Challenges with measurement and accounting of the Plus in REDD+

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Contents

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1. Introduction

The goals of the Paris Agreement cannot be met without significant carbon removals. Global carbon models that avoid dangerous climate change by 2100 not only assume a drastic decline of fossil fuel use, but also significant removals of GHGs[1]. Currently, 'negative emission' technologies are too expensive to deploy at scale; moreover, recent research suggests that bioenergy carbon capture and storage (BECCS), assumed in many climate models that limit global warming to 2°C, will not be able to deliver the removals needed without dangerous impacts to critical ecological systems. Currently, terrestrial systems (mostly forests) sequester around one-third of global GHG emissions[2]. Studies suggest that, among a variety of natural carbon capture options, restoring lost forests and increasing the carbon stocks in existing forests through better management are among the options with highest mitigation potential[3] (Figure 1.1). These processes involving removals are generally considered to be included within the Plus in REDD+.

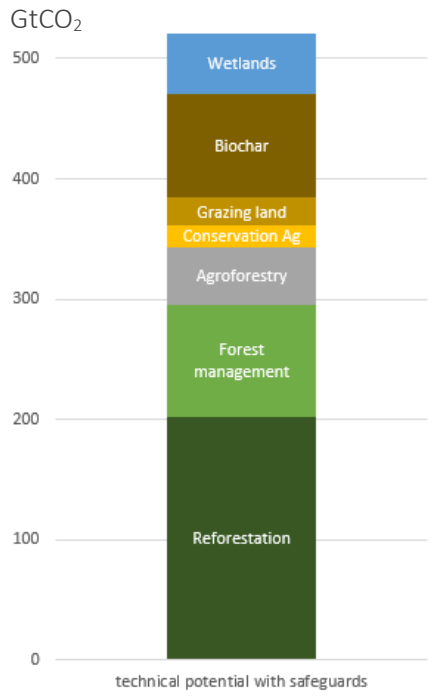

Figure 1.1: Natural carbon removal potential by activity, cumulative to 2100

REDD+ celebrated its 10-year anniversary last year. In the past decade, the focus has largely been on reducing emissions from deforestation. This has resulted in the development of accounting systems and procedures that meet the needs of countries with high mitigation potential related to stemming forest loss, but these systems may not respond well to needs and opportunities associated with removals. For some developing countries, increasing forest carbon stocks may even have greater mitigation potential under REDD+ than emissions reductions. However, most find inclusion of removals in REDD+ reference levels challenging.

The Warsaw Framework (WF) is a set of COP decisions that provides high level guidance for countries pursuing REDD+ activities; it does not give detailed instructions but refers countries to the latest IPCC guidance and guidelines. Alongside the WF, several results-based finance opportunities have been developed. These are largely consistent with the WF, but often include additional requirements for countries to access pay-for-performance funds. Some do not include removals (e.g. REDD Early Movers), while others allow removals (e.g. Green Climate Fund, FCPF Carbon Fund)—but appear to have developed a set of rules which are more suited to avoided deforestation/degradation than for increases in carbon stocks.

[1] IPCC 5th Assessment Report, Working Group 3 (2014).
[2] Le Quéré et al, 2018. Global Carbon Budget 2017. Earth Syst. Sci. Data, 10, 405-408, 2018.
[3] Figure is estimated from Griscom et al (2017), Natural Climate Solutions (Supplementary Information), PNAS vol.114, no.44, 11645-11650. The full mitigation opportunity for soils was not included in the study and may have mitigation potential in the same range as forest management. The figure provided is biophysical potential taking into account safeguards (ensuring human needs for food and fiber, and protection of biodiversity); cumulative potential also takes into account assumed saturation limits and avoids overlapping land areas. Conservation agriculture likely has higher potential than illustrated in the figure and was not fully included in the analysis due to data limitations.

The question this paper therefore seeks to tackle is: **Are current international policies, monitoring tools, carbon accounting methods, and incentive mechanisms fit for purpose for the Plus in REDD+?** This paper stems from the hypothesis that the Plus activities have characteristics that are different from those designed to reduce deforestation and degradation. This may require reconsideration of current REDD+ reporting and accounting systems and related policies in order to provide incentives for countries to maintain or increase forest carbon stocks. The paper is organized around the following two main themes:

- **The confusion around the Plus in REDD+.** To date, countries that have included carbon removals in forests in their REDD+ proposals have done so in varying ways, taking different approaches to defining conservation, sustainable management of forests and enhancement of forest carbon stocks. This section first unpacks the definitional issue around the Plus activities and then seeks to provide clarity on how countries may include forest carbon removals in ways that are consistent with IPCC guidelines. In this we consider the differences between activity-based and land-based accounting and how the different REDD+ activities could be mapped into the IPCC land-based accounting framework.

- **Accounting procedures and guidelines that are 'fit for purpose' for the Plus.** To date, REDD+ pay-for-performance initiatives—for example, the Green Climate Fund and Forest Carbon Partnership Facility—have been focused on developing rules largely based on incentivizing avoided deforestation. We start by offering some insights into differences between avoided deforestation (and forest degradation) and increasing removals. We then consider whether different rules on carbon accounting are needed for the latter—because unless accounting rules are appropriate for the Plus, such activities will not be incentivized.

Finally, we provide a set of conclusions that we hope will help to advance the evolution of REDD+, by reconsidering measurement and accounting systems that could support incentives for the Plus activities critical to achieving the goals of the Paris Agreement.

2. Confusion over the Plus activities

2.1. What is the Plus?

UNFCCC decisions name five REDD+ activities:

- reducing emissions from deforestation;
- reducing emissions from forest degradation;
- conservation of forest carbon stocks;
- sustainable management of forests;
- enhancement of forest carbon stocks.

Among these activities only deforestation has been formally defined by the IPCC[4], although there remain practical difficulties in determining whether deforestation is permanent or only temporary (Box 2.1), which has an impact on how afforestation or reforestation (AR)[5] is measured. Forest degradation has never been fully defined. Indeed, a special report commissioned by the IPCC to develop a definition was unable to advance beyond a framework definition.[6] For the purposes of REDD+, many countries have assumed that it refers to the lowering of carbon density in forests that remain forests, but how to operationalize the definition remains a challenge.

Box 2.1: Assessing deforestation: The challenge of land cover versus land use

Deforestation implies a permanent removal of forest through conversion to other uses (grassland, cropland, settlements, etc.); hence areas subjected to temporary clearance, for example due to harvest cycles or some instances of shifting cultivation (particularly when fallow/forest recuperation periods are longer than the cultivation periods), should not be considered to be deforested. Such situations may be characteristic of (sustainably) managed forests or, (e.g. in the case of primary forest to shifting cultivation) be considered degradation. This definition is based on a *land-use* concept of forest, rather than a *land–cover* concept.

Despite this definition, many developing countries in practice use (at least partially) a land-cover definition because unlike in most developed countries, their forest area tends to be subject to many more changes over time that are hard to track and most often are detected by remote sensing as ¨clearance¨. Remote sensing can more easily detect clearance (usually an abrupt and distinct change) than the subsequent regrowth (a gradual and often lengthy process where new canopy cover may only be detected years later). Without ground level surveys, it is often not possible to tell whether these clearances are temporary or permanent. This means that deforestation (in IPCC terms) will almost always be over-estimated. When measuring changes in carbon, use of land cover (instead of land use) is less critical if a comprehensive (i.e. all land use categories), land-based approach is applied (see Section 2b), as all changes would be reported and accounted. However, currently, most developing countries do not report or account for land-based GHG fluxes comprehensively[7].

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[4] The IPCC GPG for LULUCF (2003) states that "It is good practice to estimate and report separately the sum of all forest land conversions (deforestation)," implying a definition of deforestation as conversion of forest land into other land use categories.

