Approach to establishing Jurisdictional-Scale Reference Emission Level (REL) for the Future Mai Ndombe Province

As an important example of a High-Forest / Low-Deforestation (HFLD) Jurisdiction

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Section I: Executive Summary

High-Forest / Low-Deforestation (HFLD) Countries and Jurisdictions can present a particular challenge for REDD+. Observation of historical emissions alone may not accurately reflect increasing pressure on forest resources. Because Remote Sensing techniques have not yet accurately depicted forest degradation, we cannot predict future degradation by observing historical satellite images. Yet, this degradation can be significant. Furthermore, it is nearly impossible to predict future threat levels within logging concessions based solely on observation of previous deforestation. The DRC currently is undergoing massive socio-economic and political changes, and an increased burden on forest resources in the near future is inevitable. However, this burden cannot be accurately measured by looking at deforestation levels while the country was in civil war, or experiencing other severe political and social phenomena serving to prevent rapid expansion, and hence forest dependency. Therefore jurisdictional ER Programs in HFLD jurisdictions such as Mai Ndombe province must account for the varying and significant threat of deforestation originating from distinct land-use categories. These different land-use categories present different threat levels which must be accounted for when developing a Reference Emissions Level (REL) for a Jurisdictional ER Program.

Firstly, in section 2, we will first describe the unique aspects of developing a REL for an HFLD jurisdiction. We will then make the case for the relative importance of logging concessions in projecting current and future emissions within a Jurisdiction.

In section 3, we will present the methodological process used to calculate the REL for the future province of Mai Ndombe for the ER PIN.

In section 4, we will show how the proposed MRV system is compatible with the approach to developing the REL, enabling accurate comparisons of measured emissions to projected emissions for the purpose of determining the success (or failure) of various program elements.

Finally, Appendix A provides a “cheat sheet” which describes exactly how the REL presented in the ER-PIN and program Emissions Reductions (ERs) were estimated for the future Province of Mai Ndombe.

Section II: High-Forest / Low-Deforestation (HFLD) Countries and Jurisdictions

a) REDD+ As an Alternative to Destructive Forest Uses

The Democratic Republic of the Congo (DRC) is in a set of nations that have been classified as High-Forest / Low-Deforestation (HFLD). These nations feature historically very low deforestation rates relative to the size of their remaining forest estate. This may be due to a multitude of factors that have blocked or restricted private investment in the utilization of forest resources. Those factors often have little to do with the economic value of the timber in the forests. Examples of these factors include social/political insecurity, lack of infrastructure, better economic conditions for logging in other countries, and other socio-economic factors. Despite the fact that HFLD nations have not faced high historical deforestation rates, present and future threat to their forest remains high. In fact, as forest resources become more restricted in other countries, HFLD countries like the DRC are likely to face ever-increasing threat.

By contrast, historically high deforestation countries such as Brazil or Indonesia have used their forest resources destructively for decades to support and sustain economic growth. This has placed them in a financial position to forego further catastrophic deforestation without compromising rural economic development goals. This creates a clear opportunity to benefit from REDD+, as current emissions can readily be reduced below historical levels.

Since HFLD countries have not yet monetized their forest resources through aggressive harvesting, their forest sectors have not yet contributed to vital economic development. The obvious path is the destructive path that was followed by HFHD countries in the past. REDD+ provides HFLD countries with the best alternative to avoiding this destructive path. However, as they have low historical emissions from deforestation, it is difficult or impossible for them to benefit from a REDD+ ER Program if they are required to reduce current emissions below already-low historical levels. To allow HFLD nations to follow a sustainable path, REDD+ must allow for adjustments to an emission level based purely on historical deforestation data.

Although the recent average deforestation rate for the DRC has been historically very low, some forests within the DRC have undergone aggressive degradation and deforestation, providing a window into the future threat faced by the DRC's forests. For example, the Mayombe forest has disappeared due to the cascading actions of unsustainable logging, charcoal production and shifting cultivation. Its proximity to the Kinshasa market and the ports of Matadi and Boma, enabled this rapid deforestation. The Mai-Ndombe forest block is the closest remaining dense humid forest block to the Kinshasa market and to the ports. Therefore, this forest is now under increased threat, and given the ecological and socio-economic similarity to the Mayombe forest, it is likely to follow the same path.

If REDD+ is to be a viable financial alternative to the economic value that the DRC would receive from the destructive utilization of their forest resources, we must find ways to set realistic reference emission levels (RELs) that accurately capture current and future emissions threat to the DRC's forests.

b) The Importance of Logging Concessions

Primary Tropical wet forests in the Congo Basin, such as those found in the future province of Mai Ndombe, are considered impenetrable, and are therefore relatively immune to significant emissions from small-scale deforestation. Commercial logging operations penetrate the forest with access roads, use mechanized equipment to selectively remove the largest trees, and increase population densities through employment and secondary economic opportunities.

These factors make the forests inside and around the concessions vulnerable to a range of secondary agents and drivers of degradation and deforestation. The commercial logging operations themselves generally lead to degradation of forested lands within the concession boundaries, and relatively low emissions. However the ensuing secondary degradation and eventual deforestation by other agents generates significantly higher emissions. The process that begins with degradation by commercial logging, and is followed by deforestation by secondary agents, is described as “cascade deforestation”.

In Figure 1, the boundaries of logging concessions within the Mai Ndombe province are shown over a current FACET landcover map. The pattern of deforestation can clearly be seen to be radiating northeast from Kinshasa into the Mai Ndombe province. Figure 1 also shows that a significant amount of historical deforestation has occurred within logging concession boundaries. It is highly likely that many of those areas showing deforestation outside of either 1990 or 2010 logging concessions were first opened up by commercial logging concessions further back in history.

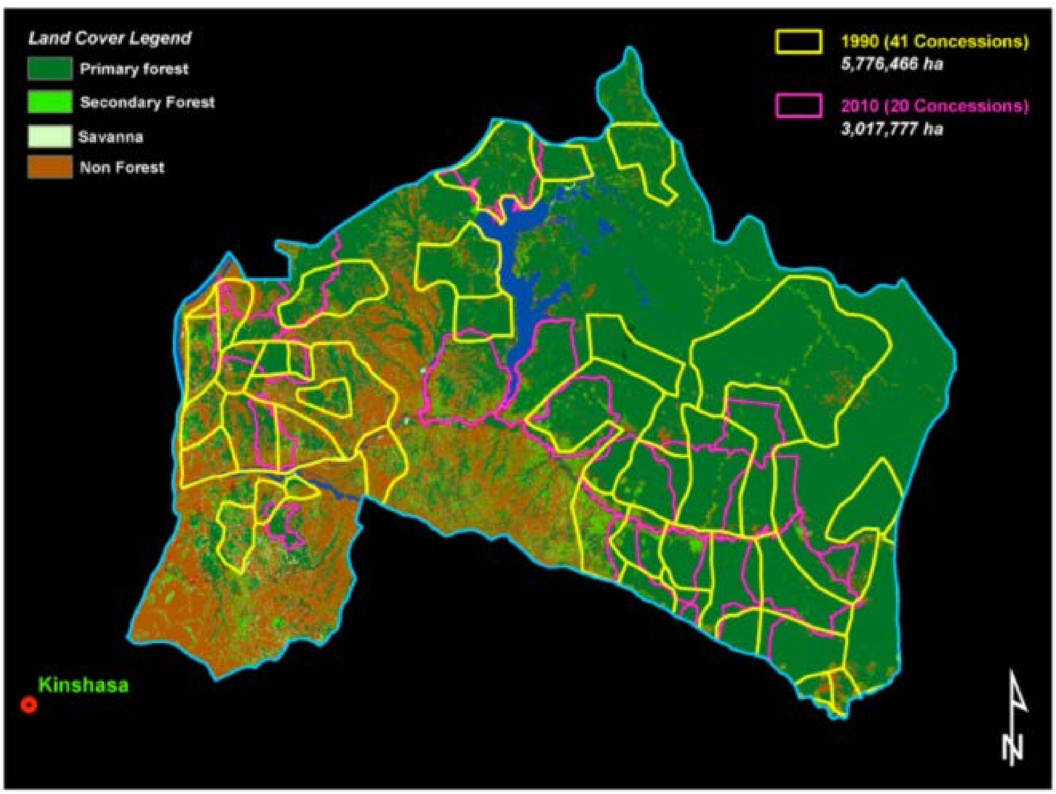

Figure 1: An overview Map of 1990 logging concessions and current (2010) logging concessions in the Mai Ndombe Province. Note the difference in the location of the two concession sets. Some of the 1990 Concessions have experienced significant deforestation, whereas the vast majority of the 2010 concessions were established in areas of pure primary forest.

The 1990 logging concessions represent concessions awarded prior to 1990 that were still legal concessions as of 1990. There is a lack of pre 1990 historical satellite imagery to establish the forest coverage of the 1990 logging concessions at the time when they were awarded, but it is reasonable to assume that forest concessions would only be established over areas that are largely primary forest.

This assumption is supported by the map of the logging concessions awarded in 2010, the boundaries of which were adjusted to conform to remaining primary forest.

Figure 2(a) illustrates the cascade of deforestation taking place in an older 1990 concession. There are still small fragments of primary forest, but much of the concession has been degraded to secondary forest, and significant areas have clearly been deforested.

Figure 2(b) illustrates that some 2010 logging concession boundaries were redrawn at the time they were awarded to encompass any remaining primary forest not yet logged. The beginning of the cascade can clearly be seen in the new 2010 concession, although that concession is still largely primary forest.

