Simplified baseline and monitoring methodology for small scale CDM afforestation and reforestation project activities implemented on wetlands

I. Applicability conditions, carbon pools and project emissions

1. The simplified baseline and monitoring methodologies are applicable if all the conditions (a)-(g) mentioned below are met.

(a) Project activities are implemented on wetlands[1];

(b) Project activities are implemented for afforestation or reforestation through assisted natural regeneration or tree planting on degraded[2] wetlands, which may be subject to further degradation and have tree and / or non tree component that is declining or in a low carbon steady-state.

(c) Direct measures/activities undertaken by the project proponents for the establishment of forest on degraded or degrading wetlands shall not lead to any changes in hydrology of land subjected to afforestation or reforestation project activity under the control of the project participants. Some examples of direct activities that are not permitted include drainage, flooding, digging or ditch blocking. Therefore, the A/R project activities are specifically restricted to the following wetland categories :

(i) Degraded intertidal wetlands (e.g. mangroves);

(ii) Undrained peat swamps that are degraded with respect to vegetation cover[3];

(iii) Degraded flood plain areas on inorganic soils and

(iv) Seasonally flooded areas on the margin of water bodies/reservoirs.

(d) This methodology is not applicable to project activities that are implemented on wetlands where the predominant vegetation comprises of herbaceous species in its natural state.

(e) Project activities are implemented on lands where in the pre-project situation, areas used for agricultural activities (other than grazing) within the project boundary are not greater than 10% of the total project area.

(f) Project activities are implemented on lands where displacement of grazing animals does not result in leakage (see Section IV). If the possibility of leakage from displacement of grazing animals is not excluded using approach provided in para 19 below, the methodology is not applicable.

(g) Project activities are implemented on lands where <10% of the total surface project area is disturbed as result of soil preparation for planting. However, in project areas with organic soils, site preparation activities such as ploughing and drainage before or after the trees are planted are not allowed.

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[1] In this methodology, “wetlands” are classified as per the definition of the category “wetlands” provided in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, and Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC 2003), which includes land that is covered or saturated by water for all or part of the year and that does not fall into the forest land, cropland, grassland or settlements categories. Rice cultivation areas are excluded.

[2] Degraded wetlands in this methodology refers to degradation only with respect to vegetation cover. To demonstrate that the applicability condition (b) is obeyed, prove that the A/R project lands are really degraded using appendix A

[3] Methodology is not applicable to managed peatlands as defined in section 7.1 of IPCC, 2006 Guidelines for National Greenhouse Gas Inventories

2. **Carbon pools** to be considered by these methodologies are above- and below-ground biomass (i.e. living biomass) of trees.

3. **Project emissions** attributable to A/R activities implemented on wetlands are assumed to be negligible hence, they are accounted for as zero in this methodology. According to IPCC GPG for LULUCF, GHGs emitted from wetlands may consist of CO_2, CH_4 and N_2O but the applicability conditions of the methodology ensure that hydrology of the project area is not changed as a result of the direct measures/activities undertaken by the project proponents for the establishment of the A/R project activity, therefore the chemical properties of the wetland soils influencing the GHG emissions will not change (Haldon et al., 2004[4]) hence, the above assumption is valid.

4. Before using simplified methodologies, project participants shall demonstrate whether:

(a) The land of the project activity is eligible, using the approach for the demonstration of land eligibility contained in appendix B;

(b) The project activity is additional, using the procedures for the assessment of additionality contained in appendix C.

II. Baseline net greenhouse gas removals by sinks

5. The most likely baseline scenario of the small-scale A/R CDM project activity is considered to be the land-use prior to the implementation of the project activity, that is degraded or degrading wetlands, where, the changes in carbon stocks in the living biomass pools of trees and non tree vegetation under the baseline scenario are expected to be in steady state or declining. Therefore changes in the carbon stocks in the living biomass pool of trees and non tree vegetation shall be assumed to be zero in the absence of the project activity.

III. Actual net greenhouse gas removals by sinks (ex ante)

6. Stratification of the project area should be carried out to improve the accuracy and precision of biomass estimates.

7. For the *ex-ante* calculation of the project biomass, the project area should be stratified according to the project planting plan that is, at least by tree species (or groups of them if several tree species have similar growth habits), and age classes.