[5] Afforestation and reforestation both refer to establishment of trees on non-treed land. Reforestation refers to establishment of forest on land that had recent tree cover, whereas afforestation refers to land that has been without forest for a much longer time period. Most developing countries use the terms interchangeably.

[6] The IPCC Special Report on Definitions and Methodological Options to Inventory Emissions from Direct Human-Induced Degradation of Forests and De-vegetation of Other Vegetation Types (2003) provided the following framework definition: "A direct, human-induced, long-term loss (persisting for X years or more) or at least Y% of forest carbon stocks [and forest values] since time T and not qualifying as deforestation", but the report was unable to provide the thresholds for carbon stock loss, minimum area affected and time period that would be needed to operationalize the definition.

[7] For more information, see Federici, S., Grassi, G., Harris, N., Lee, D., Neeff, T., Penman, J., Sanz, M.J., and Wolosin, M. (2017). GHG Fluxes from Forests: An assessment of national GHG estimates and independent research in the context of the Paris Agreement. Publication for the Climate and Land Use Alliance.

Not surprisingly, these differences in approach have led to considerable confusion in countries that are preparing for REDD+, and to challenges to their ability to monitor REDD+ activities in a manner that is consistent with IPCC guidelines.

There is even less guidance on the definition of the Plus activities—the REDD+ activities that could result in net *removals*, i.e. conservation, sustainable management of forest (SMF) and enhancement of forest carbon stock. While the lack of definitions for four out of five of the REDD+ activities has caused confusion, there are reasons why these particular terms were chosen. Delegates negotiating the REDD+ text were more concerned with the overall scope of REDD+, wanting to ensure that a wide range of activities were represented, than with the details of how GHGs were to be reported. The three Plus activities were added later in the negotiations with the aim to valorize and offer positive incentives for removals in addition to emission reductions, for example through increasing carbon stock in new or existing forests.

Moreover, a number of countries that had been conserving their forests well in the past wished to participate in REDD+. In other words, the plus activities were partly introduced to make REDD+ an attractive option for *all* developing countries. Although the texts do not explicitly say so, one may infer that the Plus also aimed to provide a comprehensive approach to mitigation in the forest sector (i.e. to include *all* human-induced GHG fluxes related to forests). The list of REDD+ activities, however, was not negotiated with much consideration of how they would be technically defined.

As a result, countries, and organizations that support them, have made their own interpretations of the five REDD+ activities, particularly those representing the Plus.

2.2. How countries define REDD+ activities in their FREL/FRL proposals

Of the 38 countries that have submitted a FREL/FRL to the UNFCCC to date, 17 (45%) included one or more of the Plus activities (see Table 2.1).

Table 2.1: REDD+ activities included in FREL/FRL proposals to the UNFCCC

	Deforestation	Degradation	Enhancement	SMF	Conservation
Brazil 2014	X				
Brazil 2017	X				
Brazil 2018*	X				
Cambodia	X	X	X		
Chile	X	X	X		X
Colombia	X				
Congo, Republic of	X	X			
Costa Rica	X		X		
Cote d´Ivoire	X		X		
DRC*	X				
Ecuador	X				
Ethiopia	X		X		
Ghana	X	X	X		
Guyana	X	X			
Honduras	X				
India*				X	
Indonesia	X	X			
Lao PDR*	X	X	X		
Madagascar 2017	X				
Madagascar 2018*	X				

Malaysia 2015				X	
Malaysia 2018*	X			X	X
Mexico	X				
Mongolia*	X	X	X		
Mozambique*	X				
Myanmar*	X				
Nepal	X	X	X		
Nigeria*	X				
Panama*	X	X	X	X	X
Papua New Guinea	X	X	X		
Paraguay	X				
Peru	X				
Sri Lanka	X		X		
Suriname*	X	X			
Tanzania	X				
Uganda*	X				
Vietnam	X	X	X		
Zambia*	X				

* UNFCCC technical assessment (TA) is ongoing and, as a result, countries may change the scope of activities covered

However, Table 2.2 shows that countries define similar fluxes differently: while there is fairly strong agreement on how to label the conversion of non-forest to forest land, which all countries except India refer to as "enhancement of forest carbon stocks", there is a lot of variety on how countries label removals from forest land remaining forest land, calling it either enhancement, SMF, conservation or a combination of these. India combines all losses and gains in stock density and area and calls this ´sustainable management of forest´. While the lack of harmonized definitions has the advantage of flexibility, it also means that comparisons between country reporting will be difficult and that countries may spend a lot of time and effort on defining the activities, including efforts to avoid double-counting of the same removal under different activities. Countries may also have the perception that all five activities need to be defined in order to assess all GHG fluxes from the forest which may complicate matters and distract from designing MRV solutions which accurately assess removals.

Table 2.2: How countries have defined Plus activities

Table includes countries with technically assessed FRLs only. F = forest, NF = non-forest.

	Removals in NF>F	Removals in F>F	Did not include:
Cambodia	**Enhancement:** Area changes in NF>F	**Enhancement:** Area changes in secondary > primary F	*Removals in forest remaining in same category*
Chile	**Enhancement:** Area changes in NF>F	**Conservation:** Area changes in secondary > primary F in formal conservation areas **Enhancement:** Area changes in secondary > primary F and conversion plantations to native forest	*Removals in forest remaining in same category*
Costa Rica	**Enhancement:** Area converted to new (natural) forest	**Enhancement:** Growth in secondary forest	*Removals in primary forest*
Cote d´Ivoire	**Enhancement:** Area changes in NF>F		*Removals in F>F*
Ethiopia	**Enhancement:** Area changes in NF>F		*Removals in F>F*
India*	**SMF****: Carbon stock change in NF>F	**SMF****: Carbon stock change in F>F	*All removals included unless they are not detected through RS*

Lao PDR*	**Enhancement:** Area changes in NF>F	**Enhancement**: Area changes in lower > higher C forest categories	*Removals in forest remaining in same category*
Malaysia*		**SMF:** Biomass growth minus stock loss from logging in production forest in permanent reserve forest **Conservation:** Biomass growth in protected areas	*Removals in NF>F*
Mongolia*	**Enhancement:** Area changes in NF>F		*Removals in F>F*
Nepal	**Enhancement:** Area changes in NF>F		*Removals in F>F*
Panama*	**Enhancement:** Area changes in NF>F	**SMF**: Area changes in lower > higher C forest categories in logging concessions **Conservation**: Area changes in low > higher C forest categories in protected areas	
Papua New Guinea	**Enhancement:** Area changes in NF>F		*Removals in F>F*
Sri Lanka	**Enhancement:** Area changes in NF>F		*Removals in F>F*
Vietnam	**Enhancement:** Area changes in NF>F	**Enhancement:** Area changes in lower > higher C forest categories and carbon stock changes in forest remaining in same category	*All removals included*

* For these countries, the technical assessment (TA) is ongoing, the country may decide to change the scope as a result of the TA
** India also includes F>NF in SMF

One of the underlying problems that leads to confusion and differences in the way countries have defined the five REDD+ activities relates to whether they are using an activity-based approach (reporting on each of the REDD+ activities separately) or a land-based approach (in which they report on changes in the status of land). This is discussed in more detail in the following section.

2.3. Activity-based versus land-based reporting

IPCC guidance and guidelines were drafted to support GHG inventory reporting, using a land-based approach to estimating and reporting GHG fluxes for forest and other land use (see Box 2.2). Many countries, however, are taking an activity-based approach to REDD+ reporting and accounting, e.g. reporting on one or more of the REDD+ activities, such as "deforestation" and/or "enhancement of forest carbon stocks", regardless of where such activities occur. In reality, many of the REDD+ activities are two sides of the same coin: i.e. AR can be considered the opposite of deforestation while enhancement in forest land remaining forest land can be considered the opposite of degradation. Activities should not be viewed in isolation from each other if they take place on the same land-unit, i.e. timber harvesting and post-harvest regrowth will occur on the same land-unit so ***net*** emissions or removals on that unit of land should be reported.