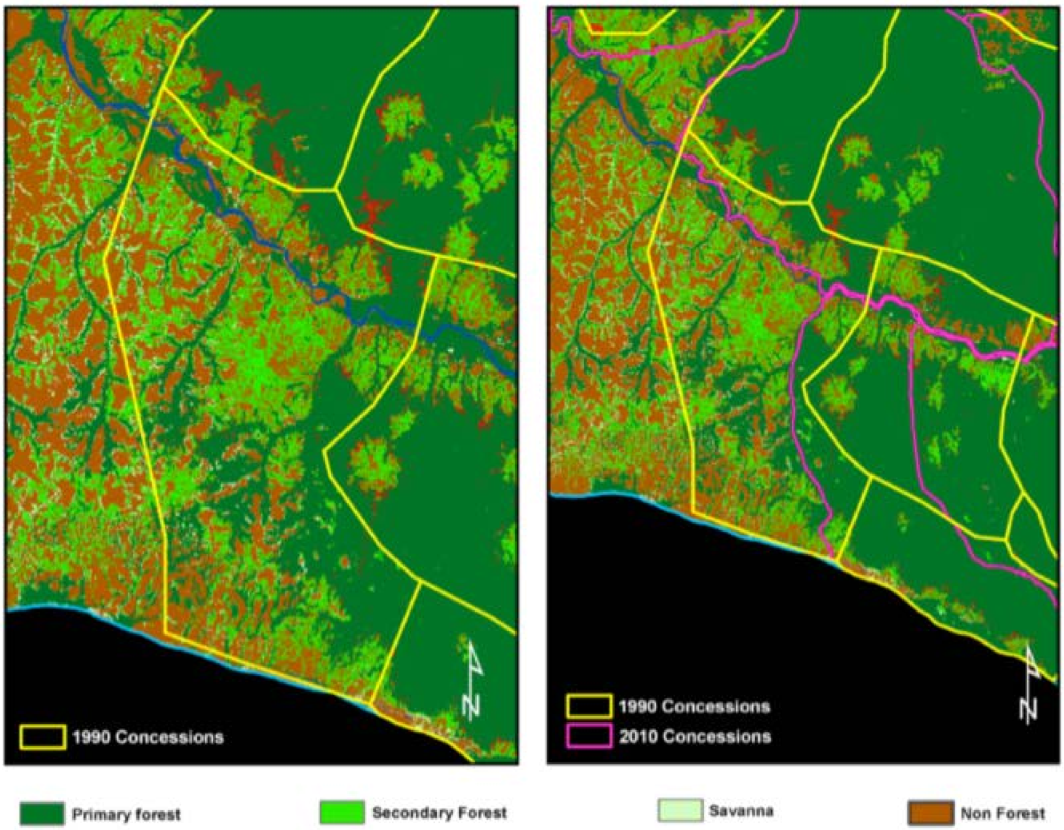

Figure 2: a) (Left) Deforestation is seen in the 1990 concessions; b) (Right) The current (2010) concession boundaries were established to capture remaining forest.

In the recent UN REDD paper, “Synthèse des études sur les causes de la déforestation et de la dégradation des forêts en République Démocratique du Congo” (MECNT, 2012). research found a strong correlation between deforestation and forest degradation, forest fragmentation and the development of roads. These factors are all related to - and the result of - commercial logging within concessions. The UN-REDD paper additionally states the following:

> “This quantitative study did not establish the link between deforestation and commercial forest logging concessions; however, qualitative studies provided evidence for industrial forest exploitation being a relatively important cause of deforestation in four Provinces (Equateur, Bandundu, Orientale and Bas-Congo).
>
> The results very clearly show the importance of activities undertaken by rural people as a cause for deforestation and degradation, which is confirmed by explanatory variables identified in the quantitative study. Moreover, a difficult economic environment and a weak institutional framework may promote such activities.” (MECNT, 2012)

The logging companies do not themselves fully deforest, but it is their activity that makes it possible for rural actors to complete the deforestation cascade process.

It is important to address whether or not active logging companies operate under different principles than those that operated in the past. Figure 3 below clearly shows that cascade deforestation has already occurred in many current concessions.

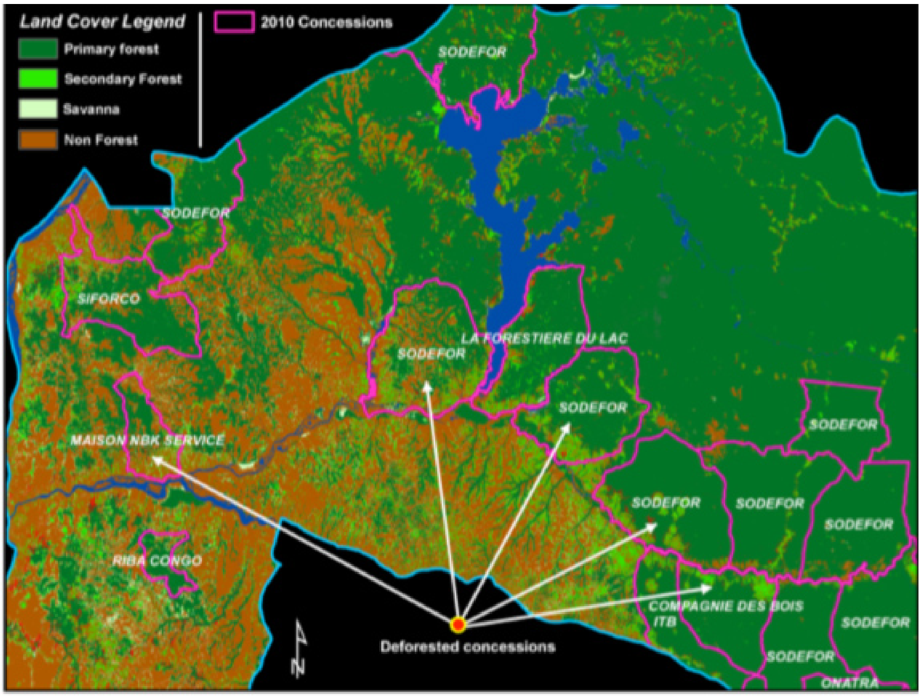

Figure 3: Current concessions / concessionaires, some of which are partially or completely deforested.

Section III: Building a REL for the Mai Ndombe Jurisdiction

Please refer to Appendix B: below for a simple explanation of the approach used to develop the REL presented in the ER PIN. Read on for an overview of the theory behind the REL approach used.

HFHD nations such as Brazil and Indonesia can develop relatively simple REL models based on net-observed forest change in a historical time period, as their high historical deforestation rate may be expected to continue in the future without intervention. This REL ensures plenty of opportunity to reduce emissions below the historical emission level, thereby instantly creating an economically valuable REDD+ opportunity (Figure 4). For these countries, the methods used to measure the REL do not capture emissions from degradation, and only quantify deforestation. It is not important for RELs for these HFHD countries to capture emissions from degradation, as the high historical deforestation rates allow for abundant emission reduction potential.

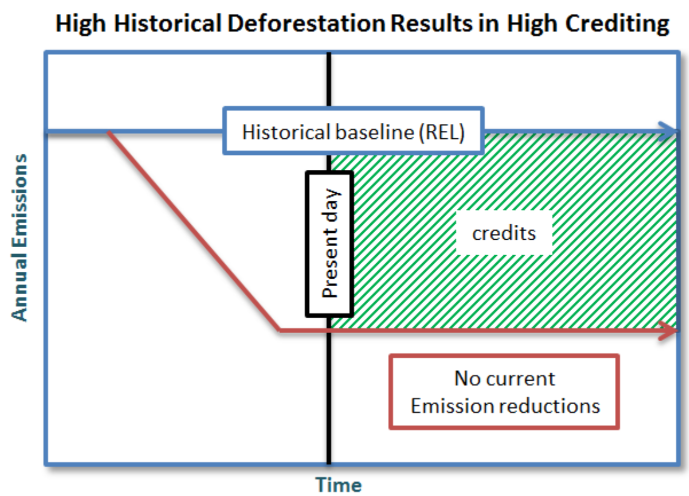

Figure 4: Example of HFHD Emission Reduction (ER) crediting scenario.

The challenge for REDD+ in an HFLD jurisdiction like Mai Ndombe is that a REL based solely on historical deforestation will often be close to or even lower than the current emission levels from forest degradation due to *legal activities*. This leaves little or no opportunity for emission reductions below the REL in an ER Program (Figure 5).

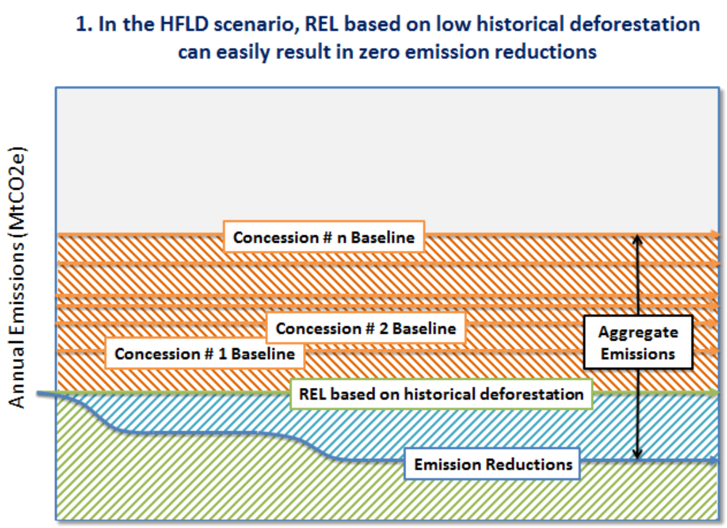

Figure 5: Example of HFLD Emission Reduction (ER) crediting scenarios. Note that this HFLD scenario generates zero ERs due to an extremely low REL and modest current emission level due mostly to logging concession activity.

For example, preliminary estimates for legal degradation emissions for the 18 active concessions in the Mai Ndombe Province total 8 Million t CO2e / yr. The REL based purely on historical deforestation in the Province is 10.45 M t CO2e / yr. Therefore, legal logging activity would result in a situation where zero REDD+ credits would likely be awarded to the jurisdiction, regardless of the success of other emission reduction activities.

