Forest Reference Levels in the Hindukush Himalaya: A Comparative Overview

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Abstract

This paper draws lessons from the development of Forest Reference Level (FRL) or Forest Emission Reference Level (FREL) in three selected countries in the Hindukush Himalayan (HKH) countries. Using a detailed textual analysis of the relevant documents of India, Myanmar and Nepal, the paper compares and contrasts the processes and contents of the FRLs of these countries. Based on literature on FRL/FREL, the United Nations Framework Convention on Climate Change (UNFCCC) guideline in particular, the paper identifies seven key criteria for comparing the documents, and then analyses major experiences and insights around those key criteria. It is learnt that both the processes and the contents of the FRL/FREL are diverse even within these three countries which can be attributed to the country contexts and capacities. Key variables reflecting country contexts influencing REDD+ (Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries), FRL/FREL are the socio-political contexts, forest-people relations, forest types and forest governance, and tenure arrangements. In addition, a country's capacity in mobilising its own resources to conduct national forest monitoring and implementing REDD+ are reflected in their levels of comprehensiveness and precision of assessments and targets. The paper argues that, FRL/FREL documents are the negotiated outcomes of universal framework provided by the UNFCCC and that of national contexts and capacities. Therefore, a right balance of these two aspects will increase the likelihoods of effective and accurate measurement of REDD+ outcomes, in terms of carbon benefits particularly, in the context of low prospects of international funding for climate actions in the long run.

Key words: Climate Change, Emissions, Forest Reference Level, Hindukush Himalaya, REDD+

INTRODUCTION

Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+) is a climate change mitigation solution where developing countries are incentivised to keep their forests standing by offering result-based payments for actions to reduce or remove carbon emissions. For countries aiming to participate in REDD+ mechanism under the United Nations Framework Convention on Climate Change (UNFCCC), the development of four key elements (Figure 1) is necessary and Forest Reference Level (FRL) or Forest

Figure 1: Four Key elements of REDD+

Reference Emissions Level (FREL) is one of the vital elements (Decision CP.16/1/ Add.1/par. 71).

FRL/FREL is guided by the UNFCCC decisions from construction to technical assessment as shown in Figure 2. Upon the development of guideline for technical assessment through the Warsaw Framework in 2012, Brazil was the first country to submit FRL/FREL - the first FREL submitted was for the subnational level for the Amazon region and included deforestation.

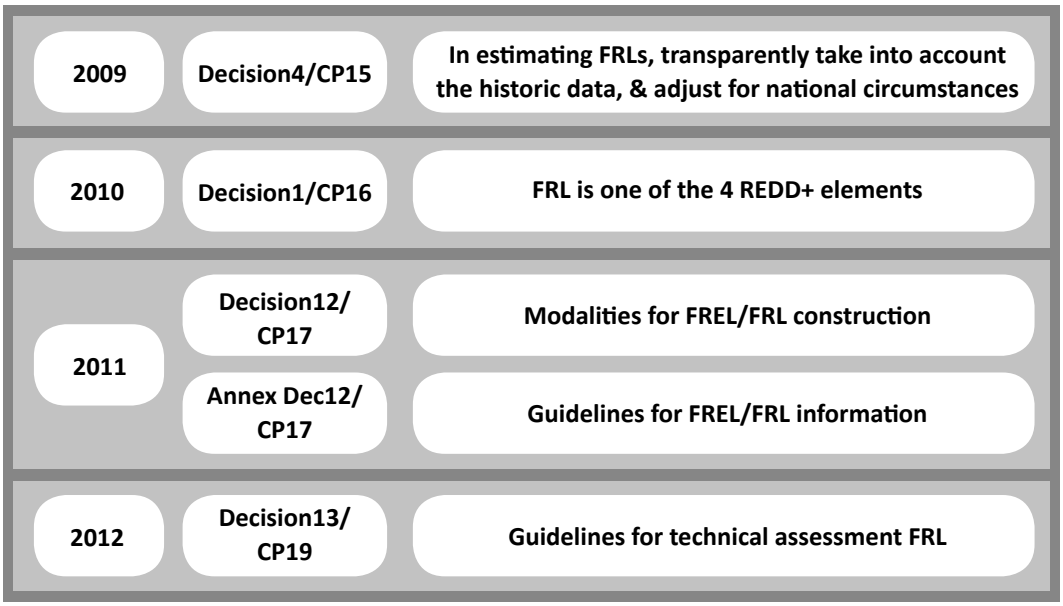

Figure 2: Chronological Overview of UNFCCC Decisions on FRL

FRL/FREL is the benchmark for assessing each country's performance in implementing the activities referred to in decision (UNFCCC, 2011)[1]. UNFCCC has not clearly specified the difference between FRL and FREL but the United Nations Programme on REDD+ (UNREDD) interprets FREL as inclusive of only emissions from deforestation and degradation whereas FRL includes both emissions by sources as well as removals by sinks. FRL/FREL is the only technically assessed element of REDD+ mechanism under the UNFCCC and is presented voluntarily by the member countries. It is relevant to assess outcomes of policies and measures taken for climate change mitigation and claim for result-based payment for the performance. It can also be vital element to assess the contribution to international mitigation through REDD+ actions.

FRL/FREL is guided by the UNFCCC guidelines and is bound to include some key elements like forest definition, scale, scope, and FRL/FREL construction approach. Scope represents the REDD+ activities[2], carbon pools[3] and greenhouse gases (GHGs) included in the FRL whereas scale refers to the spatial extent

1 UNFCCC, Decision 12/CP.17, paragraph 7.

2 Reducing emissions from deforestation, Reducing emissions from forest degradation, Conservation of forest carbon stocks, Sustainable management of forests, and Enhancement of forest carbon stock.