Box 2.2: Land versus activity-based approaches for reporting GHG fluxes from land use

The land-based approach to emissions estimation (used for GHG inventory reporting under the Convention) proceeds from the classification of all the managed territory of a country into the IPCC land categories. Emissions and removals are calculated on the basis of this classification and may be due to management practices on the land remaining in the same category, or due to changes from one category to another (such as conversion from forest to cropland, or vice versa). Since the IPCC land categories cover all the land, the land-based approach is associated with comprehensive coverage. The activity-based approach to emissions estimation (used by the Kyoto Protocol)

proceeds from identifying specific activities occurring on the land that influence GHG fluxes. This approach focuses on the anthropogenic intervention and allows differentiation between activities (which is needed if only some are to be mandatory) but does not result in comprehensive coverage unless all activities happening on the land are included. In practice, as the activity approach becomes more comprehensive, the results tend to approximate those of the land based approach.

Excerpt from: Iversen P., Lee D., and Rocha M. (2014). Understanding Land Use in the UNFCCC, Chapter 2.2.3.

To reconcile land-based with activity-based approaches for reporting, REDD+ activities can be mapped into IPCC categories (Table 2.3). Such mapping is a useful exercise since REDD+ texts call for consistency with GHG reporting (Decision 12/CP.17: Para II.8). Table 2.3 shows that a country may report only on some, rather than all five activities (e.g. deforestation, forest degradation and enhancement of forest carbon stocks) and still cover all GHG fluxes from forests comprehensively.

Table 2.3: Mapping REDD+ activities into the IPCC categories for national GHG inventory reporting[8]

IPCC categories of reporting related to forests	REDD+ activities	
Forests converted to other lands (F>NF)	• Deforestation	Sustainable management of forests and Conservation can overlap with any of these depending on whether and how countries define them
Forests remaining forests (F>F)	• Forest degradation • Enhancement of forest carbon stock	
Other land converted to forests (NF>F)	• Enhancement of forest carbon stock	

This mapping of REDD+ activities onto IPCC categories of reporting is however not entirely straightforward. First of all, enhancement of forest carbon stock may cover two quite different processes: increase in forest area (e.g. through AR) and increase in forest stock in existing forest areas (e.g. through enrichment planting, assisted natural regeneration and/or reduced off-take through e.g. extending the harvesting cycle). These two processes—expansion of forest area and increased carbon density of forests that already exist—require quite different types of intervention and they also require different measurement and accounting methodologies. Hence, combining them into one activity category may be cumbersome (not to mention inconsistent with IPCC guidance). Indeed, it would have been easier if the term ´enhancement of forest stock´ had been reserved for increases in stock within forests that remain forests, and other more intuitive terms (such as afforestation and reforestation) had been used in the REDD+ texts to cover the activities that lead to the conversion of non-forest land to forest.

Secondly, sustainable management of forest may in practice lead both to increases and to temporary[9] decreases in forest stocks, depending on whether it is applied to areas that are currently unsustainably managed or to areas that had not earlier been exploited. It could perhaps be argued that in terms of REDD+ accounting, operationally, sustainable management of forest (SMF) and enhancement of carbon stocks are (partially) duplicative. Also, if the reporting period is short-term, SMF could possibly be covered under degradation. In this instance, SMF would not constitute a separate accounting category (instead, it

[8] This table is consistent with: Methods and Guidance from the Global Forest Observations Initiative, Edition 2.0, Food and Agriculture Organization, Rome. Chapter 2.3.3.1 "Consistency with the GHGI" (Table 7).

[9] Sustainable management of forests may lead to short- to mid-term stock decrease but should not cause persistent, long-term stock loss, and therefore should not be categorized as "degradation", recalling the IPCC framework definition of degradation (see footnote 6) that refers to long-term loss of forest carbon stocks.

could be seen as a policy or program measure). Alternately, a country could account for SMF as comprising both C stock losses (short-term degradation) and gains (enhancement) in F>F.

Thirdly, conservation suggests no change in land use and also appears to refer to a type of operational intervention rather than an accounting category. While few countries include removals in forest land remaining forest land (F>F) in submitted FRLs, many[10] have done so for GHG inventory reporting (i.e. through National Communications or a BUR), including in some cases for protected forest if it is considered to be managed land. Doing so can result in very large removals and therefore in large differences between the overall net forest fluxes reported in the FREL/FRL compared to the GHG inventory. However, if the situation does not change (i.e. the same forest land was protected in the reference period and results reporting period), the difference between removals in the reference period and results period may be very small compared to other activities (such as deforestation). Moreover, the annual increment in forest carbon stock may be decreasing due to the age class structure and decreasing forest area, which could result in "negative results" if compared, for example, against historical average removals.

As already shown in Table 2.2, these different processes and how they may be accounted have been treated differently by different countries. An alternative and more systematic option is to show how the five REDD+ activities map into a land use change matrix (Table 2.4). The matrix illustrates how all C stock changes relate to either changes in *area* or *carbon density* of forest.

Table 2.4. Simplified example of a land use change matrix for forests and non-forests

Note: Temporary losses of C stock in forests in the case of SMF are not considered; rather, SMF is assumed to result in increases in the long-term average C stock.

Time 2 Time 1	High C stock forest	Low C stock forest	Non-forest
High C stock forest	(F>F) C stock density increasing (conservation, SMF or enhancement), decreasing (degradation), or no change	(F>F) Loss of C stock through density change (degradation)	(F>NF) Deforestation, loss of C stock through decrease in forest area
Low C stock forest	(F>F) Gain in C stock through density change (enhancement or SMF)	(F>F) C stock density increasing (conservation, SMF or enhancement), decreasing (degradation), or no change	(F>NF) Deforestation, loss of C stock through decrease in forest area
Non-forest	(NF>F) Enhancement of C stock through increase in forest area	(NF>F) Enhancement of C stock through increase in forest area	N/A for REDD+

Loss of forest area
Gain in forests area

Loss in carbon density
Gain in carbon density

[10] Federici, S., Grassi, G., Harris, N., Lee, D., Neeff, T., Penman, J., Sanz, M.J., and Wolosin, M. (2017). GHG Fluxes from Forests: An assessment of national GHG estimates and independent research in the context of the Paris Agreement. This report looked at 20 non-Annex I countries with significant forests; among them, 15 out of 20 reported estimates for F>F.

With this simplified model in mind, we present some options for the clarification of the three Plus activities, in Table 2.5, while recommending that countries align reporting of emissions and removals in submitted FREL/FRLs with their GHG inventories using IPCC guidelines for categories of reporting, i.e. F>NF, F>F and NF>F, as well as the guidelines for "consistent representation of lands"[11].

Summary points

- UNFCCC decisions name five REDD+ activities, but only deforestation and forest degradation have been defined (to varying extents) by the IPCC; in contrast, there is little guidance on defining the Plus activities (i.e. conservation, sustainable management of forests and enhancement of forest carbon stock);
- This has led to a range of ways in which Plus activities have been defined among the 15 countries that include removals in their forest reference level as submitted to the UNFCCC;
- Two key issues with regard to the Plus are: (a) whether countries use land cover or land use definitions and (b) whether they use an activity-based or land-based approach to REDD+ reporting;
- To increase transparency, countries should align REDD+ reporting with GHG inventory reporting. Since carbon fluxes from forest land can be categorized as: (1) positive and negative changes in area of forest and (2) increases and decreases in density of carbon stocks within forests, REDD+ activities should be translated into IPCC reporting categories of "forest to non-forest" and "non-forest to forest" (changes in area) or "forest remaining forest" (changes in density);
- In reporting REDD+ activities, countries should report the net flux happening on any land unit, ensuring application of the IPCC guidance on consistent representation of land.