Therefore, a different approach to estimating RELs, including at a minimum the inclusion of projected emissions levels from logging concessions, must be used for jurisdictions like Mai Ndombe in HFLD countries.

a) **Land-use Approach**

For HFLD countries, the REL must be developed with separate, land-use appropriate approaches being applied to each land-use category. The results of these land-use specific approaches can then be aggregated to achieve a single jurisdiction-level REL. It is important to remember that in the suggested approach, each land-use type receives its own REL against which it must reduce emissions. This avoids the risk of one type of ER activity, such as reduced-impact logging in forest concessions, usurping credits from another land-use type's activities; say reduced slash and burn conversion of forested areas outside of logging concessions. This way, the REL approach presents a fair and equitable system for each land use to demonstrate that it has reduced emissions against a measurement of a business-as-usual scenario that is appropriate for that land-use. In addition this allows for investments in emission reducing activities to be focused where they are needed to achieve successful emission reductions. Rewarding performance below the REL and penalizing emissions above the REL, within the boundaries of each land use category is essential so that the respective agents relevant to each category understand how to control their respective rewards. Agents should only be rewarded or penalized for the reductions or emissions for which they are responsible.

By comparison, a single, percentage-based REL places the same value on protection of all forest within the Jurisdiction, which may contain forests of highly different biomass emission factors and under extremely different levels of threat.

In order to ensure the environmental integrity of the ER Program at the jurisdictional total level;

- the annual deforestation and degradation as measured during the MRV process must be performed at the same land-use levels, so that each land-use type's performance can first be measured against its respective REL
- net emissions reductions must be aggregated from each land use type to the jurisdictional total net emissions reductions
- fair and equitable methods to deal with uneven success across different land use types must be developed and applied
- For example, if the annually measured emissions of one or more logging concessionaires exceed their respective REL, this reduces the potential for the entire jurisdiction to earn emission reductions from successful activities. Therefore, the ER program as a whole will need to establish accountability for such variances, ensuring where possible that unsuccessful actors within the program do not preclude successful actors from being rewarded for their positive performance. Of course if the measured emissions for the jurisdiction as a whole exceed the jurisdictional REL then no ER credits can be issued to the program as a whole
- For more detail on how MRV and REL interrelate please see Section 4 below.

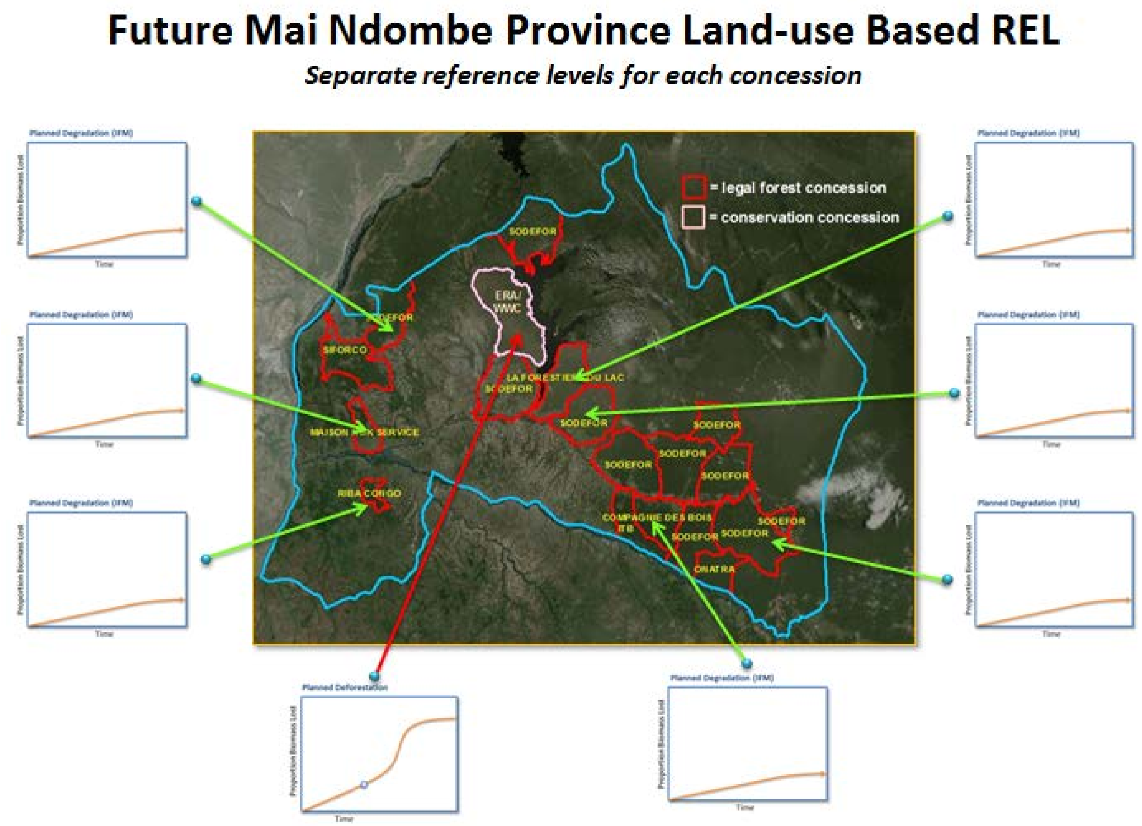

Figure 6: Demonstration of different RELs applied to the three major land-use types in the Mai Ndombe Jurisdiction. Each ER activity reduces emissions against its own REL, which is developed from historical observations according to the specific land-use category of that ER activity. All RELs can then aggregated to achieve a single REL for the Jurisdiction.

In Mai Ndombe the following land use categories were explored for applicability. RELs were created for those land use categories that could be found historically in Mai Ndombe (Figure 6 and 7). It is possible with further analysis that other REL models will need to be included.

i. Planned Deforestation

This category includes/describes all legal concessions on forested land that were granted through a formal (or informal) process to an agent who is empowered - and sometimes required by the concession agreement - to deforest some or all of the forested land within concession boundaries. Examples of this type of forest use are;

a. Economic land concessions - *(there are no new examples of this known to the authors in Mai Ndombe so no REL for this type of land use is included in the ER PIN)*

1. *Agricultural/Agro-forestry conversion* - large scale agribusiness conversion to non-forest to plant soy, palm oil, rubber, etc.
2. *Cattle ranching conversion* - large scale conversion to non-forest to create pasture for cattle grazing.

b. Governmental land concessions

3. *Urban development (a REL will have to be produced for planned expansion of forest communities during ER Program Design - as this is planned deforestation it is not likely to result in any emissions reductions, so was not estimated in the ER PIN)*

4. *Infrastructure development (roads/rail/dams etc.) (there are no new examples of this known to the authors in Mai Ndombe so no REL for this type of land use is included in the ER PIN)*
5. *Settlement schemes (there are no new examples of this known to the authors in Mai Ndombe so no REL for this type of land use is included in the ER PIN)*

c. Commercial Forestry Concessions – "cascade deforestation" - concession holder participates indirectly, either willingly or unwillingly allowing secondary agents to enter the concession after legal logging creates access to the interior of the forest. Those secondary agents then proceed to convert the degraded forest to non-forest through charcoal production, small scale agricultural production or settlement. (*a REL estimate was developed based on the VCS validated and verified ERA/WWC Mai Ndombe REDD+ conservation concession under this category in the ER PIN - further analysis may show other concessions within Mai Ndombe fall into this category)*

ii. Planned Degradation - (*a REL estimate was developed using real merchantable timber inventory data for the 18 legal concessions under this category in the ER PIN)*

Commercial Forestry Concessions managed under some form of Integrated Forest Management (IFM) - where the forest remains forest for the life of the concession, and where a primary agent (typically a commercial logging company) controls access to the forest by secondary agents, preventing the concession from "cascading" into a non-forest state. Logging concessions feature planned degradation, and they have a legal right to emissions. This means that EACH concession has its own REL, which can be modeled using either the logging management plan or some other simple Improved Forest Management (IFM) model that features a degradation of Carbon stocks from primary forest to some degraded state. Planned emissions for active concessions must be included in the Jurisdictional REL, as they are legally allowed and therefore can be considered inevitable. However we propose that the REL contributions for planned concessions not be allowed to be used to generate emissions reductions in the unplanned jurisdictional area outside of concession boundaries. That is each planned concession REL would roll up to a separate REL total for IFM concessions. Either the concession is active and logs to the REL and generates no ERs or it logs below the REL and generates ERs accordingly. Finally and importantly, if a particular concession logs above the legal limit, it will generate emissions in excess of its REL, and this will reduce the overall available ERs for the Planned IFM concession land use type. This mechanism will allow peer pressure from logging companies that wish to benefit from Reduced Impact Logging that would otherwise generate ERs putting pressure on other concessionaires not to exceed their respective RELs.

This approach to representing threat from planned deforestation presents an innovative method to project future potential emissions from an HFLD country or Jurisdiction, which shows clear potential to shift toward sharply increased deforestation and degradation within its logging concessions in the near future. However, measures must be taken to restrict the risk of perverse incentive for the issuance of new forest concessions. One solution could be that the government should agree not to award additional concessions inside the jurisdiction, once a jurisdictional REL was established. This solution if applied nationally has the added benefit of mitigating the risk of market leakage from timber concessions.

iii. Unplanned Degradation and Deforestation (*a REL estimate was developed using FACET data for this category in the ER PIN)*

This category is a catch-all for any forest-based emission activities that occur outside of the boundaries of planned forest-use areas, and that are the result of pressure from many local agents and drivers throughout the landscape. This category spans the gamut from small-scale agricultural conversion to charcoal production and local timber use. The drivers of this type of deforestation are sufficiently complicated that empirical measurement of historical deforestation has been widely accepted as the best approach for measuring its effects. In the ER PIN we included use of the FACET/historical method for calculation of the unplanned deforestation REL. However given the shortcomings of FACET for temporal rate analysis described in section 3(b) below, we suggest instead using the Biomass Emission Model (BEM) introduced in Wildlife Works' VM0009 methodology, This methodology has been double validated by the VCSA. The methodology uses a statistical photo-interpretation method that empirically observes historical deforestation over many time-periods and then, using a literature-reviewed and widely accepted logistic regression technique, predicts future deforestation under a business-as-usual scenario. The BEM methodology is explained in section 3(c) below.