3 Above Ground Biomass, Below Ground Biomass, Dead wood, Soil Organic Carbon, Leaf litter.

covered by FRL/FREL (FAO 2015). Forest definition, scale and scope are to be consistent to the national GHG inventory, however, the reasons for deviation from it should be clearly stated (FAO 2015). The performance is expressed in terms of tons of carbon dioxide equivalent per year. Transparency, completeness, accuracy and consistency are to be maintained. As per the condition and capacity of a country, step-wise approach can be taken with the inclusion of important REDD+ activities, pools and gases at present with updates in the future. However, the significant pools are not to be omitted and the reason of exclusion should be clearly mentioned. A country can develop the subnational level FRL/FREL as an interim measure and later upgrade it to the national level. The approaches taken by different countries may vary but majorly taken approaches are the historic average and projected average. Historic average takes the average of the emissions over a period of time and assesses the performance after adoption of the REDD+ activities on the basis of an average set (Meridian Institute 2011). On other hand, projected average takes future projects' emissions though modeling of the present data and conditions like deforestation, national policies and compares the performance of REDD+ activities against the projected emissions (FAO 2015). National adjustment as per the domestic circumstances of a nation can be made in both the approaches for better assessment of performance.

The Hindu Kush Himalaya (HKH) countries offer a huge potential in reversing the impacts of climate change through REDD+ (Agrawal *et al.* 2017). All the countries in the region have submitted their intended nationally determined contributions (INDCs) for emissions reduction. Many countries have now been progressing towards achieving the targets by developing FRL/FREL, national REDD+ strategies, systems for measurement, monitoring, reporting, and verification (MMR-V) and Safeguard Information System (SIS). These countries have differences in political systems, forest governance, and institutional capacities. Such diversity provides a good learning opportunity on the lessons and efforts across various dimensions of REDD+. This is particularly important in terms of identifying areas that are complementary, or even contradictory, so that they can be scaled out or replicated in other countries. Nevertheless, such comparative analysis of achievements in various fronts of REDD+ is missing in the HKH region.

This paper aims at delivering a comparison of REDD+ initiatives analyzing structural components of FRL/FREL development, approaches taken and underlying issues in three countries of the HKH region viz. India, Myanmar and Nepal. While doing so, it takes nationally determined contributions (NDCs) of an individual country into consideration in reference to the FRL/FREL. Comparative analysis of proposed FRLs of HKH countries provides a good learning opportunity on the lessons and efforts across various dimensions of trends and projections of carbon emissions from forests. Possible advantages and risks associated with different options are also discussed for future considerations to FRL/FREL construction.

METHODS

The FRL/FREL related UNFCCC decisions, guidelines developed by different international organizations like the World

Bank, Food and Agriculture Organization (FAO) of the United Nations, UNREDD, IPCC guidelines and related other publications were reviewed in order to develop an in-depth understanding about the methodologies, data requirements, accuracy and other basic elements of FRL/FREL documents. The framework criteria applied for the comparative analysis was thus developed. FRL/FREL documents submitted to the UNFCCC for their technical assessment by the three selected HKH countries were reviewed against the framework criteria. Framework criteria for comparative study were: (i) Scale of the FRL/FREL, (ii) Forest definition, (iii) Scope of the estimated FRLs, (iv) gases considered, (v) Carbon pools estimated, (vi) methodologies for estimation of Activity Data (AD) and Emission Factor (EF), and (vii) National adjustment. A matrix was prepared summarising key features and illustrating similarities and differences. Identified similarities and differences were compared, contrasted and discussed linking different country contexts.

UNDERSTANDING FOREST REFERENCE LEVEL

FRL is defined as benchmarks for assessing performance in implementing REDD+ activities (UNFCCC 2011). In other words, it is the metric to know if REDD+ program is working. Estimating performance in implementing REDD+ activities requires assessing reference levels against which future emissions and removals can be compared. Conceptually, the reference level represents Business-As-Usual (BAU) emissions or removals associated with REDD+ activities at national or (as an interim step) sub-national level, and is based on historical data and national circumstances. It is also described as FREL if only emissions from deforestation and forest degradation are estimated solely for activities that "reduce emissions" (FAO 2015). FRL measures net emissions and removals and hence includes activities that can enhance carbon stocks ('+' part of REDD+). Thus, the scope of a FRL could include the same activities as FREL plus for example, enhancement of forest carbon stocks.

Countries estimate and establish FRL/FREL for several reasons. REDD+ payment for performance to reduce emissions and enhance removals (carbon enhancement) requires the establishment of FRL. Countries may also develop FRL/FREL to evaluate national policies and measures implemented to mitigate climate change in the forestry sector and/or to contribute to international mitigation through REDD+.

The Intergovernmental Panel on Climate Change (IPCC) develops methodologies and approaches for FRL/FREL estimation and its technical assessment. The UNFCCC through its Conference of Parties (COPs) approves those methodologies and develops necessary guidelines. As shown in Figure 2, the UNFCCC has made four key decisions particularly related to the FRL/FREL. The COP 15 in 2009 informed REDD+ countries to develop a transparent FRL/FREL using historic data by adjusting them to the respective national circumstances. FRL/FREL was acknowledged as one of the four key elements of REDD+ in 2010. The modality and contents of FRL/FREL were decided in 2011 followed by guidelines for their technical assessment in 2012 (UNFCCC 2014).

FRLs are estimated following the UNFCCC guidance and country contexts.

Based on the UNFCCC decisions (FAO 2015: 5), the following are basic guidelines for FRL estimation:

- FRL must be expressed in tons of Carbon dioxide (CO_2) equivalent per year (tCO_2eq/yr);
- FRL must be developed using transparent information, tools and assumptions;
- Consider historical data from recent past. Although, the UNFCCC has not specified a timeframe, methodological guideline of the World Banks' Carbon Fund suggests going back 10 years before the REDD+ intervention;
- Maintain consistency with national GHG inventories. Consistency with national GHG inventories also means using the IPCC guidance and guidelines for both national GHG inventories as well as FRL as a basis for estimating forest-related GHG emissions by sources and removals by sinks.
- Adjust FRL for national circumstances. National socio-economic and environmental circumstances may result in an adjustment to the reference level. This must be justifiable given the actual situation in the country, including laws, area of remaining forests, population trends, development plans, and recent political or economic history compared to the future.
- Recognise step-wise approaches. Developing countries may find it useful to improve FRL over time by incorporating better data, improved methodologies and, when appropriate, additional pools.
- Allow for the use of sub-national FRL as an interim measure. Countries may develop subnational FRL as an interim measure but are expected to transition over time to a national FRL.
- Follow the UNFCCC template (framework) incorporating basic elements including forest definition, scale, scope, gases considered, pools, AD, EF, adjustment and estimated FRL/FREL.
- In addition to the UNFCCC basic guidance and modality[4], a degree of freedom is provided to countries while estimating FRL as per their national contexts such as capacity, data availability, consistency and validity of the data. Data availability and technical capacity of country determine quality (methodology, reliability, validity and acceptability) of the FRL being estimated. This suggests that FRL/FREL can be a means for assessing the country context, country capacity and other socio-ecological circumstances of REDD+ implementation. By the 2018 submission date (i.e. January, 2018), 34 countries have submitted their FRLs to the UNFCCC for their technical assessment (UNFCCC 2018).

