CDM-SSCWG53-A06

Draft Methodological tool

Tool to calculate values of fraction of non-renewable biomass

Version 01.0 draft

COVER NOTE

1. Procedural background

1. The Executive Board of the clean development mechanism (CDM) (hereinafter referred to as the Board), at its ninetieth meeting, considered the recommendations of the SSC WG in relation to the parameter fraction of non-renewable biomass (fNRB) included in methodologies "AMS-I.E: Switch from non-renewable biomass for thermal applications by the user" and "AMS-II.G: Energy efficiency measures in thermal applications of non-renewable biomass" and agreed that:

   (a) The default country-specific fNRB values already approved by the Board shall expire five years from the date of their approval;

   (b) In cases where Designated National Authorities (DNAs) decide to propose a renewal with an update to the fNRB values, they shall follow the "Procedure: Development, revision, clarification and update of standardized baselines" (standardized baseline procedures), including for the requirement related to the period of validity of the fNRB value;

   (c) The SSC WG should initiate work to propose a revision to the method for the top down development of fNRB values for the consideration by the Board. Where a DNA has made a request for the top down development of fNRB values in accordance with the standardized baseline procedures, the secretariat should, after approval by the Board, initiate the work.

2. This document describes the methods which can be used either i) by proponents or DNAs to submit region/country-specific default fNRB values, following the standardized baseline procedures, or ii) by project proponents to calculate project-specific fNRB values or region/country-specific fNRB values.

2. Purpose

3. The tool aims to provide guidance and a step-wise procedure/method to calculate fNRB values.

3. Key issues and proposed solutions

4. Subsequent to approval of fNRB values by the Board, the SSC WG, at its 51th meeting, noted that new and comprehensive information on region-specific fNRB values based on long-term studies have now become available (http://www.nature.com/nclimate/journal/v5/n3/full/nclimate2491.html). See **Appendix 1** for details. The study conducted an assessment of woodfuel supply and demand, and using 2009 as a base year, quantified the extent to which woodfuel demand exceeds supply. While the study provides global assessment of fNRB values at region/country level, the SSC WG observed that there are limitations such as outdated information on woodfuel consumption and discrepancy from the Board's definition on renewable biomass.

5. The values and methods used in registered CDM PDDs and PoA-DDs/CPA-DDs were also reviewed. While default fNRB values approved by the Board have been used in most cases, other methods to estimate fNRB values have been also used. However, it is noticed that many of the approaches used in registered CDM PDDs and PoA-DDs/CPA-DDs may not follow exactly with the definition of DRB and NRB prescribed in the methodologies (AMS-I.E and AMS-II.G), for example:

   (a) Managed and unmanaged forests are not differentiated. As per the Board definition, the extent of forests should be only the managed forests where carbon stocks do not decrease over time, and where by-products are used or are accessible to attend thermal energy (woodfuel) needs for households.

   (b) Other managed land use categories (e.g. croplands, grasslands) that could also be used for the calculation of DRB are not taken into account.

6. The draft tool is developed with aim to provide more clarity on the requirements and procedures to estimate fNRB values.

4. Impacts

7. The tool to calculate fNRB values will reduce transaction costs and facilitate the implementation of CDM project activities and component project activities (CPAs) introducing renewable energy technologies for end users that displace the use of non-renewable biomass or efficient thermal energy generation units utilizing non-renewable biomass (e.g. cook stoves), which have strong relevance for the least developed countries (LDCs) and other regions that are underrepresented in the CDM.

5. Subsequent work and timelines

8. The SSC WG, at its 53th meeting, agreed on the draft methodological tool. After receiving public inputs on the document, the SSC WG will continue working on the draft tool, at its 54th meeting, for recommendation to the Board at a future meeting of the Board.

6. Recommendations to the Board

Not applicable (call for public input).

TABLE OF CONTENTS **Page**

1. Introduction

1. This tool provides guidance and a step-wise procedure/method to calculate values of the parameter “fraction of non-renewable biomass (fNRB)”.