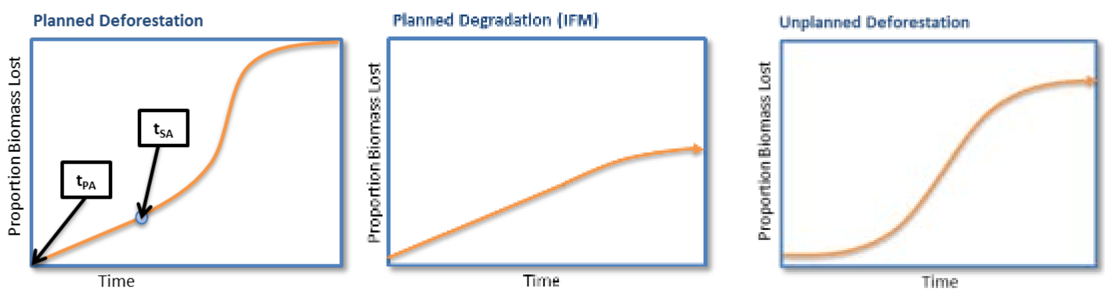

Figure 7: Three Deforestation patterns based on land-use. Left: "cascade of deforestation"; Center: IFM; Right: Unplanned Deforestation.

b) The FACET Dataset: Potential Challenges and Issues

It has been suggested that a basic analysis of the FACET dataset be utilized to estimate historical deforestation in the future Mai Ndombe province, and that this observed rate then be directly used as the REL in the future for the areas that fall under the unplanned deforestation category. While this method of modeling the REL represents a simple method of capturing historical activity and the assumption is made that this historical activity will continue into the foreseeable future, there are two significant problems with the FACET dataset that render it inappropriate for use for temporal deforestation measurement.

The first issue that has come to light with the FACET dataset is that it suffers from far too broad of a definition of secondary forest, covering everything from lightly degraded forests in forest concessions, to heavily degraded forests, and even in some cases agroforestry. This means that deforestation is being significantly underestimated, as a change from primary forest to secondary forest is not counted as 'deforestation', and therefore makes no contribution to annual emissions. If secondary forest category has been significantly misclassified, when it should have represented agroforestry or other regrowth that follows deforestation, the potential for severe underestimation of the deforestation rate exists and is most likely occurring.

Second, the method used to 'filter out clouds' from the FACET dataset renders it inappropriate for measuring a temporal activity, such as a rate of deforestation. The compositing method used to create each FACET time period aims to create a completely cloud-free composite. However, to do this, tiles from the next cloud free acquisition are used in place of any tile that is too cloudy for the time period in question. In other words, the '1990 FACET composite' actually consists of tiles anywhere from 1984 to 1995, creating a mosaic that does not represent a single time period (Figure 8). In fact, some tiles from the subsequent or previous composites overlap with the current composite, because the composites are only 5 years apart. There is therefore no substantiation for the use of the FACET dataset in a temporal study, a problem that has been backed by the leading remote sensing scientists at the University of Maryland.

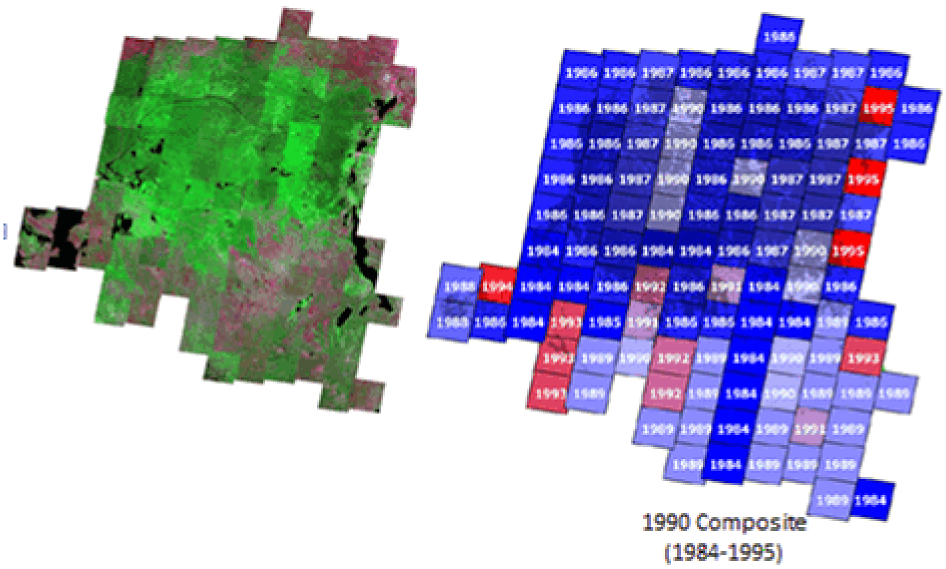

Figure 8: FACET has a couple of significant issues that prevent its accurate use in historical deforestation rate analysis.

c) The Biomass Emission Model (BEM)

As we attempt to scale REDD+ efforts to jurisdictional levels, new challenges have arisen in measuring historical deforestation, primarily due to the large areas associated with the jurisdictions as well as the inherent problems associated with obtaining cloud free historical satellite imagery. WWC has developed an approach called the Biomass Emission Model (BEM) that directly addresses these issues, and has in fact already been proven effective in multiple large scale REDD+ Projects.

Traditional remote sensing approaches to modeling historical forest change have sought to "classify" either every pixel in all images (in the case of the automated/supervised classification approach) or to manually delineate all possible areas of a particular land cover in all images.

This requires that imagery that covers 100% of the area under analysis must be available for at least 3 time periods. This has proven to be a major limitation to the implementation of deforestation rate calculations, since it is rare to have satellite images without some areas obscured by cloud or not covered by an available image. Clouds are present over portions of almost every forested landscape, especially in the tropics, and since these mask the state of the land underneath (forest or non-forest), many images must be found and spliced together to digitally remove clouds (a process known as masking). The process of splicing images together introduces error when the date of images being spliced are substantially different or when spatial registration is poor. When no cloud-free images exist, an area simply cannot be seen or used for modeling, introducing possible bias. An example of this is the FACET program that uses a large number of images from a 5-year period to construct one single cloud free image that is supposed to represent a single point in time (See section 3(b) above).

The BEM departs from these approaches by using a statistical sampling of images covering a study (or reference) area. Either a regular grid or random set of points is overlaid on the imagery. Each point is in turn manually interpreted by a human analyst for each time period as either forest or non forest or obscured. Any single image may be imperfect and/or incomplete, as long as the model meets the "double-coverage" criteria, which requires that each point in space is observed over at least two time periods. This feature alone represents a significant shift in LULC classification, as it frees the model from requiring perfect, cloud-free images for multiple dates. Not only has the traditional requirement for image perfection been difficult or impossible to achieve, even at the project level, it is also excessively expensive. The BEM is designed for use with medium resolution imagery, such as Landsat, which has been made free for the scientific community to use for such purposes as temporal deforestation modeling. This means that many separate imperfect images from as wide a range of dates as possible can be interpreted to provide a strong temporal model of deforestation.

The BEM is also particularly suited to jurisdictional / nested areas of very large spatial extent. Single automated systems cannot be used to accurately map very large areas, because there inevitably exist major natural eco- shifts as the spatial extent of the study area grows larger, and the automated system would need to be stratified and broken down into a number of smaller systems, thus introducing significant new challenges and costs. The BEM simply requires additional analysts to handle increased size. However, whereas the traditional systems will inevitably run into unsolvable obstacles, like lack of cloud-free imagery, lack of multiple image dates, environmental changes over large areas and compounding accuracy problems due to the large scale of jurisdictional/ nested programs, the BEM only requires imperfect medium-resolution imagery over the study area. There is no need for time-intensive cloud-removal, SLC-off Landsat imagery may be used, and multiple image sources may be utilized as long as they are georeferenced (i.e. Landsat, quickbird, IKONOS, GeoEYE, SPOT, geo-registered photos, etc.)

Once the forest/non forest observations have been completed for all the points in the sampling for all the available imagery dates, a relationship can then be developed between the passage of time and the proportion of forest remaining in a given area. The model form that best fits the typical deforestation data is a logistic model. Figure 9 shows how the point observations from images over the historic reference period are used to develop the logistic curve.