FINDINGS AND DISCUSSION

FRL in the HKH Countries: A Comparative Overview

Three out of the eight HKH countries namely Nepal, India and Myanmar were selected based on their progress on REDD+ readiness with FRL/FREL development in particular. Despite considerable readiness progress like REDD+ strategy preparation, national forest monitoring system design and efforts on FRL development, other three countries Bhutan, Pakistan and Bangladesh have not been considered for this study. FRL/FRELs from these

4 http://www.fao.org/3/a-i4847e.pdf

countries were not available for this study. Among the selected countries, Nepal has been receiving REDD+ readiness support from the World Bank's Forest Carbon Partnership Facility (FCPF). India has been working on its own financial and technical capability while Myanmar has been receiving support from the UN-REDD. All of these three countries have submitted their national FRL to the UNFCCC for technical assessment. All of these documents (FRLs) were assessed and the technical assessment report (TAR) were published on the UNFCCC's website[5].

Table 1: Summary of the Comparative Analysis of the FRLs Prepared by the Three HKH countries

Parameter	Nepal	India	Myanmar
Type	National	National	National
Forest definition	MMU:1ha, CC ≥10 per cent, Height: 5m	MMU: 1 ha, CC ≥ 10 per cent,	MMU: 0.5ha, ≥10 per cent, Height: 5m
Scale	National	National	National
Pools	AGB, BGB	AGB, BGB, SOC, DW, Litter	AGB, BGB, Litter
Gases	CO_2	CO_2	CO_2
Activities	Deforestation, Forest degradation and Enhancement	Sustainable forest management	Deforestation, Enhancement
Historic period (AD)	2000-2008 Derived at the level of physiographic region using bias-corrected estimates of changes to areas of forest cover and prepared using Landsat TM data for 2000–2010. Wall to wall mapping	2000-2010 Derived from the analysis of satellite imagery (IRS) that provided forest cover information for 2000, 2004 and 2008, assessed canopy class changes overtime, wall to wall mapping	2005-2015 Derived from stratified random samples generated on the basis of the stratification used in Global Forest Change (GFC) maps,12 which were adjusted according to forest definition.
EF	NFI data (two stage stratified sampling), stock difference,	NFI data (two stage stratified systematic sampling), stock difference,	District level inventory data and IPCC default values
Approach	Historical average	Historical average	Historical average
National adjustment	None	None	None
Methodological tier	Combined I, II and III	II and III	I and II
Consistency with GHG inventory	Partly	Yes	Yes
FRL	**Emission**:1,326,243 t CO_2e/year for deforestation and fuelwood consumption **Removal**: - 150,110 tCO_2e/y for enhancement by increasing forest area.	FRL from SFM: -49,700,000 t CO_2 eq/y	**Emission**: 53,807,463 t CO_2 eq/y for deforestation **Removal:** –3,351,332 t CO_2 eq/y by enhancement of forest carbon stocks

MMU: Minimum Mapping Unit; CC: Crown Cover; AGB: Above Ground Biomass, BGB: Below Ground Biomass; OC: Soil Organic Carbon; DW=Dead Wood; NFI= National Forest Inventory

5 TARs are available at: https://redd.unfccc.int/submissions.html

Compliance with the UNFCCC Principles of FRL/FREL Development

Under the UNFCCC (decision 12/CP.17, 2011), and as elaborated by the IPCC, there are five general principles guiding FRL/FREL estimation. These principles are: (1) transparency, (2) completeness, (3) consistency, (4) comparability, and (5) accuracy (UNFCCC, 2014)). As described in the "Guidelines for by Meridian Institute (2011)", transparency implies that the assumptions and methods used to prepare FRL/FREL are clearly and fully described. The FRL/FREL should be completed with respect to relevant pools and categories of activities; where pools or activities are missing, their absence should be documented along with a justification for their exclusion. As described in the UNFCCC decisions (UNFCCC 2014), FRL/FREL should be prepared in a way that is consistent with accepted standards of carbon accounting, and that allows for comparison of FRL/FREL among countries. To ensure accuracy, bias must be avoided and uncertainty must be reduced. When necessary to address large uncertainties in emission and removal estimates for key sources, the additional principle of conservativeness should be applied: conservativeness requires that, when completeness and accuracy are lacking, the risk of overestimation is lower than the risk of underestimation (Meridian Institute 2011).

Review of FRLs of India, Myanmar and Nepal found that these countries were following the five general principles discussed earlier. However, reasons for, if any, non-compliance to the principles were explained limitedly by India and Myanmar. Nepal's FRL had provided detail explanation of any non-compliance to the UNFCCC FRL/FREL principles. For example, Nepal's FRL was not consistent with the country's GHG inventory report in terms of inventory methods applied. The country has explained why such inconsistencies are there. The main reason explained is that its previous national communications was developed before the development of the national FRL. The FRL construction used more robust and more recent data on land cover and land-cover changes and methodologies. Such latest data, methods and information were not available at the time of GHG inventory for first and second national communication reports. Nepal has also explained that the third national communication will include estimates of emissions for 2010 and use the FRL estimates as a basis for estimating emissions and removals from Land Use, Land-Use Change, and Forestry (LULUCF) sector so that consistency is ensured in future submissions.

Scale of the FRLs

Scale, or area covered by the FRL/FREL, is one of the basic elements to be explained in the document. Countries either develop subnational or national FRL/FREL depending on their capacities and objectives of their REDD+ implementation. Subnational FRLs are estimated if a country's capacity is limited in terms of data availability, sources of funds, and required institutional and policy arrangements at the national scale. According to UNFCCC decisions[6], countries can go with subnational scale REDD+ project but they should ultimately develop a national FRL/FREL.

