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Application of the Oeko-Institut/WWF-US/ EDF methodology for assessing the quality of carbon credits

This document presents results from the application of version 3.0 of a methodology, developed by Oeko-Institut, World Wildlife Fund (WWF-US) and Environmental Defense Fund (EDF), for assessing the quality of carbon credits. The methodology is applied by Oeko-Institut with support by Carbon Limits, Greenhouse Gas Management Institute (GHGMI), INFRAS, Stockholm Environment Institute, and individual carbon market experts. This document evaluates one specific criterion or sub-criterion with respect to a specific carbon crediting program, project type, quantification methodology and/or host country, as specified in the below table. Please note that the CCQI website Site terms and Privacy Policy apply with respect to any use of the information provided in this document. Further information on the project and the methodology can be found here: www.carboncreditquality.org

Sub-criterion:	1.3.2 Robustness of the quantification methodologies applied to determine emission reductions or removals
Project Type:	Establishment of natural forest
Quantification methodology:	CDM AR-ACM0003 Version 2.0
Assessment based on carbon crediting program documents valid as of:	30 June 2021
Date of final assessment:	20 May 2022
Score:	3

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Assessment

Relevant scoring methodology provisions

The methodology assesses the robustness of the quantification methodologies applied by the carbon crediting program to determine emission reductions or removals. The assessment of the quantification methodologies considers the degree of conservativeness in the light of the uncertainty of the emission reductions or removals. The assessment is based on the likelihood that the emission reductions or removals are under-estimated, estimated accurately, or over-estimated, as follows (see further details in the methodology):

Assessment outcome	Score
It is very likely (i.e., a probability of more than 90%) that the emission reductions or removals are underestimated, taking into account the uncertainty in quantifying the emission reductions or removals	5
It is likely (i.e., a probability of more than 66%) that the emission reductions or removals are underestimated, taking into account the uncertainty in quantifying the emission reductions or removals OR The emission reductions or removals are likely to be estimated accurately (i.e., there is about the same probability that they are underestimated or overestimated) and uncertainty in the estimates of the emission reductions or removals is low (i.e., up to ±10%)	4
The emission reductions or removals are likely to be estimated accurately (i.e., there is about the same probability that they are underestimated or overestimated) but there is medium to high uncertainty (i.e., ±10-50%) in the estimates of the emission reductions or removals OR It is likely (i.e., a probability of more than 66%) or very likely (i.e., a probability of more than 90%) that the emission reductions or removals are overestimated, taking into account the uncertainty in quantifying the emission reductions or removals, but the degree of overestimation is likely to be low (i.e., up to ±10%)	3
The emission reductions or removals are likely to be estimated accurately (i.e., there is about the same probability that they are underestimated or overestimated) but there is very high uncertainty (i.e., larger than ±50%) in the estimates of the emission reductions or removals OR It is likely (i.e., a probability of more than 66%) or very likely (i.e., a probability of more than 90%) that the emission reductions or removals are overestimated, taking into account the uncertainty in quantifying the emission reductions or removals, and the degree of overestimation is likely to be medium (±10-30%)	2
It is likely (i.e., a probability of more than 66%) or very likely (i.e., a probability of more than 90%) that the emission reductions or removals are overestimated, taking into account the uncertainty in quantifying the emission reductions or removals, and the degree of overestimation is likely to be large (i.e., larger than ±30%)	1

Information sources considered

1 CDM A/R Large-scale Consolidated Methodology: Afforestation and reforestation of lands except wetlands (AR-ACM0003, Version 02.0)

2 Clean development mechanism project standard (Version 01.0)

3 Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities (AR-TOOL02, Version 01)

4 Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (AR-TOOL14, Version 04.2)

5 Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities (AR-TOOL12, Version 03.1)

6 Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities (AR-TOOL16, Version 01.1.0)

7 Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity (AR-TOOL15, Version 02.0)

8 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 5

The A/R Methodological Tool “Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity” is not considered, because this applies only to calculating emissions resulting from fire disturbance events. Application of this tool would result in a conservative estimate of reversals in the case of a fire disturbance (natural or otherwise).

Assessment outcome

The quantification methodology is assigned a score of 4.

Justification of assessment

Project Type

This assessment refers to the following project type:

"Establishment of a forest on non-forest land areas that are ecologically appropriate for forests, excluding naturally non-forested biomes and semi-natural grasslands as well as the boreal region due to albedo-effects. The forest will not be used for any commercial purposes, such as harvesting, but may be used for sustainable subsistence. The tree species composition is based on the natural forest type of the area. This project type does not include the restoration of marine coastal ecosystems, such as mangroves."

This is within the scope of the quantification methodology, as the methodology allows afforestation and reforestation of any land that does not fall into the category of wetland (Source 1).

