultural, and technological processes that are often distant from their area of impact. These underpin the direct/ proximate drivers and either operates at the local level or have an indirect impact from the national or international level. They are related to international (e.g., markets, commodity prices), national (e.g., population growth, domestic markets, national policies, governance), and local (e.g., change in household behaviour) circumstances (Geist and Lambin 2001; 2002; Obersteiner et al., 2009).

In fact, while proximate/direct drivers and the corresponding agents may be considered relatively straightforward to quantify within defined spatio-temporal boundaries, a thorough evaluation of underlying/ indirect causes requires other tools and methods as underlying causes are not all geographically proximate.

Given the cross-disciplinary dimension of deforestation, comprehensive assessments require collaboration amongst those with diverse skills and knowledge such as remote sensing, socioeconomic analysis, human-ecosystem interaction, and macro-economic and trade analysis.

It is also important to assess underlying/indirect and proximate/ direct drivers. Underlying drivers may result in several direct drivers. We need to understand pathways between underlying drivers and direct drivers. Drivers may differ between deforestation and degradation.

Driver pathways may be complex. For example, owing to population growth and government policy change, agricultural expansion and wide area perennial crop (rubber or oil palm) plantation will occur and result in deforestation (see Table 8).

The following figure shows the main indirect drivers (processes) that underpin the direct drivers of deforestation, modified to fit Shan State based on a study by Geist and Lambin (2002). The indirect drivers are interplay of demographic, economic, political, technological, institutional, and sociocultural factors (Kissenger et al., 2012).

Table 8: Understanding relationships between indirect and direct drivers of deforestation

Factor	Indirect driver	Direct driver	Direct driver	Direct driver
Demographic	Population growth	Agricultural expansion	Shifting cultivation /Rubber plantation	Infrastructure development (e.g., road)
Economic	Demand for wood	_	_	Infrastructure development (e.g., road)

2.3 Method for data collection and analysis of direct and indirect drivers of forest degradation

Based on three periods of LULC historical data (Table 7), spatial analysis of land use change in Shan State had been done and produced change maps and extract deforestation and forest degradation hotspot areas within Shan State. From change matrixes and change maps of the period between 2005 and 2015, we can get the two kinds of information, the changes from forest to non-forest and the changes from forest to other wooded land. Changes from forest to non-forest means deforestation in that area and changes from forest to other wooded land means forest degradation. By pursuing the source of information in those hotspot areas of deforestation and forest degradation areas, we can get the knowledge and understanding the drivers of forest degradation in those areas. This information is available from socioeconomic survey, stakeholder consultation meetings, interview participatory approaches, and general observation techniques.

Effectiveness of the REDD+ programme depends on understanding the drivers/causes of deforestation and forest degradation. Otherwise decisions taken may lead to failure. Drivers may vary by area (cultural) and forest type. Some drivers may be easy to understand (e.g., mine) while others are more difficult (e.g., poor policy leading to population migration).

Therefore, the methodological framework was developed in an iterative (repetition) process combining expert judgment, applicability in the field and stakeholder consultation, beginning with a desk-based study to review literature on assessing deforestation and forest degradation and to combine existing methods into a comprehensive framework.

For example, on account of population growth and government policy to expropriate land for industry, migration of people and fuel shortage for cooking will happen and lead to more fuelwood harvesting and forest degradation (see Table 9).

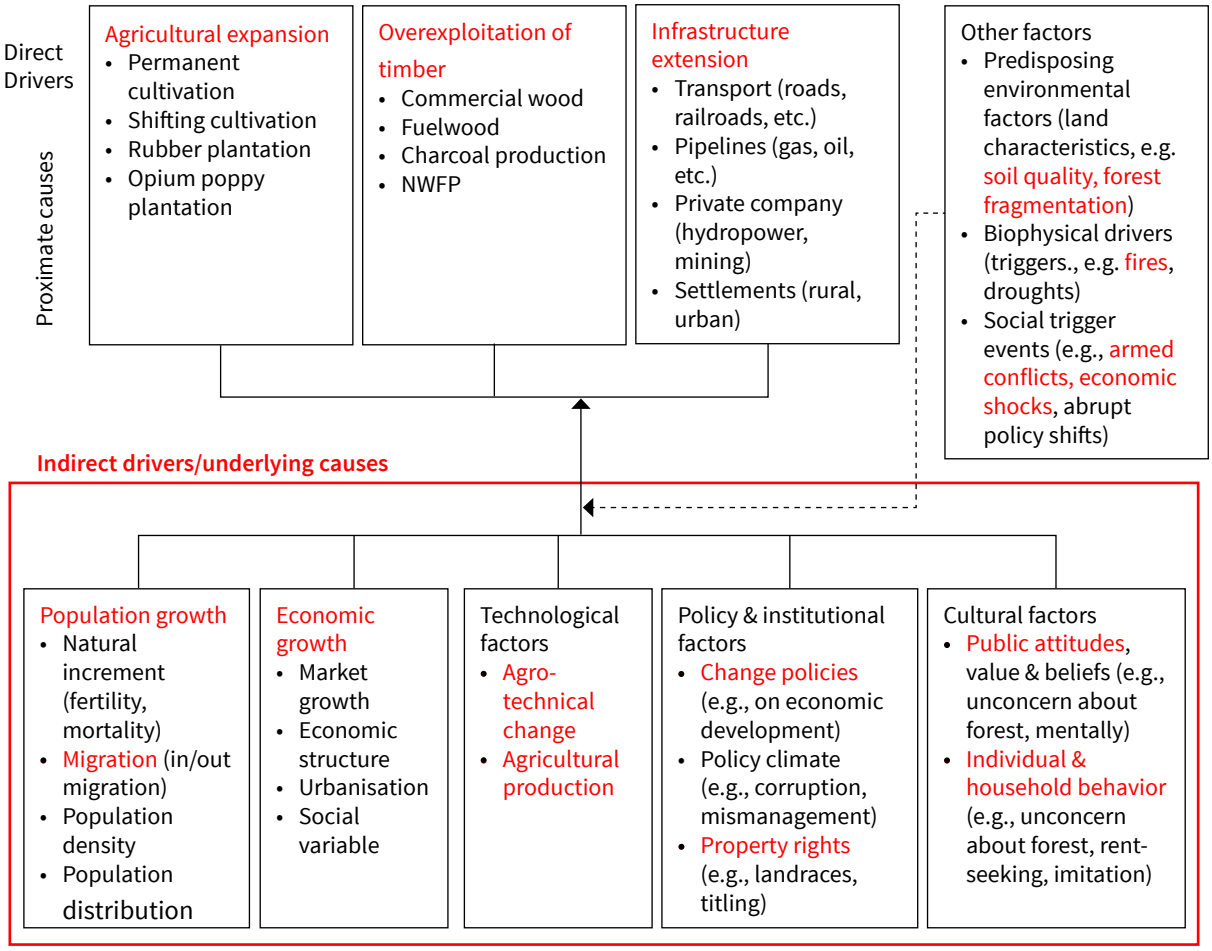
Table 9: Understanding relationships between indirect and direct drivers of forest degradation

Factor	Indirect driver	Direct driver	Direct driver	Direct driver
Demographic	Population growth	Illegal logging	Fuelwood	Road
Economic	Demand for wood	Illegal logging	Fuelwood	Road
Governance	Weak law enforcement	Illegal logging	Fuelwood	_
Tenure issues	Uncertainty	Illegal logging	_	_
Cultural	Political uncertainty	Illegal logging	_	_
Social	Poverty	Illegal logging	Fuelwood	_
Technology	Availability	_	Fuelwood	_

2.4 Method for determining strategic options for addressing deforestation and forest degradation

The first step consists of reviewing relevant information, existing research, and analytical work regarding dynamics in Shan State, including national REDD+ readiness plans and strategy documents. The second step is conducting spatial analysis of proximate and underlying causes of deforestation and forest degradation. Our assessment quantified land use changes not only due to deforestation but also due to forest degradation as mentioned above. Based on these data, strategic option prioritizations were determined by common consent from multi-stakeholder consultation workshops.

Figure 8: Relationship between direct and indirect drivers of deforestation



Source: Modified from Geist and Lambin 2002.

The consultant will also conduct a SWOT analysis for the priority options recognized the various drivers related to deforestation and forest degradation and detail how these could be implemented on the ground including possible institutional arrangements. The analysis will primarily focus on strength and weakness of governance issues and capacity and human resources of the institutions to transform opportunities into actions for better positive outcomes and manage the emerging socio Taunggyi political and economic threats.

3. Results and Conclusion

According to spatial analysis (Figures 5 and 6), forest cover in Myanmar decreased from 53.29% in 2005 to 44.86% in 2010 to 44.33% in 2015, while forest cover in Shan State declined from 52.38% in 2005 to 41.45% in 2010 and then increased slightly (6.6.9%) to 48.14% in 2015.

Based on these three periods of LULC historical data, deforestation and forest degradation hotspot areas within Shan State can be extracted. Change matrixes (Tables 10–12) and change maps (Figures 9–11) of the periods 2005–10, 2010–15, and 2005–15 are shown below.

Table 10: Change matrix of Shan State (2005–10)

		2010					
	LCover	Forest	OWL	Other	Water	Total (km²)	%
2005	Forest	48,443.40		33,169.23		81,612.63	52.38
	OWL	16,143.96	39,792.04		117.62	56,053.62	35.98
	Other			17,650.43		17,650.43	11.33
	Water				488.04	488.04	0.31
	Total	**64,587.36**	**39,792.04**	**50,819.66**	**605.66**	**15,5804.72**	**100.00**
	%	41.45	25.54	32.62	0.39	100.00	

Deforestation rate = 4.2% (3405 km²); Country deforestation rate = 0.9%

Table 11: Change matrix of Shan State (2010–15)

		2015					
	LCover	Forest	OWL	Other	Water	Total (km²)	%
2010	Forest	64,587.36				64,587.36	41.45
	OWL		39,792.04			39,792.04	25.54
	Other	10,422.37	9,216.05	31,046.43	134.81	50,819.66	32.62
	Water				605.66	605.66	0.39
	Total	**75,009.73**	**49,008.09**	**31,046.43**	**740.47**	**155,804.72**	**100.00**
	%	48.14	31.45	19.93	0.48	100.00	

Deforestation rate = -3.2% (-2084.5 km²); Country deforestation rate = 1.7%

Table 12: Change matrix of Shan State (2005–15)

		2015					
	LCover	Forest	OWL	Other	Water	Total (km²)	%
2005	Forest	75,009.73		6,602.90		81,612.63	52.38
	OWL		49,008.09	6,793.10	252.43	56,053.62	35.98
	Other			17,650.43		17,650.43	11.33
	Water				488.04	488.04	0.31
	Total	**75,009.73**	**49,008.09**	**31,046.43**	**740.47**	**155,804.72**	**100.00**
	%	48.14	31.45	19.93	0.48	100.00	

Deforestation rate = 0.42% (660.29 km²); Country deforestation rate = 1.3%

Figure 9: **Change assessment map of Shan State (2005–10) in four categories**

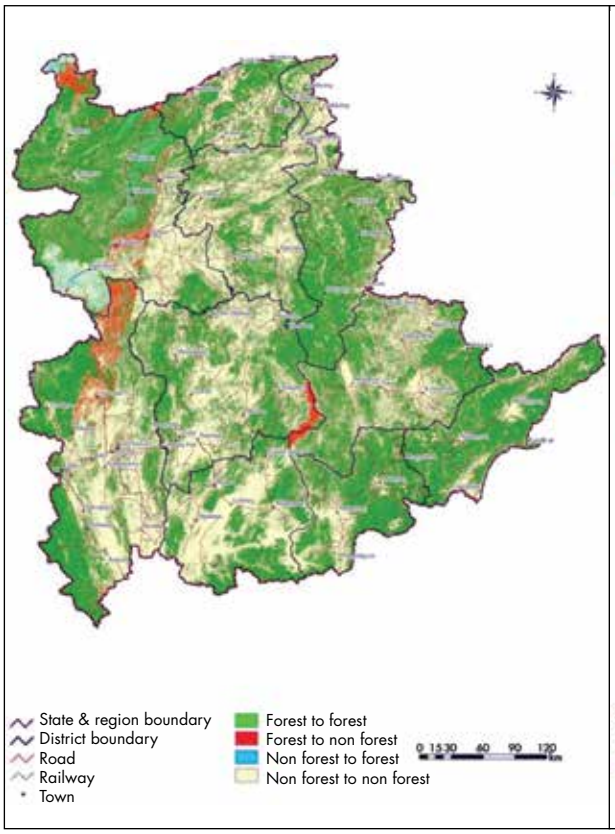


Figure 10: **Change assessment map of Shan State (2010–15) in four categories**

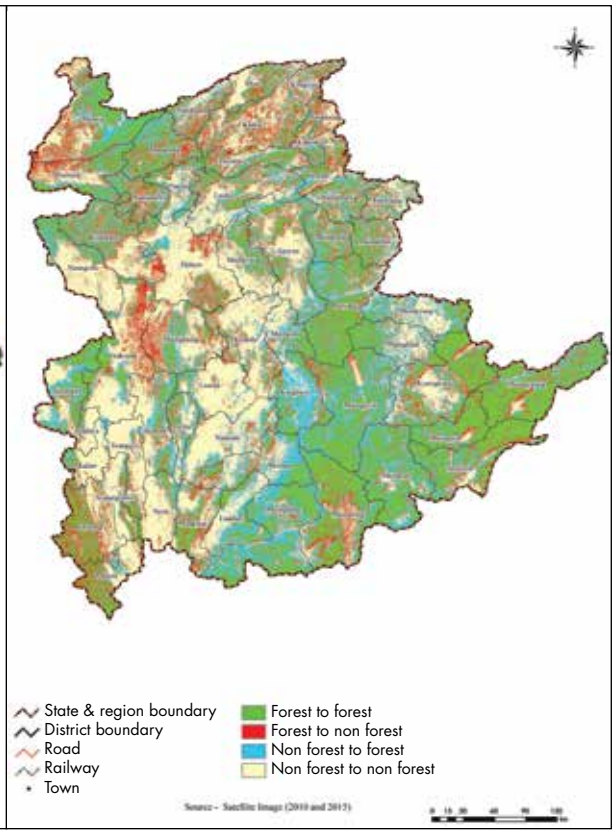
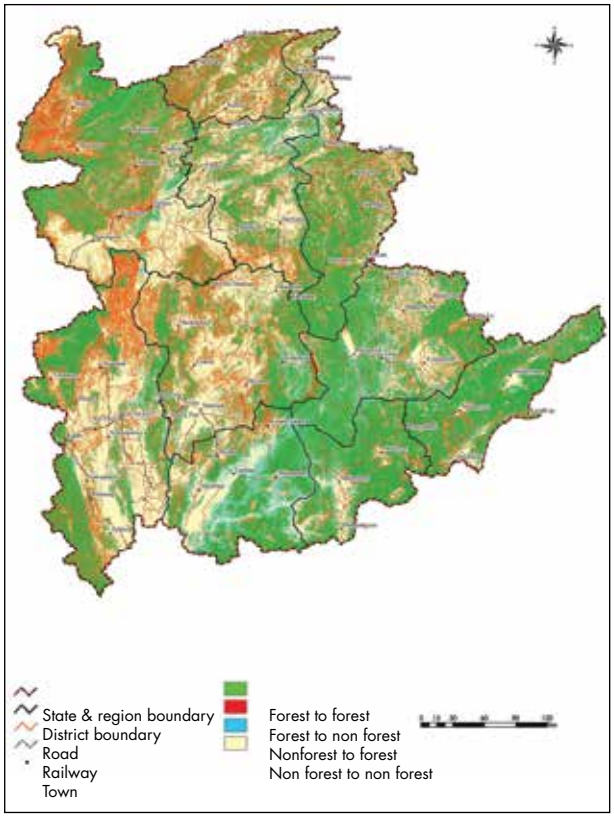


Figure 11: **Change assessment map of Shan State (2005–15) in four categories**



The condition and spatial distribution of Shan State's (closed and open) forests were assessed with special focus on changes in closed forest between the years 2005, 2010, and 2015. Results showed that forests still cover 48% of total land area of Shan State. However, logging, expanding agriculture and plantations, and degradation pose increasing threats. Good forest resource management practice will be required to protect and maintain the state's remaining forests.

Land use and land use change in Shan State are more highly fragmented than in any other state. The average annual deforestation rate of all forest was 1.62%. The deforestation rate for 2005–10 is higher than 2010–15. In 2015, forest cover is slightly more than 2010. Patches of new non-forest are distributed throughout the Shan State.

Plantations and new plantations have large clusters surrounded by forest in some areas, especially eastern and north-eastern Shan State. The northeast has a particularly patchy distribution of non-forest, new non-forest, and expanding plantations interspersed with forest.

The following maps (Figures 9–14) and respective data (Tables 13–27) offer a closer look.

Figure 12: **Change assessment map of Shan State (2005–10) in six categories**

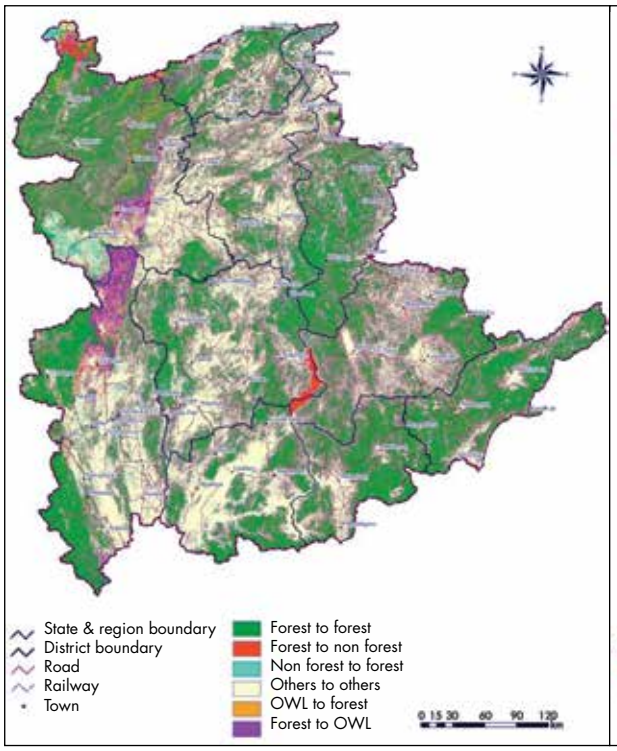


Figure 13: **Change assessment map of Shan State (2010–15) in six categories**

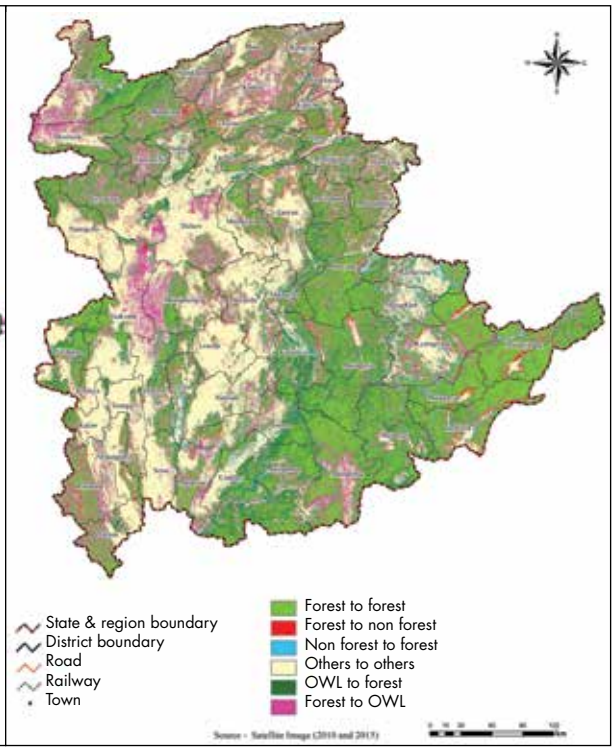


Figure 14: **Change assessment map of Shan State (2005–15) in six categories**

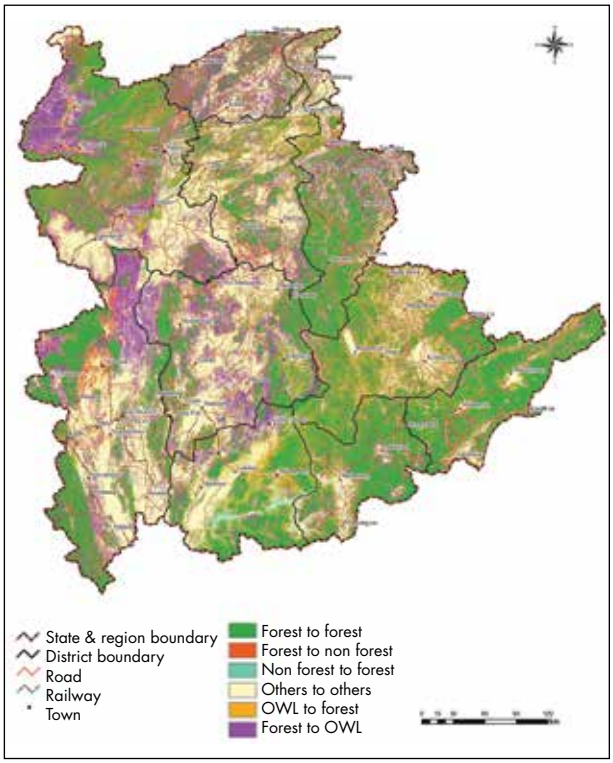


Table 13: **Change assessment data of Shan State (2005–10) in four categories**

Change data 2005–10	Reference colour	Km²	Percent
Forest-Forest		48,363.78	31.04
Forest-Non Forest		35,328.28	22.67
Non Forest-Forest		16,679.99	10.71
Non Forest-Non Forest		49,934.42	32.58
Total		**155,804.72**	**100.00**

Table 14: **Change assessment data of Shan State (2010–15) in four categories**

Change data 2010–15	Reference colour	Km²	Percent
Forest-Forest		43,226.43	27.80
Forest-Non Forest		29,574.89	18.98
Non Forest-Forest		22,998.91	14.76
Non Forest-Non Forest		60,004.48	38.51
Total		**155,804.72**	**100.00**