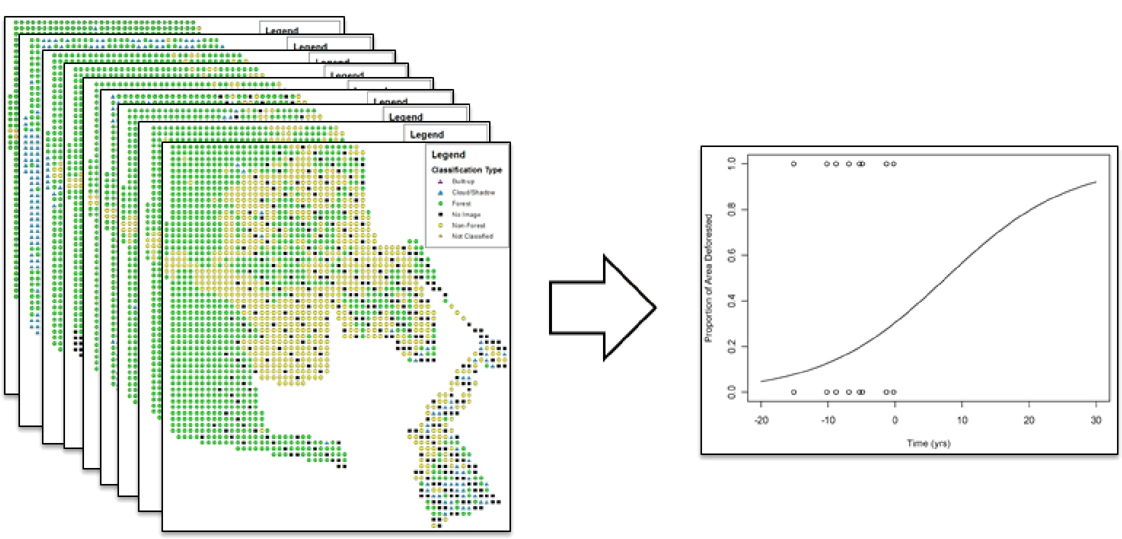

Figure 9: Data is collected for all images, organized and placed in a logistic regression algorithm. The steepness of the logistic curve represents the rate of loss of Biomass over time.

Figure 10 below demonstrates how the logistic model best describes the observed deforestation in the reference area in this example from Kenya. In the Figure 10 the black dots represent the proportion of remaining forest in a reference area observed at each time period in relation to the beginning of the historic reference period. In the graph on the left side a linear and quadratic-linear rate with curve are fit to the data, whereas on the right side the logistic (S-shaped) rate is used. While both approaches are credible, the logistic model is preferable for the way the model matches the underlying patterns of deforestation and resource depletion, its practicability, and its flexibility to other sources of uncertainty.

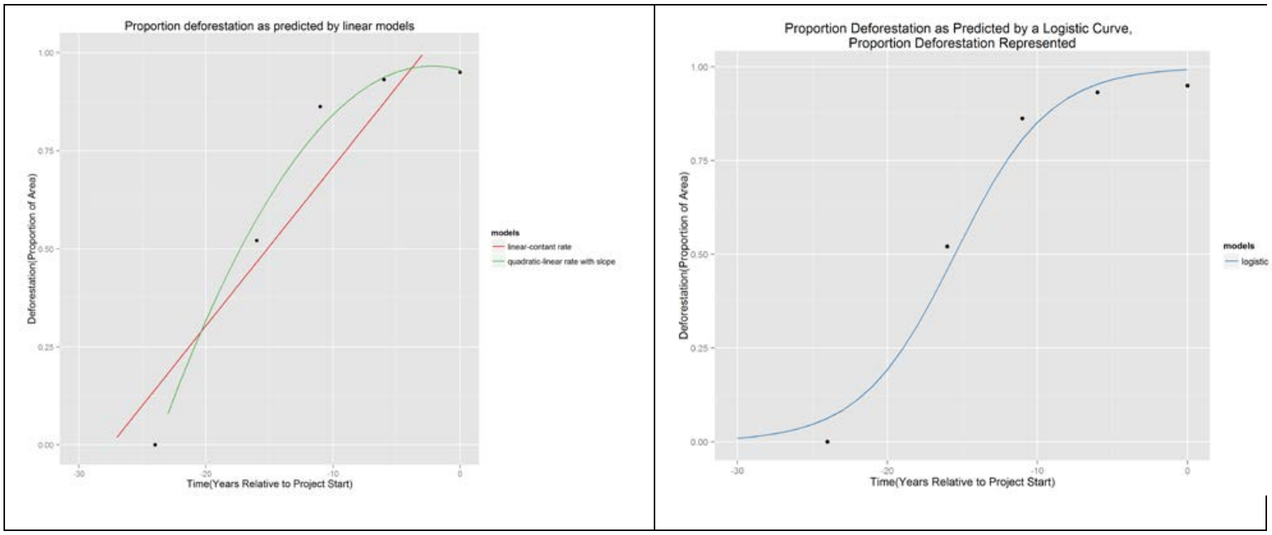

Figure 10: Linear and logistic models for deforestation, using data from South Eastern Kenya

The use of logistic models for deforestation is well-supported in resource depletion theory (e.g. Bardi & Lavacchi, 2009; Repetto, 2013). A logistic model contains lower and upper bounds, which best describe the process of deforestation. Deforestation begins slowly and as population grows and infrastructure develops it proceeds more rapidly. Finally, as the resource is depleted or the population turns to other livelihoods, the rate of deforestation slows. This slow –fast – slow pattern exactly matches that of the logistic model, and cannot be replicated using a single linear function with a constant or quadratic rate.

For avoiding planned deforestation, the direct measurement of the rate of avoided deforestation is clearly impossible, as it is a classic counter-factual scenario. One cannot measure directly what one is attempting to avoid (deforestation). To resolve this problem, the development of the BEM is done by direct observation of the rate of deforestation of another previously forested area that has been substantially deforested, and that can be proven to have been substantially similar to that forest which is being protected (same ecologically, same agents and drivers of deforestation etc.). This area is called a reference area and the concept of reference areas is described in detail in section 3(d) below.

For avoiding unplanned deforestation in a large area such as a jurisdiction that has already experienced significant historical deforestation, the BEM can be developed by direct observation of the historical deforestation that has already occurred within the jurisdiction during the historical period.

Any REL that is established for a REDD+ project must be conservative in its approach to uncertainty but also based on empirically-measured deforestation data. If the REL is not conservative it risks over-crediting the program. However, if the REL is not a realistic depiction of the deforestation threat, the emissions reduced through the Jurisdiction’s activities will be insufficient to earn significant rewards, as the increasing threat is not captured, thus threatening the financial viability of such a program. The BEM approach meets both the conservative and empirically measured tests.

d) The Reference Area Concept

Avoiding deforestation under a REDD+ program involves the protection of forests that are under threat, but have not yet themselves been converted to non-forest. To solve the problem of measuring the "without-project scenario", or what would have occurred in the project area in the absence of any intervention by the project proponents, a reference area must be used. For REDD+ projects, this reference area serves as a proxy for the project area, indicating what would have happened in the absence of intervention; it therefore must be proven to represent the project area accurately. Depending on the nature of the project, this can be done in different ways. In the case where the project stopped planned deforestation, either by halting or taking over a logging concession, the reference area

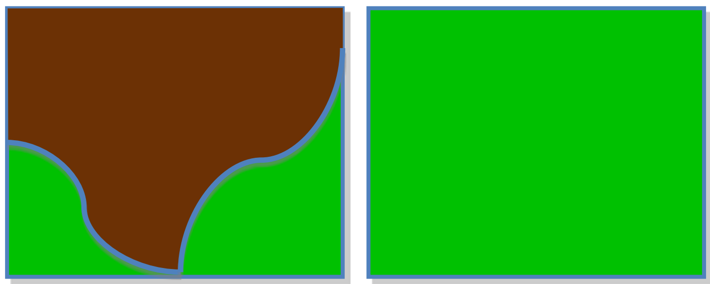

Figure 11: Deforested Block Intact Forest

should be another logging concession, ideally managed by the same agents of deforestation (same logging company), and should have been logged in the same manner that the project area would have been logged.

The same concept applied at the concession level can be scaled to the Jurisdictional level and beyond. A model that depicts planned deforestation, built by observing similar

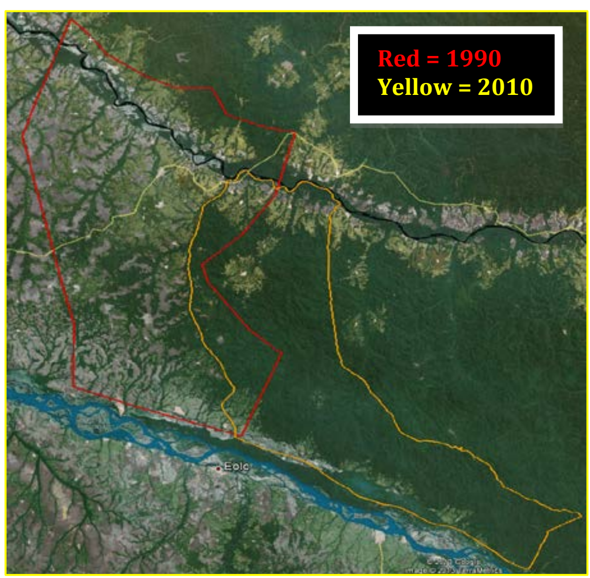

Figure 12: 1990 Concession next to a 2010 Concession in the future Mai Ndombe Province.

deforestation that has already occurred in other concessions, can be applied to those concessions that have not yet been deforested within the Jurisdiction, but are under imminent threat. This concept is best explained using visual representations at varying, incrementing scales (Figures 11 &12).

In the example shown in Figure 11, there is an intact block of forest on the right and a heavily deforested block of forest on the left. If the forest on the right is to be protected under an avoided deforestation (REDD+) scenario, the forest on the left would be used to demonstrate threat and quantify emission reductions for the forest on the right. One cannot observe deforestation on the right side block, as no deforestation has occurred yet. The left-hand block would be known as the “reference area” and the right-hand block the “project area”.

In Figure 12, a relatively intact concession is seen on the right, having been issued in 2010. To determine how biomass is likely to be lost on the right, we can model biomass loss within the 1990 concession on the left.

Section IV: Relating Monitoring, Reporting and Verification (MRV) to and the REL

To measure the annual emissions occurring from deforestation and degradation within the Mai Ndombe Province and quantify emission reductions for the Jurisdictional program, a robust Monitoring, Reporting and Verification (MRV) program must be established. The MRV program will measure emissions from the Jurisdictional forest estate over time. Individual RELs will be established for the major land-use categories found within the province, and ultimately will be aggregated into a single REL for the Jurisdiction. These RELs will be established using the methods and principles discussed above in Section 3.