2. Scope, applicability, and entry into force

2.1. Scope

2. This tool provides guidance and a step-wise procedure/method to calculate values of fNRB.

2.2. Applicability

3. This tool can be used either i) by proponents or DNAs to submit region/country-specific default fNRB values, following the procedures for development, revision, clarification and update of standardized baselines (SB procedures), or ii) by project proponents to calculate project-specific fNRB values or region/country-specific fNRB values.

2.3. Entry into force

4. Immediately upon adoption of the tool at the 94 meeting of the Board (5 May2017).

3. Definitions

5. The definitions contained in the “Glossary of CDM terms” shall apply.

6. For the purpose of this tool, the following definitions apply:

   (a) **Demonstrably renewable woody biomass (DRB)**: Woody biomass is “demonstrably renewable” if either of the conditions (i) and (ii) below is satisfied:

      (i) The woody biomass originates from land areas that are forests where:

         a. The land area remains a forest; and

         b. Sustainable management practices are undertaken on these land areas to ensure, in particular, that the level of carbon stocks[1] on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and

         c. Any national or regional forestry and nature conservation regulations are complied with.

[1] For the purpose of this tool, soil carbon does not need to be taken into account when estimating carbon stocks changes.

(ii) The woody biomass originates from non-forest areas (e.g. croplands, grasslands) where:

a. The land area remains cropland and/or grasslands or is reverted to forest; and

b. Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and

c. Any national or regional forestry, agriculture and nature conservation regulations are complied with.

(b) **Non-renewable woody biomass (NRB):** NRB is the quantity of woody biomass consumption minus the *DRB* component, as long as at least two of the following supporting indicators are shown to exist:

(i) A trend showing an increase in time spent or distance travelled for gathering fuel-wood, by users (or fuel-wood suppliers) or alternatively, a trend showing an increase in the distance the fuel-wood is transported to the project area;

(ii) Survey results, national or local statistics, studies, maps or other sources of information, such as remote-sensing data, that show that carbon stocks are depleting in the project area;

(iii) Increasing trends in fuel-wood prices indicating a scarcity of fuel-wood;

(iv) Trends in the types of cooking fuel collected by users that indicate a scarcity of woody biomass.

4. Methodology procedure

7. Proponents of Standardized Baselines or CDM Project Participants shall determine the shares of renewable and non-renewable woody biomass in the quantity of woody biomass consumption, following the steps described below.

8. The fraction of woody biomass that can be established as non-renewable, is:

$$fNRB = \frac{NRB}{NRB + DRB} \quad \textbf{(1)}$$

Where:

$fNRB$	Fraction of non-renewable biomass (fraction or %)
NRB	Non-renewable biomass (t/yr)
DRB	Demonstrably renewable biomass (t/yr)

9. On a country- or region-specific basis, a default value for fNRB can be derived by calculating total annual harvest or consumption of wood (H) from a country or region and estimating the proportion of H that is DRB and NRB.

$$H = DRB + NRB \quad \textbf{(2)}$$

Where:

H	Total annual harvest or consumption of wood (t/yr)

10. On a project-specific basis, project participants determine the shares of DRB and NRB in the total woody biomass consumption used in the absence of the project activity.

$$B_{old,total} = DRB + NRB \quad \textbf{(3)}$$

Where:

$B_{old,total}$	Total annual harvest or consumption of wood in the project area in the absence of the project activity (t/yr)

4.1. Step 1: Estimate demand for woody biomass consumption (H and $B_{old,total}$)

11. Estimate the overall demand for woody biomass, based on the number of households in the country or region (H) or project area ($B_{old,total}$).

12. H is total annual harvest or consumption of wood, which is calculated in equation 4, accounting for all harvests within the country/region (not only woodfuel but also timber and industrial consumption). Similarly, for project areas, $B_{old,total}$ is estimated in equation 5, based on the overall wood consumption in the area where the project is proposed.