8. Actual net GHG removals by sinks consider the changes in above and below ground carbon pools for trees in the project scenario.

9. Changes in above and below ground carbon pools for trees should be calculated as follows

$$\Delta C_{PROJ,t} = \frac{C_t - C_{t-1}}{T} \qquad (1)$$

where:

$\Delta C_{PROJ,t}$ = removal component of actual net GHG removals by sinks at time t; t CO_2-e yr^{-1}

C_t = carbon stocks in the above and below ground carbon pools for trees at time t ; t CO_2-e

T time difference between t and $t-1$; years

[4] Holden, J, Chapman, P.J. and Labadz, J.C. 2004. Artificial drainage of peatlands: Hydrological and hydrochemical process and wetland restoration. Progress in Physical Geography 28: 95–123.

10. Degraded or degrading wetlands may have significant number of trees at the time of start of the project activity. The carbon stocks in the above and below ground carbon pools for trees within the project boundary at the starting date of the project activity[5] ($C_{t=0}$) and for all other years at time t (C_t) shall be calculated as follows:

$$C_t = \sum_{i=1}^{I}((C_{AB,i,t} + C_{BB,i,t}) * A_i * 44/12) \quad (2)$$

where:

C_t = carbon stocks in the above and below ground carbon pools for trees at time t ; t CO_2-e

$C_{AB,\ i,\ t}$ = carbon stocks in above-ground biomass of trees for stratum i, at time t; t C ha^{-1}

$C_{BB\ i,\ t}$ = carbon stocks in below-ground biomass of trees for stratum i, at time t; t C ha^{-1}

A_i = area of stratum i; ha

i = index for stratum (I = total number of strata in project area)

For above-ground biomass

11. $C_{AB,i,t}$ is calculated per stratum i as follows:

$$C_{AB,i,t} = B_{AB,i,t} * 0.5 \quad (3)$$

where:

$C_{AB,i,t}$ = carbon stocks in above-ground biomass of trees for stratum i, at time t; t C ha^{-1}

$B_{AB,i,t}$ = above-ground biomass of trees in stratum i at time t; t dm ha^{-1}

0.5 = carbon fraction of dry matter; t C $(t\ dm)^{-1}$

There are 2 options for estimating aboveground biomass at time t. Option 1 shall be used for estimating above ground biomass ($B_{AB,\ i,t=0}$) and carbon stocks ($C_{t=0}$) in trees at start of the project activity.

Option 1

$$B_{AB,i,t} = \sum_{j=1}^{Sps} B_{AB,ij,t} \quad (4)$$

$$B_{AB,ij,t} = SV_{ij,t} * BEF_{2,j} * D_j \quad (5)$$

where:

$B_{AB,i,t}$ = above-ground biomass of trees in stratum i at time t; t dm ha^{-1}

$SV_{ij,t}$ = stem volume of species j in stratum i at time t; m^3 ha^{-1}

$BEF_{2,j}$ = biomass expansion factor of species or group of species j for conversion from stem volume to

[5] The starting date of the project activity should be the time when the land is prepared for the initiation of the afforestation or reforestation project activity under the CDM. In accordance with paragraph 23 of the modalities and procedures for afforestation and reforestation project activities under the CDM, the crediting period shall begin at the start of the afforestation and reforestation project activity under the CDM (see UNFCCC web site at <http://unfccc.int/resource/docs/cop9/06a02.pdf#page=21>).

total volume; dimensionless

D_j = basic wood density of species or group of species *j;* t d.m. m^{-3}

i = index for stratum

j = index for species (*Sps* = total number of species in stratum)

12. Documented existing local species-specific data from peer-reviewed studies or official reports (such as standard yield tables) for $SV_{ij,t}$ or $SV_{ij,t=0}$ should be used[6] . At time t = 0, $SV_{ij,t=0}$ for tree species or groups of species present at the time of start of the project activity shall be used. In the absence of such values, regional/national species-specific data for $SV_{ij,t}$ or $SV_{ij,t=0}$ shall be obtained (e.g., from regional/national forest inventory, standard yield tables such as standard yield tables). If regional/national values are also not available, species-specific data from neighbouring countries with similar ecological conditions affecting growth of trees may be used. In absence of any of the above, global species-specific data (e.g., from the GPG-LULUCF) may be used.