[11] IPCC 2006 Guidelines, Volume 4 (AFOLU, Chapter 3: Consistent Representation of Lands, found at: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_03_Ch3_Representation.pdf

Table 2.5: Different options for operationalizing and accounting carbon for the Plus activities of REDD+

REDD+ activity	Effect on carbon stocks	Also known by synonyms such as:	Typically operationalized through:	Could be accounted as:	Challenges in measurement or accounting
Enhancement of forest carbon stocks	Enhancement of stocks in existing forests (F>F)	Natural regeneration, recovery of stocks, enrichment	Regulations on forest uses; limiting offtake; abandonment; enrichment planting	Gains in average stock density (could be considered the opposite of degradation)	Density change is not visible from most types of remote sensing (RS) images; requires repeated forest inventories, although growth models could possibly be developed
	Enhancement of stocks by expansion of forest area (NF>F)	Afforestation, reforestation	Natural regeneration and/or afforestation/reforestation	Gains in forest area (could be considered the opposite of deforestation)	Requires clear definition of deforestation (gross or net) and land use (not land cover)
Sustainable management of forest	Applied to forest not yet exploited: temporary decreases in stock density (F>F)	Sustainable yield management, community forest management	Implementation of timber management plans; controlled offtake of specified products (firewood/charcoal/fodder)	Reductions in average stock density (degradation)	Requires ground measurements (inventory data) or other data to assess the impact on stock density over time
	Applied to forests that are now exploited unsustainably: increase in stock density (F>F)	Sustainable yield management, community forest management	Implementation of timber management plans; controlled offtake of specified products (firewood/charcoal/fodder)	Gains in average stock density (enhancement of carbon stocks)	Requires ground measurements (inventory data) or other data to assess the impact on stock density over time. Growth models could possibly be developed
Conservation	Zero changes (F>F)[12]	Pure conservation zones, managed wilderness	Planning, regulation, zoning	Allow an increase in the baseline for high forest cover, low deforestation (HFLD) countries where there is evidence of increasing pressure on forests	Difficult to determine "counterfactual" baselines
	Increase in stocks in areas designated ´conservation´ (F>F)	Pure conservation zones, managed wilderness	Planning, regulation, zoning	Gains in average stock density	Density change is usually not visible from RS; it requires repeated forest inventories. How to distinguish/justify these areas from ´unmanaged forest´

[12] In reality, many instances of conservation may result in either carbon stock gains or losses. ´Conservation areas´ may be inadequately protected, leading to losses, and where they are protected, increases in stock will occur as a result of natural uptake, although this will vary with the age of the trees.

3. The accounting basis for the Plus

To date, REDD+ pay-for-performance initiatives—for example, the Green Climate Fund and Forest Carbon Partnership Facility—have been developing rules largely focused on incentivizing avoided deforestation. In this section, we start by offering some insights into differences between the characteristics of processes that result in emissions compared to those that result in removals. We then consider whether different rules on carbon accounting are needed to incentivize, or influence, the processes required to achieve removals.

3.1. Differences between avoiding forest emissions and increasing removals

Deforestation and forest degradation are complex processes driven by multiple underlying causes and often involving multiple stakeholders—from governments (setting policies) to companies (responsible for investing in activities that drive deforestation) to communities (that require land for livelihoods) and consumers (creating demand for products that cause forest loss). It has been argued that to reduce deforestation and achieve 'transformation' of the land sector, a large-scale, coordinated, multi-sectoral approach is required. Several studies[13] suggest that overall (i.e. not always, but in most cases), supportive domestic policies are the strongest, most effective means to tackle the drivers of deforestation. This includes legal measures such as banning or requiring permits for deforestation at least in certain zones, broad land management, and clarifying land tenure, as well as effective enforcement or incentives for sustainable agriculture and livestock management. In some cases, 'command-and-control' policies or use of fiscal levers by governments has been the most effective approach (e.g. blacklisting of high deforestation municipalities in Brazil from accessing rural finance). An additional rationale for taking a national level approach is to control leakage, i.e. to ensure that if emissions are displaced from one region to another, this is taken into account overall. Indeed, the danger of leakage was one of the main reasons why the Warsaw Framework focuses REDD+ performance measurement at the national scale (or subnational as an interim measure).

Enhancement of forest carbon stocks is a very different process. While it can be encouraged and supported by national level forest policies, for example subsidies for AR and SMF, such activities are less likely to be the result of macro-economic policies or enforcement of land-related regulations. Also, unlike deforestation, which is sometimes illegal, unregistered, and difficult to attribute to particular landowners, the physical location of most forest enhancement activity (such as AR and SMF) can be accurately pinpointed, recorded and traced to particular causes and thus it can be clearly be tagged to particular areas and actors. Moreover, AR is less likely to generate leakage and SMF has little risk of leakage. Finally, while supportive policies can catalyze reforestation and/or improved forest management, investments (often private) at the stand scale also play an important role.

Increasing forest stock may also come about as a result of (assisted) natural regeneration, although this is not quite so straightforward as enhancements resulting from AR and SMF. It may occur through a deliberate policy of fencing of natural forest e.g. to prevent grazing incursions, or through designation of specific areas as protected and conservation zones. It may also, in part, occur as the result of abandonment of agricultural land and decreased dependence on forests for subsistence products. In this latter case, part of the growth may be considered human induced, but part could be considered natural. In practice, REDD+ countries rarely distinguish between enhancements due to assisted natural

[13] For example: Fishbein, G. and Lee, D. (2015). *Early Lessons from Jurisdictional REDD+ and Low Emissions Development Programs*. Publication for the World Bank Group, FCPF and TNC. Add other citations.

regeneration and those due to AR and SMF, not least because they tend to use medium resolution remote sensing technology to quantify changes in forest area, which does not easily differentiate different origins of forest. In addition, countries following IPCC guidelines and using a land-based approach should simply apply the managed land proxy and report all fluxes on lands designated as "managed". Whether or not to report removals from natural regeneration would be less clear in the case of activity-based reporting.

In Table 3.1 we summarize the fundamental differences between the characteristics of policies needed to promote the avoidance of deforestation and forest degradation and those that can stimulate processes for Plus activities.

Table 3.1. Differences between avoided deforestation/forest degradation and the Plus

	REDD activities	The Plus	
	Avoiding deforestation and forest degradation	**Increasing net forest area**	**Increasing net forest carbon density**
Drivers	Drivers tend to be **outside** of the forest sector, e.g. expanding croplands or ranching areas (leading to deforestation) or energy needs (causing degradation through fuelwood collection). Government policies are often required to tackle such emissions.	Both are usually driven by efforts **inside** the forestry sector itself. In some cases, government action (e.g. implementation of large-scale reforestation) is effective; in others, policies, such as subsidies and other financial incentives, can support increased removals, particularly where reforestation potential is on private land.	
Leakage	Prevention of deforestation and forest degradation in one area can result in **high displacement risk** to other areas of these activities. Larger-scale approaches and the use of national/provincial baselines means that any such leakage will be taken into account in the performance assessment and emissions calculations.	May in some cases indirectly lead to displacement.	There is typically little or no risk of displacement of emissions as a result of improved forest management
Spatial scale	Because drivers are often outside the forest area, impacts from policies or measures tend to be **diffuse**, and it is difficult to attribute specific outcomes (e.g. reduced degradation of forest) directly to the actions taken (a village adopting solar cookstoves).	AR and SMF tend to have spatial scales that are **discreet** and localized. The sequestration that results from e.g. improving forest management practice or planting trees will take place in known and defined places where these activities have been carried out, and can be easily registered. The same is true for enhancement that occurs as a result of deliberate policy to promote natural re-growth of forest in specific locations. Other natural re-growth may however be more diffuse.	
Temporal scale	Emissions mostly occur at the time of the deforestation or degradation event (with the exception of the soil carbon pool)	Removals occur over decadal scales (e.g. from 10 to over 100 years) depending on the forest types	Removal rates may vary over time; however, changes to the long-term average C stock are most critical