Table 15: Change assessment data of Shan State (2005–15) in four categories

Change data 2005–15	Reference colour	Km²	Percent
Forest-Forest		52,660.31	33.80%
Forest-Non Forest		30,859.39	19.80%
Non Forest-Forest		22,350.60	14.35%
Non Forest-Non Forest		49,934.42	32.05%
Total		**155,804.72**	**100.00**

Table 16: Change assessment data of Shan State (2005–10) in six categories

Change data 2005–10	Reference colour	Km²	Percent of total Shan
Forest–Forest		43,138.42	27.69
Forest–Non Forest		31,675.10	20.33
Other–Forest		13,571.54	8.71
Other–Other		31,886.05	20.46
OWL–Forest		31,887.78	20.47
Forest–OWL		3,645.83	2.34
Total		**155,804.72**	**100.00**

Table 17: Change assessment data of Shan State (2010–15) in six categories

Change data 2010–15	Reference colour	Km²	Percent of Total Shan
Forest to Forest		52,573.11	33.74
Forest to Non Forest		13,165.50	8.45
Other to Forest		1,186.63	0.56
Other to Other		51,738.04	33.21
OWL to Forest		20,735.20	13.31
Forest to OWL		16,406.24	10.53
Total		**155,804.72**	**100.00**

Table 18: Change assessment data of Shan State (2005–15) in six categories

Change data 2005–15	Reference colour	Km²	Percent of Total Shan
Forest to Forest		52,660.31	33.80
Forest to Non Forest		12,360.41	7.93
Other to Forest		4,487.96	2.88
Other to Other		49,934.42	32.05
OWL to Forest		17,862.64	11.47
Forest to OWL		18,498.98	11.87
Total		**155,804.72**	**100.00**

Table 19: Change assessment data of Shan South by district (2005–15)

	Shan South				
Land Cover change (2005–15)	Taunggyi	Loilen	Linkhay	Total area (km²)	%
Forest to Forest	6,641.03	4,337.04	4,093.45	15,071.52	26.87
Forest to Non F	5,616.61	4,811.32	1,086.81	11,514.74	20.53
Non F to Forest	1,749.07	2,021.41	3,266.41	7,036.89	12.55
Non F to Non F	10,127.08	8,578.98	3,752.94	22,459.00	40.05
	24,133.79	**19,748.75**	**12,199.61**	**56,082.15**	**100.00**

Table 20: Change assessment data of Shan North by district (2005–15)

	Shan North						
Land Cover change (2005–15)	Lashio	Kyaukme	Hopan	Laukkaing	Muse	Total area (km²)	%
F to F	2,903.23	7,859.24	5,808.05	275.09	1,666.95	18,512.56	30.20
F to NF	2,435.32	6,966.72	2,535.87	467.46	2,600.07	15,005.44	24.48
NF to F	2,164.82	2,530.74	1,941.47	260.74	662.86	7,560.63	12.33
NF to NF	5,795.48	8,480.66	2,172.00	890.65	2,887.78	20,226.57	32.99
	13,298.85	**25,837.36**	**12,457.39**	**1,893.94**	**7,817.66**	**61,305.20**	**100.00**

Table 21: Change assessment data of Shan East by district (2005–15)

	Shan East				
Land Cover change (2005–15)	Kyaingtong	Mongsat	Tachileik	Total area (km²)	%
Forest to Forest	7,027.06	6,231.33	5,913.49	19,171.88	49.86
Forest to Non Forest	2,300.56	1,155.66	1,005.62	4,461.84	11.60
Non Forest to Forest	3,977.32	2,124.44	1,548.23	7,649.99	19.89
Non Forest to Non Forest	4,040.30	1,970.19	1,159.05	7,169.54	18.65
	17,345.24	**11,481.62**	**9,626.39**	**38,453.25**	**100.00**

Table 22: Change assessment data of Shan South by district (2005–10)

	Shan South				
Land Cover change (2005–10)	Taunggyi	Loilen	Linkhay	Total area (km²)	%
Forest to Forest	8,537.91	6,296.64	3,983.70	18,818.25	33.55
Forest to Non Forest	3,720.44	2,852.19	1,188.70	77,61.33	13.84
Non Forest to Forest	2,229.98	2,543.20	1,180.02	5,953.20	10.62
Non Forest to Non Forest	9,645.46	8,056.72	5,847.19	23,549.37	41.99
	24,133.79	**19,748.75**	**12,199.61**	**56,082.15**	**100.00**

Table 23: Change assessment data of Shan North by district (2005–10)

	Shan North						
Land Cover change (2005–10)	Lashio	Kyaukme	Hopan	Laukkaing	Muse	Total area (km²)	%
Forest to Forest	3,590.23	11,117.93	6,820.38	427.35	3,263.00	25,263.89	41.21
Forest to Non Forest	1,748.23	3,708.03	1,556.32	269.66	1,025.27	8,307.60	13.55
Non Forest to Forest	1,743.91	3,863.93	1,558.90	271.59	971.14	8,409.47	13.72
Non Forest to Non Forest	6,216.39	7,147.47	2,521.79	880.34	2,558.25	19,324.24	31.52
	13,298.85	**25,837.36**	**12,457.39**	**1,893.94**	**7,817.66**	**61,305.20**	**100.00**

Table 24: Change assessment data of Shan East by district (2005–10)

	Shan East				
Land Cover change (2005–10)	Kyaingtong	Mongsat	Tachileik	Total area (km²)	%
Forest to Forest	6,444.62	6,065.12	5,860.12	18,369.86	47.77
Forest to Non Forest	2,879.91	1,314.48	1,064.61	5,259.00	13.68
Non Forest to Forest	2,664.76	1,300.10	1,067.45	5,032.31	13.09
Non Forest to Non Forest	5,355.95	2,801.92	1,634.21	9,792.08	25.46
	17,345.24	**11,481.62**	**9,626.39**	**38,453.25**	**100.00**

Table 25: Change assessment data of Shan South by district (2010–15)

Land Cover change (2010–15)	Shan South				
	Taunggyi	Loilen	Linkhay	Total area (km²)	%
Forest to Forest	6,341.26	4,190.00	4,092.64	14,623.90	26.08
Forest to Non Forest	4,426.63	4,649.84	1,071.22	10,147.69	18.09
Non Forest to Forest	2,048.56	2,168.45	3,263.60	7,480.61	13.34
Non Forest to Non Forest	11,317.34	8,740.46	3,772.15	23,829.95	42.49
	24,133.79	**19,748.75**	**12,199.61**	**56,082.15**	**100.00**

Table 26: Change assessment data of Shan North by district (2010–15)

Land Cover change (2010–15)	Shan North						
	Lashio	Kyaukme	Hopan	Laukkaing	Muse	Total area (km²)	%
Forest to Forest	2,939.05	7,702.25	5,874.69	280.20	1,658.00	18,454.19	30.10
Forest to Non Forest	2,395.09	7,279.61	2,504.87	463.77	2,576.33	15,219.67	24.83
Non Forest to Forest	2,128.74	2,688.19	1,906.67	257.15	682.11	7662.86	12.50
Non Forest to Non Forest	5,835.97	8,167.31	2,171.16	892.82	2,901.22	19,968.48	32.57
	13,298.85	**25,837.36**	**12,457.39**	**1,893.94**	**7,817.66**	**61,305.20**	**100.00**

Table 27: Change assessment data of Shan East by district (2010–15)

Land Cover change (2010–15)	Shan East				
	Kyaingtong	Mongsat	Tachileik	Total area (km²)	%
Forest to Forest	6,905.16	6,222.79	5,954.11	19,082.06	49.62
Forest to Non Forest	2,204.14	1,142.37	973.81	4,320.32	11.24
Non Forest to Forest	4,103.44	2,130.64	1,534.25	7,768.33	20.20
Non Forest to Non Forest	4,132.50	1,985.82	1,164.22	7,282.54	18.94
	17,345.24	**11,481.62**	**9,626.39**	**38,453.25**	**100.00**

3(a) NDVI (normalized different vegetation index) composite maps for 2005 and 2015

The NDVI composite mapping for 2005 and 2015 were developed using methodology of the high carbon stock (HCS) approach. The main purpose of the methodology is to group the land cover into homogenous classes in order to indicate potential HCS forest areas by using respect NDVI values (see Table 28).

Table 28: Homogenous classes of HCS using respective NDVI values

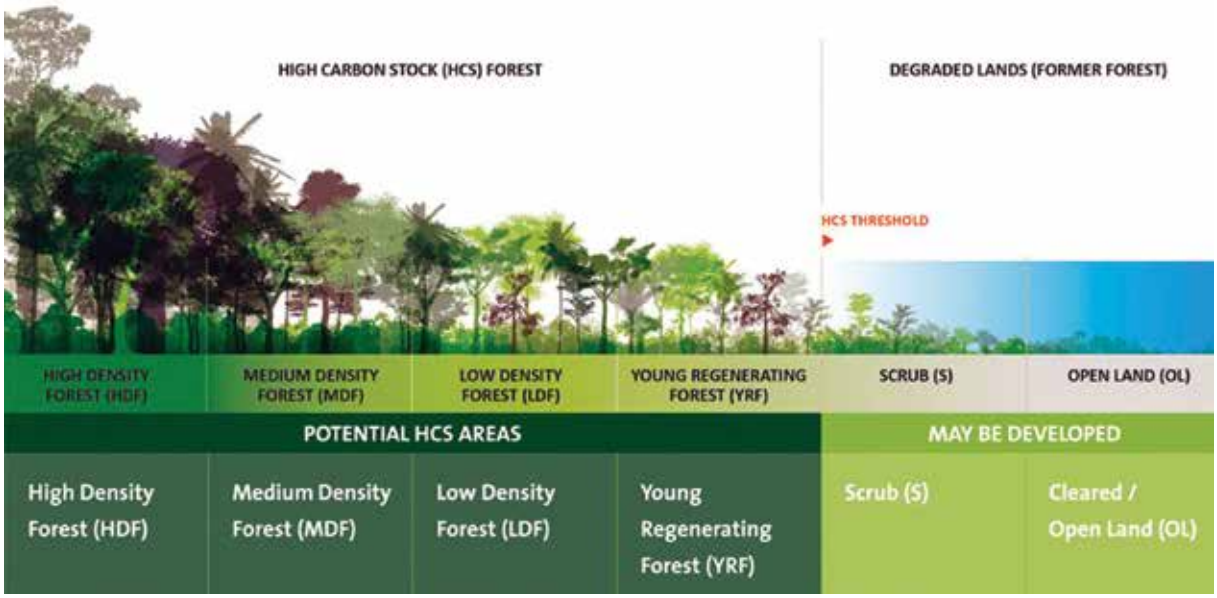
Class	NDVI
Water	< 9
Open land - OL	10
Scrub - S	11
Young regenerating forest - YRF	12
Low-density forest - LDF	13
Medium-density forest - MDF	14
High-density forest - HDF	15–20

The exercise is to differentiate:

- Low, medium, and high density forest (LDF, MDF, HDF);
- Young regeneration forest (YRF);
- Cleared and degraded former forest including scrub (S) and open land (OL); and
- Non-HCS areas such as roads, water bodies, and settlements.

As shown in Figure 15, the potential HCS forest cut-off lies between the scrub and young regeneration forest categories, where YRF, LDF, MDF, and HDF are considered potential HCS forest and S and OL are not. For detailed methodology see the *HCS Approach Toolkit, Version 1.0* (HCS Approach Steering Group 2015). In this study this methodology was used to check and confirm the result of geospatial analysis mentioned above.

Figure 15: High carbon stock (HCS) classification diagram



3(b) Estimated magnitude of carbon emission due to deforestation and forest degradation over the reference period 2005–15 in Shan State

According to the result of the Forest Cover and Carbon Mapping in the Greater Mekong Sub-region and Malaysia Project under the APFNet programme, the total estimated carbon stock of the project area was 10,165 million tonnes. For the Myanmar portion, the estimated carbon stock was 2509.16 million tonnes, and the estimated carbon stock of Shan State was 700.93 million tonnes. The carbon density distribution pattern is along most mountains. The darker green area is the higher of carbon dense area. In Shan State, the highest carbon density is only up to 180 tonnes per hectare.

According to FRA 2010 and FRA 2015, estimated carbon stock is 1,445 million tonnes (mt) in 2005, 1,378 mt in 2010, and 1,292.8 mt in 2015, respectively. In Shan State, it is 791.40 mt in 2005, 754.71 mt in 2010, and 722.83 mt in 2015, respectively. Distribution of carbon in Shan State can be seen in Figure 30. That is why carbon emission in Shan State is 7.34 mt per year from 2005 to 2010 and 6.38 mt per year from 2010 to 2015. Generally speaking, 6.86 mt per year of carbon were emitted between in the 2005 to 2015 period in Shan State.

In addition, according to the group homogenous matrix of NDVI values 2005 and 2015 (Table 31), young regeneration forest (YRF) and low-density forest (LDF) have increased in 2015. High-density forests have apparently decreased. That means forest cover of Shan State has been obviously deforested and degraded between 2005 and 2015. Other lands were reduced and scrub lands are increasing. That means some bare

Table 29: Land use/cover status of Shan State as per NDVI (2005)

NDVI class	Area (km²)	% of total Shan State area
Water	1,028.58	0.66
Open land - OL	34,595.80	22.20
Scrub - S	24,741.40	15.88
Young regenerating forest - YRF	26,717.40	17.15
Low-density forest - LDF	24,336.69	15.62
Medium-density forest - MDF	24,837.62	15.94
High-density forest - HDF	19,547.22	12.55
	155,804.72	**100.00**

Table 30: Land use/cover status of Shan State as per NDVI (2015)

NDVI classes	Area (km²)	% of total Shan State
Water	480.77	0.31
Open land	6358.46	4.08
Scrub - S	46071.52	29.57
Young regeneration forest - YRF	56920.14	36.53
Low-density forest - LDF	39174.68	25.14
Medium-density forest - MDF	6778.09	4.35
High-density forest - HDF	21.06	0.01
	155804.72	**100.00**

Note: HDF+MDF+LDF+YRF = 66.04%; HDF+MDF+LDF = 29.51%

lands are becoming covered with tree canopies. That is a result of rubber plantations. All in all, that NDVI result is supposed to be the same with the spatial analysis results of Landsat imagery. Another negative is that hardly any high-density forest (HDF/intact forests) is left in Shan State.

3(c) Global Forest Watch data were used to compare the spatial analysis results with international data

According to Global Forest Watch forest cover data, Myanmar's dense forests are found mostly in Shan (**25%** of the country's forests using a 50% tree-cover threshold), Kachin (**19%**), and Sagaing (**14%**) in the northern parts of the country. These states and regions have also had the highest aggregate loss of forests, amounting to nearly **850,000 hectares**

Figure 16: Land use/cover map of Shan State as per NDVI (2005)

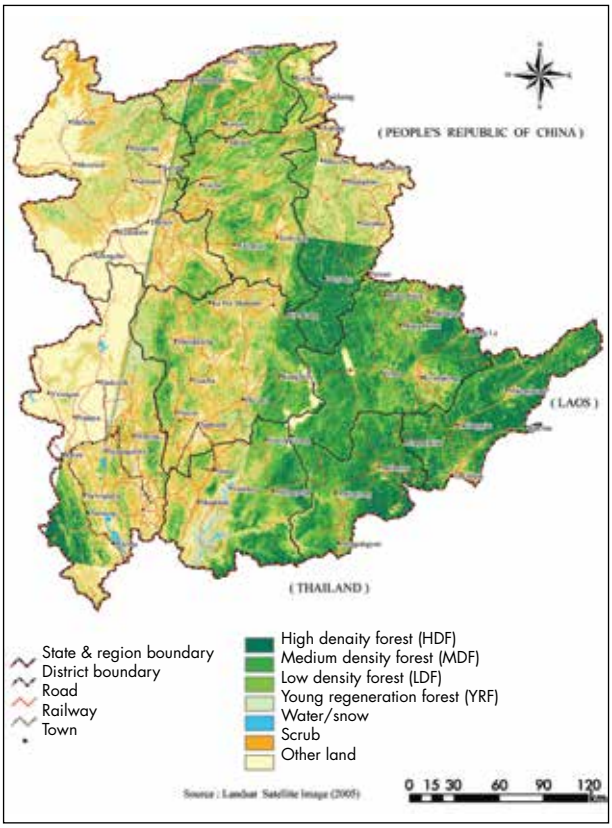


Figure 17: Land use/cover map of Shan State as per NDVI (2015)

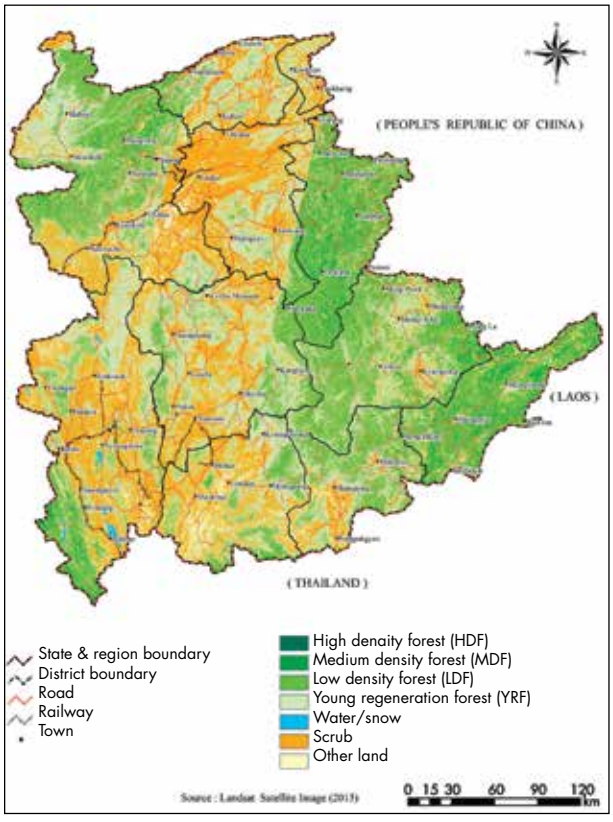
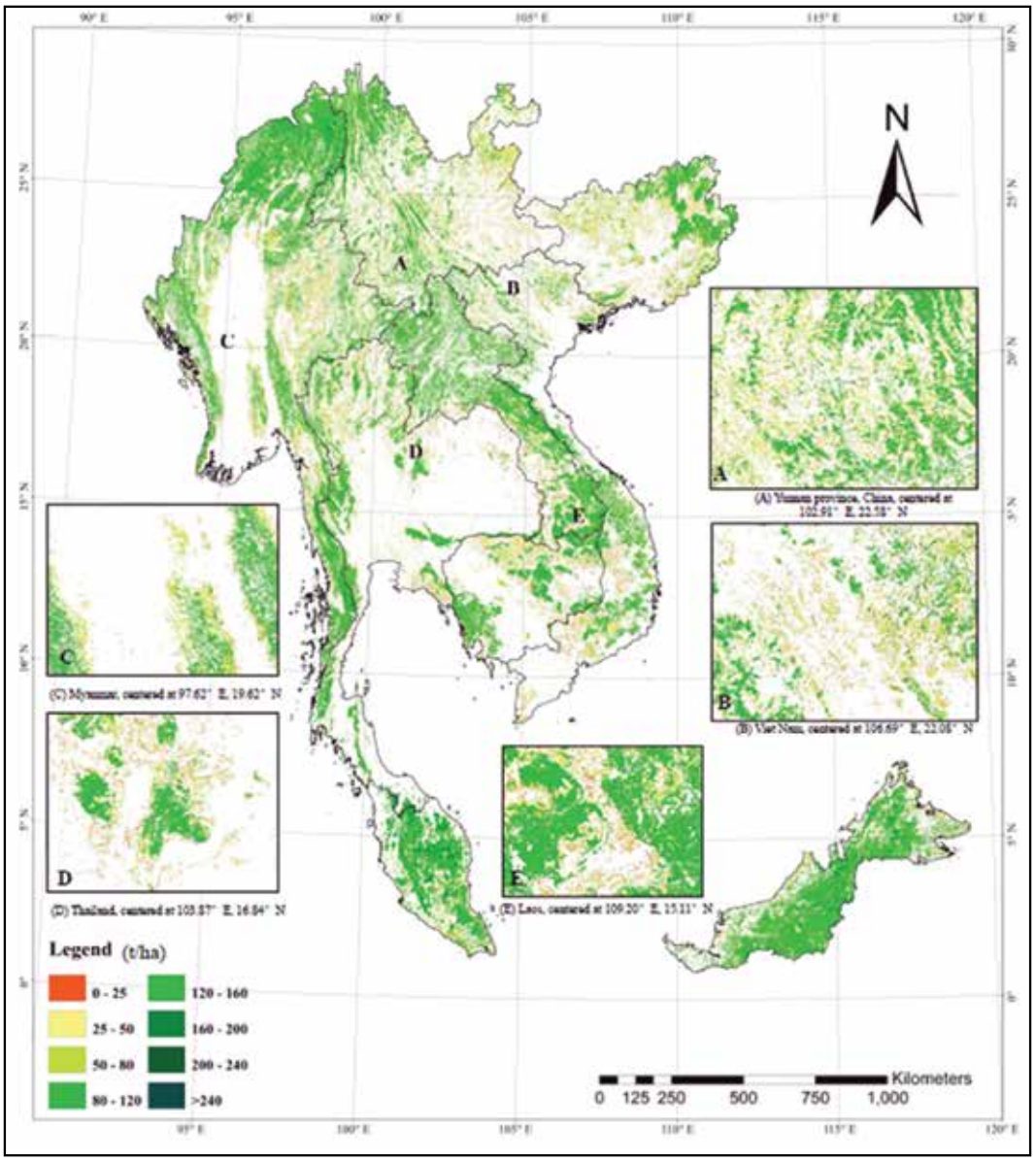


Table 31: Change matrix of NDVI land use/cover of Shan State

	2015								
2005	Water	OL	Scrub	YRF	LDF	MDF	HDF	Total	%
Water	480.77		547.81					1028.58	0.66
OL		6358.46	20782.31	7455.03				34595.80	22.20
Scrub			24741.40					24741.40	15.88
YRF				26717.40				26717.40	17.15
LDF					24336.69			24336.69	15.62
MDF				18059.54		6778.09		24837.62	15.94
HDF				4688.17	14837.99		21.06	19547.22	12.55
Total	**480.77**	**6358.46**	**46071.52**	**56920.14**	**39174.68**	**6778.09**	**21.06**	**155804.72**	
%	0.31	4.08	29.57	36.53	25.14	4.35	0.02		100.00

Figure 18: Forest carbon storage of 2005, GMS and Malaysia area



Source: Forest cover and carbon mapping in the GMS and Malaysia Project.