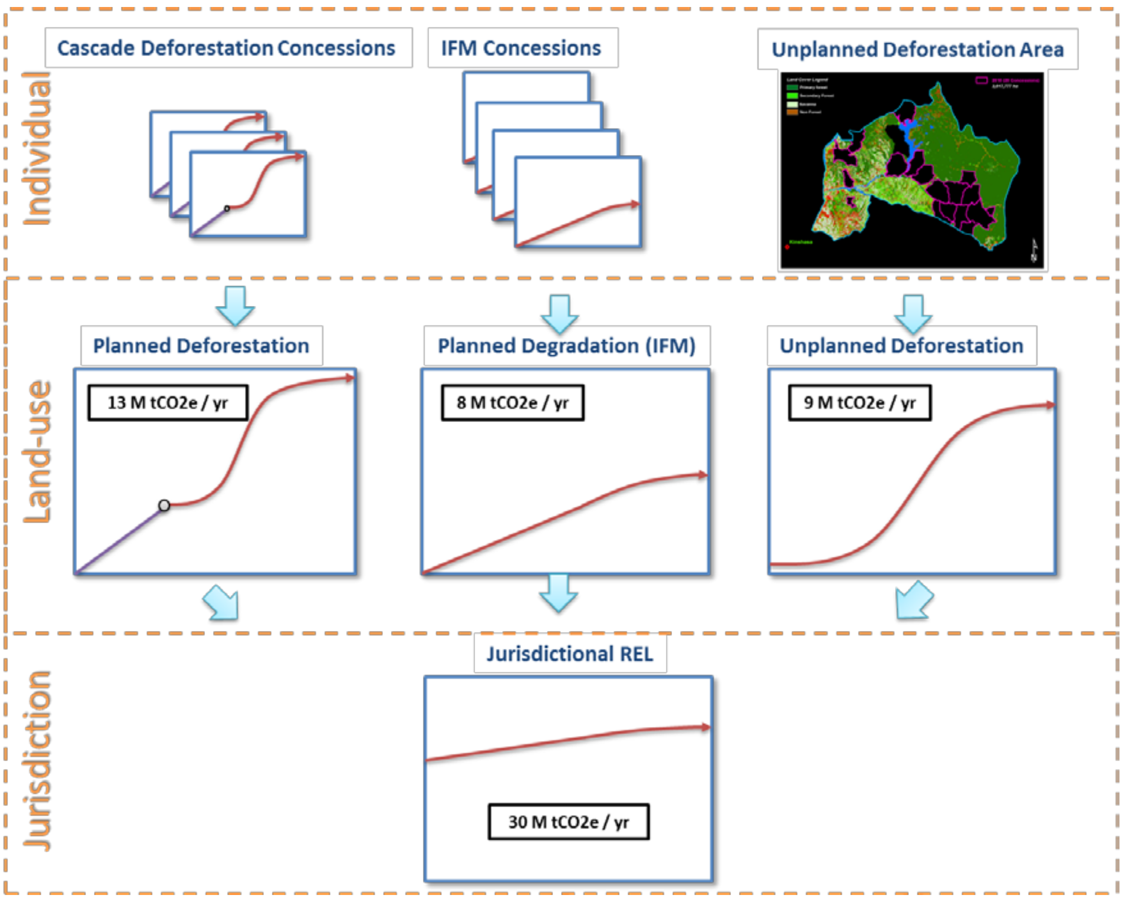

Figure 13. RELs aggregated from the most granular level to the Jurisdictional level.

Firstly, a REL is calculated for each concession in the Jurisdiction, as well as an REL for the unplanned areas outside of concessions. Concessions are grouped either by "planned deforestation" or "planned degradation" (as described in section 3a above). For planned degradation and planned deforestation land-uses, RELs from the individual concessions are aggregated to the land-use level, yielding an REL for each land-use category (see Figure 13 above). The unplanned area features a single REL that encompasses all areas outside of concessions within the boundaries of the Jurisdiction. Subsequently, each of these 3 land-use RELs are aggregated to achieve a single REL for the entire Jurisdiction. Current estimated REL values (shown in Figure 13 above, starting at the land-use level) are also presented in the ER-PIN in table 13, Section 11.2.

MRV Program Components

The goal of the MRV program is to provide a detailed annual inventory of jurisdictional forest carbon stocks. To accomplish this, the MRV Program features 2 main approaches, which will be applied to the land-use categories found within the jurisdiction. This section will describe those approaches and their sub-components in detail. The program must capture the deforestation or degradation threat specific to each land-use type. Thus, the next section will describe how the components of these approaches are individually applied to the three land-use categories that comprise the Jurisdiction.

The two main approaches of the MRV system are: a remote-sensing method that measures forest cover in the jurisdiction on an annual basis, and a ground-based forest plot system which will measure changes in forest biomass. Before these annual components are applied, a baseline map will be established at the start of the MRV program. A "wall-to-wall" thematic map of forest type is needed to determine the quantity and types of forest in the unplanned deforestation area within the jurisdiction.

To determine annual change in forested area, one of the two following methods will be used: The first is a remote-sensing approach, where a "wall-to-wall" map could be generated for each program year, and a pixel-based change detection performed to estimate total areal conversion from forest to non-forest. In this approach, a small number of forest sample plots will be needed for the development of annual forest carbon emission factors. These factors will be used to expand forested area calculations to emission values.

The second approach would utilize a larger number of ground-based forest inventory plots, coupled with a targeted remote sensing analysis of forest loss. This approach would mainly focus on measuring incremental biomass gain (or loss), as opposed to the first method which involves pixel-based analysis of deforestation only. These ground-based plots would capture shifts in forest biomass due to either forest degradation or regrowth. Then, to capture deforestation, a remote-sensing "honing" procedure, utilizing coarse-resolution satellite imagery like MODIS, could focus only on areas of high biomass change. Measurement of deforestation could then be measured only in those areas identified as "hotspots".

The ground-based forest inventory described above will be compatible with the national DRC forest inventory that is currently being designed and implemented by the Japanese space agency, JICA. Additionally, the development of the ground-based plots methods will utilize the considerable experience gained from the Lac Mai Ndombe REDD+ MRV Program. According to sample design theory, the number of plots needed is dependent on maintaining an acceptable amount of standard error. Therefore, the number of plots is not determined by sheer size of the Province, but rather on the homogeneity of the forests within each forest type. To assist in controlling variation between forest sample plots, the forest estate will be stratified by forest type, and plots randomly placed within forest strata (stratified/random plot design). There are typically a number of variables in the design of a forest inventory system, all of which present advantages and disadvantages to the overall Program goal. Plots can be designed as permanent plots or temporary plots, and fixed radius plots, nested fixed radius plots, and variable radius plots. Some considerations of pros and cons in regard to plot design are as follows:

Permanent plots generally result in less variation in measurement from year to year, however they are more prone to sabotage or alteration since their location will be known. For some areas, such as measuring forest degradation in IFM concessions, temporary variable radius plots may be advantageous, since they will allow a greater area to be efficiently sampled, and less prone to tampering since the plot locations are unknown.

Because currently, a low-cost, effective remote sensing solution for measuring forest degradation has not yet presented itself, emissions within the forest degradation category will be measured using ground-based plots placed within legal logging concessions.

Any emission removals (from agroforestry or afforestation areas) from the ER program will be measured using fixed plots in areas of planned biomass regrowth. These plots will quantify forest biomass change, and ultimately total carbon sequestered within agroforestry activities within the Jurisdiction.

Application of the MRV Components - Calculation of Emissions

a) Unplanned Deforestation

The unplanned deforestation land-use category comprises all of the forested land that is outside of forest concession boundaries in Mai Ndombe Province. It is proposed that only deforestation will be measured in this land-use category. Forest degradation is assumed to immediately precede deforestation in this type of unplanned deforestation; therefore emissions will eventually be captured when deforestation occurs, so it is considered conservative to exclude degradation from this land use category. Additionally, since the REL is developed from historic deforestation observations, MRV of deforestation only is appropriate for this land use category. ER Program emissions reductions for this category are calculated as follows;

i. To estimate PROJECTED GHG Emissions, we multiply the current Biomass emission proportion in any given year (derived from the REL curve at year x) by the beginning GHG inventory (baseline biomass inventory as described in Section I above), and subtracting the result of the same calculation for the previous year.
ii. OBSERVED GHG Emissions are calculated by a simple subtraction of the current year's measured GHG inventory and last year's measured inventory (GHG_t – GHG_{t-1}). These GHG inventories may utilize either of the two options presented in section I above (remote sensing deforested pixel count or fixed-plot / targeted remote sensing).
iii. Unplanned Degradation ERs = PROJECTED GHG $EMISSIONS_t$ - OBSERVED GHG $EMISSIONS_t$

Note that for simplification we have assumed that one REL curve can fit the deforestation process for the entire area outside of concessions within the jurisdiction. However it is possible that during program design the government recognize significant differences in rates of deforestation in a spatially explicit way even in the unplanned areas, and in that case the unplanned area could easily be subdivided and separate REL curves could be developed to assist in managing emission reduction performance differentially in hot spots, or to ensure communities are being rewarded for more local performance rather than for the performance of the jurisdiction as a whole.

b) Planned Degradation

In the forest concessions that are included in the "planned forest degradation" (or "IFM") land-use category, ground based plots will predominantly be used to determine annual emissions. This is essentially required because current remote-sensing methods cannot cheaply and accurately measure forest degradation, as discussed above. Emissions will be calculated individually for each concession and then aggregated to the land-use level.

i. To calculate PROJECTED GHG Emissions, we use the same technique as used for the unplanned areas (current Proportion Biomass lost from the REL * beginning GHG inventory) - (prior years proportion biomass lost * beginning GHG inventory) but using the relevant REL curve for EACH concession.

ii. OBSERVED GHG Emissions are calculated by adding measured deforestation and degradation, yielding a total GHG loss for each concession in tCO_2e. This is achieved by installing either fixed plots, variable (random) plots or a combination of the two in the concessions. The Pros of using a fixed plot scheme are: ease of plot administration, always comparing "apples to apples" over time. Pros of a random scheme are: it avoids "gaming" because nobody knows where to find plots and they can't be tampered with or avoided.
iii. Planned Degradation ERs = PROJECTED GHG $EMISSIONS_t$ - OBSERVED GHG $EMISSIONS_t$

c) Planned Deforestation (Concessions)

Concessions in the planned deforestation category are characterized by exhibiting substantial deforestation within their boundaries, either due to conversion to development, agriculture or because they are assumed to have started down the path of "cascade deforestation". For the cascade deforestation concession type, the technique described in Wildlife Works' VCS methodology VM0009 will be used to quantify the REL. This technique is described in detail in section 2c of this document. MRV techniques described in VM0009, or comparable MRV methodologies will be used to quantify annual emissions and ERs. This is similar to and compatible with the other land use categories above.