13. The following equation should be used.

$$H = HW \times N + TI \quad \textbf{(4)}$$

$$B_{old,total} = HW \times N + TI \quad \textbf{(5)}$$

Where:

HW	Average household woodfuel consumption, including fuelwood and charcoal (t/yr/household)
TI	Timber and non-domestic wood consumption within the country/region/area that are domestically or locally sourced. This includes the wood consumption extracted from forests or land areas for attending non-domestic uses (e.g. commercial, industrial or institutional uses of wood either as energy sources (ovens, boilers, etc.) or non-energy applications (construction, furniture, etc.) that are extracted from the country/region/project area for which the estimate of fNRB is to be made (t/yr)
N	Number of households potentially consuming woodfuel for thermal applications within the country/region/project area (households)

14. One possible procedure to determine *N* is as follows:

    (a) The number of households potentially consuming woodfuel to attend thermal needs within the country/region/project area (*N*) will be taken as a proportion of the total population or households in the country/region/area, whose income is lower than the critical threshold, according to the following steps:

        (i) Step 1: Make the estimate of overall population of the country/region/area;

        (ii) Step 2: Determine the most preferred fuel or energy source used in the country/region/area for attending thermal needs in households with higher

income levels, among the following options: kerosene, liquefied petroleum gas (LPG), electricity;

(iii) Step 3: Estimate the average cost per capita of the monthly or annual fuel/energy consumption to attend domestic thermal needs within the country using the most preferred energy source of previous step;

(iv) Step 4: Determine the population of the country/region/area (N), whose monthly or annual per capita income is lower than 10 times the cost determined in the previous step.

15. Average household consumption of woody biomass (HW) shall be determined using one of the following options:

(a) Approved standardized baselines valid for the country/region/area; or

(b) Official statistics or public studies/reports with adequate accuracy and based on vintage of data representing the present situation, or able to be extrapolated to estimate the present situation; or

(c) Results of a sampling survey conducted as per the latest version of "sampling and surveys for CDM project activities and programme of activities"; or

(d) Default values adopted within CDM framework valid for the country/region/area.

4.2. Step 2: Estimate DRB

16. Estimate the potential supply of renewable biomass (DRB) in the country/region/area:

(a) Estimates of the Mean Annual Increment of biomass (MAI) of the managed forests in the country/regions, which by-products are available or accessible to attend household's thermal needs;

(b) Estimates of the MAI of trees outside forests in managed lands (e.g. croplands, grasslands, rural and urban areas).

17. For the scope of this tool, a land area is considered to be managed, available or accessible to attend household's thermal needs, and with not decreasing carbon stocks, if the following conditions are attended:

(a) The land area is not defined as environmental protected or nature conservation area, that restricts or impedes the extraction of woody by-products;

(b) The conditions in paragraph 6 (a) (i) for **forest areas** and paragraph 6 (a) (ii) for **non-forest areas (e.g. croplands, grasslands, rural and urban areas)** are fulfilled.

(c) In order to demonstrate fulfilment of conditions in paragraph 6 (a) (i) b and 6 (a) (ii) b with regard to sustainable management practices, official statistics for the changes of forest and non-forest resources may be used. For grasslands, it may be difficult to prove that sustainable management is undertaken, therefore the check may focus on the demonstration of non-decrease of carbon stocks.

(d) Alternatively, if detailed information is not available for the country/region/area, the land areas that have not changed their use or cover sub-category (forest,

agriculture, pasture, urban, etc.) in the last 5 years may be considered as managed and without decreasing carbon stocks, whereas the areas that have changed the use or cover in the last 5 years are considered as non-managed areas.

18. Then, sum up total MAI (t/yr) of forest and non-forest resources that are classified as DRB.

$$DRB = \sum_i MAI_{forest,DRB,i} + \sum_i MAI_{non-forest,DRB,i} \quad \textbf{(6)}$$

Where:

$MAI_{forest,DRB,i}$	Mean Annual Increment of woody biomass growth in sub-category i of forest areas that is concluded as renewable (DRB) (t/yr)
$MAI_{non-forest,DRB,i}$	Mean Annual Increment of woody biomass growth in sub-category i of non-forest areas that is concluded as renewable (DRB) (t/yr)
i	Sub-category i of forest areas and non-forest areas

19. Mean Annual Increment of biomass (MAI) of woody biomass is calculated in equation 7 and 8 as the product of the Extent of Forest (F) or Non-Forest (NF) in hectares and the Growth Rate (GR) of woody biomass respectively:

$$\sum_i MAI_{forest,DRB,i} = \sum_i F_{DRB,i} \times GR_{DRB,i} \quad \textbf{(7)}$$

$$\sum_i MAI_{non-forest,DRB,i} = \sum_i NF_{DRB,i} \times GR_{DRB,i} \quad \textbf{(8)}$$