Figure 19: **Forest carbon storage of Myanmar, 2005**

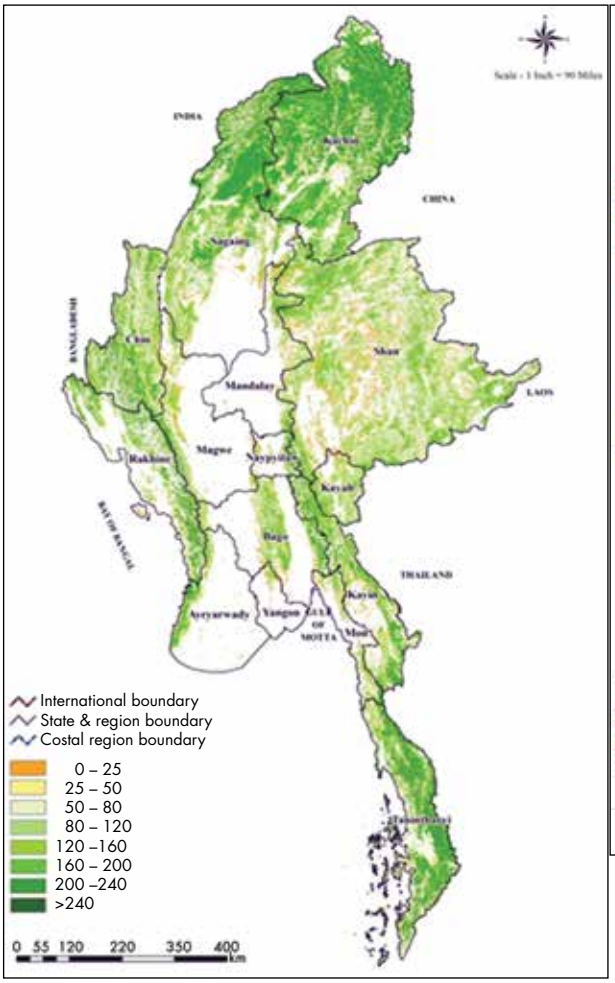
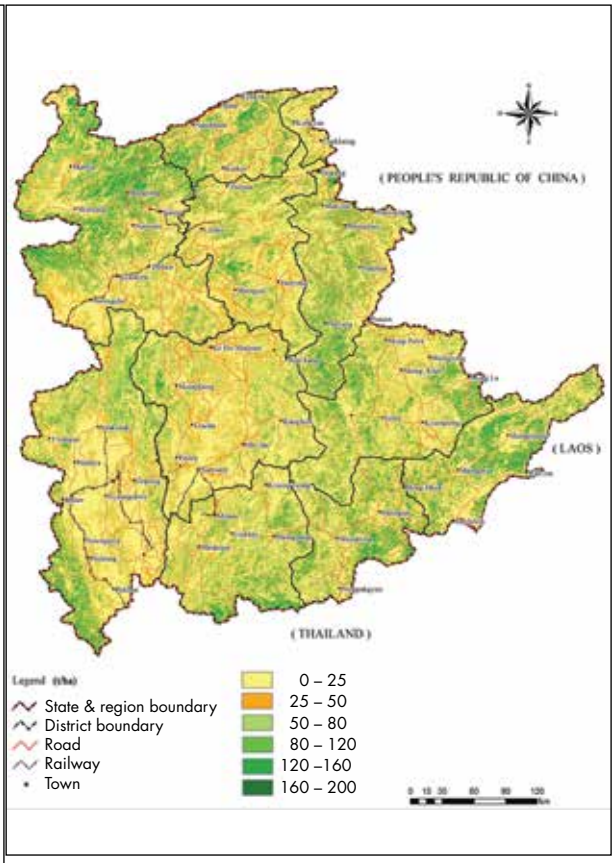


Figure 20: **Forest carbon density distribution map of Shan State**



between 2000 and 2012, according to research led by **Matthew Hansen**. In 2012, Shan State forest cover is still good compared with forest cover of other regions and states, but dense forest or intact forest is lower than in Kachin State. Moreover, annual forest loss is highest around 2010. That coincided with the result of special analysis. Also, annual forest loss of Shan State is higher than other regions and states (see Figures 21 and 22).

Climate change mitigation policies for REDD+ aim to address the drivers of deforestation and forest degradation and reduce the emissions that are associated with these drivers. Therefore, it is important to understand and monitor drivers of deforestation and forest degradation in order to develop these mitigation policies and define effective strategies and interventions to reduce emissions.

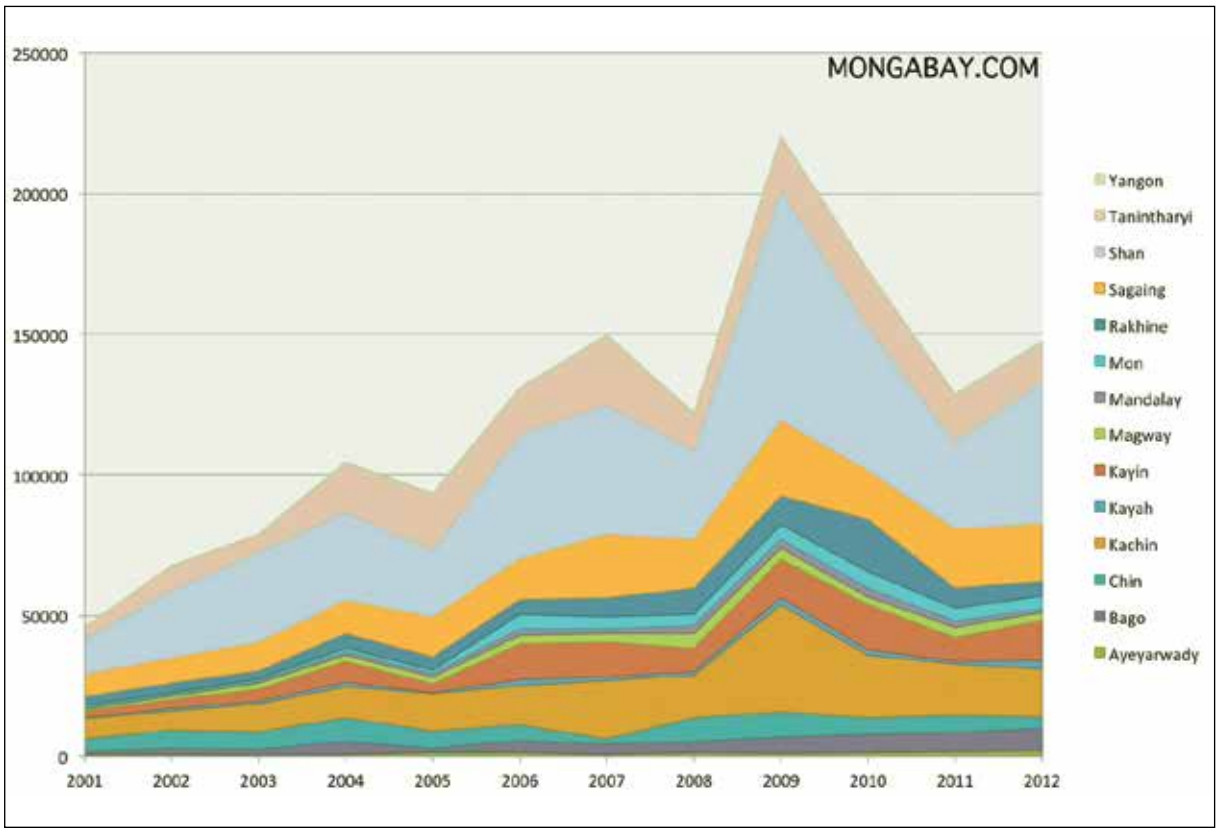
Before analysing the drivers of deforestation and forest degradation, the definitions of deforestation and forest degradation should be clarified. Here we used the following definitions:

Deforestation is defined as the conversion from forest into other land use categories, with the assumption that forest vegetation is not expected to regrow naturally in that area.

Forest degradation is defined as reduction of the canopy and loss of carbon in forests remaining forests, where the human disturbances are not associated with a change in land use and where, if not hindered, the forest is expected to regrow or be replanted.

There are two different paths of drivers of deforestation and forest degradation: direct causes and indirect causes. Direct drivers are direct human activities that affect forest cover. Indirect drivers are complex

Figure 21: **Annual forest loss in Myanmar, 2001–12 (Hansen 2013/GFW 2014)**



interactions of fundamental social, economic, political, cultural, and technological processes that are often distant from their area of impact. For deforestation these are mainly large-scale processes; for forest degradation these are small-scale processes, or processes that take place underneath the canopy. Indirect drivers are the underlying processes of the direct human activities.

Drivers of forest degradation are more difficult to detect with remote sensing than drivers of deforestation. High spatial and temporal variation in forest carbon stock changes due to degradation, so frequent ground surveying is required. This study assumes that forest cover changes from high-density to low-density cover mean forest degradation as aforementioned in paragraph 2.2.

In terms of deforestation drivers, whether at the national or Shan State level, two types of negative drivers can be distinguished: direct and indirect drivers. Direct drivers concern human activities that directly affect forest cover and deplete carbon stocks. Indirect drivers occur at multiple scales and concern the complex interactions of social, economic,

Figure 22: **Myanmar forest cover, 2012 (ha)**

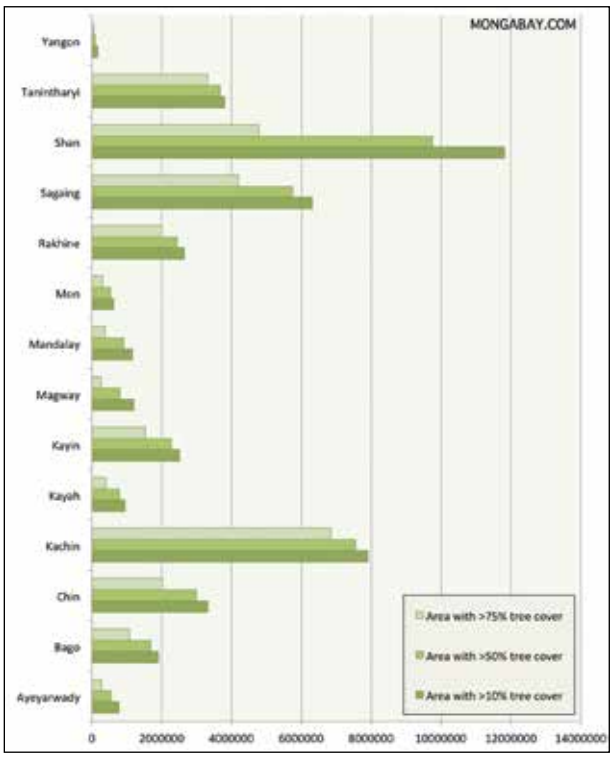


Table 32: **Forest cover in Myanmar by region and state (Global Forest Watch 2012, ha)**

	Total forest area		Dense forest area		Forest gain		Forest loss		Total land area
	>10% tree cover (ha)	% total land cover	>50% tree cover (ha)	% total land cover	2001–12 (ha)	% total forest cover	2001–12 (ha)	% total forest cover	(ha)
Ayeyarwady	768,428	23.5%	546,097	16.7%	273,667	35.6%	12,710	1.7%	3,275,753
Bago	1,910,966	50.2%	1,680,721	44.2%	1,070,202	56.0%	50,728	2.7%	3,806,832
Chin	3,325,158	90.5%	2,984,199	81.2%	2,026,305	60.9%	72,655	2.2%	3,676,180
Kachin	7,903,403	89.5%	7,549,154	85.5%	6,847,749	86.6%	194,024	2.5%	8,828,256
Kayah	952,549	81.9%	791,798	68.1%	396,304	41.6%	15,882	1.7%	1,162,810
Kayin	2,503,069	84.0%	2,279,428	76.5%	1,532,746	61.2%	106,425	4.3%	2,979,847
Magway	1,197,412	27.5%	805,003	18.5%	261,313	21.8%	33,138	2.8%	4,357,480
Mandalay	1,162,141	32.1%	911,583	25.2%	379,932	32.7%	21,014	1.8%	3,617,003
Mon	630,408	55.2%	520,857	45.6%	295,295	46.8%	38,568	6.1%	1,143,005
Rakhine	2,646,337	76.1%	2,445,983	70.3%	2,006,187	75.8%	81,940	3.1%	3,477,437
Sagaing	6,309,647	66.7%	5,748,087	60.8%	4,198,361	66.5%	193,580	3.1%	9,454,745
Shan	11,808,703	76.1%	9,752,146	62.9%	4,776,243	40.4%	458,093	3.9%	15,516,533
Tanintharyi	3,802,235	92.7%	3,668,722	89.5%	3,324,755	87.4%	179,778	4.7%	4,100,807
Yangon	160,352	17.1%	106,068	11.3%	54,328	33.9%	3,729	2.3%	937,507
Myanmar	45,080,808	68.0%	39,789,847	60.0%	27,443,387	60.9%	1462,263	3.2%	66,334,194

political, cultural, and technological processes that affect direct drivers. Indirect drivers include processes such as changing markets and commodity prices, population growth, national policies and governance, and dynamics of subsistence and poverty (Kissinger et al., 2012).

3.1 Drivers and status of deforestation

According to the socioeconomic field survey, most of the forest village dwellers did not practice shifting cultivations over the last 10 years except villages that cultivate opium poppy. In Yawngan Township, the villagers of Kyaukkulay Village under the SinGhaung village group are now getting to know the importance of forests. That is why they are trying to manage their remaining forests as much as they can even though they cannot avoid the usage of NTFPs. That is why the Lorenz curve showing the forest dependency of Kyaukkulay Village was very low in comparison with other villages. In Pindaya Township, Wataya and Shaukpin villages faced with no more forests left around their villages. Only small woodlots are left around Shaukpin. That is why these two villages encountered with water shortage in dry season. In the rainy season they have to catch rainwater in the ponds to use in the dry season because they cannot drill underground for water around their villages.

The following Lorenz curves (Figures 23–26) show the proportion of cumulative income versus proportion of cumulative population sample, with forest resource income included and excluded, of some of the hotspot area field survey villages.

3.1.1 Direct/Proximate drivers and deforestation

- Agriculture expansion and agribusiness plantations such as rubber and oil-palm plantations
- Shifting cultivation with short fallow period and opium poppy plantations
- Infrastructure developments
- Mining

Figure 23: **Lorenz curve showing % total income vs. % households of Kyaukkulay Village with forest resources income included and excluded**

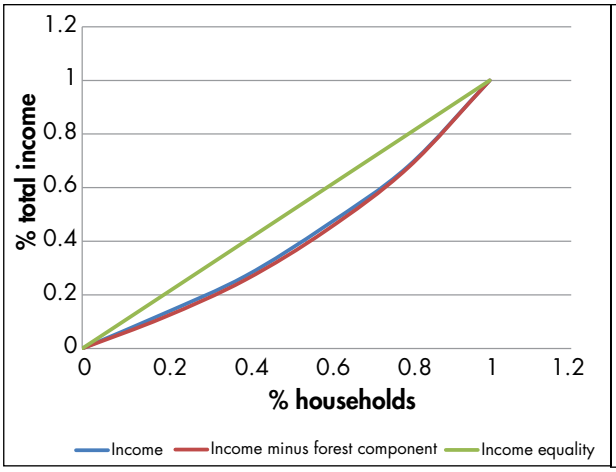


Figure 24: **Lorenz curve showing % total income vs. % households of Kaungbo Village with forest resources income included and excluded**

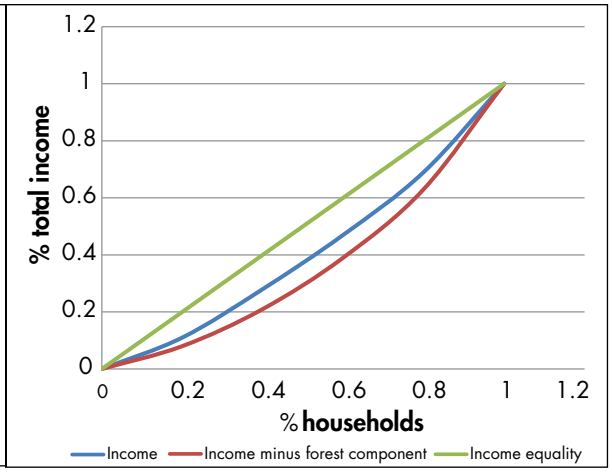


Figure 25: **Lorenz curve showing % total income vs. % households of Sanphu Village with forest resources income included and excluded**

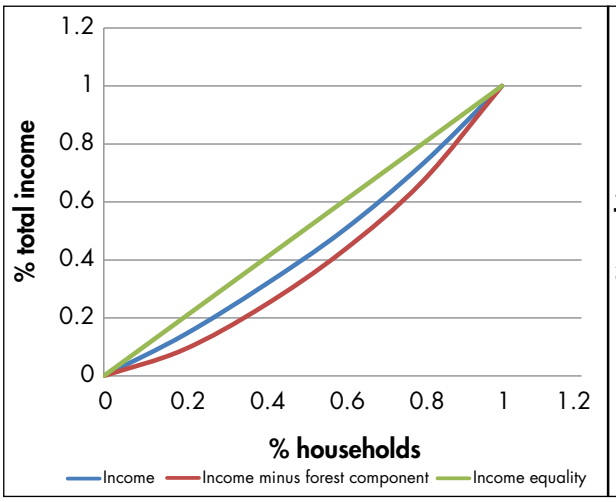
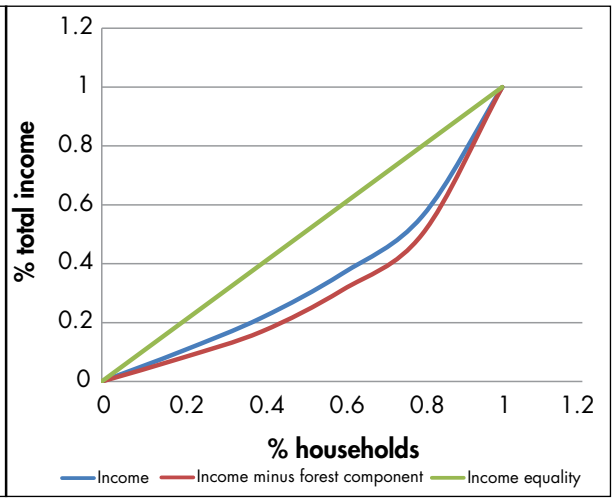


Figure 26: **Lorenz curve showing % total income vs. % households of MaHlaingKon Village with forest resources income included and excluded**



To be more comprehensive understanding and knowledgeable, it is need to explain more about each driver.

Agriculture expansion and agribusiness plantations

In Myanmar it is widely acknowledged that the clearing of forests to make way for the expansion of commercial agricultural fields is increasingly the leading driver of deforestation, alongside legal and illegal logging, and for infrastructure projects such as roads and hydropower dams.

While the conversion of forests for agricultural development has been occurring for many decades, it is the unprecedented rate of this conversion that is now so astounding — as well as the fact that the government is encouraging increasing levels of investment for large-scale industrial agricultural expansion. Despite national statements purporting to protect Myanmar's remaining forests, a new set of land and investment laws is still facilitating the conversion of forests into private agribusiness concessions. In the forest sector itself, promising new reforms have been progressing, but so far have focused only on the managed timber

estates under the direct control of the Myanmar Forest Department. The remaining natural forests in the country's resource-rich, ethnic-populated states are still lack any effective forest management and are thus even more prone to extensive logging and forest conversion.

Economically, southern Shan State is highly reliant on agriculture. Shan State is famous for its main local products such as tea leaves and thanaka (*Limonia acidissima* Roxb). Paddy fields are prevalent in the lowland small basins. On the hillsides, people used to sustain shifting cultivation systems. Within Shan State, rice is the main crop grown for household use. Double cropping is practiced extensively in southern Shan State, where rice is often followed by potato, tomato, or chickpea in flat areas, while different rotations are seen in sloping hill areas.

At present, they no longer practice shifting cultivation in some areas of southern Shan State and instead grow annual crops on the rainfed and irrigated uplands continuously, as well as perennial crops in gardens (rice terraces were rare on the hillside). In the past, upland rice was grown using shifting cultivation systems. In the first year, people grew rice after slashing and burning, followed by groundnut or other crops in the second year. After two-year cropping, they would allow the field to lie fallow for three years before the next cultivation. Now this traditional cultivation had already changed to short-fallow shifting cultivation, which was not sustainable. They could not maintain a long enough fallow period because of population pressure. Land that had been used in shifting cultivation systems had begun to be cultivated continuously since the 1970s, and crop production had become more commercial. Cultivation of *thanapet* (*Cordia dichotoma* Forst.) in gardens and summer cropping of wheat had increased and taken the place of shifting cultivation of upland rice. *Thanapet* is a perennial crop, the leaf of which is processed and used to wrap cigars. Both *thanapet* and wheat were grown as commercial crops.

Intensification of farming technology in irrigated upland fields was practiced during the 2000s. Farmers have grown garlic in the dry season using irrigation from spring water. This irrigated upland farming was carried on in the past when farmers mainly practiced shifting cultivation. Therefore upland farming using irrigation could be a system with the potential for high productivity and profitability in the mountainous zone. Additionally, because irrigated farming generally offers more crop options than rainfed farming, more varied cropping patterns are attainable. Because irrigated upland farming can adapt to unpredictable agricultural commodities market, it can ensure income stability.

But the upland irrigation farming was found as a consequence of site-specific development. Under certain favourable ecological conditions, for example, on land where spring water was available or in a valley where enough surface water could be caught, terraced paddy fields had often been developed in earlier periods in the mountainous region of mainland Southeast Asia.