6 UNFCCC, Decision 12/CP.17, par. 11; Decision 13/CP.19, Annex, par. 2 (c)

The subnational FRL/FREL may be elaborated as an interim measure (FAO 2015). It is justified because national scale REDD+ intervention avoids the internal displacement of emissions and is useful to properly assess the impact of national policies and measures. Countries having subnational FRLs should discuss about them in the national FRL/FREL by linking with the plan of scaling up (Meridian Institute 2011; FAO 2015).

The FRLs developed by the three countries (India, Myanmar and Nepal) and submitted to the UNFCCC for their technical assessment were of national scales. The basic decisions and steps for developing FRL/FREL are relevant at both national and subnational scales. The UNFCCC at COP 17 in Durban decided that countries may opt to work on their historical emissions and removals data in a stepwise fashion, starting with selected states or provinces where changes in forest cover have historically been high (Walker *et al.* 2012). Out of the three countries, Nepal has developed a subnational FRL for a jurisdictional emission reduction program to access World Bank's carbon fund (MoFE 2018). According to the REDD Implementation Center (REDD IC) Nepal *(personal communication)*, the jurisdictional FRL has been developed for the Terai Arc Landscape (TAL) and will not be considered as a part of the national FRL. once the Emissions Reduction Purchase Agreement (ERPA) is signed between Nepal and the World Bank, the TAL area will be taken out of the national FRL. This will avoid possible double counting of reduced emissions and enhanced removals. India and Myanmar have not developed subnational REDD+ projects and FRL/FREL.

Forest Definition for the FRLs

Countries implementing REDD+ must identify areas eligible for specific national scale REDD+ activities and distinguish between areas of forest and non-forest within the country (UNFCCC 2014; GOFC-GOLD 2015). Distinction between forest and non-forests requires a single consistent national definition of "forest" that is appropriate for local conditions (UNFCCC 2014). Forest definition adopted in FRLs vary from nation to nation but it should follow a common framework that includes threshold values for minimum area, minimum height, and minimum level of crown cover[7]. Under the UNFCCC, the three thresholds are: 10 per cent to 30 per cent for crown cover, 2 to 5 m for height, and 0.1 to 1 hectare (ha) for minimum area (IPCC 2006)[8]. These thresholds of forest definition have implications for measuring and monitoring of forest conditions overtime. Specifically, these thresholds are used to detect changes in forest area (deforestation and afforestation) and their conditions (degradation and enhancement) using remote sensing data. This could influence cost, availability of data, and abilities to integrate and compare data through time. Text from the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA) in Durban states that countries should provide a national definition for forests to the UNFCCC and that it must be justified if it differs from the one used in the national GHG inventory or reporting to other international organizations. Unresolved differences over forest definitions can cause

7 UNFCCC, Decision 12/CP.17

8 According to the thresholds for defining forest in the Marrakesh Accords.

complications in the M-MRV system and significantly impact the benefits and their distribution, representing a key barrier to the implementation of REDD+. It is important that the national definition of forest remains consistent over time in order to allow for comparison.

As summarized in Table 1, this study found that the three countries have defined forests in their FRLs consistently with the UNFCCC guidance. India has adopted the same definition as adopted in GHG inventory and takes the stand with minimum area of 1 ha. with tree canopy cover of 10 per cent as the forest. The stand of bamboo, palms and orchards are also considered within forest definition. On other hand, Nepal and Myanmar follow the definition of forest stated by the FAO as the stand of trees with minimum area of 0.5 ha with tree canopy cover of 10 per cent with growth up to 5m in maturity. The definition of forest of Nepal includes young natural stand and plantation for forest, seed orchards, nurseries, forest roads, firebreaks, small open areas in forest; shelterbelt, windbreaks of area greater than 0.5 ha and width greater than 20m and excludes predominant agricultural land. Similarly, the seed orchard, nurseries, windbreak and shelterbelt are considered within category of forest by Myanmar. However, the minimum mapping unit for AD applied by Nepal is different from the threshold applied for the forest definition (i.e. 0.5 ha). The justification behind these differences as described in the FRL document is that 2.25 ha. can achieve highest accuracy while mapping changes in the forests using Landsat images particularly in the Nepalese context such as large terrain effects, shaded relief, mosaic and fragmented land cover. Both India and Myanmar have applied a single threshold. These countries have argued that they have the capacities, in terms of data sources, human resources and technologies to meet desirable accuracy despite their biophysical conditions being very similar to that of Nepal. This again suggests that the country capacity largely determines progress and performance of REDD+ policy intervention as suggested by literatures like FAO (2015), Meridian Institute (2011) and Walker *et al.* (2012).

Scope of the FRLs

Many land use activities are incorporated into REDD+, and all fall into broad categories of deforestation, forest degradation, sustainable management of forests and enhancement of carbon stocks. Discussion on the selection of activities, pools and gases to include in the FRL/FREL including the concept of significance, and consideration of national REDD+ objectives is required while analyzing the choice and related decisions on scope of FRL (FAO 2015). The following similarities and differences were noticed in the scope of the three studied FRLs/FREL.

Activities Considered for the FRLs

India has considered four out of the five activities of REDD+ policy intervention including deforestation, forest degradation, enhancement and sustainable management of forests (SFM). The SFM has been considered as the major activity contributing to both emissions reduction and carbon stock enhancement (removals) significantly.

Myanmar has considered two activities i.e. deforestation and enhancement of

carbon stock through afforestation/ reforestation for the FRL estimation. This country has described deforestation as the significant contributor of emissions and hence has estimated its historical trend. Myanmar has also described its National Reforestation and Rehabilitation Programme in Myanmar (NRRPM) to be significantly contributing to the carbon stock enhancement.

Nepal has included three REDD+ activities viz. i) Reducing emissions from deforestation, ii) Reducing emissions from forest degradation from fuelwood harvesting; and iii) Enhancement of forest carbon stocks from afforestation/ reforestation. Net degradation by fuelwood collection over regenerative capacity of forest is taken as proxy for degradation and other factors like grazing and fire are not considered in the absence of credible data. The contribution of community-based forest management (CBFM) practices on forest enhancement is also lacking despite having significant contribution in restoring and rehabilitating degraded forest land throughout the country.