The information and table above is generalized, and may not hold in all situations. There are instances and countries in which government policies have been highly instrumental in large-scale AR or forest

restoration. Examples include China, India, South Korea and Viet Nam—countries that have, in fact, achieved major increases in forest carbon stocks[14]. Government actions may be more effective for carbon removals in command economies or countries where forests are largely state-owned. By contrast, in some places, activities that lead to carbon stock increases (e.g. tree planting, changing forest management practices to increase carbon storage such as adopting longer rotation periods) require the implementation of activities by a diffuse set of private land owners or managers. Several developed countries (e.g. Australia, New Zealand) have recognized this and, as a policy response to international commitments, have developed 'nested' systems that provide incentives at smaller scales, recognizing that the project scale is more effective for implementation. Such systems are designed to align, as much as feasible, accounting systems for projects with national reporting to the UNFCCC[15].

In this context, it is interesting to note that Mexico, while actively assisting communities to engage in REDD+ through provision of up-front investments for a range of REDD+ type activities, will attribute the resulting performance in reduced deforestation to national and state efforts and policies, and will claim ownership of the credits for this at national level. However, Mexico considers that increases in rates of sequestration (removals) are essentially the result of efforts of the local land/tree owners, and that therefore any resulting credits will be the property of these owners. For this reason, Mexico has not developed a national reference level for removals, but has stated that individual owners are free to sell any such credits on local or international voluntary markets[16].

Finally, we note that AR within the Clean Development Mechanism allows for crediting and international transactions at the project scale. It is as yet unclear what the implications of this are for countries that develop national scale FRLs including removals from AR. It is assumed that such cases would require a 'nested' approach to accounting, under which credits already attributed to these CDM project would be deducted from the national achievements under REDD+.

3.2. Approaches to accounting performance from the Plus

There are a number of different approaches that could be used in accounting REDD+ performance, all of which require some kind of reference level. We discuss these in terms of their appropriateness for measuring removals in general terms first, before presenting the current practice in REDD+.

Possible ways of accounting for removals, with their associated types of reference levels, are listed in the bullets below, and the challenges that each involve are presented in Table 4.1.

- A **base year** can be selected with a known balance of emissions and removals. The balance in a given future year can then be compared to this, and the difference would be considered ´performance´ (i.e. net-net accounting; see Box 4.1 for an explanation of terms). Several countries are using this approach for their NDC, for example Australia, Brazil, Canada, US.

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[14] Wolosin, M. (2017). Large-scale Forestation for Climate Mitigation: Lessons from South Korea, China and India. Publication for the Climate and Land Use Alliance. Meyfroidt P, Lambin EF (2008) The causes of the reforestation in Vietnam. Land Use Policy 25:182–197.

[15] Lee, Donna; Llopis, Pablo; Waterworth, Rob; Roberts, Geoff; Pearson, Tim. 2018. Approaches to REDD+ Nesting: Lessons Learned from Country Experiences. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/29720 License: CC BY 3.0 IGO

[16] CONAFOR (2017) Emissions Reduction Initiative (IRE) Document; Mexico. Submitted to the Forest Carbon Partnership Facility, World Bank: https://www.forestcarbonpartnership.org/sites/fcp/files/2017/Nov/__ENGLISH_6november_2017_Mx.pdf; also Skutsch, M., Balderas Torres, A and Carrillo, J.C. (2017). Policy for pro-poor distribution of REDD+ benefits in Mexico: how the legal and technical challenges are being addressed. *Forest Policy and Economics.* 75: 58-66.

- Use of '**gross-net**' accounting for NF>F removals (see Box 4.1). This is the approach that was used by developed countries with targets under the KP, where all emissions from F>NF and removals from NF>F in the accounting year are reported as results; many have transferred this accounting approach to their NDC.

- A **simple extrapolation** can be projected, as a proxy for business as usual, where historical data indicates a trend. The trend is then projected forward (in a straight line or curve) as a proxy estimate of what would happen in the future if REDD+ were not implemented.

- A **more complex modelled** baseline may be constructed to approximate business-as-usual by calculating expected removals in the absence of 'no new policies' as of a certain date, but taking into account expected changes in annual rates of removals that result from past policies (i.e. legacy effects, such as decreases over time in growth rates of trees planted previously). Many Annex I countries have done this under the Kyoto Protocol when developing "forest management reference levels"[17].

- A FRL can also be based on a **simple historical average**. For the case of removals, the average net removals from land afforested/reforested during the historical reference period is used, and performance is measured against this during the implementation period. Several countries used this approach in their UNFCCC FRL, for example Costa Rica, Côte d'Ivoire, Nepal, Sri Lanka.

- Any of the above methods could in addition use an '**adjustment'** based on national circumstances. To date, only Vietnam has suggested such an adjustment for removals (several more have used an adjustment for avoided emissions) in its UNFCCC FRL. In Vietnam's case the adjustment was for a large tree planting program that ended in 2010; the justification provided for the adjustment was that historical removals did not reflect 'business as usual' removals in the future.

- Any of the above options may also be implemented with a **cap**, as has been employed under the Kyoto Protocol[18]. Such an option may be used, for example, to provide HFLD countries that actively manage large conservation areas that sequester carbon the opportunity to receive payments within a certain prescribed cap. The argument for such a cap would be to limit payments for indirect human-induced removals (e.g. carbon fertilization in large forest areas).

Box 4.1: Gross-net vs. net-net and use of a cap[19]

Under the Kyoto Protocol, countries account for deforestation and afforestation/reforestation (AR) using a "gross-net" approach, which basically credits a country for all net removals achieved in the accounting year regardless of the annual removals achieved historically. In the first commitment period, forest management (F>F) was also accounted (in Annex 1 countries) using this same approach. However, to avoid an excess of credits, a cap was negotiated for each country—which set a limit on the number of credits that could be claimed. All countries exceeded the cap (some by a large margin), which created no incentive to increase removals from forest management. Therefore, in the second commitment period, "forest management reference levels" were developed that represent a BAU baseline taking into account: (a) removals or emissions from forest management as shown in greenhouse gas inventories and relevant historical data; (b) age-class structure; (c) forest management activities already undertaken; (d) projected forest management activities under a 'business as usual' scenario; (e) continuity

[17] A synthesis report by the UNFCCC secretariat on the construction of Forest Management Reference Levels can be found at: https://unfccc.int/sites/default/files/resource/docs/2011/awg16/eng/inf02.pdf
[18] For an explanation of how caps have been used, see: Iversen P., Lee D., and Rocha M. (2014). Understanding Land Use in the UNFCCC. Found at: http://www.climateandlandusealliance.org/reports/understanding-land-use-in-the-unfccc/
[19] Partly summarized from Iversen, P. et al (2014), ibid.

with the treatment of forest management in the first commitment period; (f) the need to exclude removals from indirect effects. This approach provides stronger incentives to increase removals, although a cap is still applied to removals (but not emissions) in the second commitment period.

Many (developed) countries are using similar accounting approaches for land use as those used within the Kyoto Protocol for their NDCs under the UNFCCC[20]. A few are using net-net accounting approaches, i.e. they compare the emissions/removals in the accounting year against emissions/removals in a base year and the difference is reported against their stated target. This makes the baseline more comparable to non-LULUCF sectors, which usually use a base year. For example, the US, Canada and Brazil all use the year 2005 as the base year (i.e. performance will be measured against fluxes in that year). Where countries have large removals compared to emissions from the forest sector in the baseline estimates (e.g. the US, Canada), taking the net-net approach may be considered more conservative than using gross-net accounting. The opposite is true if emissions were higher than removals in the base year (e.g. Brazil).