Aggregation of Measured Emissions and Emissions Reductions

Total emissions and any verified emission reductions (ERs) must be measured at the most granular level possible, and then aggregated up to land use level and eventually to the Jurisdictional level. Essentially, the MRV Program described above is a nested performance model, which features the following:

As discussed above, the emissions for planned deforestation and planned degradation land-use categories are first determined for each individual concession. These emissions are then summed to calculate the total annual emissions for each land-use category. For the unplanned deforestation land-use category, a single annual emission value taken from the unplanned model represents the unplanned land-use level.

When aggregated at the land use level, total observed annual emissions can be compared to the predicted aggregate REL for each land use type. Emissions will then be aggregated up to the Jurisdictional level, by aggregating the annual emissions from the three land use categories. At this level, total emissions from the three land use types must be less than the total Jurisdictional REL in any given monitoring period for the program to generate ERs (credits). If, as measured at the Jurisdictional program level, the program generates credits based on the aggregated observed emissions being lower the aggregated REL, ERs may be distributed amongst the land use types based on their respective achievements in reducing emissions against the REL at the land-use level. For the planned deforestation and planned degradation land-use categories, credits may then be distributed to the concessionaires based on their measured performance against individual concession RELs.

There are many scenarios that can be envisioned where either a single concession or an aggregate land-use category(ies) may emit in excess of their REL. Such an excess would "roll-over" to the other categories, essentially offsetting their successful ERs, to ensure environmental integrity at the Jurisdictional level. Distribution rules must be developed so that actors within land-use categories or concession holders that are successfully reducing emissions may still be rewarded for their actions.

To illustrate the aforementioned scenario, consider the following example illustrated in Figure 14 below: if within the planned degradation category, one concessionaire successfully achieves a reduction in emissions of 2 M tCO_2e below their REL, and two others achieve reductions of 1 MtCO2e each but the remaining concessionaire's emissions exceed their REL by a total of + 10 M tCO_2e in the same year, the net value for the IFM concession category would be +6 M tCO_2e, and that category would then be eligible to receive zero credits. However, if the other 2 categories (planned deforestation concessions and unplanned areas) net emission reductions below their respective RELs were - 4M tCO_2e and -5MtCO2e, the overall emissions reduced for the Jurisdiction would be (-9 + 6) =-3 M tCO_2e (see diagram below for illustration of this nesting aggregation). The Jurisdiction would then have 3 million credits to award to Program participants. The planned degradation concessionaires would not be eligible for any of those credits. The other two categories would be eligible according to their performance as a category, but some pro rata allocation model would have to be used because the IFM category's failure had reduced the total ERs available that year.

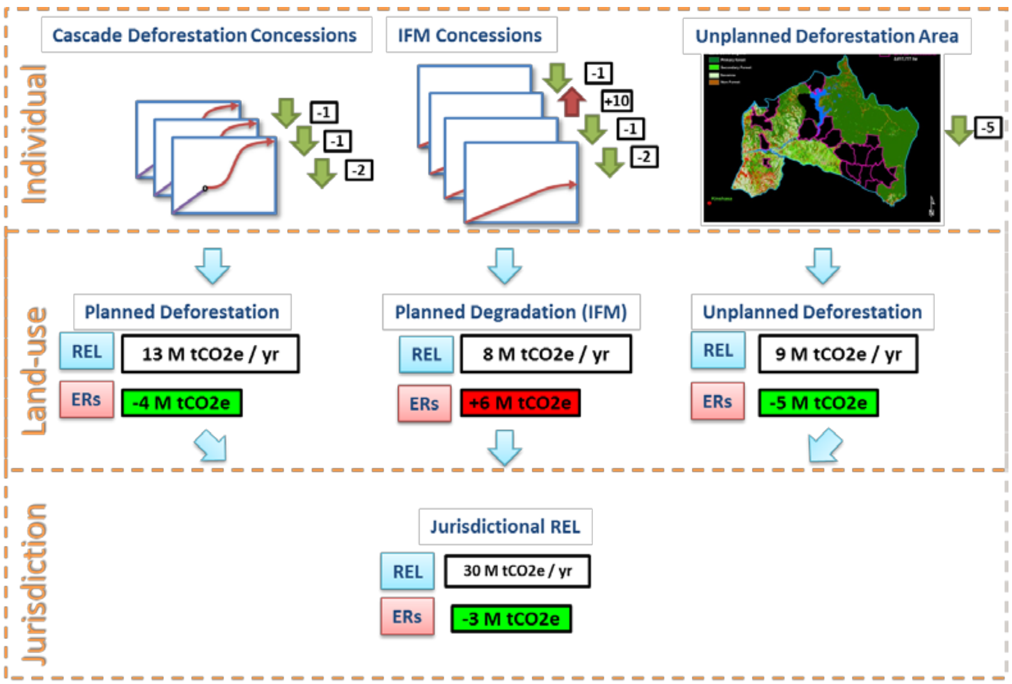

Figure 14. Example of nested ER Performance and aggregation to the Jurisdictional level.

It is clear that a political decision would be needed to ultimately determine how exactly to award performance across actors in the case that some achieve ERs and some exceed their RELs. MRV and especially credit distribution are by no means simple concepts. Ultimately, decisions about the distribution of credits from the ER Program must follow the principles of environmental integrity, be fair and equitable across actors but reward performance according to verified emission reductions whenever possible.

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Appendix A - Summary of Calculations for the ER PIN Reference Emission Level (REL)

1) **Starting point**; where does the 0.21% come from? It is a simple historical average of the DEFORESTATION RATE for the future Mai Ndombe Province based on FACET data.

The total area counted as "deforested" from the three types of forest between 2000-2010 is 196,282.2 ha (See table below). Note: This is strictly *total deforestation in the area* divided by *total remaining forest area as of 2010* (a simple division).

Basic mathematical steps: The table below shows the data used to achieve the 0.21% number. We simply take the total number of hectares deforested (according to FACET) between the years 2000 and 2010, which is 196 282.00 ha. This value is extracted directly from the FACET dataset. Dividing this value by the total forested hectares in the province in the year 2010 (196 282.00 / 9 174 537.12) yields 2.1%. However, to calculate yearly percentage deforested, we need to divide this by the number of years that we observed the deforestation, which is 10. (2.1% / 10), yielding 0.21%. This is the gross mean deforestation rate, as observed between the years of 2000 and 2010, according to the FACET dataset. We refer to the value as a negative number (-0.21%), because we are *losing* forest over this period of time.

However, this is an *academic rate*, as it is *not weighted by the area of each forest stratum*, and as these forest classes have extremely different areas and carbon emission factors, this simple number (0.21%) is not representative of the annual emissions % at all.

Category (ha)	TOTAL future province de MAI NDOMBE (ha)
Surface Total hectares	**12 532 533.24**
Surface de Forêt en 2010	**9 174 537.12**
Forêt 2010/total	**73.21%**
Perte couvert 00-05 en **savane arborée**	**5 013.18**
Perte couvert 00-05 en **forêt primaire**	**23 381.94**
Perte couvert 00-05 en **forêt secondaire**	**73 053.29**
Perte couvert 05-10 en **savanes arborées**	**6 494.76**
Perte couvert 05-10 en **forêt primaire**	**47 982.29**
Pert couvert 05-10 en **forêt secondaire**	**40 356.74**
Taux déforestation Global 00-10	196 282.20
Taux déforestation Global 00-05	-0.22%
Taux déforestation Global 05-10	-0.21%
Taux déforestation Global 00-10	***-0.21%***

2) What is the total carbon stock number associated with the 9 174 537.12 ha of remaining forest in Mai Ndombe in the year 2010?

To answer this question, we must go back to the areas of each forest type according to FACET in the 2010 map, and then apply an emission factor (or carbon stock factor) to each type of forest to capture the difference in carbon values for each of these forest types. The table below shows these areas for each type of forest as of 2010, according to the FACET dataset.

Category	Surface (ha) in 2010
Zones non-forestières	2 736 200
Plans d'eau	420 330
Pas de données (en RDC)	5 290
Savanes arborées/formations boisées	271 360
Forêts primaires tropicales humides	8 215 420
Forêts secondaires tropicales humides	687 750
Total	**12 336 350**
Total Forêt (2010)	**9 174 530**
Forêt 2010/total	74%

This table below shows the carbon stocks used in the aforementioned calculation. The emission factors' sources are listed next to each factor. Each factor is derived by peer-reviewed literature source, including the emission factor for Forêts primaires, which is derived directly from the ERA/WWC Lac Mai Ndombe REDD+ Project forest inventory:

	Strate	Stocks moyens		Source de la donnée
FORÊT	Forêts primaires	289 tC ha^{-1}		Inventaire biomasse d'ERA/WWC
	Forêts secondaires	96.8 tC ha^{-1}	±29	Makana, 2004
	Savanes arborées	21 tC ha^{-1}	±6	OFAC, 2008

This results in the following total carbon stocks based on FACET as of 2010.