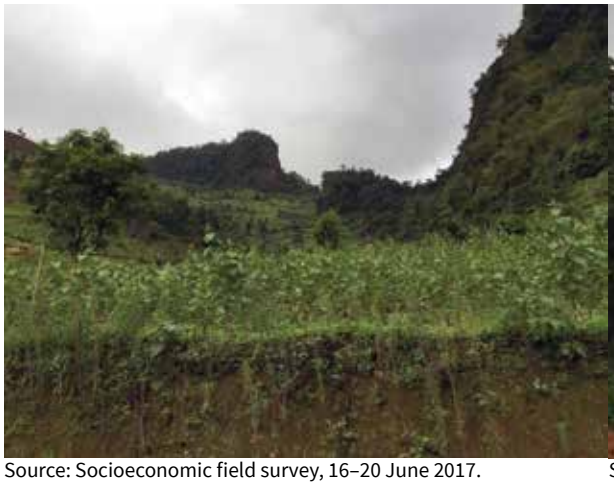
Figure 27: Landscape around Wataya Village is little more than agricultural land

Source: Socioeconomic field survey, 16–20 June 2017.

Figure 28: Thanapet (*Cordia dichotoma*) plantations around Kyauktan Village

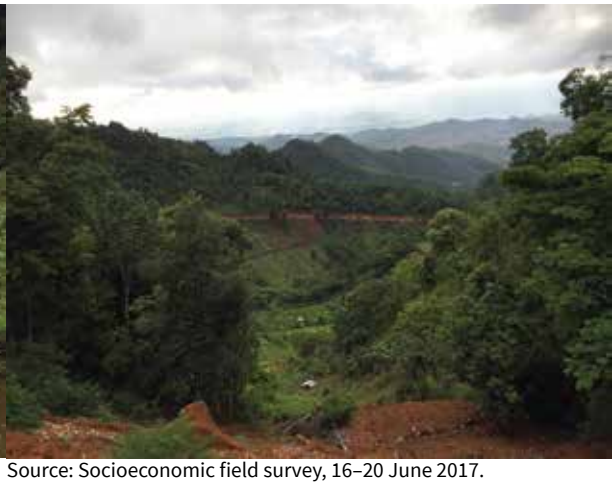
Source: Socioeconomic field survey, 16–20 June 2017.

Figure 29: **Thanaphat (*Cordia dichotoma*) plantations around Sanphu Village**



Source: Socioeconomic field survey, 16–20 June 2017.

Figure 30: **Forest condition around Sanphu Village, Hopone township Source: Socioeconomic field survey, 16-20 June 2017.**



Source: Socioeconomic field survey, 16–20 June 2017.

Figure 31: **Forest condition between Moemeik and Mabein Township**

Figure 32: **Validation workshop on Drivers of Deforestation and Forest Degradation Report in Taunggyi, 4 August 2017**

Figure 33: **Validation workshop on Drivers of Deforestation and Forest Degradation Report in Taunggyi, 4 August 2017**

Figure 34: **Poppy fields mosaics owned by Palaung Village**

Source: UNODC field survey, eastern Shan State, February 2013.

Figure 35: **Poppy fields on northern side of Tonta, eastern Shan State Source: UNODC field survey, eastern Shan State, February 2014.**

Source: UNODC field survey, eastern Shan State, February 2014.

Figure 36: **Beautiful poppy fields of eastern Shan State**

Source: UNODC field survey, eastern Shan State, 2013.

Figure 37: **The consultant in his UNODC opium poppy field survey, eastern Shan State, in 2013/14**

Source: UNODC field survey, eastern Shan State, taken 2013.

Figure 38: **Resin collectors in opium poppy fields**

Source: Opium poppies growing in Myanmar, www.peteralanlloyd.com, 2012.

Whatever farming system is practiced, some farmers turn to poppy cultivation because it's easier to earn a living from it. Drugs have become an alarming issue in Shan State. The vast mountain ranges which are difficult to travel become a hideout for poppy farmers where they can grow poppy in secret.

Shifting cultivation with short fallow period and opium poppy plantations

In the country's hilly region including Shan State, one of the major causes of deforestation is shifting cultivation or slash and burn farming, traditionally known as *taungya*. Shifting cultivation (swidden) has been practiced by ethnic minorities for a long time in hilly areas. Up to the middle of the 19th century, long rotations were possible as the population in hilly areas was very sparse. However, as the population rose, shifting cultivation gradually increased, and with shorter fellow period damage to the natural environment has increased. Repeated slash and burn practices in the same area destroys valuable timber species and hinders their regeneration, causing soil erosion and depletion of soil fertility, ultimately leading to deforestation and forest degradation.

This kind of cultivation practices are not only in Myanmar but also farmers in the mountainous region of mainland Southeast Asia. They practiced shifting cultivation, with plots of land cultivated temporarily and

then allow them to convert to secondary forests within a fallow period.

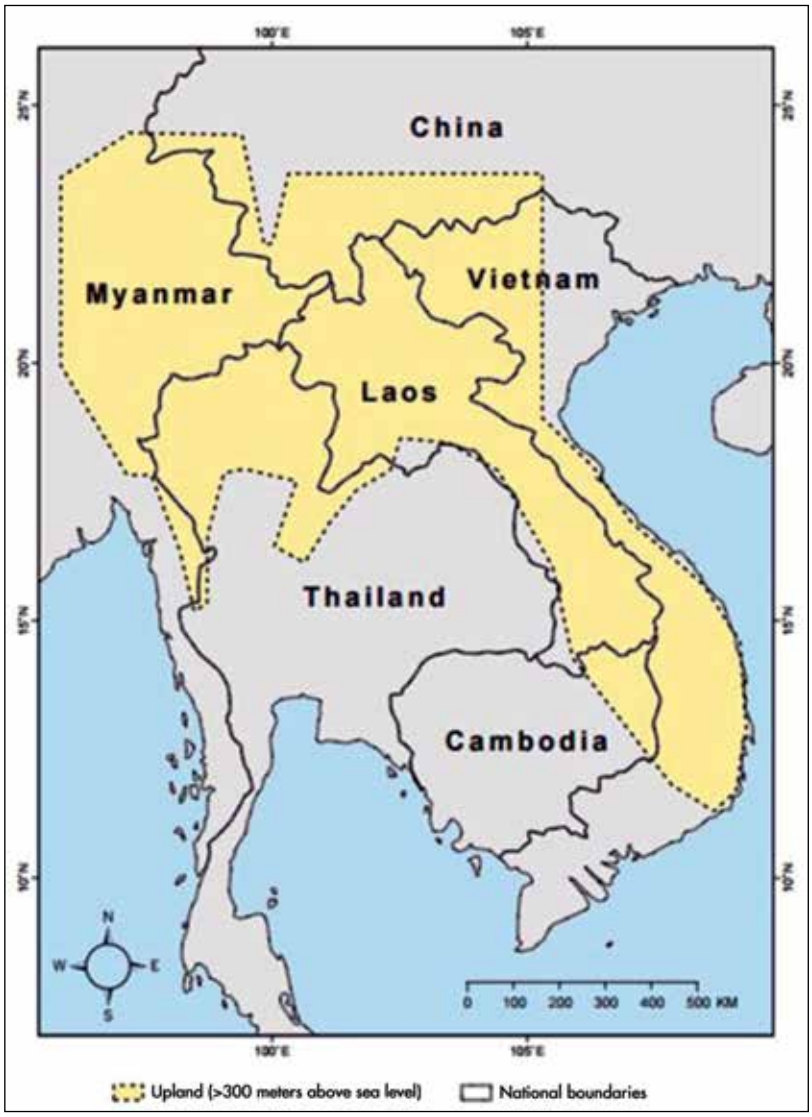
In 2012, more than 1 million hectares have been converted to rubber plantation. By 2050, the area under rubber trees in the mountainous regions of Cambodia, Laos, Myanmar, Thailand, Vietnam, and China's Yunnan Province is predicted to increase fourfold, largely replacing secondary forests and land currently under shifting cultivation (Fox et al., 2012).

Preliminary research suggests this massive land-use change could lead to drier conditions locally plus surface erosion, loss of soil quality, sedimentation and disruption of streams, and risk of landslides. And it appears that when primary and secondary forests are converted to rubber, carbon emissions are likely to increase.

Despite environmental concerns, both local farmers and outside entrepreneurs are likely to continue expanding rubber plantations because of high economic returns.

The mountainous region of mainland Southeast Asia (land above 300 metres elevation) harbours a wealth of natural resources, including globally important forests, multiple plant and animal species, and the headwaters of rivers. The region covers about one-half of the combined land area of Cambodia, Laos, Myanmar, Thailand, Vietnam, and China's Yunnan Province (Figure 39).

Figure 39: **The mountainous region of mainland Southeast Asia (land above 300 metres elevation), which covers about one-half of the combined land area of Cambodia, Laos, Myanmar, Thailand, Vietnam, and China's Yunnan Province**



For centuries, farmers in this region have practiced diverse systems of shifting cultivation, in which plots of land are cultivated temporarily and then allowed to revert to secondary forest during a fallow period. The staple crop is upland rice, but cultivated plots may include a range of secondary food and cash crops such as maize, cassava, banana, sugarcane, ginger, cardamom, or opium poppies (Mertz et al., 2009).

Fruit trees or other useful tree species may be planted on fallow plots, or the fallows may be left entirely to natural regrowth. **These practices produce a unique landscape mosaic combining small agricultural plots with**

secondary forests. These traditional land use systems are environmentally sustainable, protecting the region's rich biodiversity and soil and water resources (Ziegler et al., 2011).

Over the past decades, traditional forms of land use in many of these areas have evolved into more intensive agricultural systems. Plots tend to remain under cultivation longer, with less time allowed for the regrowth of secondary forests. In many instances, shifting cultivation has been replaced by permanent cropping, and in particular by rubber plantations.

One factor driving the transition toward more intensive agriculture has been population growth, including substantial migration from the lowlands. Another factor has been the expansion of road networks and markets, making it easier for farmers to purchase agricultural inputs and to sell their crops.

Government-sponsored **crop-substitution programmes** have also driven a shift toward rubber. Several countries, including the United States and China, have made substantial investments in **programmes designed to eliminate the cultivation of opium poppies** in the region. The ability to store and transport rubber easily as well as the overall return on investment make rubber far superior to any other cash crop **as a replacement for opium**. While more intense agriculture production may pose a threat to fragile local environments, it is not possible to turn back the clock. Rubber plantations, in particular, have proven highly profitable. Given financial realities, neither local farmers nor outside entrepreneurs are likely to return to less profitable forms of agriculture, even if the earlier forms are potentially more environmentally friendly. Therefore production systems that provide the best balance between economic return and environmental sustainability are needed to improve the long-term outlook of the region.

Infrastructure developments

Expanding cities and towns require land to establish the infrastructures necessary to support a growing population which is done by clearing the forests. Forests are the major target of infrastructure developments for oil exploitation, logging concessions, and hydropower dam construction which inevitably conveys the expansion of road networks and the construction of roads in pristine areas. The construction of roads, railways, bridges, and airports opens up the land to development and brings an increasing number of people to the forest frontier. Whether supported or not by government programmes, these settlers have usually colonized the forest by using logging trails or new roads to access the forest for subsistence land.

The developments of these infrastructure projects are of concern, both worldwide and here in Shan State. Since the last one or two decades, infrastructure developments had emerged across Shan State, such as Ayethayar, a new town just outside Taunggyi. It contains the Technological University of Taunggyi and the Aye Thar Yar Golf Resort. Following the same projects were establishments of the Technological University of Lashio in 1997, Technological University of Kyaing Tong in 2001, and Technological University of Pinlon in 2002. After that Kyaing Tong, Momg Phyat, and Tachileik highway construction and Mandalay, Lashio, and Muse highway construction were significant developments.

Nowadays, the latest of China's infrastructure projects in Myanmar consists of oil and gas pipelines criss-crossing the country, starting from a new terminus at Kyaukpyu up to Mandalay and through Lashio and on to the Chinese border town Ruili and then Kumming. There are also proposed projects comprising a port at the Kyaukphyu Special Economic Zone in Rakhine State and a 1,200-kilometre-long railway line linking Kumming and Kyaukpyu Port, with an expressway running parallel to the oil and gas pipeline. Therefore, the construction of roads, railways, and this kind of gas pipeline contribute the most to the eventual level of deforestation and forest degradation because roads encourage urbanisation (itself responsible for a further 10% of deforestation) and spread of agriculture into forests, particularly in remote areas where property rights are unclear or poorly regulated.

Mining

Mining is an important and promising sector for Myanmar's economic growth. Myanmar is home to potentially large reserves of copper, lead, zinc, tin, tungsten, gold, coal, and barite as well as precious and semiprecious stones. Myanmar possesses large reserves of mineral ore, many yet to be thoroughly explored. According to the Department of Geological Survey and Mineral Exploration (DGSE), the country boasts — in addition to gemstone — oil shale and natural gas-iron and metals for steel alloys (iron, manganese, chromium, nickel, molybdenum); base and non-ferrous minerals (lead, zinc, copper, tin, tungsten, antimony); chemical and fertilizer minerals (barite, fluorite, gypsum, rock salt); ceramic and refractory minerals (clay, limestone, dolomite, feldspar, quartz, glass sand); construction and building minerals (decorative stones, limestone for cement); and fuel minerals such as coal.

Shan State is famous for its various mines such as Mongshu ruby mine, including sapphire and gems; the Bawdwin mine in Namtu; Barite mine in Heho; Gypsum resource at Mankaung in Thibaw; Sam Lao Coal mine in Thibaw; Mong Hkok Coal mine in Mongsat; Mong Len gold mine in Tachileik and Man Maw tin mine in Wa county. Estimated tin production by Myanmar has seen a more then tenfold increase in the four years to 2015. This is almost entirely due to the rapid growth in a major new mining centre in Wa county, close to the border with China's Yunnan Province.

Figure 40: Rubber plantation in Wa area

Source: UNODC field survey, eastern Shan State, March 2013.

Figure 41: Rubber plantation in Wa area

Source: UNODC field survey, eastern Shan State, March 2013.

Figure 42: Rubber plantation in Wa area

Source: UNODC field survey, eastern Shan State, March 2013.

Figure 43: Rubber plantations between Tachileik and Mongsat

Source: UNODC field survey, eastern Shan State, March 2013.

Conversely, poorly managed and supported mining sites lead to environmental disturbances that extent well beyond the extent of mineralized areas. Mining activities, especially with open pit systems, usually convert green land to bare land that is often polluted with hazardous materials. They also contaminate air and water in nearby streams and rivers. In most mining sites in Myanmar, environmental considerations and operations to repair environmental damage, including deforestation and forest degradation, are lacking.

For example, in Shan State over 10 companies have been carrying out mining in the Loi Kham hills east of Ta Lay, Tachileik Township, since 2007. They have dug up over 11 square miles of forested hillsides and used large amounts of cyanide to extract gold. The resulting soil erosion and water pollution have destroyed the farming livelihoods of about 340 people in two nearby villages, Na Hai Long and Weng Manaw. The main local water source, the Nam Kham stream, is now shallow and polluted. Rice fields and vegetable gardens have been destroyed, farm animals poisoned, and people are suffering from skin diseases. Families can no longer afford to send their children to school, and young people are migrating to neighbouring countries to work. Only minimal compensation has been provided by companies. Therefore, the affected villagers and the Shan Farmers' Network have submitted the following demands to Shan State Parliament:

The gold mining companies must stop their mining operations in Mong Len area, and withdraw all equipment and personnel from the area. The waterways and lands must be restored to the condition they were in before the mining began. Full compensation must be provided for all the losses incurred by local villagers due to the mining. This happened July 16, 2014, in eastern Shan. (This problem, i.e. awaiting action on the demands, is still going on up to now, a Tachileik district forest officer said at the validation workshop held 4 August 2017.)

3.1.2 Indirect/Underlying drivers of deforestation

- Population growth (natural and migration)
- Economic growth (international and national)
- Weak law enforcement
- Poverty and subsistence
- Conflicting policy
- Language barriers

Figure 44: Shwe gas-oil pipeline crossed near Kyaukme

Source: The Irrawaddy: China's "Strategic" Gas Pipeline in Myanmar.

Figure 45: Shwe gas-oil pipeline construction in northern Shan State

Source: The Shwe gas pipeline seen in northern Shan State, April 2012.

- Land tenure uncertainties
- Inadequate natural resources planning and monitoring

Population growth (natural and migration)

Myanmar's economy largely depends on natural resources and agriculture. In light of the aforementioned, inadequate infrastructure, limited expertise, and administrative constraints have stifled the manufacturing sector. Poverty levels are at an estimated 26% of the population, and poverty is twice as high in rural areas, where 70% of the population lives. Heavy dependence on forests due to poverty results in deforestation, land degradation, and self-destruction of the micro- environment as well as erratic climatic conditions. Again, severe environmental and climatic conditions cause greater poverty and more destruction (FAO and RECOFTC 2016).

This kind of environmental degradation is serious in Shan State. According to the 2014 census report, the population of Shan State has increased by about 56% between the 1983 and the 2014 censuses. The population of Shan State ranks fourth in size when compared with other regions and states in the country, surpassed only by Yangon Region, Ayeyarwady Region, and Mandalay Region in that order. In terms of the proportion of the total population, the population of Shan State has increased from 10.5% in 1983 to 11.3% in 2014.

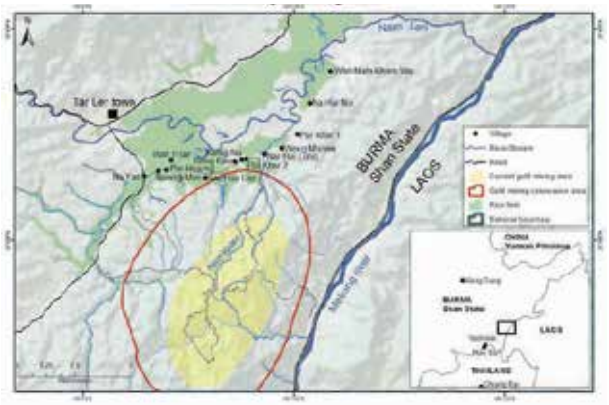
Farmers in Shan State face numerous problems. The soils are generally infertile, and crop and livestock yields are low. The area's isolation and lack of infrastructure make it difficult for farmers to sell any surplus produce at a profit. Landholdings are small, and population growth forces farmers to overexploit the natural resources (cutting more trees for fuelwood and clearing land on steep slopes for cultivation). The environmental degradation further reduces yields, reinforcing a **vicious cycle of poverty.**

That is why as mentioned above, to make a living, some farmers turn to poppy cultivation because of the easiness to earn a consequent living from it. The end result of these changes will be drugs have become an alarming issue in Shan State.

Economic growth (international and national)

The new economic policy of the new government is highlighting national reconciliation and job creation as an important consideration for the policy which guarantees nationwide equitable development. It brings equitable development to the agricultural, livestock, and industrial sectors. Regarding natural resource extraction, the new government is trying to keep a balance between environmental conservation and the economic development of the country with consent of the people.

Figure 46: Gold mining in Mong Len, Tachileik Township, Shan East



Source: Stop gold mining: Gold-mining-leaflet-in-Eng.pdf

Although the country's long-term economic potential is bright on account of its moderate population growth and abundant natural resources, the lack of security remains a disrupting influence on Myanmar's economic life, especially in upland areas. It is important to encourage private-sector enterprise to improve the standard of living. Myanmar has begun the catch-up process and is undergoing an important agriculture sector development. The purpose of the Sustainable Agricultural Development Strategy towards 2030 is modernizing Myanmar's agriculture sector based on achieving food security and ensuring the progress of farmers and rural society. At present, 55% of farms are tiny plots, measuring less than 2 hectares, and the country lacks the basic infrastructure, investment, and expertise to process higher-value goods for exports.

That is why the Government of Myanmar is trying to introduce a mechanized agriculture system and permanent large plots and irrigation system even in hilly regions as much as possible. Thus, intensification of irrigated upland farming system was carried out in the past when farmers mainly practiced shifting cultivation as well as extended vast untapped farmland. That means most of the fallow lands were permanently changed to other land uses.

The rapid growth of agribusiness concessions in northern and eastern Shan State is worse. Northern borderlands of Myanmar have undergone dramatic changes in the last two years. Rapid socioeconomic changes were taking place in resource-rich ethnic borderlands of northern and eastern Shan State, especially Wa region in eastern Shan State.

At the same time Chinese agricultural investments in northern and eastern Shan State had increased under China's opium substitution programme, especially in rubber. The main benefits of these programmes do not go to poppy growing communities, but to Chinese businessmen and local ethnic armed groups. Among agricultural crops cultivated in northern Myanmar is rubber, which is in great demand in China where there are limited suitable areas remaining for rubber cultivation. Other crops are paddy, corn, watermelon, banana, sugarcane, cassava, and tea plants. In fact, this is a kind of land colonization under the name of China's national opium substitution program. Local populations who have been forcibly displaced from their upland swidden agroforestry lands for the Chinese agricultural estates are further contributing to poverty, drugs production and trade, and social and political conflict.

The huge increase in large-scale commercial agricultural plantations in northern Myanmar is taking place in an environment of unregulated frontier capitalism. Land encroachment and clearing are creating new environmental stresses, such as further loss of forest biodiversity, increase d soil erosion, and depleted water sources.

Figure 47: **Satellite image of gold mining area in Mong Lin, Tachileik, Shan East**

Source: Google Earth

Weak law enforcement

Shan State is constituted with one administrative region, four self-administrative zones, 11 districts, and 55 townships. Shan State is belonging to diverse ethnic and religious groups, being a minority of Bamar and majority of Shan. The contradiction between Bamar and ethnic groups highlights the long history of armed conflict that hampered the development and affected the quality of life of the inhabitants of the region. Rules and regulations are not effective in some portions of Shan State because of conflict and a lack of security.

Shan State is amongst the areas in Myanmar with the greatest religious and ethnic diversity, namely Shan, Danu, Palaung, Padaung, Pa-O, Kokang, Wa, Kachin, Bamar, Ahkhar, Lahu, Lisu, and others. The authorities of Shan State government have been able to serve the interest of regional residents with sweeping reforms in various spheres during a one-year period of the new administration. With a view to ensuring the improvement of the socioeconomic status of local residents, peace and stability in the region, and rule of law and multi-sector development, the Shan State government had made relentless efforts for agricultural development, construction of bridges in both urban and rural areas, ensuring power supply and development of the education, health, and tourism sectors.