Selection of emission sources for calculating emission reductions or removals

The AR-ACM0003 methodology explicitly identifies the following “sources, sinks, and reservoirs” relevant for quantifying net removals associated with reforestation projects:

Table 1 Assessment of sources, sinks and reservoirs covered

Source, sink, or reservoir	Included in quantification methodology?	Relevant for this assessment?
Above- and below-ground biomass (trees and shrubs)	Yes	Yes. Primary source of removals from the project activity. Also a potential source of emissions at project initiation.
Herbaceous vegetation	No	Yes. Potential source of emissions at project initiation.
Standing dead carbon (carbon in all portions of dead, standing trees)	Optional	Yes. May be a reservoir of additional stored carbon. Also a potential source of emissions at project initiation.
Lying dead wood carbon	Optional	Yes. Could be a source of emissions at site preparation; could also be a reservoir of additional carbon stored due to the project activity.
Litter and duff carbon (carbon in dead plant material)	Optional	Yes. Could be a source of emissions at site preparation; could also be a reservoir of additional carbon stored due to the project activity.
Soil carbon	Optional	Yes. Could be source of emissions from site preparation activities. Since no harvesting is assumed for this assessment, however, significant effects on soil carbon are unlikely. The methodology also assumes project activities could increase soil carbon.
Carbon in in-use forest products	No	No. No harvesting assumed.
Forest product carbon in landfills	No	No. No harvesting assumed.
Mobile combustion emissions from site preparation activities	No	Yes. Could be significant source of emissions, depending on scale.
Mobile combustion emissions from ongoing project operation and maintenance	No	No. Likely insignificant since the assessed project type involves no harvesting.
Stationary combustion emissions from ongoing project operation and maintenance	No.	No. Not likely to differ from baseline.

Emissions from clearing of forest land **outside** the project area	Yes. Afforestation on land currently used for grazing or growing crops may cause displacement of these activities to other lands, leading to a reduction in carbon stocks on those lands (e.g., due to clearing of trees and shrubs).	Yes. Significant potential source of leakage.
Emissions/removals from changes in harvesting on forest land outside the project area	No.	No. No harvesting is assumed.

The methodology defines a reasonably comprehensive GHG assessment boundary for this project type. However, some possibly significant sources of emissions – such as mobile combustion emissions from road buildings and site preparation activities – are excluded, while certain carbon reservoirs that could be the source of emissions are only included at the discretion of project developers. The methodology explicitly excludes emissions "resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary, and transportation attributable to the project activity" (Source 1). Excluding these sources – along with lying dead wood, litter and duff, and soil carbon pools at a project developer's discretion – could result in some overestimation of emission reductions/removals if, for example, heavy site preparation is involved. This is assessed further below.

Determination of baseline emissions

The methodology requires project owners to conduct an assessment of possible baseline scenario alternatives, using the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Source 3). Alternatives must include continuation of pre-project land use, forestation without being registered as a CDM activity (i.e., BAU forestation), and BAU increase in forest cover (partial forestation) due to legal requirements or common practice activities (paragraph 9 of the tool).

The associated tool for "estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Source 4) is applied to determined baseline carbon stocks. For a number scenarios and conditions, it is acceptable to assume that there will be zero change in baseline carbon stocks (see paragraphs 11 and 12 in the tool). These conditions mostly appear conservative, though some subjectivity and uncertainty could be involved in demonstrating their applicability and in asserting that they will continue in the future (e.g., periodic land-use cycles involving slash-and-burn or clearing-regrowing cycles – paragraph 12(f)).

Pre-existing trees and shrubs must be identified and monitored to ensure that they are not lost due to project activities, and are excluded from estimations of carbon stock growth due to the project activity (Source 4, section 5, paragraph 11). If project activities disturb pre-existing trees and shrubs, these emissions must be accounted for.

Possible concerns here include:

- While existing legal requirements must be reflected at the time the project is initiated, there appear to be no provisions for updating the baseline if new legal requirements (or incentives) are

adopted – or there are changes to common practice in the area – such that tree planting on the project area could be expected in the baseline. The risk here is difficult to assess generically. However, given a crediting period of up to 30 years, assuming continuation of pre-project activities (e.g., ongoing clearing and regrowing without any change in practice, legal requirements, or incentives) may not be conservative in all cases. This would need to be assessed on a project-by-project basis.

- Finally, related to this, there are no provisions for anticipating in the baseline the possible effects of meeting NDC or LEDS targets.

Determination of project emissions

The methodology quantifies net project removals by quantifying the change in carbon stocks in required and optionally selected carbon pools: trees, shrubs, dead wood, litter, and soils (Source 1). If total carbon stocks decrease due to fire, then non-CO_2 emissions from combustion of biomass must also be estimated.