13. Documented local values for BEF_{2j} should be used. In the absence of such values, national default values should be used. If national values are also not available, the values should be obtained from literature or data shall be obtained from a region that has similar ecological conditions affecting growth of tree species. If no information is available in the literature the project proponents should conduct sampling to generate such value using common standardized method. Sampling can be done in other locations where such ecosystem exists.

14. Documented local values for *Dj* should be used. In the absence of such values, national default values shall be consulted. If national default values are also not available, the values should be obtained from Reyes et al. 1992; Wood Density database http://www.worldagroforestrycentre.org/Sea/Products/AFDbases/WD/Index.htm or from table 3A.1.9 of the IPCC good practice guidance for LULUCF. If no information is available from any of the above sources, the project proponents should conduct sampling to generate such value using common standardized method.

Option 2:

Alternatively local, national, or regional sources on aboveground biomass accumulation through time for the species planted in the project area may exist and that are fit to standard biomass growth equations (biomass in t ha^{-1} versus time). These can be used directly for $B_{AB,i,t}$:

$$B_{AB,i,t} = \sum_{j=1}^{Sps} B_{AB,ij,t} \tag{6}$$

$$B_{AB,ij,t=n} = B_{AB,ij(t=n-1)} + g * \Delta t \tag{7}$$

where:

$B_{AB,i,t}$ = above-ground biomass of trees in stratum *i* at time *t*; t dm ha^{-1}

$B_{AB,ij,t=n}$ = above-ground biomass of trees of species *j* in stratum *i* at time *t*=*n*; t dm ha^{-1}

g = annual increment in biomass; t d.m. ha^{-1} yr^{-1}

Δt = time increment; years

n = running variable that increases by Δt for each iterative step

j = index for species (*Sps* = total number of species in stratum)

[6] Mean annual increments from documented sources may be used in the absence of annual increments.

For below-ground biomass

15. $C_{BB\ i,\ t}$ is calculated per stratum *i* as follows

$$C_{BB,i,t} = \sum_{j=1}^{Sps} C_{BB,ij,t} \tag{8}$$

$$C_{BB,ij,t} = B_{AB,ij,t} * R_j * 0.5 \tag{9}$$

where:

$C_{BB\ i,\ t}$ = carbon stocks in below-ground biomass of trees for stratum *i*, at time *t*; t C ha^{-1}

$C_{BB,ij,t}$ = carbon stocks in below-ground biomass of trees of species *j* in stratum *i*, at time *t*; t C ha^{-1}

$B_{AB,ij,t}$ above-ground biomass of trees of species *j* in stratum *i* at time *t;* t dm ha^{-1}

R_j = root to shoot ratio for species or group of species *j*; dimensionless

0.5 = carbon fraction of dry matter; t C $(t\ dm)^{-1}$

16. Documented local or national values for R_j should be used. If national values are not available, a default value of 0.1 should be used.

17. **Project emissions** are assumed to be negligible hence, they are accounted for as zero in this methodology (refer to para 3). The *ex-ante* actual net greenhouse gas removals by sinks in year *t* are therefore equal to:

$$\Delta C_{ACTUAL,t} = \Delta C_{PROJ,t} \tag{10}$$

where:

$\Delta C_{ACTUAL,t}$ = annual actual net greenhouse gas removals by sinks at time *t*; t CO_2-e yr^{-1}

$\Delta C_{PROJ,t}$ = removal component of actual net GHG removals by sinks at time *t*; t CO_2-e yr^{-1}

IV. Leakage

18. According to decision 6/CMP.1, annex, appendix B, paragraph 9: “If project participants demonstrate that the small-scale afforestation or reforestation project activity under the CDM does not result in the displacement of activities or people, or does not trigger activities outside the project boundary, that would be attributable to the small-scale afforestation or reforestation project activity under the CDM, such that an increase in greenhouse gas emissions by sources occurs, a leakage estimation is not required. In all other cases leakage estimation is required.”