There are advantages and disadvantages to each of these approaches. Base year methods and historical averages are simpler and more transparent, but in the case of removals, they often do not represent carbon sequestered from new efforts. Methods that approximate ´business as usual´ are, in theory, a better approach to measuring forest carbon performance (that is, in determining what is additional to what would have occurred in the absence of REDD+ policies)[21]. However, they also tend to be technically more demanding and may require a large number of assumptions (e.g. projecting expected removals from growth requires assumptions on survival rates and expected future growth). They may also require assumptions on policies that are expected to be in place, as well as decisions on which polices qualify to be integrated in the reference level.

For the case of AR and other forest area enhancement strategies, it could be argued that countries could use gross-net accounting methods, that is, to simply account for all removals that occur from land use change from non-forest to forest (this also avoids the obstacle of lack of historical data). The validity of this is still under discussion, and it may not be acceptable unless the country also applies the same accounting method (gross-net) to deforestation or is using a strict land use rather than land cover definition to measure changes.

For the case of increases in (carbon) stock density that result from e.g. improved forest management or protection, gross-net accounting might give an unreliable estimate of the performance of REDD+ measures. This is partly because it would include and credit any indirect or non-anthropogenic causes of (carbon) stock density increase (such as CO_2 fertilization and background growth). Such impacts tend to be small per hectare, but over large forest areas (particularly where countries measure changes in F>F), can be significant. Under net-net accounting, however, such effects would be largely cancelled out.

An important issue connected with accounting for removals is the legacy effect (see Box 4.2). This occurs as a result of the fact that removals by plantations established in the reference period will in most cases continue throughout the accounting period. The question is whether countries should report growth in plantations during the crediting period or whether these impacts should have been included in the FRL. If included in the FRL, this may under-estimate efforts needed to manage growth in healthy plantations, but if not included in the FRL, countries may be accused of claiming results for past actions.

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[20] Noting that the EU recently agreed to limit the afforestation period to 20 (or in justified circumstances 30) years, which means that only forests planted < 20 years ago are accounted using a gross-net approach (compared to using a 1990 cut-off date). The EU Regulation (2018/841, 30 May 2018) can be found at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.156.01.0001.01.ENG&toc=OJ:L:2018:156:FULL

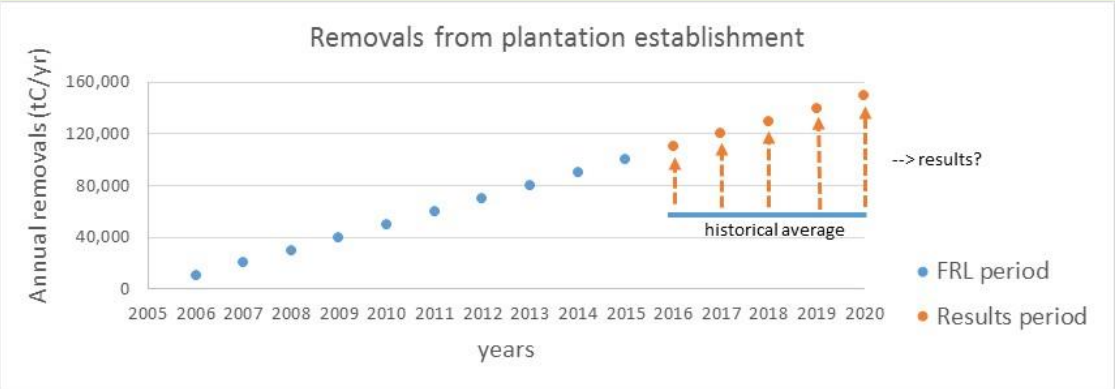
[21] Grassi, G., Pilli, R., House, J., Federici, S. and Kurz, W. (2018). Science-based approach for credible accounting of mitigation in managed forests. Carbon Balance and Management, 13:8.

In principle, IPCC requires one to follow land for 20 years following land conversion from one land use category to another, to take into account the changes in pools over the transition period. In the case of plantations, growth in biomass can extend over many years, though not necessarily in a linear fashion; similarly, emissions from soil following deforestation may continue for a long period (particularly deforested peatlands which, if drained, can continue to emit large quantities of CO_2 for decades as organic soils, accumulated over millennia, decompose). However, in the case of deforestation, most countries omit soil and simplify emissions from the other pools by assuming full, instant loss at conversion. In the case of removals, reference periods for REDD+ FRLs, which are typically around 10 years, can be considered only a snapshot. The snapshot can give a distorted picture because it only considers a fraction of a long and continuous process, e.g. growth of newly planted forest usually covers both the reference and results period. This distortion can result in hot air during the results if, e.g. an average historical reference level is used and if removals from prior activities continue and are accounted against it.

Box 4.2: Legacy effects

For deforestation, emissions from biomass largely occur at the time of the activity (e.g. when a forest is cleared to plant crops). The assumption that all above and below ground biomass (but not the soil carbon) is instantaneously oxidized is a reasonable proxy or default method. By contrast, removals from AR and other forest area enhancement strategies occur over decadal time scales. The result is that activities that take place during the reference period (or before) can have impacts well into the future—and therefore may create hot air under certain types of baselines, for example historical averages.

Example of use of an historical average baseline for removals
Example of a situation where a fixed annual area of afforestation/reforestation is added each year, accounting of removals starts from the year 2005 after which growth is considered each subsequent year; this example is simplified by assuming per hectare growth is linear and continues for 20 years (while typically annual increments are larger in earlier years).



In reference to removals under REDD+, it may be important to recognize the difference between removals due to afforestation/reforestation (NF>F) or managed forests (F>F) compared to those from natural regeneration of forest area (which may be NF>F or F>F). In the case of natural regeneration, measuring 'performance' related to REDD+ efforts may require consideration on a country-by-country basis; for example, a country may provide evidence of assisted natural regeneration efforts when presenting results. Large-scale removals from, e.g. agricultural abandonment, are not common in developing countries where the pressure on land is increasing; however, there may be instances where a country is undergoing a process of forest transition due to urbanization and, with fewer people depending directly on agriculture for their livelihood, there is natural regeneration from abandonment.

By contrast, fallow periods related to shifting cultivation may be considered as part of a cyclical degradation/forest enhancement process in forest that remains forest (or cropland that remains cropland depending on how the country defines shifting cultivation).

Table 4.1 Benefits and challenges of different accounting methods and baseline for removals

Option	Benefit	Policy issue	Data/technical challenges
Base year	Simple, transparent	Inter-annual variability may be greater than the change from REDD+ efforts, thereby not measuring the impact of REDD+ efforts; could also be subject to gaming, i.e. picking a favorable year for the baseline	Requires data on historical patterns of carbon density change in F>F
Gross-net	Simple, transparent	May overestimate BAU if 'common practice' includes carbon stock increases (e.g. market-led reforestation, laws implemented that are leading to improvements of forests, long standing government reforestation programs); only valid for NF > F and may only make sense if F>NF also accounted using the same method; not applicable to carbon density change in F>F	Simple, no technical challenges
Trend projection	Better reflection of performance	Mathematical projection (linear or other) may over or underestimate BAU removals, as it does not account for correct age of planted stands	Requires data on historical patterns of carbon density change in F>F or historical knowledge of land use change (NF>F) and age class structure
BAU (complex)	Best reflection of performance	Determining a cut-off date for no new policies; requires multiple assumptions and as such could be subject to gaming, i.e. choosing favorable assumptions for the baseline	Requires dynamic modeling as well as information on prior removal rates
Historical average	Simple, transparent	Does not take into account legacy effects or changes in policies; may not provide sufficient incentive	Lack of data on historical patterns of carbon density change in F>F
Adjustment	Enables countries to factor in policy changes	Have to be agreed on an individual country basis	Estimating impact of changes in policies
Caps	Prevents excessive ´windfall´ claims	Negotiating appropriate level of the cap	
Account only additional area planted	Simple, transparent, best reflection of performance	Not clear how the FRL is expressed since this cannot be in area but needs to be in tCO_2/yr. May not provide incentives for countries that planted large areas in the past	Only applies to AR, not removals in F>F