The above findings indicate two important points in relation to the choice of REDD+ activities. First, a country's capacity to assess historical emissions/removals, and required institutional and methodological arrangements for the M-MRV system determine its choice of activities. Full scope activities selection by India through SFM but not by other two countries indicate that the latter countries have limited capacities. India, with a strong NFI system having time-series images covering the entire country and strong institutional arrangements (i.e Forest Survey of India), has selected all of the five REDD+ activities. Nepal with limited access to high resolution images, limited coverage of recently established NFI system and proposed but not functional M-MRV system, could only select deforestation, partly degradation (only fuelwood) and enhancement (only afforestation/ reforestation). Myanmar's selection of activities was also due to its limited capacity in mapping changes in forest areas and lack of NFI system at national scale. Myanmar's NFI covers 40 forest districts out of the 68 districts in the country.

Second, the FRL/FREL development process is not one-time end process. In other words, it is an ongoing process and progresses with improved capacities following a stepwise process following the modality developed by the UNFCCC during COP 17 in 2011[9]. The omission or partial consideration of forest degradation and carbon stock enhancement by Myanmar and Nepal in their FRLs despite knowing that these activities can contribute substantial carbon benefit-supports the need and relevance of the step-wise approach. These countries have not incorporated enhancement of carbon in 'forests remaining forests' as REDD+ activity. Further, Nepal has not assessed and included the contribution of CBFM. Both these countries, however, intend to incorporate these activities when they are capable of doing so. The TAR of Nepal and Myanmar have identified a number of areas/activities for the future technical

9 Decision12 (II), CP17: 10. a step-wise approach to national forest reference emission level and/or forest reference level development may be useful, enabling Parties to improve the forest reference emission level and/or forest reference level by incorporating better data, improved methodologies and, where appropriate, additional pools, noting the importance of adequate and predictable support as referenced by decision 1/CP.16, paragraph 71;

improvement and acknowledged that these improvements are subject to national capabilities and policies[10][11]

Carbon Pool

Carbon pools are the pools in forest where carbon is stored (GOFC-GOLD 2015). Altogether five carbon pools are listed for carbon measurement in forests viz. AGB, BGB, DW, litter and SOC. Countries are allowed to choose any of the pools based on their capacities in measuring them and mapping changes over time. However, they must provide an explanation of the carbon pools considered for FREL/FRL (UNFCCC 2014; FAO 2015). It means, reasons and explanations are needed in either case (i.e. if any carbon pool are considered or omitted in the FRL/FREL).

Out of the three HKH countries considered for this study, India has selected all of the five carbon pools in its FRL. Myanmar has incorporated three pools (i.e. AGB, BGB and litter) whereas Nepal has considered only AGB and BGB carbon pools. India has opted to include all the carbon pools as it has time series quality data of all the carbon pools in its NFI program.

Myanmar has included AGB, BGB and litter using allometric equations derived from district forest database and has also adopted from the IPCC default values. Myanmar has provided justification on omission of the two carbon pools. The FRL document says that studies on site specific soil carbon content were carried out but not correlated with land cover classes at national level. The national data on dead wood was lacking and no clear default value for varying sites, conditions, forest type and management was provided by IPCC. Thus, latter two pools were omitted from the FREL.

Nepal has omitted dead wood and litter and described that these pools were considered to be insignificant. As per FRA (2014), litter and dead wood were found to consist 1.19 t/ha carbon against an average AGB of 108.88 t/ha. This comes to less than 5 per cent and therefore is justified to be considered as insignificant. The IPCC guideline (2003) describes that carbon content less than 25-30 per cent should not be considered as significant. SOC was omitted due to unavailability of credible data and the cost of data collection was considered likely be greater than the benefit of including SOC. The technical assessment report of Nepal's FRL has also noted these justifications provided by Nepal as satisfactory[12].

In line with the UNFCCC, IPCC, FAO (2015) and Meridian Institute (2011), all of the three countries have selected the pools considering (i) their significance in terms of volume changes and (ii) availability of credible data. Omission of SOC by Nepal and Myanmar was more related to the unavailability of credible data and costs associated with doing so. India has considered all of the five carbon pools because this country was having credible time series data to do so, as explained the Indian national FRL 2018 reviewed[13]. This finding suggests that countries with limited capacity will not be able to measure their performance correctly hence are likely to get less benefit they actually deserve.

10 https://unfccc.int/resource/docs/2017/tar/npl.pdf

11https://unfccc.int/sites/default/files/resource/tar2018_MMR.pdf

12 UNFCCC/TAR/2017/NPL

13 Available at: https://redd.unfccc.int/submissions.html?country=ind

Gases Considered

UNFCCC decision 12/CP.17, Annex (c) does not explicitly seek justification for any omission of gases as it seeks for pools and activities. Concerning the inclusion or omission of gases, countries should try to maintain consistency with their GHG inventory and should provide a justification for omission(s). A country may propose to include fewer gases in the FRL/FREL than included in the GHG inventory, because they may not have detailed or disaggregated enough information for the REDD+ activity in the FRL/FREL (FAO 2015). Gases to be considered, whether CO_2 or none CO_2 GHGs, in the FRL/FREL need to be clearly described with justification behind the consideration. Selected activities and carbon pools are the basis for selecting gases. In addition to CO_2, countries with peatland, wetland and frequent flooding may wish to consider Methane (CH_4) because these pools significantly emit non-CO_2 gasses like CH_4. Countries' capacity to assess emissions of different gasses also influences their choice.

This study found that only CO_2 gas is considered for FRL development in these three countries. Other GHGs like CH_4, NO_2 and N_2O are not considered significant from deforestation and forest degradation, and hence have not been estimated for the FRLs. These countries have provided explanations on why non-CO_2 gases were not considered. A common reason that has been explained in the FRLs is that non-CO_2 gases emission was insignificant. For example, Myanmar has explained that the total combined emission of non-CO_2 GHGs viz. CH_4, N_2O and NO_2, primarily due to land clearing and forest fire, was 637 Giga tons while that of CO_2 was 102,264 Giga ton. India has considered CO_2 with no further explanation for not considering non-CO_2 emissions. Nepal has explained that the non-CO_2 gases were not significant in Nepal because of the following reasons:

- There are no mangroves in Nepal.
- There are no seasonally or permanently flooded forest areas in Nepal.
- Fires are not a significant source of emissions.