Where:

$F_{DRB,i}$	Extent of Forest (F) in sub-category i (ha)
$NF_{DRB,i}$	Extent of Non-Forest (NF) in sub-category i (ha)
$GR_{DRB,i}$	Annual Growth rate of woody biomass in sub-category i (t/ha-yr)

Alternative paragraphs to paragraph 18 and 19 above

20. DRB is Mean Annual Increment of biomass (MAI) of wood, which is calculated in equation 9 as the product of the extent of each land cover sub-category (Ei) in hectares, the Growth Rate (GR) of woody biomass in the forest, and the estimated fraction of woody biomass present in the land sub-category "i" as compared to the forest areas (r_i):

$$DRB = \sum_i MAI_{DRB,i} = \sum_i E_i \times r_i \times GR \quad \textbf{(9)}$$

Where:

$MAI_{DRB,i}$	Mean Annual Increment for sub-category i of land areas that were considered as attending the condition of demonstrable renewable (DRB) (t/yr)
i	Sub-category i of forest areas and non-forest areas that were considered as attending the condition of demonstrable renewable (DRB).

Ei	Extension of the area classified as sub-category "i" within the country/region/area (hectares)
r_i	Ratio of estimated density of trees in the sub-category "i" in relation to the density of trees in the forest category for which the parameter GR is estimated. This ratio may be estimated for each sub-category "i" based either in number of trees per hectare or in above ground biomass in trees per hectare (tons/ha) (Fraction).
GR	Annual growth rate of the forest category taken as representative of the natural forests of the country/region/area ($t.ha^{-1}.year^{-1}$)

4.3. Step 3: Assess the evidence of NRB consumption

21. Assess NRB in the country/region/area. Check whether at least two supporting indicators described in paragraph 6 (b) (i) to (iv) are shown to exist.

22. If this is confirmed, total biomass consumption minus the DRB component can be used to determine NRB.

4.4. Step 4: Calculate NRB

23. NRB is calculated as the difference between total biomass consumption (H or $B_{old,total}$) and DRB.

$$NRB = H - DRB \quad \textbf{(10)}$$

or

$$NRB = B_{old,total} - DRB \quad \textbf{(11)}$$

4.5. Step 5: Calculate fNRB

24. Calculate fNRB using the equation (1).

Appendix 1. Method based on woodfuel supply and demand model

1. Method based on woodfuel supply and demand model

1. Subsequent to approval of fNRB values by the Board, the SSC WG, at its 51th meeting, noted that new and comprehensive information on region-specific fNRB values based on long-term studies have now become available (http://www.nature.com/nclimate/journal/v5/n3/full/nclimate2491.html).

2. The study conducted an **assessment of woodfuel supply and demand**, and using 2009 as a base year, **quantified the extent to which woodfuel demand exceeds supply.** In the assessment, the study defines the wood harvested in excess of the incremental growth rate as non-renewable biomass. If an area is harvested for woodfuel below the annual growth rate, then woody biomass stocks are not depleted and harvesting is sustainable. However, if annual harvesting exceeds incremental growth, it is unsustainable, leading to a decline of woody biomass stocks.

3. **Demand features:** Woodfuel demand was derived from national and sub-national studies supplemented by data from the Food and Agriculture Organization (FAO), International Energy Agency (IEA) and United Nations (UN) Statistics Division. Woodfuel demand has subsistence and commercial components.

   (a) **Subsistence demand** occurs primarily in rural areas, where people collect their own fuel using simple non-motorized forms of transportation from within a few hours of their homes.

   (b) **Commercial demand** originates in urban and some densely populated rural locations and is typically supplied by motorized transport over much longer distances.