The methodology explicitly excludes the following potential sources of project emissions from quantification: GHG emissions resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary, and transportation attributable to the project activity. These sources are deemed insignificant and therefore accounted as zero. For most project activities, this may be a reasonable assumption. However, certain sources – like fertilizer use, road building, and transportation emissions could conceivably be significant for some projects, depending on circumstances.

The methodology also (effectively) assumes that net emissions due to site preparation from optional carbon pools (dead wood, litter, and soils) will be insignificant. Rather, the default assumption is that project activities may lead to significant *increases* in the carbon in these pools (i.e., net removals), and therefore project proponents may choose to include their quantification as a basis for generating credits. This approach could potentially overlook significant emissions, primarily from dead wood and (especially) soil carbon due to site preparation or other project activities. In cases where such emissions occur, project owners could choose not to account for them.

This risk is minimized for soil carbon, however, because the methodology excludes project activities that take place on wetlands, and excludes projects where soil disturbances cover more than 10% of the project area on land that: (1) contains organic soils; or (2) was subject to certain land-use and management practices that applied carbon inputs (such as manure). Guidance for making a determination for (2) is obtained from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories; however, some subjectivity may be involved in assessing prior practice and input levels.

Changes in carbon stocks in trees, shrubs, and optional carbon pool are quantified using prescribed sampling and measurement approaches, including appropriate stratification. Where increments in tree and shrub carbon stocks are difficult to measure (e.g., because insufficient time has passed to cost-effectively obtain a statistically significant measurement of change), project proponents have the option to make a determination of “no decrease” in the relevant carbon pool, backed by remote sensing or other monitoring methods. Risks of overestimation in this case would be minimal.

For dead wood and litter, measurements or conservative defaults may be used to estimate carbon. Default approaches correlate carbon in these pools to live tree cover, and are based on the

assumption that no removal of dead wood and litter occurs. Some (minor) risk of overestimation may occur if this assumption does not hold and/or is not sufficiently verified.

Estimation of the increase in soil organic carbon (SOC) is based on the assumption that "implementation of an A/R CDM project activity increases the SOC content of the lands from the pre-project level to the level that is equal to the steady-state SOC content under native vegetation." The approach uses default reference levels for SOC in different types of soils and regions under native vegetation. Initial SOC is determined using these same defaults, adjusted using additional default discount factors to determine (typical) starting SOC values based on baseline land use, management, and nutrient input regimes. This is a highly "standardized" approach (little to no actual measurement is involved). This reduces costs given the significant effort required to measure SOC. However, whether the results are conservative is difficult to determine without knowing more about project-specific circumstances. For the project type being assessed here (which involves planting of native tree species), it is likely to be reasonably conservative.

Finally, for measurements used in the estimation of carbon stocks and/or changes in carbon stocks (including in trees and shrubs, and possibly litter and dead wood), an "uncertainty discount" is applied whenever uncertainty (defined using a 90% confidence interval) exceeds 10% of the mean value. The discount increases in graduated fashion depending on how large the uncertainty is compared to the mean value. If uncertainty exceeds 30% of the mean value, the discount is 100%. This helps to ensure that project carbon stocks (and carbon stock increases) are not overestimated. However, if applied to baseline (pre-existing) trees and shrubs, and these trees and shrubs are removed due to the project activity (e.g., during site preparation), the uncertainty discount could result in an underestimation of emissions (or an overestimation of net carbon removals). The methodology seems largely premised on the idea that removal of trees and shrubs will not happen (see section 5 of the tool for "estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" – Source 4). However, such clearing is not ruled out, and the methodology does not seem to explicitly prohibit the use of an uncertainty discount (or require applying an uncertainty multiplier) in cases where projects must measure baseline carbon stocks.

Determination of leakage emissions

Leakage associated with reforestation projects can occur if reforestation displaces other land uses, e.g., by converting agricultural land to forest land, leading to a displacement of agricultural production. Leakage must be calculated using the tool for "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Source 7).

Under the tool, agricultural activities are assumed to be displaced to other forested land areas on a one-for-one basis. That is, if 10 hectares of land in the project area were previously used for cropland, then it is assumed that 10 hectares of forest land will be cleared elsewhere to accommodate the displacement of cropping activity. This may or may not be conservative, depending on circumstances. On the margin, net agricultural activity may decline if there are costs associated with shifting to other land areas, which could lead to less than one-for-one displacement of other forest land. On the other hand, if receiving land areas are less productive, this could lead to clearing of *more* forest land than the area that was planted in trees. The actual net effect would be hard to determine without knowing project-specific circumstances (and even so, may be hard to estimate).