However, Nepal's explanation that forest fire is not significant contradicts with other government documents like REDD+ preparation proposal, the second national communication report (2015) and FRA report (2015). All of these documents explained forest fire as one of the major drivers of deforestation and forest degradation. The FRL however, explained that a total of 281,470 tCO_2e non-CO_2 emissions come from forest, which consists of 12 per cent of the total annual emissions from forests. But this figure was estimated using data from Global Forest Resources Assessment (2015) along with IPCC default values for fuel biomass consumption, the combustion factor and emission factor of dry matter burnt per mass. The technical assessment report of Nepal's FRL has also noted this contradiction. The technical assessment report (paragraph 37) explains that "the assessment team considers the treatment of non-CO_2 gases in the construction of the FRL to be an area for future technical improvement in order to maintain consistency with future GHG inventories and to improve the accuracy of the estimates that will be submitted together with Nepal's third national communication."[14].

14 UNFCCC/TAR/2017/NPL

Activity Data

The quantity of an activity that results in emissions/removals is referred to as activity data (AD). In other words, AD refers to the extent of an emission/ removal category. In most cases, AD are measured in area (ha). In the cases of deforestation, afforestation/reforestation, forest degradation, and enhancement of forest carbon stocks, AD refers to the areal extent of those activities, that is, the area change data expressed in hectares per year (FAO 2015). Forest area changes data should be expressed as gross changes, they should be spatially explicit, and they should be able trackable into the future (i.e. monitoring how a given pixel changes through time). Such data would be based on the interpretation of remote sensing imagery; images are the primary sources of AD. It is also relevant to include trends in AD for deforestation, degradation, and forestation. Not only are estimates of annual averages over a period of time needed, but systematic patterns of change over the same period are also necessary. A partial extrapolation of such historic trends could improve the reliability of BAU projections (Meridian Institute, 2011). Satellite images are the primary sources of AD for FRL/FREL estimation of any REDD+ activity. AD are developed using spatial datasets and expertise skills along with non-spatial data and ground truthing.

As shown in Table 1, this study found that all of the three countries have followed related UNFCCC and IPCC guidelines to the extent possible while estimating AD. These countries have also considered available data sources of their own (NFI data specifically) and selected activities. India has selected a single activity viz. SFM while Nepal has selected three viz. deforestation, degradation and enhancement by afforestation/ reforestation. Myanmar has selected deforestation and enhancement of carbon stock activities. All of these countries have used Landsat images applying wall-to- wall mapping system. Despite these similarities, however, there were many differences among these three countries in terms of applied tools and techniques.

India has applied wall-to-wall mapping system with overtime spatial data sets generated by the Forest Survey of India (FSI). FSI has been applying digital interpretation of the satellite data with spatial resolution of 23.5 meters and delivering time series maps of changes in the forests since 1987[15]. India has used forest type maps with scale of at 1:50,000 for mapping AD of this FRL. This method has produced AD maps with MMU of 1 ha. and acceptable accuracy. India classified forests into three density classes viz. very dense forest (with canopy density of more than 70 per cent), moderately dense forest (with canopy density between 40 and 70 per cent) and open forest (with canopy density between 10 and 40 per cent). A total of 4000 sample plots were verified using forest inventory data, high resolution image and field verification. The classification accuracy (i.e. 90 per cent) was within the acceptable limit.

Nepal has used land cover change assessment data, primarily between forest and non-forest, between 2000 and 2010 to estimate AD of the FRL. Landsat thematic mapper (TM) and enhanced thematic

15 FRL 2018, India. Available at: https://redd.unfccc.int/submissions.html?sortCountry=asc&sortLevel=asc&country=ind

mapper (ETM) data downloaded from USGS global visualisation were primarily used to develop the land cover and change maps. Advanced space-born thermal emission and reflection radiometer (ASTER), DEM with 30 m and 90 m resolution (ICIMOD 2010) and forest cover database of year 2010 by Rapid Eye 5m resolution (DFRS 2015) were used as supplementary sources for estimating AD of deforestation and afforestation.

The pixel data were grouped into two classes viz. below than 2.25 and above 2.25 ha. The size class below 2.25 ha. was not considered because of unsatisfactory level of accuracy obtained and inherent hilly terrain induced registration errors, hilly shadows, highly fragmented and intermixed land cover mosaic were termed as possible sources of error. Thus, only the size class above 2.25 ha. (equivalent to 5x5 pixel window) was considered for FRL estimation. Though the forest definition takes 0.5 ha. area as minimum area, 2.25 ha has been taken as minimum mappable unit for forest change. All other changes below 2.25 ha were added back to stable non-forest to make more conservative forest estimate.

AD for Myanmar's FRL were developed by estimating the forest area change using estimates of areas of forest, non-forest and deforestation for the period 2005–2015, excluding the areas subject to forest degradation, forest improvement and forest area gain. Emission estimated by measuring deforestation over time. Myanmar has not applied the widely practiced approach of pixel counting wall-to-wall method due to the lack of evidences assuring that estimates were unbiased or the uncertainties are reduced. Stratified random sample was used to achieve desired accuracy. This sampling design allows reducing standard error by increasing the sample size. With no existing consistent satellite imagery data available, the Global Forest Change (GFC) map (Hansen *et. al.* 2013) were adjusted to forest definition of Myanmar and used for stratification of forest.

The finding that the three countries have applied different tools and techniques with varying accuracies suggests that acquiring reliable data, analyzing them accurately and precisely as required is largely determined by country capacity, established national forest monitoring system, data generation and outsourcing capacity in particular. Higher accuracy of the India's AD than those of Nepal and Myanmar was because of India's established National Forest Monitoring System (i.e FSI) and robust database management and analysis system. Nepal's choice of MMU (2.25ha) was a result of limited capacity. This might have underestimated AD because deforestation and afforestation activities in Nepal largely happen in small areas (MFSC 2010). The technical assessment report of Nepal's FRL also supports this argument. The report (paragraph 24)[16] noted that "by using the MMU of 2.25 ha, which is higher than the MMU in the national forest definition (1 ha.), the resulting estimate may be an underestimate of the actual deforestation and afforestation happening in the country. Implication would be that countries with limited capacity like Nepal and Myanmar cannot map actual changes they might have made hence deprive of accessing carbon benefits they actually deserve.