However, with a total population of over 5.8 million, Shan State is home to only a minority of Bamar ethnicity, the majority being Shan. This contradiction to the nationwide picture (where Bamar are a majority) underscores the long history of armed conflict that hampered the development and affected the quality of life of the inhabitants of the region.

In terms of forest law, the first Forest Act was enacted in 1902, which was updated as the 1992 Forest Law and followed by the Forest Rule in 1995. Both were prepared in harmony with the Forest Policy 1995. The Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law was formulated in 1994. The Community Forestry Instructions (CFI) were also issued in 1995. The 1992 law supports conservation, sustainable forestry, and socioeconomic benefits. Moreover, the 1992 law decentralizes forest management to some degree and encourages private sector and community participation in forest management. In fact, one of the basic principles of the Forest Law is to safeguard against degradation and depletion of natural

forests and to conduct afforestation in areas where natural forests are depleted. At present, those Forest Law and Community Forestry Instructions were amended to be in line with the current situation in 2016.

However, in reality, these rules and regulations and instructions cannot be fully enforced in most portions of Shan State because of armed conflicts and a lack of security. Forest operations and activities also cannot be properly done across the state.

Poverty and subsistence

According to the UNDP's Human Development Report 2016, Myanmar's HDI value for 2015 is 0.556 (see Table 31), which put the country in the medium human development category, positioning it at 145 out of 188 countries and territories.

The country rated poorly in the 2015 World Economic Forum (WEF) Global Competitiveness report, ranking 134 out of 144 between Madagascar and Venezuela. Access to financing, a poorly educated workforce, political instability, tax complexity, weak bureaucracy, and inadequate infrastructure were all highlighted as problems by the WEF.

The World Bank highlighted issues with contract law, minority shareholder protection, access to credit, insolvency protection, and difficulties in starting a business as impediments to doing business in Myanmar. Corruption is a major problem; the 2016 Transparency International Corruption Perceptions Index ranks Myanmar 136 out of 176, between Lebanon and Nigeria (Transparency International 2016). The World Bank recently published Ease of Doing Business Rankings for countries in Southeast Asia. Myanmar ranks 170 out of 190 countries this year (Figure 48).

Figure 48: The Ease of Doing Business Ranking in Myanmar

Conflicting policy

In some cases, forest policy and law conflicts with the Vacant, Fallow and Virgin Lands (VFV) Management Law, e.g., some of the community forestry area is overlapping with agricultural business expansion area within the vacant, fallow, and virgin lands because local forest and agricultural departments did not know the implementing activities of each other. The worse is regional administer can permit rural farmers up to 50 acres for their own agribusiness by VFV law.

In fact, competition for land for investment, resource extraction, and conservation is becoming more common. It is said that community-outsider conflict is believed to have increased in both number and severity. This kind of conflict which takes place normally between internal actors (communities and indigenous peoples) and external actors (such as government agencies and developers) has received considerable attention in the media but little analytical attention.

The direct causes of conflict were more diverse. When a local community's culture and deep connection to land and forests was disrupted by outsiders, conflict emerged and worsened. The prominent direct causes of conflict in Shan State were as follows:

- Destruction of community economic and social assets (e.g., land, gardens, orchards) because of company operation (e.g., mining, logging, plantation development);
- Loss of income and livelihood opportunities due to the establishment of conservation areas;
- Eviction of local communities from their land;
- Pollution (e.g., air pollution, soil and water pollution, noise) caused by logging, plantation, and mining operations.

For instance, there are land conflicts between local villagers and over 10 gold mining companies in the Loi Kham hills east of Ta Lay, Tachileik Township. In Taunggyi District, the Pangpet steel factory and Cement factory also face with the same problem. In the mining sector, such stories are common across Shan State.

Language barriers

As mentioned above, Shan State is amongst the areas in Myanmar with the greatest ethnic diversity. Out of 135 officially recognized ethnic groups in Myanmar, Shan has 33 different groups. The people of Shan State can be divided into nine primary ethnic groups: Shan, Pa-O, Intha, Lahu, Lisu, Taungyo, Danu, Ta'ang, Ahka, and Jinghpaw (Kachin). The valleys and tableland are inhabited by the Shans, who in language and customs resemble the Thais, Dai, and Lao.

Linked to its ethnic diversity, their language also got diverse. Local languages in Myanmar are usually not inter-intelligible, for example, Kachin language speakers will not understand representatives of the Shan linguistic community. That is why local forest officers face difficulties in communication with local ethnic people in implementing forest activities and explaining forest law and regulation and also mobilizing.

Land tenure uncertainties

Tenure insecurity has consistently been identified as an underlying driver of deforestation in Myanmar. The most common form of traditional tenure that still holds good and is also recognized by law is *dama-ucha*, literally "the one who wields the machete first is the owner", even if the field has been fallow. This is also applies to *taungya* and paddy land. The Burmese word commonly used to mean swidden cultivation is *taungya* (a combination of *taung* meaning 'hill' and *ya* meaning 'cultivation'). In fact, the exact word for swidden is '*shwe pyaung taungya*'. Several other phrases have been used to describe this process, including shifting cultivation, rotational cultivation, and slash and burn.

Shifting cultivation (swiddening) is a traditional and well-established agricultural system in Myanmar. It provides subsistence or supplementary livelihood to many farming families, particularly in the hilly border regions. However, it continues to come under pressure from economic, political, demographic, social, and technological changes. These drivers are causing a transition from widespread reliance on swidden to more permanent forms of cultivation.

Table 33: Myanmar's HDI trends based on consistent time series data

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2011 ppp$)	HDI value
1990	58.7	5.9	2.4	745	0.353
1995	60.5	7.2	2.7	928	0.393
2000	62.1	7.6	3.1	1,257	0.427
2005	63.6	8.0	3.6	2,196	0.474
2010	65.0	9.1	4.1	3,604	0.526
2011	65.3	9.1	4.3	3,780	0.533
2012	65.5	9.1	4.5	4,020	0.540
2013	65.7	9.1	4.7	4,314	0.547
2014	65.9	9.1	4.7	4,660	0.552
2015	66.1	9.1	4.7	4,943	**0.556**

Moreover, most land in Myanmar, in particular in the uplands, is not titled. Only 15% of farmers have land use certificates and around 30–50% of rural families, depending on region, are landless and work as casual labour in agriculture. Communities practicing rotating fallow farming systems or shifting cultivation have no titles although most of this untitled agricultural land has long been used by farmers (land core group). The Farmland Law, passed in 2012, created property rights for individuals by allowing for the issue of land-use certificates depending on its registrations. Nevertheless, the government still maintains ultimate ownership of the land, and it can rescind the relevant usage rights for any number of violations.

The Vacant, Fallow, and Virgin Lands Management Law, known as the VFV Law, was also passed in 2012. The law is updated from the Rules for the Grant of Waste Land (1861) and Wasteland Instruction. Under the VFV Law, a tract of land can be leased from the government for up to 30 years. A company or a person can acquire 5,000 acres each purchase and can acquire a total of 50,000 acres. Agriculture use is included under the law, but properties cannot be sold or leased onward without the permission of the government. Foreigners can participate in the programme, and rural farmers can apply for up to 50 acres.

However, in most upland areas, land tenure systems are based on customary rights under local institution (Eberhardt 2003). These customary land management systems have been poorly integrated with the state land management system. The 2012 Farmland Law and VFV Law significantly altered how agricultural land is managed. But these laws also contain minimal interaction with customary land management systems.

That is why tenure security is essential to fulfil REDD+ safeguards as recognized in the Cancun Agreement. Without ownership of forests and forest carbon stocks, REDD+ payments could not create an incentive for land grabs by carbon speculators. Tenure security is also necessary so that direct payments for forest conservation and management can be received by the legitimate owners of the forests.

The National Land Use Policy recognizes customary tenure and specifically land under shifting cultivation. REDD+ could help to implement this policy by recognizing tenure over shifting cultivation fields and fallows. Securing tenure of shifting cultivation would reduce emissions by allowing farmers to protect this land from conversion and to maintain relatively carbon-rich, long-fallow rotations.

Inadequate natural resources planning and monitoring

For forestry administration purposes, the country was divided into districts under 15 regions, including NayPyiTaw Region, and into states each of which was covered by a forest management plan. A midterm plan of 10 years, each plan had its annual yield checked at midterm and was revised at the termination of the period. All forestry activities were carried out strictly as prescribed in the plan. The district forest management plans if appropriately implemented will (beyond doubt because of integrated both social and environmental dimensions into the economic development of the sector) lead to the sustainable development of both flora and fauna of Myanmar. However, the prevailing political, financial, and social environment of the country severely

Figure 49: Location of Pang pet Steel Mill and Cement Factory

Source: No - 2 Steel Mill, Pang Pet, which is suspended now (March 20, 2017)

Figure 50: **Entrance of Pangpet No. 2 Steel Mill**

Source: No - 2 Steel Mill, Pang Pet, which is suspended now (March 20, 2017)

Figure 51: **Satellite image of Pangpet Steel Mill**

Source: Google Earth

constrains the realization of the management plan prescriptions.

The MTE is solely responsible for the extraction of both teak and other hardwoods. MTE is mandated to harvest timber within the bounds of annual allowable cuts (AAC) following corresponding girdling and marking schedules prescribed in the 10-year forest district management plans prepared by Forest Department and approved by the Minister of Forestry.

Because of difficult terrain, practice of the selection system, and very low per unit area yield, mechanized logging is not economical. In light of this, MTE extensively uses elephants and buffaloes for stumping and skidding of logs. MTE now uses more than 3,000 elephants and 1,200 buffaloes for logging.

Although Myanmar Forest Department is trying to practice Myanmar Selection System (MSS) with annual allowable cuts (AAC) basis to meet Sustainable Forest Management (SFM), unfortunately, it has not actually happened in Myanmar forestry sector. Most accessible forests are repeatedly cut, while the backlog of green and girdled teak and other hardwoods in remote areas is being illicitly exploited.

Modified procedure (MP) of timber extracting, with Forest Department has to approve in insecure areas, and is extremely dangerous to the sustainability of the forest resources. Harvesting wastage and damage are too big. About 30% of the felled volume is estimated to be left in the forest, while about 15% is lost in transit, let alone very low recovery at the state sawmills. Construction of temporary extraction roads is not properly planned and thus costly both financially and environmentally, and destructive to the forest soils and the forests.

Despite the laws, systems, and institutions in place, the forest sector has not been well managed. Less strict controls in the past allowed for the overproduction and sale of logs, and this practice was largely responsible for the decline in forest land. Myanmar has the third-worst rate of deforestation in the world, following closely behind Brazil and Indonesia.

Although Myanmar has a well-established set of rules and regulations guiding forestry, it lacks an internationally recognized certification system, and the authorities have failed to distinguish between timber harvested in official forest production areas and timber sourced as a consequence of areas being cleared for agriculture. Myanmar is undertaking a number of significant reforms. Due to the lifting of sanctions and emphasis on foreign direct investment and value added, the country has started to look more closely at its priorities when it comes to forestry resources, recognizing the need for conservation.

In April 2014, Myanmar banned export of raw timber logs to slow deforestation and boosts its own production. Despite the ban, illegal logging has thrived on the north-eastern border where valuable teak and rosewood are smuggled over the border to neighbouring China. Every year, Myanmar seizes between 50,000 and 60,000 tonnes of illegal logs, for an average of 40,000 tonnes a year over the past 10 years.

As such, a bid to curb deforestation and allow regrowth, the government implemented a nationwide ban on logging for one year. Major forested areas, like the mountain ranges in Rakhine, Shan, and Kachin states, were suspended. A logging ban of 10 years will be maintained in the Bago Yoma range (home of famous Myanmar teak) from 2017–18 to 2027–28.

In light of the aforementioned, reform is urgently needed. The MTE plans to reduce the harvest in 2015–16 and stop logging completely in 2016–17. The MTE should be corporatized or privatized, but it cannot because of its responsibility over natural resources. That is why MTE reformation is still under consideration and remains a dilemma.

In this context, southern Kachin State and northern Shan State are the track of illegal timber trade to China. Most of the tracks of illegal timber transportation to the Myanmar-China border area cross mostly northern Shan State and southern Kachin State. Although Myanmar has developed a legal framework and tracking system to control the timber, seizing and monitoring cannot be done properly because of limited financial and human resources and limited equipment and capacity of Myanmar's law enforcement agencies, as well as long and porous national land and protected-area borders. These issues are compounded by the high level of demand for natural resources and wildlife products, both domestically and across the borders in China and Thailand.

The other factor is that government officers cannot access everywhere because of security concerns, especially in Palaung and Kokang Self-Administration Zones (SAZ) and Wa Self-Administration Division (SAD) without prior knowledge to them. Another serious problem in some regions is communication. For instance, in Linkhay area, local ethnic people don't want to have any dealings with government officers and only believe and respect their tribe leader.

3.2 Drivers and status of forest degradation

- Overexploitation of timber (legal and illegal logging)
- Fuelwood consumption
- Forest fire

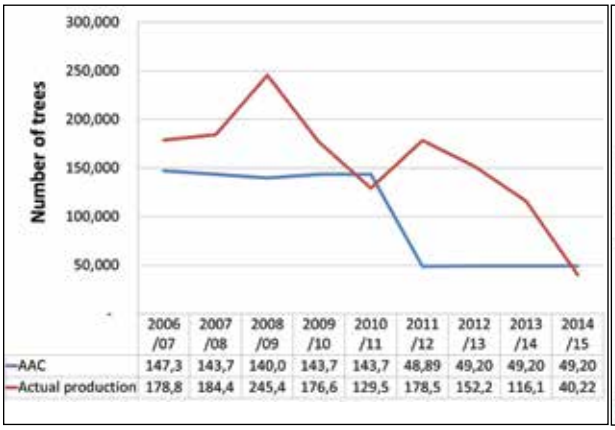
3.2.1 Direct/Proximate drivers of forest degradation

Overexploitation of timber (legal and illegal logging)

Global demand for timber, agricultural commodities, and extractives is a significant driver of deforestation worldwide. The majority of the world's forests, including Myanmar and Shan State, are owned by governments, which often enter into contractual agreements with private companies or individuals for resource exploitation or conversion in a specific area for a predetermined amount of time.

Under the Myanmar Selection System, the annual allowable cut (AAC) is the main indicator and controlling factor for sustainable management of forests. Timber harvesting basically followed the AAC until 1980. However, between the 1980s and 2011, the forestry sector was required to set its own annual income target to contribute to the regional as well as national GDP. This rush for income required additional harvesting of immature trees and led to weakening of well-developed forest management systems. Consequently, annual timber production by Myanmar Timber Enterprise (MTE) exceeded the prescribed AAC of that period. Figure 52 compares the actual teak production and the prescribed AAC during the period 2006/07 to 2014/15. Figure 53 also compares the actual hardwood production and the prescribed AAC during the period 2006/07 to 2014/15. It is obvious that the government had harvested teak over the AAC within the respective period, but hardwood harvesting did not exceed its AAC. Moreover, in terms of the AAC of the whole country (Figure 54), Shan State is the second highest after Sagaing Region. Shan State has the highest forest cover, but Kachin State has the highest intact forest coverage (see Figure 22). The AAC amount of Kachin State is lower than Sagaing Region and Shan State because most of Kachin area is an insurgent area where logging operations cannot be properly done.

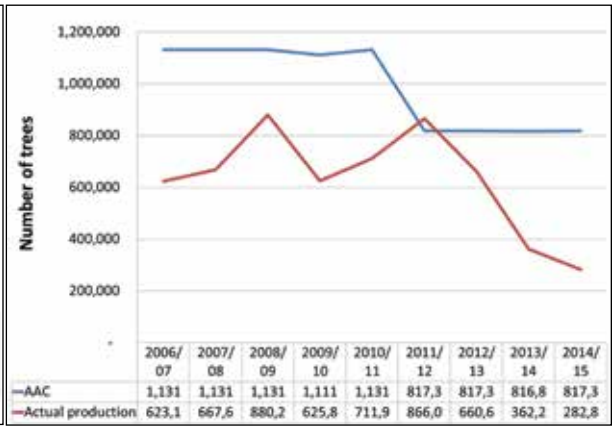
Figure 52: **Actual teak production versus AAC between 2006–14**



	2006 /07	2007 /08	2008 /09	2009 /10	2010 /11	2011 /12	2012 /13	2013 /14	2014 /15
AAC	147,3	143,7	140,0	143,7	143,7	48,89	49,20	49,20	49,20
Actual production	178,8	184,4	245,4	176,6	129,5	178,5	152,2	116,1	40,22

Source: Forest Department, Planning and Statistics Division.

Figure 53: **Actual HW production versus AAC between 2006–14 FY**



	2006/ 07	2007/ 08	2008/ 09	2009/ 10	2010/ 11	2011/ 12	2012/ 13	2013/ 14	2014/ 15
AAC	1,131	1,131	1,131	1,111	1,131	817,3	817,3	816,8	817,3
Actual production	623,1	667,6	880,2	625,8	711,9	866,0	660,6	362,2	282,8

Source: Forest Department, Planning and Statistics Division.

Figure 54: **Actual annual cut (AAC) by regions and states**

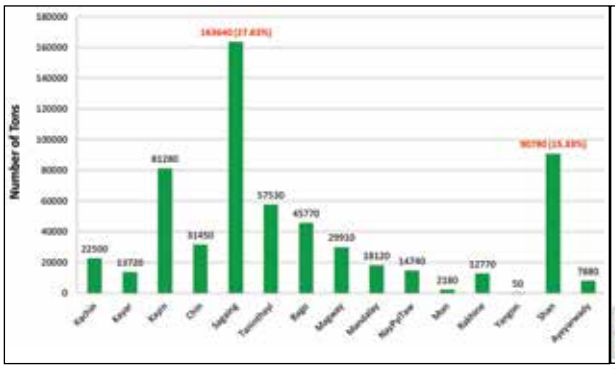
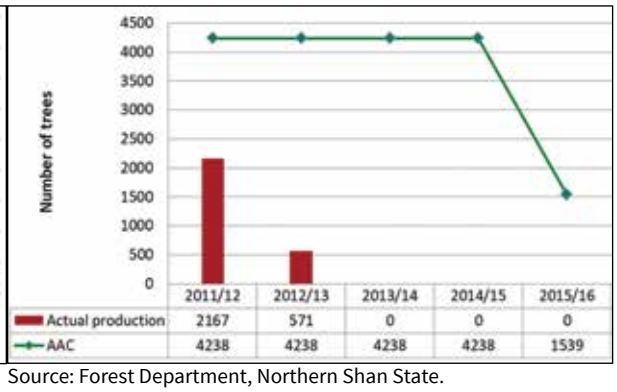


Figure 55: **Actual teak production versus AAC between 2011–15 FY in northern Shan State**



Source: Forest Department, Northern Shan State.

In terms of Shan State, according to the regional office data, in Taunggyi District, teak had been extracted in 2014/15 without any AAC; hardwood also had been extracted over AAC in 2011/12. In Linkhay District, timber had been extracted by modified procedure (MP system) (see Figures 57 and 58). In northern Shan State, teak extractions were under the AAC limit, but hardwood extractions were more than AAC before 2012/13. In eastern Shan State, all extractions were practiced under modified procedure. That means the MSS system had not been practiced in that area (see Figures 56, 59, and 60).

Figure 56: **Actual HW production versus AAC between 2011–15 FY in northern Shan State**

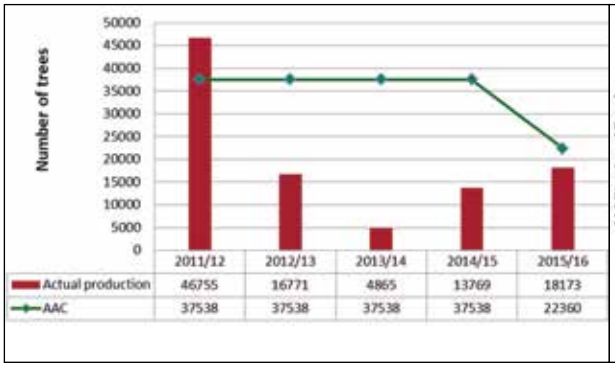
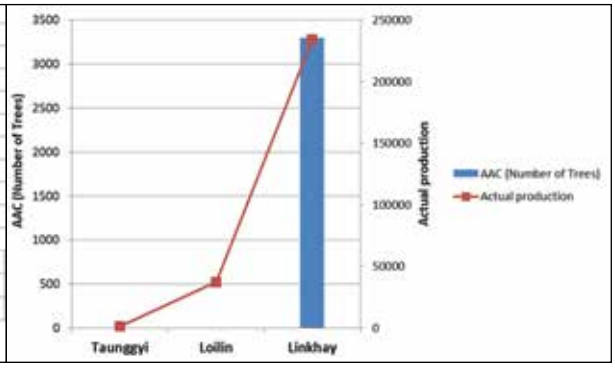
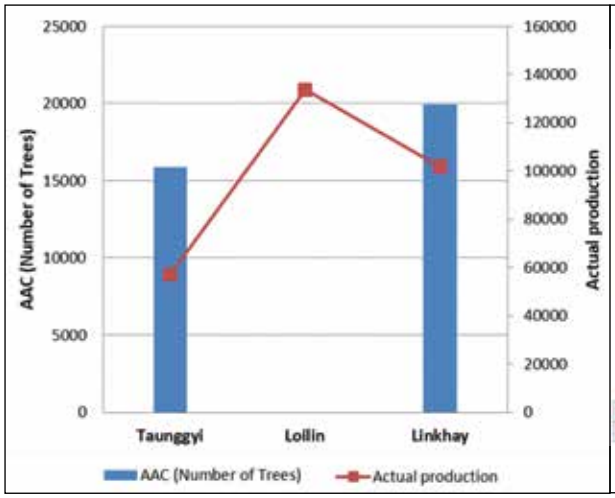


Figure 57: **Actual teak production versus AAC between 2006–15 FY in southern Shan State**



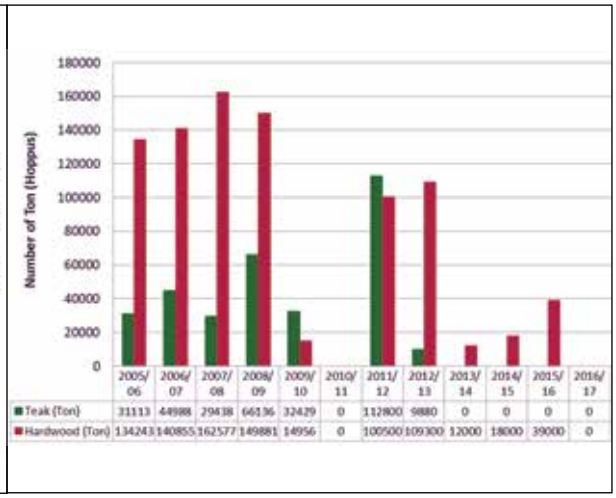
Source: Forest Department, Southern Shan State.