3.3. Reference levels under different initiatives

The difficulties for countries in selecting an appropriate accounting method and reference level is compounded by the fact that various different kinds of reference levels have been used earlier under the

Kyoto Protocol (including IPCC supplementary guidance on reporting for land use activities) and now under the Paris Agreement (as reflected in NDCs). Various financing initiatives for REDD+ performance have also stated what types of reference levels they are willing to accept, e.g. the Green Climate Fund and the FCPF Carbon Fund's Methodological Framework. The voluntary carbon sector has also developed its own rules for reference levels in some cases, as have Joint Implementation and the CDM (for afforestation and reforestation). The table below summarizes different baseline methods that have been, or are being, used to account for forest-related climate mitigation performance.

Table 4.2 Methods for setting baselines for forest-related GHGs in various contexts

Context	Purpose	Case		
		F→NF (Deforestation)	F→F (e.g. Forest management)	NF→F (e.g. AR)
REDD+ submissions to UNFCCC	Most countries: "in the context of results-based finance"	Various methods, although most use historical averages for all activities; a few countries have made linear projections or 'adjustments'		
Green Climate Fund	Non-market finance	Average historical value*	Average historical value	Average historical value
FCPF Carbon Fund	Pilot market transactions	Average historical value**	Average historical value	Average historical value
Independent standards (e.g. Verra)	Issuance of emission reduction units	BAU	BAU	BAU
KP CDM	Issuance of Certified Emission Reductions	N/A	N/A	BAU
Kyoto Protocol accounting	CP1: Removals used to help achieve targets	Gross-net	Gross-net with a cap	Gross-net
	CP2: Rules change to increase incentives for removals	Gross-net	BAU with a cap for removals only	Gross-net
NDCs	Mitigation contributions	Variable methods: Most Annex I use KP accounting methods (as above) with a few using a base year (e.g. US, Brazil); most non-Annex I use BAU		

* High forest cover low deforestation (HFLD) countries can increase baseline 0.02% per year during the 5-year crediting period.
** HFLD allowed to adjust ref level upwards by 0.1% of carbon stock per year.

It is worth noting that, under the Kyoto Protocol, gross-net accounting is used for both AR and deforestation—but also that accounting for both activities is mandatory. It is also worth noting that, in the second commitment period of the Kyoto Protocol, the baseline method for forest management—where most countries were receiving credits—was updated to provide stronger incentives for performance, i.e. by promoting a business-as-usual approach over the gross-net approach, and by making accounting for forest management mandatory, along with AR and deforestation (to cover all forest-related activities).

3.4. Current practice in FRL submissions to the UNFCCC

The Warsaw Framework provides high-level guidance for construction of "forest reference emission levels and forest reference levels (FRELs/FRLs)[22]", defined as 'benchmarks for assessing each country's performance in implementing REDD+ activities'. It states that countries should "use historical data and may adjust for national circumstances", but provides no further details on how FREL/FRLs should be constructed. This lack of guidance (and the conflicting signals) has resulted in a variety of reference level construction methods being employed by developing countries in FRLs submitted to the UNFCCC. Many submit average historical values, although a few have proposed adjustments and/or suggested a "zero" level, as illustrated in Table 4.3 below.

Table 4.3. Summary of methods used to develop FRLs for forest carbon removals

Activity	Method	Countries
NF→F	Historical average (assessing growth during the historical period without projecting continued growth in plantations during the accounting period)	Cambodia, Chile, Costa Rica, Cote d'Ivoire, India*, Nepal, Panama*, Sri Lanka
	Historical average (assuming full carbon stock is attained at time new forest is detected**)	Ethiopia, Laos*, Mongolia*
	Historical average with adjustment	Vietnam
	Assessed at "zero"	PNG
F→F	Historical average	Chile, India*, Malaysia, Panama*
	Linear projection	Ghana*,***

* For these countries, the technical assessment (TA) is ongoing and the country may decide to change the scope as a result
** Noting that this approach of reporting "committed removals" is not consistent with IPCC guidelines
*** Projection of the net value of all REDD+ activities included in the FRL

As can be seen in Table 4.3, most countries use historical average removals in their FRL for growth in afforestation/reforestation detected during the reference period. In practice, most countries do not estimate or report growth of forests that occur in lands afforested or reforested in the years prior to the FRL period. However, after detection (of a new forest area) during the reference period, growth is projected to continue—and will continue throughout the reference period and into the results reporting period. It is yet unclear how these countries will therefore report results against an average historical FRL and whether continued growth in the afforested areas detected in the FRL period will be included or not.

The reason that many countries submitted average historical values was probably not because they considered it to represent the best proxy for a 'business as usual' estimate. Rather, it is likely that average historical values are submitted because of simplicity, donor government signals, and feedback from UNFCCC technical assessment teams. It may also be due to guidance drafted for avoiding deforestation

[22] The difference between a FREL and a FRL is not stated in official COP decisions. However, in practice, countries have used the term FREL to refer to baselines for emission reductions only, that is to say, for reductions in deforestation and forest degradation. Countries have generally referred to a FRL when they include removals as well as emission reductions, or when they develop a separate baseline for removals. Different countries have taken different paths in this regard, some even developing separate baselines for each REDD+ activity that they include in their proposals, although they may finally merge these together to reach a ´net´ level of emissions and removals. For example, Chile, Ethiopia and Viet Nam submitted a separate FRL for removals and FREL for emissions, while Costa Rica, Côte d'Ivoire and Cambodia sum emissions and removals into a FRL.

and degradation or by the translation of "the use of historical data" into historical average values. However, use of this type of baseline means that, in some cases, countries may report results in the future with no additional efforts. Or, alternately, there may be insufficient incentives to increase carbon removals—particularly where countries have implemented major afforestation or reforestation programs in the past (e.g. Viet Nam). If the afforestation or reforestation rate was very high in the past, maintaining this rate may not be realistic or cause issues when competing with land needed for other purposes, such as food security. Since land is finite, opportunity costs are likely to rise when looking for new areas for additional efforts. This raises the question: Can countries only report results from AR, SMF or natural regeneration if future removals *exceed* removals from efforts in the past? In this instance, a country may be required to make extra efforts in order to simply keep pace with past planting efforts. It also gives countries that had not invested earlier in such activities an advantage over those that had, which may be perceived as inequitable.

3.5. Technical challenges that underlie the Plus problem

In addition to issues mentioned above, there are a number of other challenges that countries face in accounting for removals under REDD+.

Measurement systems and tools. Measuring density change in forests remaining forests may require repeated forest inventories with consistent measurement approaches, which many developing countries have not yet been able to implement; in fact, many have not yet completed their first national forest inventory. With regard to measuring changes in non-forest to forest, this requires both measuring changes in area (usually through remote sensing) and estimating the growth rates in new forest areas, which may be done with inventories or with growth models.

As regards the estimation of new area, and where countries are dependent on remote sensing to estimate such areas, one challenge is that trees planted in year one may not be detected by medium resolution satellite imagery (on which many developing country inventories rely for activity data) until at least year five or six. This is particularly an issue if reporting periods are short and/or incentives are provided in an inconsistent way over time. For example, the Green Climate Fund REDD+ pilot provides payments for results from 2014 to 2018 with no guarantee that the program will be continued beyond this period, while the FCPF Carbon Fund will sunset in 2023. Hence, neither program currently provides incentives for countries where this detection lag exists.