4. **Supply features:** Woodfuel supply is defined by the productivity of woody biomass. The study used recent maps of land cover and ecological zones to define a broad system of land units, including cropland and crop mosaic (often neglected in assessments of woodfuel supply). Each land unit is assigned an above-ground biomass (AGB) stock, using three types of source: AGB distribution maps; geo-referenced field plots; and forest inventories from known locations for specific forest types. The study subtracted woody components not typically used for woodfuels (twigs, leaves and stumps), to build a map of dendro-energy biomass (DEB) stock. The study then estimated woodfuel supply as the mean annual increment (MAI) of DEB, which is modelled as a functional relationship between approximately 2,800 spatially explicit field observations of MAI and corresponding AGB. The study then **made adjustments for potential supply from plantations and accessibility**. Accessibility has legal and physical determinants. Legal accessibility is based on IUCN (International Union for Conservation of Nature) categorization of “Protected Areas”. Physical accessibility is a function of the effort required to access woody biomass from a consumption site.

5. **Woodfuels and land cover change (LCC) by-products:** LCC (e.g. deforestation and afforestation) impacts woodfuel supplies. Deforestation creates large volumes of non-renewable woodfuel, and afforestation augments renewable woodfuel supplies by adding

to the growing stock of DEB. When deforestation occurs in regions accessible to woodfuel users, the cleared woody biomass may be used as timber and woodfuel. Similarly, afforestation adds DEB equivalent to the MAI of the surrounding land class. However, the degree to which LCC by-products are actually used as woodfuel is unknown. To accommodate this uncertainty, the study assumed two scenarios and estimated NRB respectively.

(a) In **Scenario A**, it is assumed that LCC by-products generated in accessible regions are not used for woodfuel. Woodfuels are harvested entirely from other sources. NRB_A is calculated as the quantity of non-renewable biomass from sources unrelated to LCC. NRB_A is applicable where LCC by-products are inaccessible to smallholders despite being physically proximate. This might be the case if large-scale farming or timber extraction drives LCC on private land that smallholders cannot enter.

(b) In **Scenario B**, LCC by-products generated in accessible regions are used as woodfuel. Three quantities are calculated:

(i) NRB_{B1} refers to the amount of LCC by-products used to meet woodfuel demand in a given region. By-products of deforestation are always considered non-renewable and by-products of afforestation are considered renewable.

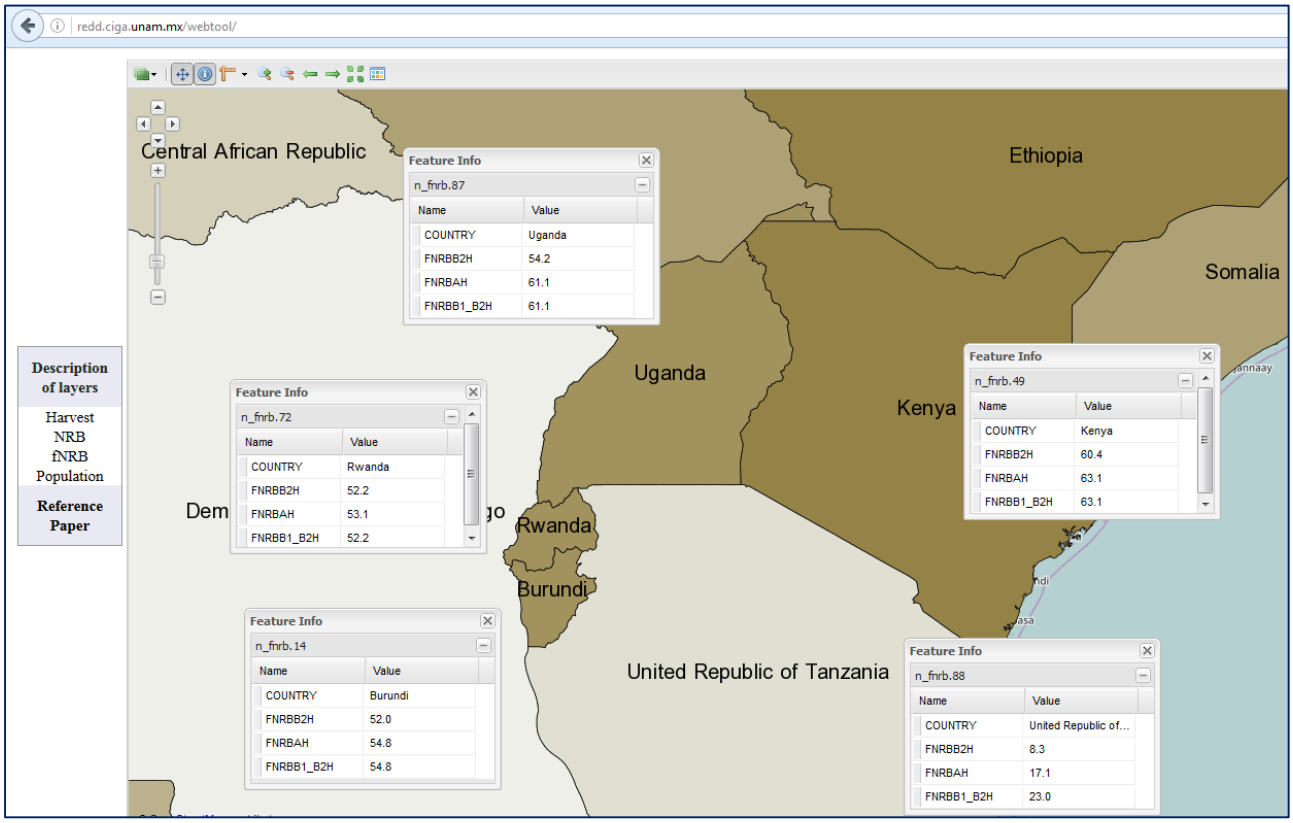
(ii) NRB_{B2} refers to the amount of woodfuel from other sources required to meet demand after LCC by-products are exhausted. LCC by-products may meet 100% of demand so that $NRB_{B2}=0$.