16 UNFCCC/TAR/2017/NPL

Emission Factor

EF refers to GHG emissions and/ or removals per unit area under REDD+ intervention. For example, tons of CO_2 emitted per hectare of deforestation. Emissions/removals resulting from land-use conversion can be estimated by one of two methods: either the difference in carbon stock between two successive measurements or the difference between the gain and loss of carbon (e.g., loss due to timber harvesting and gain from regrowth) of the pre and post-conversion land cover category (FAO 2015). NFI data are the primary source of information for estimating EF of any REDD+ activities. EF will be combined with AD in the FRL/ FREL and M-MRV system to estimate emissions and removals from REDD+ activities. This study has found that Nepal, Myanmar and India have applied different approaches and methods for estimating EF for their FRLs.

India has adopted stock difference method for its forest emissions and removals estimation. All the carbon pools viz. AGB, BGB, DW, leaf litter and SOC were measured for emission factor. The Indian NFI data (2002-2008) and data generated from a special study (2008-2010) were used to estimate EF of its first national FRL. These inventories were carried out in two phases with stratification of country in 14 homogenous strata based on physiography, climate and vegetation at first phase.

Nepal has mostly used its NFI data for estimating EF for its first national FRL. Nepal's NFI applies two phase stratified systematic cluster sampling design. The five physiographic regions as defined by Department of Survey viz. High Himal, High Mountains, Middle mountains, Churiya and Terai were used as the strata. A hybrid approach was used for forest inventory by using the satellite images at first phase and field measurement of forest characters at second phase. A total of 2,544 plots (450 clusters) were allocated systematically in all and strata and measured. Out of the total 2,544 plots, 1,553 plots located in forest areas whereas 886 and 105 plots were located in other non-forest land (OL) and other wooded land (OWL) respectively. Different emission factors derived from NFI on stem volume biomass, tree branch and foliage biomass estimation and below ground biomass estimation were used whereas the Woodfuel Integrated Supply/Demand Overview Mapping (WISDOM) model was applied to assess emissions from forest degradation due to unsustainable harvesting for fuelwood consumption in particular. AGB was measured by summing up the biomass of stem, branches and foliage. For stem, nonlinear mixed-model approach was used to establish relationships between dbh and total heights of trees using the 'Lmfor' package in R software (Mehtatalo 2012). Allometric equation developed by Sharma and Pukkala (1990) was used to estimate the volume over bark of standing trees.

Myanmar also mostly used its NFI data available by 2017 to calculate EF of the country's first national FRL. NFI process in Myanmar was ongoing and completed 40 districts out of the 68 forest districts in the country at the time of the FRL estimation. The EF estimated was based on the inventory data from the 40 districts. Information such as dbh, basal area and tree density collected from 11,284 sample plots systematically located throughout the 40 districts were used for estimating average growing stock. AGB

was estimated using average dbh from sample plots and applying allometric equation developed for pan-tropical forest types by the following equation from IPCC GPG for LULUCF (IPCC 2006). BGB was calculated by multiplying AGB by R (Ratio of BGB to AGB) values as described in IPCC Guideline. Forest litter was calculated by using default Litter value as per the forest type as described by Tier 1 default values for Litter in IPCC (2006) guideline. Using three carbon pools for the respective forest districts, weighted mean values of tCO2 eq. per ha for a national level EF was calculated[17].

As discussed earlier in the section about AD, the choice of tools and techniques and the varying accuracy reached suggests that acquiring reliable data, analyzing them accurately and precisely as required is largely determined by country capacity, established national forest monitoring system, data generation and outsourcing capacity. As the finding shows forest cover assessment accuracy and uncertainty of EF of more than 91 per cent and less than 3 per cent respectively by India but not by other two countries, who have limited NFI coverage and were relying largely on IPCC default values was largely because of country capacity. Overall uncertainty of the Nepal's FRL and Myanmar's FRL were 7 per cent and 12 per cent respectively. These uncertainties and lower methodological tiers will have a huge implication on future performance claim (carbon money) of the two countries. Highest the uncertainty and/or lowest methodological tier will reduce performance result significantly. According to the emissions reduction (ER) program buffer guideline of FCPF[18], carbon credit generated by ER programs with high uncertainty and risk of reversal will have to set a side up to 15 per cent and 40 per cent of the generated carbon credit for minimising buffer risk.

Adjustment for National Circumstances

Paragraph 9 of Decision 12/CP.17 invites parties to submit the information and rationale of the FRL/FREL development with inclusion of national adjustment and consequent adjustments made, in accordance with the guidelines (UNFCCC 2011; 2017). Adjustments are made considering national policy contexts and other circumstances. Countries should prepare to submit details of their national circumstances, if they would like to adjust their FRLs upwards or downwards, deviating from historical data (average or trend). Following information may be needed for countries to be eligible for national adjustment.

- Population: growth rates, distribution, migration, density and other issues on food security
- Economy, including agriculture, mining, industry and other sectors
- Conflicts and post-conflict situations
- Foreseen land development plans and policies

None of the countries studied have adjusted their FRL/FREL considering national circumstances. India and Myanmar have described contexts forest governance, institutions and management

17 Please refer to Myanmar's' FRL document at https://redd.unfccc.int/files/2018_frel_submission_Myanmar.pdf for more details.

18 https://www.forestcarbonpartnership.org/sites/fcp/files/2015/December/FCPF per cent20ER per cent20Program per cent20Buffer per cent20Guidelines.pdf

regimes being applied in the national circumstances section. Nepal has presented its national circumstances a bit differently and explained why this country could not claim for FRL adjustment despite indicating so many areas for future adjustment considering country restructuring (federal system) based on the new constitution passed on 2015. Several development plans for metropolitan and industrial areas, airports, dams, etc. are under preparation in different states, details of such development plans are not yet finalized and approved to be considered for adjustment while preparing this FRL. These adjustments might be possible in the next updated version of FRL. Out of the 10 years reference period (2000-2010), Nepal only used data from two time point (year 2000 and year 2010) due to lack of complete and consistent data in between. Similarly, only the data of NFI 2010 was used to estimate degradation resulted from unsustainable fuelwood harvesting, as no national data from year 2000 was available. Thus, the degradation was estimated only from year 2010 data with the assumption that no significant change on pattern of fuelwood consumption has taken over preceding 10 years.