Figure 58: **Actual HW production versus AAC between 2006–15 FY in southern Shan State**



Source: Forest Department, Southern Shan State.

Figure 59: **Teak and HW production (legal) in northern Shan State**

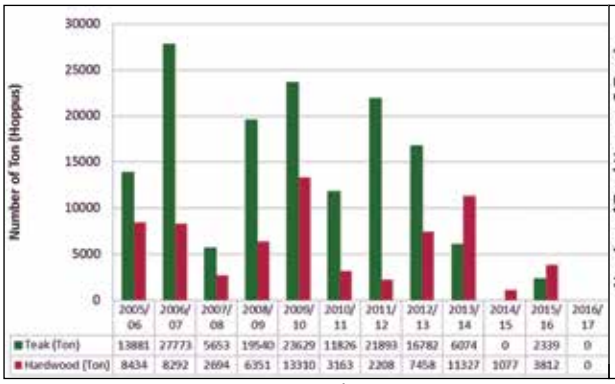


Source: Forest Department, Northern Shan State.

Furthermore, Myanmar forests have faced additional pressure from illegal logging, removal of fuelwood, and harvesting of NTFPs. Illicit logging is a common problem. Usually it is carried out by forest dwellers and small local merchants who take advantage of the remoteness of forest areas and weak law enforcement. The fundamental causes of illicit logging are, amongst others, increased demand for forest products in local and neighbouring countries, particularly timber and fuelwood, and high timber prices due to supply-demand imbalance and corruption (see Figure 61).

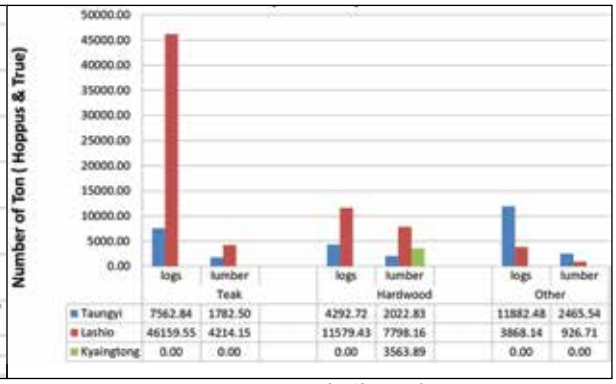
That is why the Government of Myanmar enacted a ban on the export of raw logs, which took effect on 1 April 2014. The new Government of Myanmar has agreed a one-year temporary national logging ban and a 10-year logging ban in the Bago Yoma region to give beleaguered forest breathing space from years of unchecked exploitation. Taken together with the fall in the official cross-border timber trade, the new logging ban proposed by the Minister of Natural Resources and Environmental Conservation (MONREC), U Ohn Win, gives grounds for hope that Myanmar is entering a new era of forest management in which conservation and transparency are at the fore.

Figure 60: Teak and HW production (legal) in eastern Shan State



Source: Forest Department, Eastern Shan State.

Figure 61: Volume tonnes (hoppus & true) of timber by type, seized by Forest Department of Myanmar (2005/06–2016/17FY) *Up to August



Source: Forest Department Regional Offices, Shan State.

Fuelwood consumption

Fuelwood (firewood and charcoal) is the most common biofuel in Myanmar. Stems of cotton, sesame, pulse and beans, and other agricultural residuals are also utilized for daily cooking in the villages. Although urban households have more opportunities to use electricity or gas, there are still many limitations and blackouts in urban areas. Based on the household energy consumption of different types of energy for the period 1990–2010 and the projection for 2020 (estimated by the Energy Planning Department; FAO 2009), the share percentage of fuelwood and charcoal consumption significantly decreased over time from 84% in 1990 to 69% in 2010, and is projected to be 58% in 2020 (Table 34). However, due to the growing population, it is unlikely to decline in volume. MONREC has estimated that fuelwood consumption per household per annum is about 1.4 cubic tons (t_3) for urban households and 2.5 t_3 for rural households. With this rate and in combination with the increasing population rate, MONREC estimates that demand on fuelwood will increase from 17.5 million t_3 in 2001 to 20 million t_3 in 2020. This w fuelwood demand or removal is 12 to 13 times higher than the average annual harvesting of 300,000 tons of teak and 1.2 million tons of hardwood (total 1.5 million tons per annum) for the period 2006–12 (MONREC). MONREC has estimated that 90% percent of wood removal from forests is due to fuelwood production. People living in both rural and urban areas rely on forests to meet this huge fuelwood demand. This trend will continue unless household energy demand is substituted with other energy sources or sustainable forest management practices are implemented to meet rural wood energy needs (FAO and RECOFTC 2016).

Table 34: Fuel consumption in type of energy (percentage), 1990–2020

Type of energy	1990	1995	2000	2010	2020
Crude oil	6.69	7.05	8.00	8.00	9.00
Natural gas	3.94	4.32	4.50	6.00	10.00
Coal	0.25	0.37	0.41	0.80	1.00
Hydropower	1.70	3.91	6.0	9.00	13.00
Agricultural residuals	3.31	4.00	4.48	6.80	9.00
Firewood and charcoal	84.11	80.35	76.61	69.40	58.00
	100.00	100.00	100.00	100.00	100.00

Source: Energy Planning Department.

Similarly, Shan State woodfuel remains the main energy source for the majority of people. The use of fuelwood is the only form of energy for cooking. Men, women, and children from nearby forested areas collect firewood. At the high elevations people collect firewood during winter months only and store it in heaps for the whole year, whereas, at lower elevations wood is collected throughout the year. Due to collection of huge amounts of fuelwood, forests near the villages are subjected to rapid degradation and overexploitation. A very small fraction of fuelwood comes from the agriculture residues. According to the fuelwood consumption study paper in Taunggyi District, the main cause of deforestation and forest degradation is fuelwood collection (60%) and others including agricultural expansion, wildfire, mining, increased population, illegal logging, and shifting cultivation (40%). In addition, the dependency of fuelwood on forests is 60% and agricultural residue is 4%. From that study, the annual per household consumption of fuelwood in the village is estimated to be 2.6 tonnes, and charcoal is estimated to be about **1.34 tonnes in Taunggyi District**. According to the studies of Soe Tint (1996), the fuelwood consumption per household is 7.25 tonnes per year in the Ayeyarwaddy Region and 8.6 tonnes per year per household in the Mandalay Region. According to the World Bank review, fuelwood consumption in the Ayeyarwaddy, Mandalay, Sagaing, and Bago Regions and Shan State were 3.35 tonnes, 4.41 tonnes, 4.37 tonnes, 4.87 tonnes, and 4.37 tonnes, respectively. In Shan State, it was observed that fuelwood consumption decreased if we compare with the World Bank study and the previous study. Nevertheless, using fuelwood and charcoal in rural areas cannot be avoided until they have access to alternative energy sources such as oil, natural gas, and electricity.

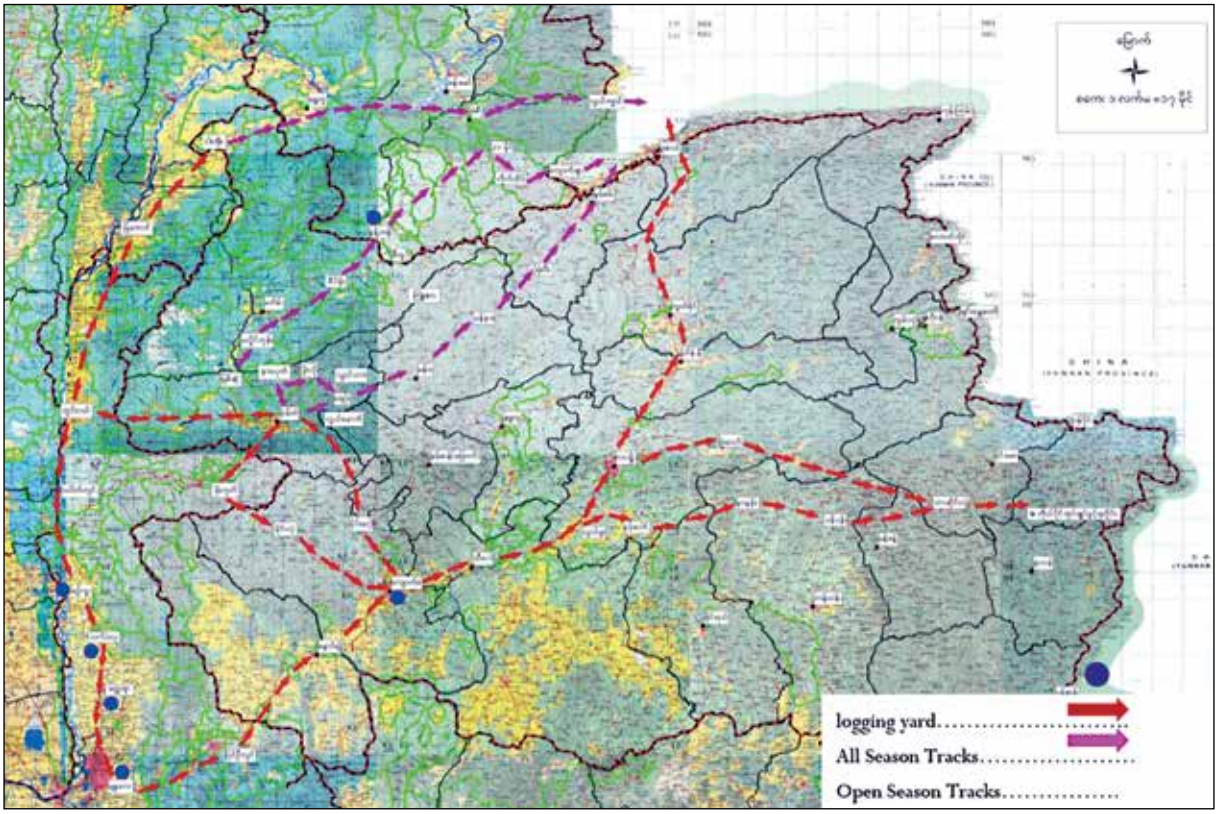
Figure 62: Legal logging in MongPuGyi area in eastern Shan State

Source: UNODC field survey, eastern Shan State, February 2017.

Figure 63: Legal logging on the way from Mongsat to Tachileik

Source: UNODC field survey, eastern Shan State, February 2014.

Figure 64: Map showing the trace of illegal timber trade



Source: Planning and Statistics Division, Forest Department.

Figure 65: Seized timber in northern Shan State

Source: Forest Department, Northern Shan State, 2017.

Figure 66: Seized timber in Namkham, northern Shan State

Source: Forest Department, Northern Shan State, 2017.

Figure 67: Seized timber in eastern Shan State (Ingyin & Thit-e)

Source: Forest Department, Eastern Shan State, June 2017.

Figure 68: Seized timber in southern Shan State

Source: Forest Department, Southern Shan State, April 2017.

Figure 69 shows fuelwood and charcoal production according to regional forest office data in northern Shan State. Charcoal production obviously declined in the later years because of national electric grid extension up to rural areas. In southern and eastern Shan State, most of the local people used fuelwood from their own woodlots (Cassia siamea) and community forests. There was no official production of fuelwood and charcoal in southern and eastern Shan State.

According to the 2014 census, the need for fuelwood (including charcoal) in the whole country is about 18 million tonnes. However, the government supplies only 900,000 tonnes, which means the remaining 17.1 million tonnes are harvested from illegal or unsustainable sources.

Figure 69: Fuelwood and charcoal production (legal) in northern Shan State

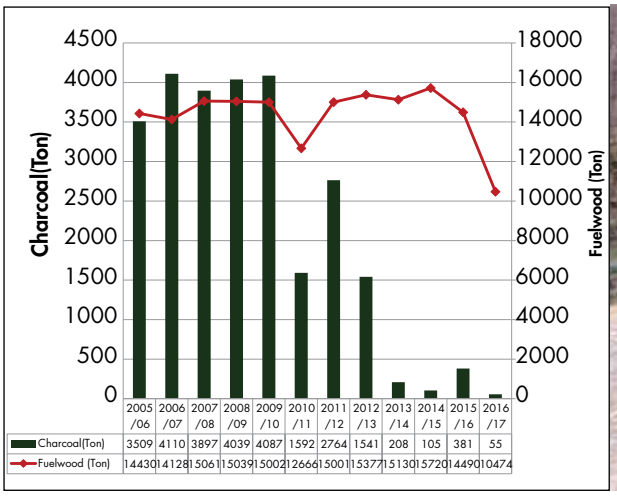


Figure 70: Fuelwood collection by children in eastern Shan State

Source: UNODC field survey, eastern Shan State in Wa area, March 2012.

Figure 71: Fuelwood collection in northern Shan State

Source: UNODC field survey, northern Shan State.

Figure 72: Commercial fuelwood production in Tagaung, Ayeyarwady riverbank, some from northern Shan State

Source: Forest Department, Northern Shan State.

Forest fire

In Myanmar, forest fires, referred to locally as wildfire, are mainly surface fires that can spread over a large area but do not turn into intensified burning. Due to the excessive forest coverage of the country, the incidents are found sporadically in almost all regions and states. However, they are more common in upland regions and states such as Bago, Chin, Kayah, Kachin, Mandalay, Rakhine, and Shan.

Figure 73: Commercial fuelwood production in Tagaung, Ayeyarwady riverbank, some from northern Shan State

Source: Forest Department, Northern Shan State.

Figure 74: Fuelwood collected from their own woodlots in eastern Shan State

Source: Forest Department, Northern Shan State.

Two main sources of forest fire in Myanmar can be categorized as natural and manmade. Yet, natural causes of lightning and friction of tightly packed trees are rarely the reasons and the following anthropogenic causes are responsible for the majority of incidents:

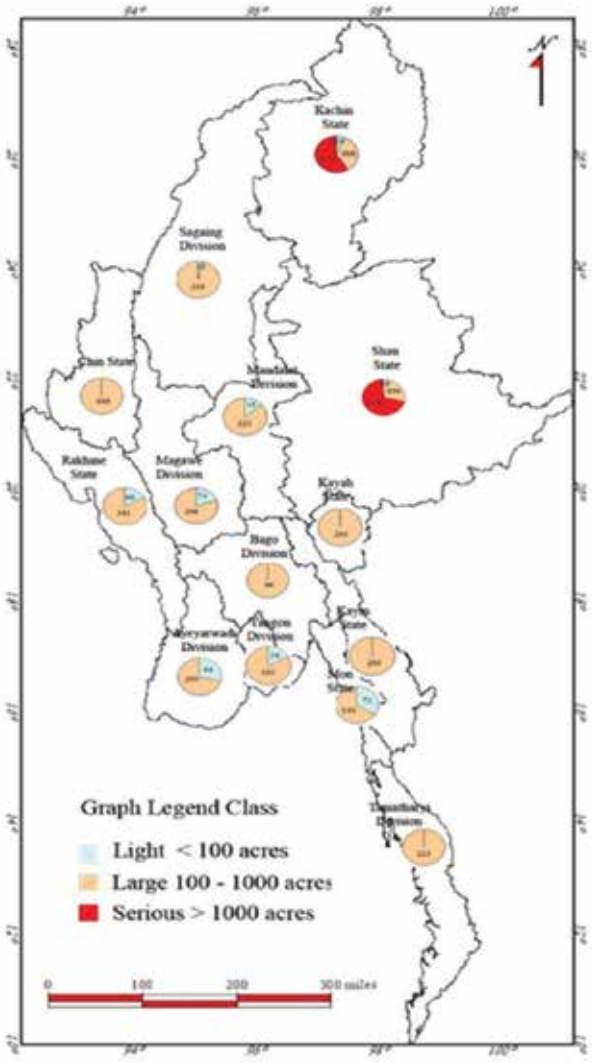
- Shifting cultivation (slash and burn or swidden);
- Deliberate burning of the forest for hunting purposes;
- Careless use of fire (smoking or cooking) in the forest;
- Intentional blazing of tree trunks to collect resin; and
- Purposeful burning of fodder ground to make room for the growth of new grass.

Notwithstanding the scarce cases of major forest fires in Myanmar, the outcomes are equally devastating and far-reaching regardless of the strength of a fire. Significant impacts include:

- Loss of invaluable woodland;
- Threat to watershed areas;
- Threat to wildlife;
- Threat to recreational facilities and resorts located within forest reserves;
- Loss of fodder ground;
- Threat to economy;
- Air and haze pollution; and
- Threat to public properties.

Myanmar's climate is principally influenced by the seasonal southwest monsoon. Consequently, three distinct seasons occur: **the hot season** from

Figure 75: Map of serious forest fire regions and states in Myanmar



Source: Forest Department, Planning and Statistics Division.

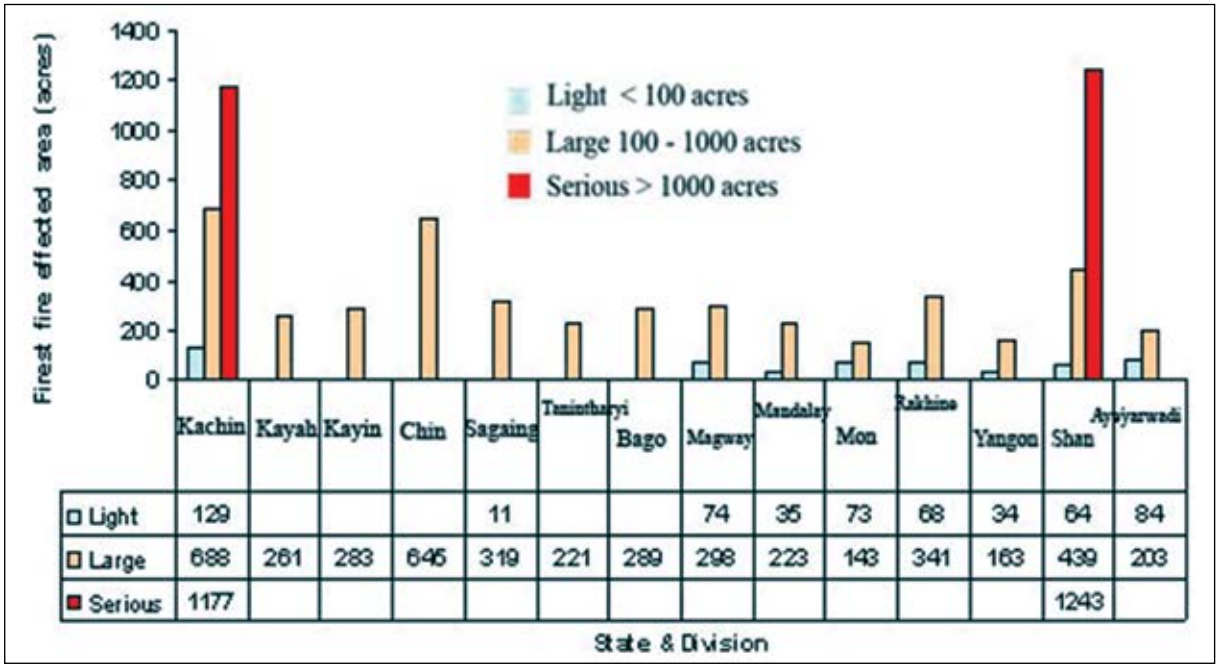
mid-February to mid-May, **the rainy season** from mid-May to mid-October, and **the cool season** from mid-October to mid-February. In Myanmar, forest fire (wildfire) normally occurs in the hot season. According to the analysis of MODIS hotspot data, the most serious forest fire areas are Kachin and Shan States. Forest fire in Myanmar is getting serious since last four years according to the hotspot data of Myanmar (see Table 35).

Table 35: NOAA hotspot data for ASEAN (ASMC 2015)

ASEAN country	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cambodia	6650	10526	13885	12911	14701	14270	14992	19033	17349
Laos	8566	16580	14139	15327	22819	12707	17679	15770	11540
Indonesia	29059	15141	14982	25792	8180	22386	27667	15613	24898
Sumatera	12014	7017	8349	10297	4147	10320	14032	8398	9728
Kalimantan	17045	8124	6633	15495	4033	12066	13635	7215	15170
Malaysia									
Peninsular	299	587	632	858	939	862	1236	1418	2608
Sabah & Serawak	1147	1798	1523	2467	1577	1468	2401	1549	1719
Philippines	1606	2322	1311	1357	2894	952	1167	1462	1946
Myanmar	18751	33468	27740	34871	38359	27976	52033	44397	37926
Vietnam	5193	8394	8947	9897	12537	9448	13981	12442	13225
Thailand	8578	14696	13654	14314	18503	13920	27033	22817	19120

Source: ASEAN Specialized Meteorological Centre-ASMC.