Historical data. Most developing countries do not have the long historical data sets that are needed to accurately estimate historical removals as a result of forest area increase, especially where only medium resolution imagery (Landsat) is available. AR and other activities resulting in forest area enhancement are often extremely challenging to assess with Landsat imagery but if local information on the location of such activities is used, and if high resolution imagery is available for those areas, visual assessment may greatly improve the assessment. Similarly, as noted above, these countries do not have historical data on C stock changes in managed forests. While countries may have more accurate data for the accounting period because high resolution imagery has become more widely available in recent years, a second national forest inventory may have been completed, and information on the exact location of AR and SMF activities is available, challenges may still arise due to methodological inconsistency of this data with that of the historical period.

Natural disturbances. Forests are often subject to natural (i.e. non-anthropogenic) disturbances that can release carbon stocks and non-CO_2 gases into the atmosphere, and the question is how to separate these effects out from man-made impacts (Box 4.4 describes the application of the ´Managed Land Proxy´). In

some instances, these disturbances can be large and overwhelm the positive results from policies and measures to increase removals. This can create risks for a country if reporting periods are short-term.

Most natural disturbance would be expected to recover over time, regaining C stocks lost. The Kyoto Protocol, for its second commitment period, developed special accounting rules[23] for countries with quantified targets to reduce the risk of underperformance due to such disturbances (i.e. a "natural disturbance provision" that includes rules for identifying disturbances eligible for the provision) and, under the Clean Development Mechanism, it created 'temporary' credits for A/R projects due to concerns of permanence. Other mechanisms in use by carbon standards to manage the risks of disturbance events include pooled buffer reserves (in the case of natural disturbances) or legal liabilities (in the case of direct human-induced events).

BOX 4.4: The Managed Land Proxy

The 2006 IPCC Guidelines for national GHGIs apply a concept called the *managed land proxy* as a first order separation of anthropogenic and non-anthropogenic emissions and removals. The rationale for this approach is that emissions and removals in managed lands are predominantly of anthropogenic origin (both direct and indirect) and that the contribution from natural effects is assumed to average out over time. This proxy was introduced to overcome the challenge of providing a practicable and broadly applicable methodology to separate *direct* and *indirect* human-induced effects from natural effects (e.g. GHG fluxes that result from natural disturbances). Under the managed land proxy, all GHG fluxes from areas that countries designate as "unmanaged" are not reported. According to IPCC guidance, managed land is *land where human interventions and practices have been applied to perform production, ecological or social functions.*

Most developing countries, however, do not make use of the managed land proxy (with the exception of a few countries, such as Brazil and Peru), despite the fact that some have primary, intact forests that may not be subject to human interventions or practices. In others, almost all forests may be under some form of human influence, for example from grazing cattle. Too narrow a definition of ´managed forest´ can lead to severe underestimation of stock losses: for example, Mexico in its early National Communications defined managed land as forest with active forest management plans, ignoring the fact that people are informally extracting timber and using forests for a variety of other purposes in almost all forested areas. A key reason why the managed land proxy is not used by most REDD+ countries may however simply be lack of capacity and the need for simplification when reporting GHGs.

For more information, see Federici et al (2017). *GHG fluxes from forests: An assessment* of national GHG estimates and independent research in the context of the Paris Agreement. Publication for CLUA found at: [hyperlink here]

In conclusion, while BAU estimations for future removals are likely the best option to measure performance of the Plus, they are technically challenging for most developing countries. More work will need to be done to assist countries in detecting reforested areas and understanding their origin (natural regeneration or AR), measuring carbon stock changes in forested areas over time, and developing a robust and consistent time series of data that can be used to measure performance in the future.

[23] For details on the natural disturbance provision, see: Iversen P., Lee D., and Rocha M. (2014). Understanding Land Use in the UNFCCC. Publication for CLUA: http://www.climateandlandusealliance.org/reports/understanding-land-use-in-the-unfccc/

Summary points

- Reducing emissions from deforestation and forest degradation requires operational activities and means of assessment that are fundamentally different from those required for increasing removals (through e.g. AR or forest management). Among such differences are the spatial scales of the drivers, the risk of leakage, and the time scales at which emissions ("fast out") versus removals ("slow in") occur.
- Accounting rules for REDD+, in particular the use of historical averages and large jurisdictional accounting areas, have been principally designed to assess emission reductions from deforestation and forest degradation and may not apply well to the Plus activities.
- Further complicating the situation, under the Kyoto Protocol and Paris Agreement, countries have used a range of approaches to setting baselines, or reference levels, against which to measure performance—often resulting in accounting that is not comparable or consistent.
- More needs to be done to support developing countries to estimate removals and create consistent time series that can be used to measure performance. More can also be done to develop consistent methods to account for removals from forests.

4. Conclusions

In the past decade, since REDD+ was first adopted as a concept under the UNFCCC, more attention has been paid to reducing emissions from deforestation and forest degradation than to the Plus—in part, due to an urgent need to halt natural forest loss. With the adoption of the Paris Agreement, including ambitious goals of limiting global warming to 1.5°C and achieving a balance between emissions and removals in the second half of the century, new attention is being paid to the need to increase removals, both through increasing forest area (e.g. through afforestation/reforestation) and through increasing carbon stocks within existing forests, for example through improved forest management. This raises the question: Are approaches that have been developed to measure REDD+ performance 'fit for purpose' for the Plus?

As a first step, it may be useful to achieve greater transparency in how the "plus" in REDD+ is reported. Different countries refer to the same forest carbon fluxes with different names based on national definitions for each of the REDD+ activities; this is particularly true with the Plus activities. We suggest in this paper that more clarity can be obtained if REDD+ activities are translated into IPCC land categories. Doing so will also help align REDD+ reporting with reporting in the national GHG inventory, and ultimately clarify the relationship between REDD+ efforts and a country's Nationally Determined Contribution (NDC) under the Paris Agreement.

There is a lack of consistent guidance and methods for countries that wish to include removals in their FRLs. Different guidance has been suggested by various payment mechanisms (e.g. the Green Climate Fund and FCPF Carbon Fund), requirements applied to Kyoto Protocol Annex I countries, or precedents set by developed country targets expressed in NDCs. This has resulted in proposed FRLs that may not be optimal as benchmarks for performance. To date, many countries are under the impression that an historical average is the option expected—particularly by donor governments. There is a need to provide guidance and methods for the application of alternative baseline options that ensure additionality without undercutting incentives.

Fundamentally, it is important to keep clear the principle that changes in carbon fluxes can occur in two situations: change in forest area and change in stock density. With regard to changes in area, deforestation (loss of forest area) and AR (gains in area) are fundamentally different processes. Deforestation has external drivers that a country may seek to regulate (i.e. reducing pressure on forests) while AR is often driven by efforts inside the accounting area. As such, while arguably the best benchmark against which to assess deforestation reductions is the historical average at large scale, the case of AR is less clear—for example, every hectare planted could be considered a new implementation effort regardless of past AR efforts. Legacy growth should be considered, but this may be technically challenging. For changes in carbon density of forests, average historical GHG fluxes (changes in density) are likely a good starting point to develop a baseline for measuring performance, however, many developing countries do not at the moment have the data necessary for this.

In sum, more needs to be done to assist countries in better measuring and monitoring removals from forests. In addition, given the significant amount of removal potential in developing countries, creative new methods to account, and provide incentives, for performance of the Plus need to be developed urgently. The initiatives and institutions currently offering results-based payments for REDD+ need to stimulate this process with a view to adopting and promoting assessment methodologies better fit for purpose for the Plus activities of REDD+.