(iii) The sum of NRB_{B1} and NRB_{B2} (NRB_{B1+B2}) indicates the total quantity of unsustainable woodfuel consumption that occurs when woodfuel users have access to LCC by-products. These values are applicable in regions where LCC is driven by smallholder agriculture or regions hosting intense commercial woodfuel extraction. Household energy interventions can mitigate NRB_{B2}, but it is unclear how they would affect NRB_{B1}.

6. The supply/demand balance was mapped at pixel level, and based on assumptions above, range of fNRB values was estimated. The study concluded that global woodfuel demand in 2009 was 1.36 Gt, of which 22-34% was harvested unsustainably (fNRB), depending on the extent to which LCC by-products are utilized.

7. The results are available in Global NRB map (<http://redd.ciga.unam.mx/webtool/>). As an example, the map below shows fNRB values of some East African countries.

Figure 1. fNRB values calculated for East African countries using the method based on woodfuel supply and demand model



Note: In order to view fNRB values for a country or a region, first select "National fNRB" or "Subnational fNRB" from "Layer Switcher" in the menu bar, and then using the "Get Feature Info", click your country or region. Then, it will show the information on three estimates of the fraction of non-renewable biomass consumed (the ratio of NRB and Harvest), i.e. 1) $fNRB_{B2} = NRB_{B2}$ / Harvest; 2) $fNRB_{A} = NRB_{A}$ / Harvest; 3) $fNRB_{B1+B2} = NRB_{B1+B2}$ / Harvest.

2. Limitations of the method based on woodfuel supply and demand model

8. However, some limitations of the method used in this study have been also indicated. For example, one limitation of the study is a lack of reliable woodfuel consumption data. For FAOSTAT, while national fuelwood and charcoal consumption figures are available for all countries, very few data are provided by national agencies. Where national agencies do not submit figures, FAO uses estimates from models based on survey data that were developed in 2001 (Broadhead et al., 2001)[2]. Since development of the models, the magnitude of factors used to extrapolate woodfuel consumption such as income, urban population proportion and forest cover have changed considerably.

- - - - -

[2] Broadhead J.S., Bahdon J., Whiteman, A. (2001) Global Forest Products Outlook Study - Past Trends and Future Prospects for the Utilisation of Wood for Energy. Annex 2. Working Paper No: GFPOS/WP/05. FAO, Rome.

Document information

Version	Date	Description
Draft 01.0	3 April 2017	SSCWG 53, Annex 06 A call for public input will be issued for this draft methodological tool.

Decision Class: Regulatory
Document Type: Tool
Business Function: Methodology
Keywords: biomass, fraction of non-renewable biomass, wood products