Some exceptions are made for displacement of grazing activities, e.g., displacement of project area grazing to other grassland areas that are capable of supporting more intense grazing. These

exceptions are reasonable. However, determining to where pre-existing grazing activities are displaced may be subject to uncertainty (it may be difficult to monitor in some cases), which could make application of these exceptions somewhat subjective.

The amount of carbon that is emitted from receiving land areas is determined either through direct measurement (assuming project proponents can determine where these areas are located) or through use of IPCC default numbers for average forest carbon stocks in different regions and countries (i.e., using Table 3A.1.4 of the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC 2003)). Again, it is difficult to determine *a priori* whether the approach is conservative. There could easily be uncertainty in trying to determine precisely where agricultural activities are displaced to, and therefore whether a measurement approach is accurate or conservative. When using defaults, however, it is difficult to know without further information whether they would be conservative for a specific project.

Summary and conclusion

The following Table 2 summarizes the assessment. For each of the previously discussed elements it derives the potential impact on removal quantification.

Table 2 Relevant elements of assessment and qualitative ratings

Element	Fraction of projects affected by this element[1]	Average degree of under- or overestimation where element materializes[2]	Variability among projects where element materializes[3]
Elements potentially overestimating emission reductions/removals			
OE1 Lack of required baseline adjustment to reflect any changes in legal requirements,	Medium (depends on project context and length of crediting period)	Unknown (depends on the nature of requirements,	High (could be up to 100%, for example, if afforestation

1 This parameter refers to the likely fraction of individual projects (applying the same methodology) that are affected by this element, considering the potential portfolio of projects. “Low” indicates that the element is estimated to be relevant for less than one third of the projects, “Medium” for one to two thirds of the projects, “High” for more than two third of the projects, and “All” for all of the projects. “Unknown” indicates that no information on the likely fraction of projects affected is available.

2 This parameter refers to the likely average degree / magnitude to which the element contributes to an over- or underestimation of the total emission reductions or removals for those projects for which this element materializes (i.e., the assessment shall not refer to average over- or underestimation resulting from all projects). “Low” indicates an estimated deviation of the calculated emission reductions or removals by less than 10% from the actual (unknown) emission reductions or removals, “Medium” refers to an estimated deviation of 10 to 30%, and high refers to an estimated deviation larger than 30%. “Unknown” indicates that it is likely that the element contributes to an over- or underestimation (e. g. overestimation of emission reductions in case of an omitted project emission source) but that no information is available on the degree / magnitude of over- or underestimation. Where relevant information is available, the degree of over- or underestimation resulting from the element may be expressed through a percentage range.

3 This refers to the variability with respect to the element among those projects for which the element materializes. “Low” means that the variability of the relevant element among the projects is at most ±10% based on a 95% confidence interval. For example, an emission factor may be estimated to vary between values from 18 and 22 among projects, with 20 being the mean value. “Medium” refers to a variability of at most ±30%, and “High” of more than ±30%.

incentives, or common practice		incentives, common practice)	occurs in the baseline but simply at a later date)
OE2 Exclusion of multiple potential fossil and biogenic emission sources associated with site preparation and/or project activities	Low (methodology assumes these are immaterial for all projects; for a small number, however, they could be significant)	Low	Medium
OE3 Application of uncertainty discounts when measuring pre-existing carbon stocks that are removed due to project activities	Low	Low	Low
Elements potentially underestimating emission reductions/removals			
UE1 Application of uncertainty discounts when measuring carbon stocks in project trees and shrubs	Medium (depends on how many projects have 10% or greater sampling error)	Low	High (Depends on measurement precision; where precision is low, the degree of underestimation may be high)
Elements with unknown impact			
U1 Allowing optional (not required) accounting of dead wood, litter, and soil organic carbon	Unknown (The methodology's default assumption is that projects are likely to increase carbon in these pools; the risk, however, is that project owners will only include them if there is an increase, and exclude them in cases where a decrease occurs. The latter would result in overestimation of removals)	Low	Low
U2 Allowed use of default calculations to estimate carbon in litter and dead wood	Unknown (the defaults may be conservative, but they depend on monitoring to ensure no removal of these carbon pools occurs)	Low	Low
U3 Standardized approach to determining soil organic carbon increases	Unknown	Low	Medium
U4 Methods to determine leakage emissions	Unknown	Medium	High

Based on this summary, the quantification methodology is assigned a score of 3 overall. Underestimation of removals may result from the uncertainty discount applied to measurements of carbon stock changes in trees and shrubs, which will be the dominant source of net removals associated with a project. Notably, however, there are several methodology elements that could also result in overestimation of removals. In most cases – but not universally – the magnitude of overestimation is likely to be small. However, baseline and leakage uncertainties may be a more serious concern for some projects.