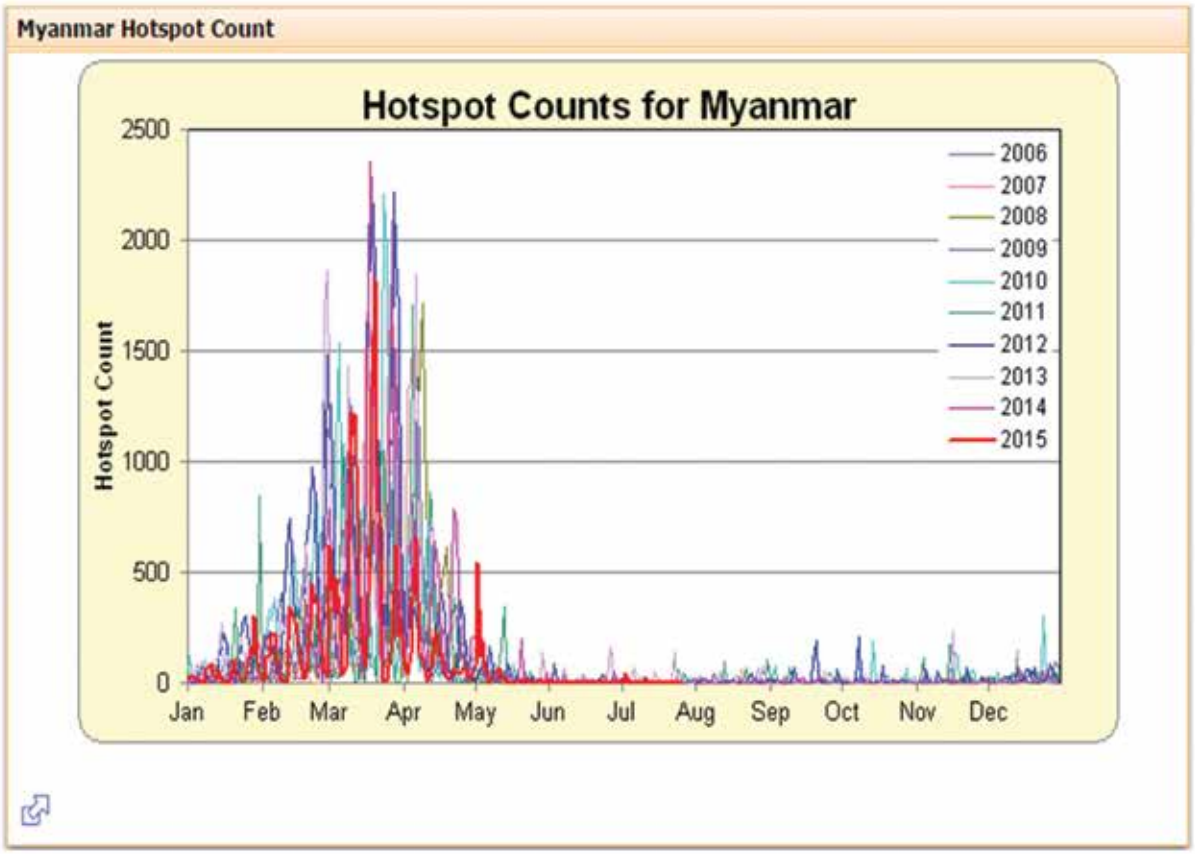
Figure 76: Bar graph showing serious forest fire regions and states in Myanmar



Source: Forest Department, Planning and Statistics Division.

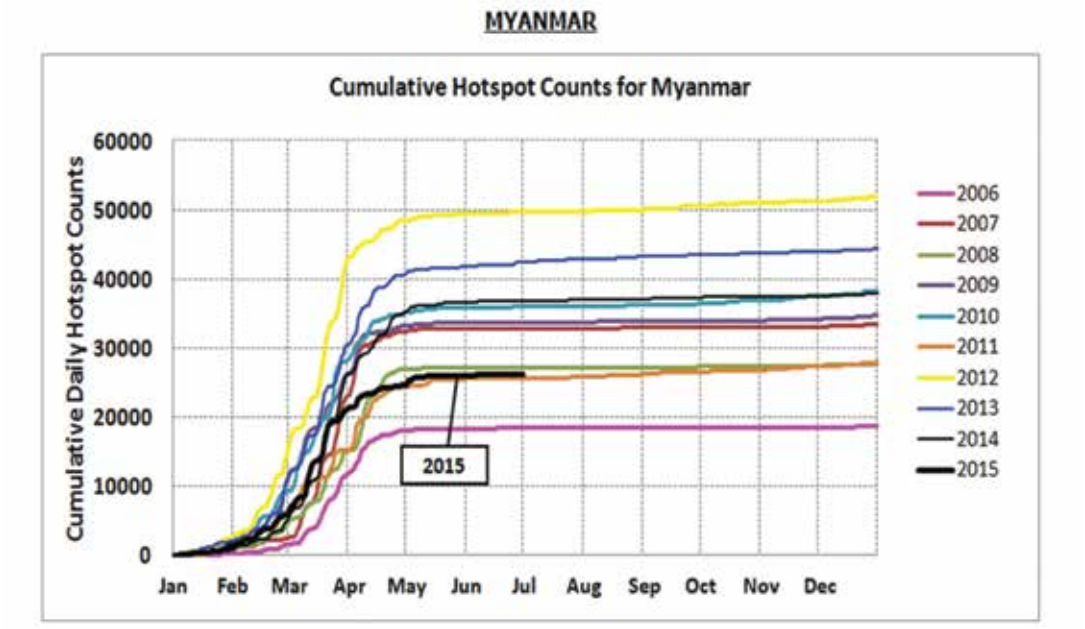
According to the final fire susceptibility map (Figure 81), central Myanmar is more susceptible to fires than the northern or southern regions due to unique land cover characteristics, which is mostly dominated by shrub lands followed by deciduous broadleaf and cropland-natural vegetation mosaics. At the state level, the highest fire susceptibility is observed for **Shan**, Kayah, Kayin, Mon, central Bago, southern Rakhine, southern Kachin, southwestern Sagaing, the borders of Chin, Magway and Sagaing, and northern and central

Figure 77: **Forest fire hotspot counts for Myanmar, 2006–15**



Source: Forest Department, Planning and Statistics Division.

Figure 78: **Forest fire cumulative hotspot counts for Myanmar, 2006–15**



Myanmar								
2006	2007	2008	2009	2010	2011	2012	2013	2014
18751	33468	27740	34871	38359	27976	52033	44397	37926
2015								
26168								

Source: Forest Department, Planning and Statistics Division.

Figure 79: **Surface fire in eastern Shan State**

Source: UNODC field survey, eastern Shan State, March 2013.

Figure 80: **Surface fire in northern Shan State**

Source: Near NaungCho, northern Shan State.

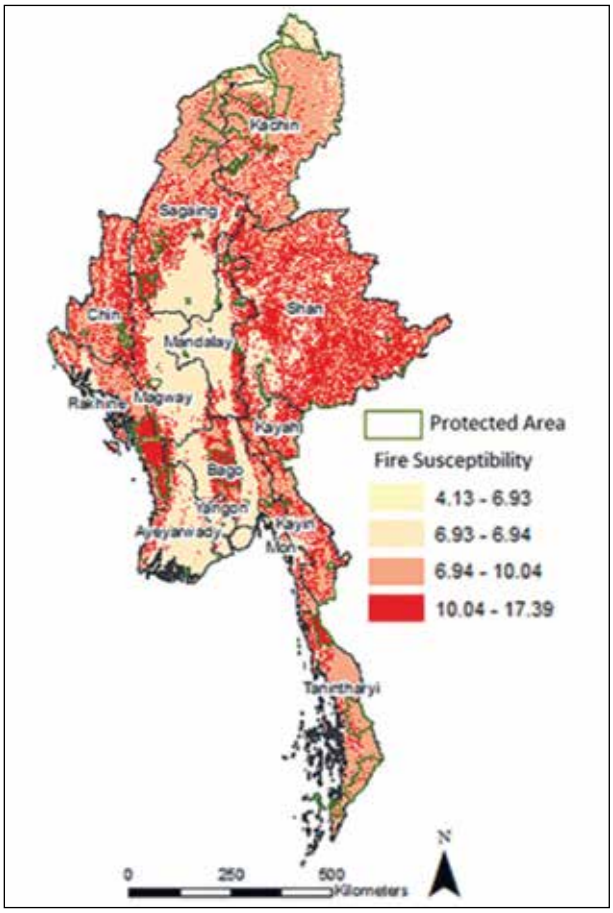
Tanintharyi. District clusters of fires with highest frequencies were observed in Thandwe in Rakhine; Bago, Toungoo, and Thayarwady in Bago; and Lashio, Kyaukme, Loilen, and Taunggyi in **Shan** (see Figure 81).

Further, most low elevation fires are associated with clearing near settlements while high elevation fires were associated with slash and burn agriculture (*taungya*) practiced by the rubber plantations in recent times

3.2.2 Indirect/Underlying drivers and forest degradation

Although direct/proximate drivers are human activities which directly impact forest cover, as seen in Figure 8, indirect/underlying drivers consist of interplay of population growth, economic growth, and technological, institutional, and sociocultural factors (Geist and Lambin 2002). According to the results of the consultation meeting and as mentioned in Section 3.1.2, the main **underlying drivers of degradation** are also population growth, economic growth, weak law enforcement, poverty and subsistence, conflicting policy, land tenure uncertainties, and inadequate natural resource planning and monitoring.

Figure 81: **Fire susceptibility map of Myanmar**



Source: Biswas et. al. 2015.

3.3 Strategic options for addressing drivers of deforestation and forest degradation

3.3.1 Priority order of the strategic options

According to the result of the stakeholder meeting in Shan State, the strategic options were prioritized as follows:

Priority 1. Reduce forest loss from agricultural expansion and agribusiness plantations

- Include input from Forest Department on site selection and allotment.
- Introduce high-yielding variety crops and farming systems and disseminate higher yielding variety seeds and seedlings.
- Tax the cutting of trees also outside of permanent forest estate (PFE) (all relevant line departments: GAD, DOA, DALMS).

Priority 2. Reduce forest loss from shifting cultivation

- Introducing agroforestry practice with the support of perennial crop seedlings.
- Establishing forest villages for shifting cultivators.
- Introducing sustainable shifting cultivation system with suitable rotation.
- Establishing community forestry.
- Establishing private forest plantations.
- Establishing model farming.

Priority 3. Reduce impact of overexploitation of commercial logging

- Determining the AAC based on the need of the changing socioeconomic, environmental, and silvicultural considerations and limited harvesting of timber of all species to the specified AAC.
- Conducting pre- and post-harvesting inventory.
- Inspecting whether timber production will be in line with AAC and followed departmental instructions or not.
- Practicing timber extraction according to the instruction of Reduce Impact Logging of Code of harvesting.
- Monitoring every process.

Priority 4. Reduce impact of illegal logging

- Poverty reduction, ending hunger, and assuring food security.
- Awareness raising and law enforcement within local communities.
- Standardization of rule and regulation of seizure of illegal timber across the country.
- Support full facility and security to government staffs who take duty of seizure.
- Fulfil basic needs of local people and country demands.
- Permit forest products extracted in an amount not exceeding the stipulated quantity, without obtaining a permit under Sanction 17 of Forest Law.

Priority 5. Reduce impact of fuelwood consumption

- Electricity and energy sector development.
- Sustainable fuelwood and charcoal consumption.
- Promotion and dissemination of efficient stoves.
- Job creation within local communities.
- Training programmes on bamboo and cane craft manufacturing.

Priority 6. Reduce impact of infrastructure developments

- Practice with least environment impact techniques.
- Have project permissions in every development project.
- Compensate relevant land plot for the permission of development projects within PFE areas.
- Tax forest products used in development projects.

Priority 7. Reduce impact of mining activities

- Practice with least environment impact techniques.
- Practice EIA/SIA before starting the project.
- Practice according to departmental instructions.

- Take actions with the prior consent of the authorities of self-administration zone/self-administration division (SAZ/SAD).

Priority 8. Reduce impact of forest fire

- Making sure to make fire lines before burning their agricultural plots.
- Introducing the use of control burning.
- Raising awareness of fire as good servant but bad master.

Priority 9. Reduce impact of weak law enforcement

- Develop ongoing peace process which is linked to good governance and security for sustainable development.
- Strengthen legal, policy, and institutional frameworks for forest conservation and monitoring.
- Encourage and promote Nationwide Ceasefire Agreement (NCA) and National Peace Process.
- Raise awareness.

Priority 10. Reduce impact of poverty and language barriers

- Activate poverty reduction, ending hunger, and assuring food security
- Take priority over local peoples for appointing government staffs
- Use pamphlets and posters by local language in motivating local people for environmental conservation

Priority 11. Reduce impact of conflicting policy

- Promote coordination between government organizations with overlapping mandate.
- Encourage early consultation with local communities before making decision about land use change.

Priority 12. Reduce impact of land tenure uncertainties

- Making the National Land Use Policy effective across the country
- Ensure state land management system and customary land management system are well integrated.
- Encourage early consultation with local communities before making decision about land use change.

Priority 13. Reduce impact of inadequate natural resource planning and monitoring

- Encourage and promote Nationwide Ceasefire Agreement (NCA) and National Peace Process.
- Promote financial, facilities, and human resources to implement forestry activities and monitoring effectively.
- Facilitate armed guards and build capacity within the department to monitor effectively.

3.3.2 SWOT analysis of the most prioritized strategic options

The four highest prioritized options are selected for SWOT analysis (Tables 36, 37, 38, and 39).

3.3.3 Organizations should be involved in implementing strategic options

With consent of the stakeholder consultation meeting held in Taunggyi, the following organizations should be involved in implementing the strategic options.

3.3.4 Priority orders of suitable districts where REDD+ mechanism should be pursued

As determined at the validation workshop held in Taunggyi on 4 August 2017, priority orders of suitable districts where REDD+ mechanism addressing drivers of deforestation and forest degradation should be pursued.

All in all, according to the results of the stakeholder meeting, officers of Shan State determined the following are the main drivers of deforestation and forest degradation in Shan State:

3.4 Drivers and status of deforestation

3.4.1 Direct drivers of deforestation

- Agricultural expansion
- Shifting cultivations
- Infrastructure development
- Mining

3.4.2 Indirect drivers of deforestation

- Population growth (natural and migrant)
- Economic growth (international and national)
- Weak law enforcement
- Poverty and subsistence
- Conflicting policy
- Language barriers
- Land tenure uncertainties
- Inadequate natural resources planning and monitoring

3.5 Drivers and status of forest degradation

3.5.1 Direct drivers of forest degradation

- Overexploitation of timber (legal and illegal)
- Fuelwood and charcoal consumption
- Forest fire

3.5.2 Indirect drivers of forest degradation

These are the same with indirect drivers of deforestation.

According to the spatial analysis results (see Tables 10, 13, and 16), within the period of 2005–15, actual forest to non-forest (others) change areas are just **12,360.41 km²** (agricultural lands and other categories, such as urban, water body, etc.). **Therefore, we can say the total change from forest areas to other land cover classes (agricultural areas and water body and so forth) is 12,360.41 km² within the period of 2005–15.** And again the change from forests to other wooded lands (OWL-crown density or canopy cover less than 10% as per FAO definition) is **18498.98 km²** (Table 18). That means forest degradation amounts will be generally **18,498.98 km²**. Underlying drivers and agents will be population growth, economic growth, poverty, weak law enforcement, and so forth.

Moreover, according to the result of the group homogenous NDVI matrix, it is supposed to be the same with the spatial analysis results of Landsat imagery. There is hardly any high-density forest (HDF/intact forests) left in Shan State. Although human population densities in the mountainous areas of Myanmar

Table 36: SWOT analysis for priority strategic option: expansion of agriculture and agribusiness plantations

Expansion of agriculture and agribusiness plantations: Introduce high-yield crop varieties and farming systems and disseminate higher yield crop seeds and seedlings.	
Strengths • Prioritized strategy by government • High poverty alleviation potential • Growing fodder trees within crop fields as source of livestock feeds and multi-story crop production	**Weaknesses** • Limited as private sector and foreign investment at only security area • Market access for agricultural products is mostly abroad
Opportunities • Value chain activity development creating employment • Alternative development project potential	**Threats** • Resistance to adopting new farming system and technology • Soil erosion and land degradation

Table 37: SWOT analysis for priority strategic option: shifting cultivation with short fallow period

Shifting cultivation with short fallow period: Introduce agroforestry practice with the support of perennial crop seedlings.	
Strengths • Prioritized strategy by government • High poverty alleviation potential • High emission abatement potential due to avoided deforestation • High social acceptance due to existing cultural land management practices	**Weaknesses** • Unsustainable land tenure • Encourage farmers to turn toward poppy cultivation, which offers an easier way to earn for a living and discourages the drug trade because it is difficult to travel in those steep mountainous remote areas • Fragmentation of farm plots doesn't allow use of machines
Opportunities • Alternative development project potential • Agri-wood residues have potential to become an income generating resource for large-scale biofuel production	**Threats** • Resistance to adopting new farming system and technology • Soil erosion and land degradation • Making drug addicts potential

Table 38: SWOT analysis for priority strategic option: overexploitation of timber and illegal logging

Overexploitation of timber and illegal logging: Determine the AAC based on the need of the changing socioeconomic, environmental, and silvicultural considerations and limited harvesting of timber of all species to the specified AAC.	
Strengths • Prioritized strategy by government • Timber production will be in line with AAC starting 2015–16 fiscal year • Conducting forest inventory and calculating the AAC • Strict implementation of Myanmar Selection System (MSS)	**Weaknesses** • Overexploitation in the past • Illegal logging because of weak law enforcement • Weak implementation of MSS • Corruption within local authorities
Opportunities • Logging bans in the country • Strengthen legal, policy, and institutional frameworks • Strengthen FLEGT-VPA process	**Threats** • Increase CO_2 emission • Decrease in government's revenue • Forest degradation and carbon emission

Table 39: SWOT analysis for priority strategic option: fuelwood consumption and population growth

Fuelwood consumption and population growth: Sustainable fuelwood and charcoal use and dissemination of efficient stoves.	
Strengths • Prioritized strategy by government • Economic benefits to households due to saving time and money for fuelwood • Low cost per stove unit • Woodlots expanding among local farmers	**Weaknesses** • Lack of forestry knowledge at all levels regulating fuelwood industry and weak law enforcement • Lack of policy and legal direction governing fuelwood development and marketing • Efficient stoves required • Fuel briquettes required
Opportunities • Woodlots have co-benefits for nearby forest by reducing pressure • Rural electrification schemes and the country's huge potential for power production from renewable energy • Expanding electrification grid and low electric consumption stoves in urban areas and reducing pressure on forest biomass	**Threats** • Growing population and increasing energy demand • Dwindling resources for fuelwood • Long awareness creation and technology adoption process • Poor households can't afford a stove

are lower than those in most neighbouring countries, the level of human impact on the landscape is increasing. Myanmar's forests support a great diversity of commercially valuable species, including Teak (*Tectona grandis*), ironwood (*Xylia xylocarpa*), rosewood (*Pterocarpus indicus*) and various members of the Dipterocarps and Laguminesae. During the last decade, a lot of timber extraction especially teak to export had been done in Shan State, especially Kyaukme, Momaik, Mabain, Taungyi, Loilen, Linkhay, Yarksauk, Mongton, and Mongsat (see Figures 54–60). Logging system was practiced under MSS in the areas of southern Shan State and northern Shan State, while eastern Shan State only modified procedure were used because of security condition.

Table 40: Organizations that should be involved in implementing strategic options

Organization	Duties
GAD	• Ensure cooperation among government organizations and companies. • Ensure people obey laws and regulations.
Police Department	• Ensure cooperation in security.
Tatmadaw (Myanmar Army)	• Cooperation in security.
Forest Department	• Obey exactly laws and regulations.
MTE	• Obey exactly laws and regulations.
ECD	• Perform EIA/SIA to reduce environmental impact.
Mining Department	• Inspect mining sites thoroughly.
DOA	• Support higher yielding variety seeds and seedlings. • Guide correct cultivation techniques and farming systems.
DALMS	• Manage arable lands and virgin lands. • Manage practicing land use by keeping a balance between environmental conservation and the economic development with consent of the people.
Judicial/Regional court	• Obey current laws and regulations. • Take exact action on outlaws.
CSO/NGO/INGO/Media	• Raise awareness.

Table 41: Suitable districts where REDD+ mechanism should be pursued

	Priority 1	Priority 2	Priority 3
Shan South	Taunggyi	Loilen	Linkhay
Shan North	Lashio	Kyaukme	-
Shan East	Kyingtong	Mongsat	-

All in all, in Shan State, agricultural expansion, agribusiness plantations, shifting cultivation, rubber plantations, opium poppy plantations, and poverty are the main drivers of deforestation and are interrelated. Population growth and economic growth are the same. In terms of forest degradation overexploitation either legal or illegal, fuelwood consumption are the main causes of forest degradation. As mentioned above, Director General of Forest Department said in Myanmar, there is a high level of forest degradation due to illegal logging and excessive use for firewood. For the whole country the need for fuelwood is about 18 million tons and the Government supplies only 900,000 tons, which means that the remaining 17.1 million tons come from illegal logging and unsustainable sources (MONREC, IUCN and TNC, workshop on Restoring Myanmar's Degraded and Deforested Landscapes, 2016).

These drivers are the most important drivers of deforestation and forest degradation in Shan State. Mining, infrastructure development including urban expansion, forest fire, and livestock grazing are also important but less prominent.

According to the results of the stakeholder meeting, the priority drivers of deforestation and forest degradation per respective districts and townships are detailed below (Figures 82–97).

Figure 82: **Priority drivers of D&FD by district in southern Shan State**

Southern Shan State				
Sr.	**Driver**	**Taungyi Dist.**	**Loilen Dist.**	**Linkhay Dist.**
1	Agri-Expansion	Sh_Cult/Opium	Sh_Cult/Opium	Sh_Cult/Opium
2	Sh_Cult/Opium	Fuelwood/Charcoal Consumption	Overextraction of Timber	Overextraction of Timber
3	Overextraction of Timber	Agri-Expansion	Policy & Land Conflict	Language Barriers/ Low Knowledge
4	Fuelwood/Charcoal Consumption	Overextraction of Timber	Infrastructure Development	Agri-Expansion
5	Infrastructure Development	Infrastructure Development	Weak Law Enforcement/Security	Fuelwood/Charcoal Consumption
6	Mining	Forest Fire	Mining	Mining
7	Forest Fire	Mining	Fuelwood/Charcoal Consumption	Weak Law Enforcement/ Security
8	Population Growth	Weak Law Enforcement/ Security	-	Infrastructure Development
9	Economic Growth	Language Barriers/ Low Knowledge	-	-
10	Weak Law Enforcement/ Security	Economic Growth	-	-
11	Poverty & Subsistence	Policy & Land Conflict	-	-
12	Language Barriers/ Low Knowledge	Weak Law Enforcement/ Security	-	-
13	Policy & Land Conflict	Population Growth	-	-

Figure 83: **Priority drivers of D&FD by township in Taunggyi District**

Taunggyi District (Southern Shan State)						
Sr.	**Driver**	**Taungyi**	**Nyaungshwe**	**Kalaw**	**Pekhon**	**Yarksauk**
1	Agri_Exp	Infra_Dev	Infra_Dev	Sh_Cult/Opium	Sh_Cult/ Opium	Over_Ex
2	Sh_Cult/ Opium	Fuel/Char	Sh_Cult/ Opium	Infra_Dev	Infra_Dev	Agri_Exp
3	Over_Ex	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Sh_Cult/ Opium
4	Fuel/Char	Mining	Fuel/Char	For_Fire	For_Fire	Fuel/Char
5	Infra_Dev	Over_Ex	Mining	Mining	Mining	Infra_Dev
6	Mining	-	LB/LK	LB/LK	LB/LK	WLE/Security
7	For_Fire	-	-	-	-	LB/LK
8	Pop_Gr	-	-	-	-	-
9	Eco_Gr	-	-	-	-	-
10	WLE/Security	-	-	-	-	-
11	Poverty	-	-	-	-	-
12	LB/LK	-	-	-	-	-
13	Conflict	-	-	-	-	-
Note: Yarksauk: dams (Zawgyi, KyaingKham); swidden (corn, pigeon pea). Nyaungshwe: hotel zone 622 acres. Kalaw: agriculture expansion (potato, ginger, corn, garlic).						