19. Leakage (L_t) can be considered zero if evidence can be provided that

(a) there is no displacement, or the displacement of pre-project grazing or agricultural activities or fuel wood collection will not cause deforestation attributable to the project activity, or

(b) displacement of grazing animals or agricultural activities or fuel wood collection occurs to other degraded non wetlands which contain no significant biomass (i.e. degraded land) and if evidence can be provided that these lands are likely to receive the shifted activities, or

(c) displacement of grazing animals occurs to other areas such as grasslands (non wetlands) and that the total number of animals so displaced is less than 15% of the average grazing capacity of such area.

Such evidence in (a), (b) can be provided by scientific literature or by experts' judgment and in (c) through sound estimation[7].

20. If the possibility of leakage from displacement of grazing animals is not excluded using approach provided in para 19 above, the methodology is not applicable.

21. In cases, where the possibility of leakage from displacement of agricultural activities other than from grazing is not excluded as provided in para 19 above, project participants should assess the possibility of leakage by considering the area used for agricultural activities within the project boundary displaced due to the project activity.

22. If the area under agricultural activities within the project boundary displaced due to the project activity is lower than 10 per cent of the total project area then for the ex-ante calculation it is assumed that entire leakage shall be equal to 20 per cent of the ex-ante actual net GHG removals by sinks accumulated during the first crediting period, that is the average annual leakage is equal to:

$$L_{t\_A} = \Delta C_{ACTUAL,t} * 0.20 \qquad (11)$$

where:

L_{t_A}	=	annual leakage due to displacement of agricultural activity attributable to the project activity at time *t;* t CO_2-e yr^{-1}
$\Delta C_{ACTUAL,t}$	=	annual actual net greenhouse gas removals by sinks at time *t*; t CO_2-e yr^{-1}

23. If the area under agricultural activities within the project boundary displaced due to the project activity is greater than 10 per cent of the total project area then this methodology is not applicable.

24. In cases where the possibility of leakage displacement due to fuel wood collection is not excluded as in para 19 above, leakage shall be equal to 5 per cent of the ex-ante actual net GHG removals by sinks accumulated during the first crediting period. The 5% value is estimated based on potential fuel wood collection possible from a degraded wetland ecosystem that represents the maximal biomass of fuel wood that is likely to be displaced elsewhere. The average annual leakage is equal to:

$$L_{t\_FW} = \Delta C_{ACTUAL,t} * 0.05 \qquad (12)$$

where:

L_{t_FW}	=	annual leakage due to displacement of fuel wood collection attributable to the project activity at time *t;* t CO_2-e yr^{-1}
$\Delta C_{ACTUAL,t}$	=	annual actual net greenhouse gas removals by sinks at time *t*; t CO_2-e yr^{-1}

25. Total leakage is calculated as the sum of leakage due to displacement of agricultural activities and displacement of fuel wood collection is estimated as :

$$L_t = L_{t\_A} + L_{t\_FW} \qquad (13)$$

where*:*

[7] See appendix E

L_t		Total leakage attributable to the project activity at time *t;* t CO_2-e yr^{-1}
L_{t_A}	=	Annual leakage due to displacement of agricultural activity attributable to the project activity at time *t;* t CO_2-e yr^{-1}
L_{t_FW}	=	annual leakage due to displacement of fuel wood collection attributable to the project activity at time *t;* t CO_2-e yr^{-1}

V. Net anthropogenic greenhouse gas removals by sinks

26. The net anthropogenic GHG removals by sinks for each year during the first crediting period are calculated as,

$$ER_{AR\ CDM,\ t} = \Delta C_{ACTUAL,\ t} - L_t \qquad (14)$$

where:

$ER_{AR\ CDM,t}$	=	annual net anthropogenic GHG removals by sinks at time *t* ; t CO_2-e yr^{-1}
$\Delta C_{ACTUAL,\ t}$	=	actual net greenhouse gas removals by sinks at time *t*; t CO_2-e yr^{-1}
L_t	=	total leakage attributable to the project activity at time *t;* t CO_2-e yr^{-1}

For subsequent crediting periods L_t=0.