Carbon Stock Calculations for each Forest type	Calculation	Result
Primary Forest	289 * 44/12 * 8,215,420	8,705,606,726.7 or **8,705 Million tCO2e**
Secondary Forest	96.8 * 44/12 * 687,750	244,105,400 or **244 Million tCO2e**
Wooded Savanna	21 * 44/12 * 271,360	20,894,720 or **20 Million tCO2e**
Grand Carbon Stock Total for 2010		**8,970,606,846.7 tCO2e or 8,970 Million tCO2e**

3) How was the starting REL from FACET calculated?

To calculate the starting reference emission level (REL), we must assume that deforestation does not mean 100% carbon stock loss. We must measure the difference between the starting state of the land before deforestation occurs and the end-state following deforestation, which is not 0% Carbon, but rather some measured Carbon value, albeit small, for the agricultural stocks that exist after deforestation occurs. The following POST DEFORESTATION CARBON STOCKS were used to calculate the LOSS of Carbon from deforestation of each of the three studied forest types:

Ag Land Cover Class	C Stock (after deforestation)	Error	Source
Savanes herbeuses	5 tC ha-1	±2	OFAC, 2008
Agriculture sur abatis-brûlis			
Rotation de 6 ans (2 ans en culture et 4 ans en *Chromalaena* jachère)	5 tC ha^{-1}	± 1,5	Palm et al 2000
Rotation de 11 ans (2 ans en culture et 9 ans en jachère forestière)	32 tC ha^{-1}	± 9,6	Palm et al 2000
Rotation de 25 ans (2 ans en culture et 23 ans en jachère forestière)	77 tC ha^{-1}	± 17	Palm et al 2000
Simple Average from classes above	**38 tC ha^{-1}**		
Agriculture	**28 tC ha^{-1}**		Inventaire biomasse d'ERA/WWC

To calculate historical emissions, we use the difference between the starting carbon stocks in 2) above and the residual post deforestation stocks in the table immediately above. We then multiply these residual stocks by the total hectares deforested for each forest type over the ten year observation period. Results are shown in the tables below:

Category	TOTAL future province de MAI NDOMBE (ha)
Surface Total (ha)	12 532 533.24
Surface de Forêt en 2010	9 174 537.12
Forêt 2010/total	73.21%
Déforestation 2000-2010 in wooded savanna forest(savane arborée)	11 507.94
Déforestation 2000-2010 in secondary forest (forêt secondaire)	113 410.03
Déforestation 2000-2010 in primary forest (forêt primaire)	71 364.23

Calculations for *annual FACET-based emissions*:

Land Cover Category	Calculation	Result
wooded savanna Forest	(21 tC/ha - 5 tC/ha) * 44/12 * 11,507.94 ha	675,132 tCO2e
Secondary Forest	(96.8 tC/ha - 5 tC/ha) * 44/12 * 113,410.03ha	38,173,816 tCO2e
Primary forest	(289 tC/ha - 38 tC/ha) * 44/12 * 71,364.23ha	65,678,879.7 tCO2e
Grand Total FACET emissions between 2000-2010 for all forest types		**104,527,827.7 tCO2e**
Divide by 10 to get to annual average FACET emissions	**(104 527 827.7 / 10)**	**10.45 M tCO2e/year**
Average Historical Emissions as a % of total C stocks	**10.45 / 8,970 Million tCO2e**	**0.11%**

[note that WWF had in a previous version of the ER-PIN applied an adjustment to this number that brought it to 12.21 MtCO2e, but that idea was dropped when we took a modeling approach to adjusting the baseline]

Therefore the average historical emissions as captured by FACET as a percentage of the total carbon stocks as of 2010 can be calculated as:

10.45/8,970 = .11% as shown in the final row in the table above…

Now, some of the historically measured deforestation captured by FACET was ***within logging concessions*** and we therefore reduced the REL estimate reported in the ER-PIN for *unplanned deforestation* to:

9M tCO2e per year.

4) We adjusted the FACET-based baseline REL for both legal and illegal emissions activity within forest concessions. These emissions were originally largely excluded from FACET because the concessions were either not active during the 10-year period that FACET analyzed data, or because active concessions undergoing degradation will not show up in the FACET deforestation data. However, these concessions contain legal degradation emissions that need to be included in the baseline. We adjust for these concessions according to the following steps:

a) Degradation in legal logging concessions ("IFM" Concessions):

The reference emissions profile of a legal logging concession is based on its specific merchantable timber inventory and management plan. Each concession will be modeled uniquely during the actual ER Program. However, for the purposes of the estimate for the ER-PIN, merchantable timber volumes were taken from the extensive inventory performed for the ERA-WWC Mai Ndombe REDD+ project and scale-adjusted to the area of remaining forest in each of the 18 concessions in Mai Ndombe province. More detailed analysis of each concession is clearly required, and will be performed during ER Program design.

We performed a basic analysis based on the total area under logging concessions in 2010, merchantable Carbon stocks based on the merchantable species found within the Lac Mai Ndombe REDD+ Project area and a conservative reduction.

This analysis yielded the potential for **8 MtCO2e** per year from legal logging concessions.

b) Avoided deforestation in conservation concessions converted from legal logging concessions, avoiding the deforestation "cascade" process:

These forest concessions contribute a *modeled adjustment to the historical REL*. This adjustment is derived from the direct observation of historical deforestation in a similar "reference" forest concession in the DRC that had previously been deforested by the same agents of deforestation as owned the concession before it was converted to conservation use. An example of this REL approach is represented by the ERA/WWC Lac Mai Ndombe REDD+ Project, which was validated and verified by the VCS and CCBA standards in December, 2012.

This analysis yielded the potential for **13 MtCO2e** per year from concessions following the "cascade of deforestation" pattern

These three numbers (unplanned/FACET, IFM/legal concession degradation and cascade deforestation) add up to a total adjusted REL = (9 MtCO2e + 13 MtCO2e + 8 MtCO2e) = **30 MtCO2e/year, which is the number reported in section 11.2 table 13 of the ER-PIN, repeated here:**

Table 13 – REL Estimate

REL Estimate	**REL (Mt CO2e · yr^{-1})**	**REL As % of original forest carbon stock**
Unplanned Deforestation (slash & burn)	**9**	
Planned Deforestation (cascade, agriculture, etc.)*	**13**	
Planned Degradation (IFM)	**8**	
TOTAL PROJECTED GHG EMISSIONS	**30**	
TOTAL AGROFORESTRY GHG REMOVALS	**0**	
Total	**30**	**.33%**

Preliminary estimate of jurisdictional REL for the Mai Ndombe Province ER Program

In the ER PIN the percentage shown in the table above was 0.6% which was a simple ratio of the adjusted REL compared to the original FACET-based REL times the FACET based deforestation rate;

= (30 MtCO2e/10.45 MtCO2e) * .21% = .60%

This is technically not entirely correct as we are comparing an emissions ratio to scale up a deforestation rate. However, for the purposes of the ER-PIN we felt this would provide a sound basic comparison.

In fact, because the emissions from legal logging concessions are the result of degradation (not deforestation), and those from cascade concessions represent much higher emissions per hectare from deforestation than the average background rate, the projected annual adjusted deforestation rate computed correctly would be *significantly lower than .60%*.

Perhaps a better comparison is to compare the two RELs as a percentage of original carbon stocks;

From FACET alone, we had:

(10.45 MtCO2e/yr / 8,970 MtCO2e/yr) = .11%
of the original Carbon stocks being predicted to be lost every year

Now, adjusting for forest concession degradation and cascade deforestation (from concessions) in the REL we have;

(30 MtCO2e/yr / 8,970 MtCO2e/yr) = .33%
of the original carbon stocks being predicted to be lost every year

5) Expected Emissions Reductions:
The table shown below, which is in section 11.3 of the ER-PIN, then makes estimates of how successful different Emission Reduction activities might be in each of the land use types, and predicts a potential range of emissions reduction that the ER Program might earn.

Table 14 – Expected ER's

ER Estimate	ER - total (range - Mt CO2e)		ER - % of the REL (range)		ER – to Dec. 31, 2020 (Mt CO2e)	ER – 10 years (Mt CO2e)	ER – Program Lifetime (to 2050) (Mt CO2e)
	low	high	low	high	average	average	average

Planned Deforestation within forest concessions (cascade, agriculture, etc.)(REDD)*	3	10	23%	77%	39	65	195
Planned Degradation within forest concessions (IFM)	1	7	12.5%	87.5%	24	40	120
Unplanned Deforestation (slash & burn) (AUDD)	3	6	33%	66%	27	45	135
Afforestation/ Reforestation	.2	.4			1.8	3	90
Protected Areas	No estimates made at this time. Not expected to be significant % of ERs pre 2020.						
Mining concessions	No estimates made at this time. Not expected to be significant % of ERs pre 2020.						
Total	**7.2**	**23.4**	**37%**	**78%**	**91.8**	**153**	**540**

Preliminary estimate of Emission Reductions for the Mai Ndombe Province ER Program

[Note: these are only estimates. The ER Program will not earn any ERs unless the MRV system shows emissions below the REL in any given year. THE REL DOES NOT EQUATE TO EMISSION REDUCTIONS. Program proponents must REDUCE EMISSIONS BELOW THE REL, the magnitude of this reduction measured by the MRV system. The REL is simply an estimate of business-as-usual emissions activity, and can be looked at as what we estimate will happen in the Province of Mai Ndombe should there not be an Emission Reduction Program. The distinction between reference level and emission reductions is crucial to the successful defense of this proposal.]