Figure 84: **Priority drivers of D&FD by township in Taunggyi District (Danu SAZ)**

Taungyi District (Southern Shan State) (Danu SAZ)			
Sr.	**Driver**	**Pindaya**	**YwaNgan**
1	Agri_Exp	Agri_Exp	Sh_Cult/Opium
2	Sh_Cult/ Opium	Infra_Dev	Over_Ex
3	Over_Ex	Fuel/Char	Fuel/Char
4	Fuel/Char	Eco_Gr	Agri_Exp
5	Infra_Dev	Pop_Gr	Eco_Gr
6	Mining	For_Fire	LB/LK
7	For_Fire	-	-
8	Pop_Gr	-	-
9	Eco_Gr	-	-
10	WLE/ Security	-	-
11	Poverty	-	-
12	LB/LK	-	-
13	Conflict	-	-

Note: YwaNgan: Swiddens (wheat, yearly shift); agribusiness (ginger, wheat, cabbage, cauliflower, potato, garlic, orange, and tea); Panlaung Wildlife Sanctuary; ecotourism: (Blue Water Pond, East/West-sighted mountain)

Figure 85: **Priority drivers of D&FD by township in Taunggyi District (Pa'O SAZ)**

Taunggyi District (Southern Shan State) (Pa'O SAZ)				
Sr.	**Driver**	**Hopone**	**Sisaing**	**Pinlaung**
1	Agri_Exp	Sh_Cult/ Opium	Agri_Exp	Sh_Cult/ Opium
2	Sh_Cult/ Opium	Agri_Exp	Infra_Dev	Agri_Exp
3	Over_Ex	Mining	Fuel/Char	Infra_Dev
4	Fuel/Char	Fuel/Char	Sh_Cult/ Opium	Fuel/Char
5	Infra_Dev	Infra_Dev	Mining	LB/LK
6	Mining	-	-	-
7	For_Fire	-	-	-
8	Pop_Gr	-	-	-
9	Eco_Gr	-	-	-
10	WLE/Security	-	-	-
11	Poverty	-	-	-
12	LB/LK	-	-	-
13	Conflict	-	-	-

Figure 86: Priority drivers of D&FD by township in Loilin District

Loilin District (Southern Shan State)								
Sr.	**Driver**	**Loilen**	**Leacha**	**Mongkai**	**Kyaethi**	**Namsan**	**Mongshu**	**Kunhein**
1	Agri_Exp	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium
2	Sh_Cult/ Opium	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp
3	Over_Ex	Conflict	Conflict	Conflict	Conflict	Conflict	Conflict	Conflict
4	Fuel/Char	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev
5	Infra_Dev	WLE/ Policy	WLE/ Policy	WLE/ Policy	WLE/ Policy	WLE/ Policy	WLE/ Policy	WLE/ Policy
6	Mining	Mining	Mining	Mining	Mining	Mining	Mining	Mining
7	For_Fire	Fuel/ Char	Fuel/ Char	Fuel/ Char	Fuel/ Char	Fuel/ Char	Fuel/ Char	Fuel/ Char
8	Pop_Gr	-	-	-	-	-	-	-
9	Eco_Gr	-	-	-	-	-	-	-
10	WLE/Policy	-	-	-	-	-	-	-
11	Poverty	-	-	-	-	-	-	-
12	LB/LK	-	-	-	-	-	-	-
13	Conflict	-	-	-	-	-	-	-

Figure 87: Priority drivers of D&FD by township in Linkhay District

Linkhay District (Southern Shan State)					
Sr.	**Driver**	**Linkhay**	**Mongpan**	**Monae**	**Maukmae**
1	Agri_Exp	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium
2	Sh_Cult/ Opium	Over_Ex	Over_Ex	Over_Ex	Over_Ex
3	Over_Ex	LB/LK	LB/LK	LB/LK	LB/LK
4	Fuel/Char	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp
5	Infra_Dev	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char
6	Mining	Mining	Mining	Mining	Mining
7	For_Fire	WLE/Policy	WLE/Policy	WLE/Policy	WLE/Policy
8	Pop_Gr	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev
9	Eco_Gr	-	-	-	-
10	WLE/Policy	-	-	-	-
11	Poverty	-	-	-	-
12	LB/LK	-	-	-	-
13	Conflict	-	-	-	-

Figure 88: Priority drivers of D&FD by district in northern Shan State

Northern Shan State						
Sr.	**Driver**	**Lashio**	**Kyaukme**	**Hopan**	**Laukkai**	**Muse**
1	Agri_Exp	Agri_Exp	Over_Ex	Agri_Exp	WLE/ Security	Agri_Exp
2	Sh_Cult/ Opium	Fuel/Char	Agri_Exp	Fuel/Char	Agri_Exp	Fuel/Char
3	Over_Ex	WLE/ Security	Fuel/Char	WLE/ Security	Fuel/Char	WLE/ Security
4	Fuel/Char	Infra_Dev	Mining	Infra_Dev	Infra_Dev	Infra_Dev
5	Infra_Dev	Sh_Cult/ Opium	WLE/ Security	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium
6	Mining	-	Sh_Cult/ Opium	-	-	-
7	For_Fire	-	-	-	-	-
8	Pop_Gr	-	-	-	-	-
9	Eco_Gr	-	-	-	-	-
10	WLE/ Security	-	-	-	-	-
11	Poverty	-	-	-	-	-
12	LB/LK	-	-	-	-	-

Figure 89: Priority drivers of D&FD by township in Lashio District

Lashio District (Northern Shan State)						
Sr.	**Driver**	**Lashio**	**Theinne**	**Mongyai**	**Tanyan**	**Kunlon**
1	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp
2	Sh_Cult/ Opium	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char
3	Over_Ex	WLE/ Security	WLE/ Security	WLE/ Security	WLE/ Security	WLE/ Security
4	Fuel/Char	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev
5	Infra_Dev	-	-	-	-	-
6	Mining	-	-	-	-	-
7	For_Fire	-	-	-	-	-
8	Pop_Gr	-	-	-	-	-
9	Eco_Gr	-	-	-	-	-
10	WLE/ Security	-	-	-	-	-
11	Poverty	-	-	-	-	-
12	LB/LK	-	-	-	-	-
13	Conflict	-	-	-	-	-

Figure 90: **Priority drivers of D&FD by township in Kyaukme District**

Kyaukme District (Northern Shan State)							
Sr.	**Driver**	**Kyaukme**	**Thibaw**	**Namtu**	**Naungcho**	**Mabein**	**Moemeik**
1	Agri_Exp	Over_Ex	Over_Ex	Over_Ex	Over_Ex	Over_Ex	Over_Ex
2	Sh_Cult/ Opium	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp
3	Over_Ex	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char
4	Fuel/Char	Mining	Mining	Mining	Mining	WLE/ Security	WLE/ Security
5	Infra_Dev	WLE/ Security	WLE/ Security	WLE/ Security	WLE/ Security	-	-
6	Mining	-	-	-	-	-	-
7	For_Fire	-	-	-	-	-	-
8	Pop_Gr	-	-	-	-	-	-
9	Eco_Gr	-	-	-	-	-	-
10	WLE/ Security	-	-	-	-	-	-
11	Poverty	-	-	-	-	-	-
12	LB/LK	-	-	-	-	-	-
13	Conflict	-	-	-	-	-	-

Figure 91: **Priority drivers of D&FD by township in Hopan District**

Hopan District (Northern Shan State) (Wa-SAD)							
Sr.	**Driver**	**Hopan**	**Pansan**	**Panwaing**	**Maimaw**	**Matman**	**Narphant**
1	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp
2	Sh_Cult/ Opium	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char
3	Over_Ex	WLE/ Security	WLE/ Security	WLE/ Security	WLE/ Security	WLE/ Security	WLE/ Security
4	Fuel/Char	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev
5	Infra_Dev	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium
6	Mining	-	-	-	-	-	-
7	For_Fire	-	-	-	-	-	-
8	Pop_Gr	-	-	-	-	-	-
9	Eco_Gr	-	-	-	-	-	-
10	WLE/ Security	-	-	-	-	-	-
11	Poverty	-	-	-	-	-	-
12	LB/LK	-	-	-	-	-	-
13	Conflict	-	-	-	-	-	-

Figure 92: Priority drivers of D&FD by township in Muse District

Muse District (Northern Shan State)				
Sr.	**Driver**	**Muse**	**Namkham**	**Kutkai**
1	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp
2	Sh_Cult/ Opium	Fuel/Char	Fuel/Char	Fuel/Char
3	Over_Ex	WLE/Security	WLE/Security	WLE/Security
4	Fuel/Char	Infra_Dev	Infra_Dev	Infra_Dev
5	Infra_Dev	-	-	-
6	Mining	-	-	-
7	For_Fire	-	-	-
8	Pop_Gr	-	-	-
9	Eco_Gr	-	-	-
10	WLE/Security	-	-	-
11	Poverty	-	-	-
12	LB/LK	-	-	-
13	Conflict	-	-	-

Figure 93: Priority drivers of D&FD by township in Laukkai District

Laukkai District (Northern Shan State) (Kokant-SAZ)			
Sr.	**Driver**	**Laukkai**	**Kongyan**
1	Agri_Exp	WLE/Security	WLE/Security
2	Sh_Cult/ Opium	Agri_Exp	Agri_Exp
3	Over_Ex	For_Fire	For_Fire
4	Fuel/Char	LB/LK	LB/LK
5	Infra_Dev	Conflict	Conflict
6	Mining	Fuel/Char	Fuel/Char
7	For_Fire	Eco_Gr	Eco_Gr
8	Pop_Gr	Sh_Cult/ Opium	Sh_Cult/ Opium
9	Eco_Gr	-	-
10	WLE/Security	-	-
11	Poverty	-	-
12	LB/LK	-	-
13	Conflict	-	-

Figure 94: **Priority drivers of D&FD by district in eastern Shan State**

Eastern Shan State				
Sr.	**Driver**	**Kyaingtong**	**Mongsat**	**Tachileik**
1	Agri-Expansion	Sh_Cult/Opium	Sh_Cult/Opium	Sh_Cult/Opium
2	Sh_Cult/Opium	Fuelwood/Charcoal Consumption	Agri-Expansion	Mining
3	Overextraction of Timber	Infrastructure Development	Overextraction of Timber	Infrastructure Development
4	Fuelwood/Charcoal Consumption	Agri-Expansion	Fuelwood/Charcoal Consumption	Agri-Expansion
5	Infrastructure Development	Fuelwood/Charcoal Consumption	Infrastructure Development	Weak in Law Enforcement/Security
6	Mining	Weak Law Enforcement/ Security	Weak Law Enforcement/ Security	Fuelwood/Charcoal Consumption
7	Forest Fire	Economic Growth (Fish Pond)	-	Economic Growth (Border Trade)
8	Population Growth	-	-	-
9	Economic Growth	-	-	-
10	Weak Law Enforcement/ Security	-	-	-
11	Poverty & Subsistence	-	-	-
12	Language Barriers/ Low Knowledge	-	-	-
13	Policy & Land Conflict	-	-	-

Figure 95: **Priority drivers of D&FD by township in Kyaingtong District**

Kyaingtong District (Eastern Shan State)					
Sr.	**Driver**	**Kyaingtong**	**Mongyang (Monglar)**	**Mongpyin**	**Mongkhat**
1	Agri_Exp	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium
2	Sh_Cult/ Opium	Fuel/Char	Fuel/Char	Fuel/Char	Fuel/Char
3	Over_Ex	Agri_Exp	Agri_Exp	Agri_Exp	Agri_Exp
4	Fuel/Char	Infra_Dev	Infra_Dev	Infra_Dev	Infra_Dev
5	Infra_Dev	Eco_Gr (Fish Pond)	Eco_Gr (Fish Pond)	Eco_Gr	Eco_Gr
6	Mining	-	-	-	-
7	For_Fire	-	-	-	-
8	Pop_Gr	-	-	-	-
9	Eco_Gr	-	-	-	-
10	WLE/Security	-	-	-	-
11	Poverty	-	-	-	-
12	LB/LK	-	-	-	-
13	Conflict	-	-	-	-

Figure 96: **Priority drivers of D&FD by township in Mongsat District**

Mongsat District (Eastern Shan State)			
Sr.	**Driver**	**Mongsat**	**Mongton**
1	Agri_Exp	WLE/Security	WLE/Security
2	Sh_Cult/Opium	Sh_Cult/ Opium	Sh_Cult/ Opium
3	Over_Ex	Agri_Exp	Over_Ex
4	Fuel/Char	Over_Ex	Mining
5	Infra_Dev	Mining	LB/LK
6	Mining	LB/LK	Fuel/Char
7	For_Fire	-	-
8	Pop_Gr	-	-
9	Eco_Gr	-	-
10	WLE/Security	-	-
11	Poverty	-	-
12	LB/LK	-	-
13	Conflict	-	-

Figure 97: **Priority drivers of D&FD by township in Tachileik District**

Tachileik District (Eastern Shan State)				
Sr.	**Driver**	**Tachileik**	**Mongphyat**	**Mongyaung**
1	Agri_Exp	Sh_Cult/ Opium	Sh_Cult/ Opium	Sh_Cult/ Opium
2	Sh_Cult Opium	Mining (Gold Mine)	WLE/Security	Agri_Exp (Rubber)
3	Over_Ex	Infra_Dev (Kyailat Bridge)	Agri_Exp (Rubber)	Mining
4	Fuel/Char	Agri_Exp (Rubber)	Over_Ex	WLE/Security
5	Infra_Dev	WLE/Security	Mining (Coal Mine)	Fuel/Char
6	Mining	Eco_Gr (Border Trade)	LB/LK	Eco_Gr
7	For_Fire	Fuel/Char	Eco_Gr (Border Trade)	Infra_Dev
8	Pop_Gr	-	Infra_Dev	-
9	Eco_Gr	-		-
10	WLE/Security	-	-	-
11	Poverty	-	-	-
12	LB/LK	-	-	-
13	Conflict	-	-	-

Conclusion

The Shan Plateau in eastern Myanmar is an extensive, mountainous upland ranging in height from 1,000 m to 2,300 m. The area harbours a wealth of natural resources, including globally important forests, multiple plant and animal species, and headwaters of major rivers. However, the area is undulating and has been stripped of natural forest, making it subject to severe erosion. Erosion from the uplands threatens to clog the reservoirs with silt, endangering much of the country's hydropower production and irrigation water supplies for the lowlands.

According to the spatial analysis, it is obvious that the forest cover of Shan State decreased from 52.38% of the state area in 2005 to 48.14% in 2015. But according to NDVI study there is hardly any intact forest left in the state. Only 0.02% of high density forest (HDF) had been left in 2015 (see Table 31). Serious deforestation and forest degradation hotspot areas are Loilin and Taunggyi districts in southern Shan State, Kyaukme and Muse districts in northern Shan State, and Kyaingtong and Mongsat districts in eastern Shan State (see Tables 19, 20, and 21). Forest cover of Shan State decreased from 2005 to 2010 and increased slightly from 2010 to 2015. The change is due to a boost in rubber plantations, especially in northern and eastern Shan State under the Chinese opium substitution programme since 2006.

In terms of carbon stocks and carbon emission, as per the APFNet programme, the estimated carbon stock of Shan State was 700.93 million tonnes (mt) in 2005. According to FAO FRA, estimated carbon stock of Shan State was 791.40 mt in 2005, 754.71 mt in 2010, and 722.83 mt in 2015.

The most prominent drivers of deforestation and forest degradation are **agricultural expansion** (commercial and subsistence), **shifting cultivation** (known as *taungya* and swidden) with short fallow period and poppy plantations, **overexploitation of timber** (legal and illegal logging) and **unsustainable fuelwood consumption, infrastructure developments, mining, and forest fire**. Indirect drivers are population growth (natural and migration), economic growth (international and national), weak law enforcement, poverty and subsistence, conflicting policy, language barriers, land tenure uncertainties, and inadequate natural resource planning and monitoring.

Agricultural expansion for commercial and subsistence purposes has been reported as a major driver across Shan State. Although the culture of **shifting cultivation** with long enough fallow periods in sustainable manner is not a major driver for deforestation, it makes only forest degradation to some extent. But if it has evolved into a shorter fallow period system and changed to agribusiness region, it will seriously damage the environment and create soil erosion and degradation. Rubber plantation areas of north-eastern and eastern Shan State especially have been drier than ever. These mass expansions of rubber plantations, mostly by Chinese companies under the Chinese opium substitution programme, have been unprecedented during these days, especially in Wa self-administration division.

Decades of civil war have left the farmers of Shan State in an environment where food insecurity and poverty are prevalent and income sources besides opium cultivation are scarce. Combining the fragility of Shan State with its remoteness and lack of governmental influence, opium poppy cultivation is the only viable livelihood for rural communities.

On the other hand, eradication efforts that put farmers into absolute poverty and do not contribute to a reduction of opium cultivation are widespread. Alternative development has been used to provide rural development for drug-producing communities with the goal of establishing sustainable livelihoods and reducing drug production at the same time. In this context, the UNODC's Alternative Development project goal in southern Shan State to implement a coffee-based agroforestry system has been successfully achieved.

The main underlying causes of deforestation and forest degradation are attributed to continued population growth, promotion of agricultural investment, poverty, weak law enforcement, and lack of an all-inclusive land use policy. Conflict, insecurity, and weak forest regulation enforcement has been reported to aggravate the deforestation and forest degradation throughout Shan State.

Deforestation and forest degradation in Shan State have resulted in heavy soil erosion and land degradation especially in the Myelat area (between Kalaw to Taunggyi) and consequently, declining annual yield for crops, and increased CO2 emission, which are anticipated to increase in the future.

If the existing trend continues, the impacts are predicted to be worse in the future. Furthermore, deforestation and forest degradation have aggravated loss of biodiversity, habitat loss, a decline in household income, exposure of land to invasive species, and pollution.

To overcome deforestation and forest degradation, and consequently land degradation and its associated impacts in Shan State and the entire country, MONREC has developed a 10-year Restoration and Rehabilitation Programme (2017–27) in cooperation with related stakeholders, building on past experiences and lessons learned. This programme will be implemented in collaboration with related stakeholders, including NGOs, civil society organizations, the private sector, academia, local community groups, and indigenous peoples.

Moreover, the Government of Myanmar is also developing a new land law in order to harmonize existing laws related to land. Under this law, a National Land Use Council will be set up. In order to maintain forests and reverse deforestation and forest degradation and also to avoid conflicting policy, it will be critical to adopt a culture of cooperation among the government agencies.

To address forest degradation, dependency on natural resources must be reduced. In particular, it is essential to reduce poverty and provide alternatives to local communities, in order to sustain forest resources (MONREC, IUCN and TNC organized jointly *Restoring Myanmar's Degraded and Deforested Landscapes*). Now the Union Government has released its economic policy, highlighting national reconciliation and job creation as basic considerations for the policy which guarantees nationwide equitable development.

Based on the preliminary results, the validation workshop was conducted on 4 August 2017 in the Forest Department, Taunggyi, to identify, develop, and confirm prioritized strategic options addressing these drivers. The result of the most important and recommended prioritized strategic options are as follows:

- Introduce high-yielding variety crops and farming systems and disseminate higher-yielding variety seed and seedlings.
- Introduce agroforestry practice with the support of perennial crop seedlings.
- Enhance the establishment of community forestry.
- Enhance the establishment of private forest plantations.
- Determine the AAC based on the need of the changing socioeconomic, environmental, and silvicultural considerations and limited harvesting of timber of all species to the specified AAC.
- Conduct pre- and post-harvesting inventory.
- Practice timber extraction according to the instruction of Reduce Impact Logging of Code of harvesting.
- Encourage and promote the extension of the national electricity grid.
- Create jobs for local communities.
- Practice EIA/SIA before starting the project.
- Encourage and promote National Ceasefire Agreement (NCA) and National Peace Process.
- Activate poverty reduction, ending hunger and assuring food security.
- Make the National Land Use Policy effective across the country.

In the validation workshop, senior officers from the Forest Department of Shan State and relevant line departments also recommended the following districts which can pursue REDD+ mechanism to address deforestation and forest degradation drivers in the future:

- Taunggyi and Loilin districts in southern Shan State
- Kyaukme and Lashio districts in northern Shan State
- Kyaingtong and Mongsat districts in eastern Shan State

In the consultant opinion, according to security and accessibility, Taunggyi District is the most suitable site for future REDD+ mechanism addressing drivers of deforestation and forest degradation, followed by Loilin District. Second priority is Kyaukme District, followed by Lashio and Kyaingtong districts. In the field visit of socioeconomic survey, the survey team found that the villagers of Kyaukkulay (Tatkon), Ywangan Township and Kyauktan, Hopone were very enthusiastic about the conservation of the remaining forests in their township.

Thus, this study will be used to identify and prioritize the potential activities, investments, and actions that provide the most promising interventions to reduce deforestation and forest degradation, as well as improve the management of forested landscapes of Shan State as a whole. The selected prioritized strategic options will ensure local stakeholder acceptance of the relevant strategy options.

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