Two important arguments in relation to adjustment for national circumstances can be made based on the finding. First, countries do not claim for FRL/FREL adjustment if their national policies being implemented/planned do not demand deforestation (or use of existing forest areas) and or not likely to cause forest degradation. India's silence on FRL adjustment despite its explanation of national circumstances like policy, governance and management regimes supports this argument. Second, countries cannot claim adjustment despite having knowledge that deforestation will take place due to lack of detail plans and accurate information on scope, scale and location of the likely future development activities requiring use of forest areas (deforestation to take place). Nepal's FRL support this argument. This country has described that more deforestation is likely as the country restructuring process will progress. The technical assessment report of the UNFCCC also substantiates this concern. The report in its 13th paragraph describes "Nepal stated that it may undertake a more detailed study of the key socioeconomic factors in order to improve future projections of emissions from deforestation and forest degradation as part of the stepwise approach."

Further, findings of this study have clearly justified the need and importance of stepwise approach for FRL/FREL development. Each of the countries have indicated that they will use more robust methodologies and update FRL/FREL achieving highest accuracy and reliability. The step wise approach is applied to improve FRL/FREL over time by incorporating better data, improved methodologies, when appropriate, additional pools, gases and national adjustment. UNFCCC allows country parties to update FRL/FREL submission from simple type of estimation (using default values for example) to robust and highly accurate estimation overtime. The stepwise approach suggests three major steps to estimate FRL/FREL including (i) estimation with simple projections, based on historical data (Step 1), (ii) progressively updating the FRL/FREL based on more robust national datasets for country-appropriate extrapolations and adjustments (Step 2) and (iii) ultimately

basing the FRL/FREL on more spatially explicit activity data and driver-specific information support (Step 3) (Meridian Institute 2011; FAO 2015). However, some unintended results are also likely to appear. FRL/FREL development process may take long-time shifting reference year for performance claim forward. Implication would be that countries' efforts to reduce emissions after the reference period proposed earlier would not be considered for performance claim. According to the FCPF methodological framework, reference year should not be more than two years back of the FRL/FREL submission (FCPF 2016). FAO (2015) argues that over stretching the reference period may result in the inclusion of emission patterns/trends that are not representative of expected future emissions, and therefore may not provide a good basis for the FRL/FREL estimation.

CONCLUSION

The development of FRL/FREL is one of the key requirements for countries to be a part of REDD+ policy implementation. UNFCCC develops basic modalities to be followed by countries while developing their FRL/FREL with some flexibilities for incorporating country contexts. This study reviewed FRLs developed by the three HKH countries namely India, Nepal and Myanmar and submitted to the UNFCCC for their technical assessment and compared against the framework criteria/elements defined by the UNFCCC modality. The primary objective was to identifying areas that are complementary, or even contradictory, so that learnings can be scaled out or replicated in other countries.

The FRLs submitted by the three countries were found to be consistent and in compliance with the UNFCCC principles and modality[19]. All of these countries developed FRL considering both emissions and removals. All of the three FRLs were estimated based on historical average considering referencing period of 2002-2008 by india, 2000-2010 by Nepal and 2005-2015 by Myanmar. India considered one (i.e. SFM) activity as major while Nepal selected three (i.e. deforestation, forest degradation and carbon stock enhancement through afforestation/reforestation) and Myanmar selected two (i.e deforestation and carbon stock enhancement through afforestation/reforestation) activities. All of these documents were national scale and estimated CO_2 with justification for omitting another non-CO_2 GHGs. India measured all of the five carbon pools while Nepal and Myanmar measured AGB, BGB and AGB, BGB and litter respectively. AD and EF were estimated using two types of data sources and methodologies broadly including (i) country generated data sources and (ii) default values/ methodologies from literature. Country generated methodologies, as India largely used and achieved more than 91 per cent accuracy, were found better in achieving accuracy of the estimation. Despite describing country circumstances, none of the three countries adjusted FRL estimation. Nevertheless, Nepal has explained its country restructuring process and related development plans as unavoidable national priority programs and indicated that upward adjustment of its FRL will be required.

19 Decision12 (II), CP17

This study concludes that there are some technical, methodological and procedural issues complicating the FRL/FREL development process particularly for the countries with limited capacity. Countries lacking at least 10 years or more history of established NFI system, lacking access to high resolution images and with limited human capacity for assessing and analyzing land cover and biomass changes in forests are less likely to produce credible FRL/FREL. FRLs developed by Nepal and Myanmar appear incapable to capture all activities, pools and gases because of their limited capacity. For example, Nepal could not include the success and achievements of CBFM in rehabilitating degraded forests due to lack of updated maps showing those changes with standard methods. Unless countries develop their capacity to access advance tools and techniques and apply, they will not be able to develop credible FRL/FREL against which they can claim REDD+ benefits they actually deserve. Using advance tools and techniques and improving technical capacity require reliable financial resources which is less likely for such poor countries.

Although the stepwise approach allows countries to redevelop FRL/FREL with updated information and reference level, it however undermines efforts countries might have provided in between the first and the revised FRL/FREL development. Time spent for revising the FRL/FREL actually shifts the reference year and countries cannot claim benefits for the changes they might have brought during that period.

This study concludes that developing FRL for forest degradation, enhancement through regrowth and sustainable management of forests are not straight forward as other two activities deforestation and afforestation/reforestation do. Use of remote sensing images like Landsat, which is freely available hence most of the countries have used, is considered not very much effective for degradation assessment. Omission of this activity by Myanmar and using indirect approach by Nepal reveal this issue. UNFCCC and IPCC guidelines also do not clearly prescribe methodology for assessing forest degradation. Countries like Nepal where forest degradation has been identified as one of the major emissions contributors (MFSC 2010) and where consistent multi-date observations of forest biomass stock are not available, measuring and mapping emissions from forest degradation remains a challenge. This limitation hinders countries' (like Nepal and Myanmar) aspiration to be benefited from REDD+ policy implementation.

Overall, development of FRL/FREL with desirable accuracy is not easy for nations with limited capacity, despite availability of modality and guidelines, flexibilities for choosing tools, techniques and methodologies and provisions for country circumstances adjustment. A country can only get benefits from these modalities, guidelines, flexibilities and provisions if required capability, in terms of information, technologies and resources, for FRL/FREL estimation are available. All of the three countries, Nepal and Myanmar specifically, were lacking such capability. Based on the technical assessment report of Nepal, this study concludes that all of the three FRLs/FREL will have to be revised by (i) including more activities, pools and gases, (ii) improving

methodological tiers, development of local biomass model for example, and (ii) adjusting FRL considering country contexts.

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