27. The resulting temporary certified emission reductions (tCERs) at the year of assumed verification t_v are calculated as follows:

$$tCER_{(tv)} = \sum_{t=0}^{tv} ER_{AR-CDM,t} \qquad (15)$$

where:

$tCER_{tv}$	=	Temporary certified emission reductions (tCERs) at the time of assumed verification t_v; t CO_2-e
$ER_{AR\ CDM,t}$	=	annual net anthropogenic GHG removals by sinks at time *t* ; t CO_2-e yr^{-1}
t_v	=	assumed year of verification (year)

28. The resulting long-term certified emission reductions (lCERs) at the year of assumed verification t_v are calculated as follows:

$$lCER_{(tv)} = \sum_{t=0}^{tv} ER_{AR\ CDM,t} - lCER_{(t-k)} \qquad (16)$$

where:

$lCER_{tv}$	=	long-term certified emission reductions (lCERs) at the time of verification *tv*
$ER_{AR\ CDM,\ t}$	=	Annual net anthropogenic GHG removals by sinks in year t; t CO_2-e yr^{-1}
k	=	time span between two verifications (year)
t_v	=	year of assumed verification (year)

VI. Simplified monitoring methodology for small-scale afforestation and reforestation projects under the clean development mechanism

A. Ex post estimation of the baseline net greenhouse gas removals by sinks

29. The baseline net GHG removals by sinks is estimated at zero in this methodology. Therefore monitoring of the baseline is not required. .

B. Ex post estimation of the actual net greenhouse gas removals by sinks

30. Stratification of the project area should be carried out to improve the accuracy and precision of biomass estimates.

31. For *ex post* estimation of project GHG removals by sinks, strata shall be defined by:

(i) Relevant guidance on stratification for A/R project activities under the clean development mechanism as approved by the Executive Board (if available); or

(ii) Stratification approach that can be shown in the PDD to estimate biomass stocks for the species or groups of species according to good forest inventory practice in the host country in accordance with DNA indications; or

(iii) Other stratification approach that can be shown in the PDD to estimate the project biomass stocks to targeted precision level of ±10% of the mean at a 95% confidence level.

32. The carbon stocks in above-ground biomass of trees within the project boundary at the starting date of the project activity ($C_{t=0}$) and for all other years at time t (C_t) shall be shall be estimated through the following equations:

$$C_t = \sum_{i=1}^{I} (C_{AB,i,t} + C_{BB,i,t}) * A_i * 44/12 \qquad (17)$$

where:

C_t = carbon stocks in the above and below ground carbon pools for trees at time t; t CO_2-e

$C_{AB,\ i,\ t}$ = carbon stocks in above-ground biomass of trees for stratum i, at time t; t C ha^{-1}

$C_{BB\ i,\ t}$ = carbon stocks in below-ground biomass of trees for stratum i, at time t; t C ha^{-1}

A_i = area of stratum i; ha

For above-ground biomass

33. For above-ground biomass $C_{AB,i,t}$ is calculated per stratum i as follows:

$$C_{AB,i,t} = B_{AB,i,t} * 0.5 \qquad (18)$$

where:

$C_{AB,i,t}$ = carbon stocks in above-ground biomass of trees for stratum i, at time t; t C ha^{-1}

$B_{AB,i,t}$ = above-ground biomass of trees in stratum i at the time t; t dm ha^{-1}

0.5 = carbon fraction of dry matter; t C $(t\ dm)^{-1}$

34. Estimate of above-ground biomass of trees at the start of the project activity $B_{AB,i,t=0}$ and at time t achieved by the project activity $B_{AB,i,t}$ shall be estimated through the following steps:

(a) **Step 1:** Establish permanent plots and document their location in the first monitoring report;

(b) **Step 2:** Measure the diameter at breast height (*DBH*) and tree height, as appropriate and document it in the monitoring reports;

(c) **Step 3:** Estimate the above-ground biomass for each stratum using allometric equations developed locally or nationally. If these allometric equations are not available:

(i) Option 1: Use allometric equations included in **appendix D** to this report or in annex 4A.2 of the IPCC good practice guidance for LULUCF;

(ii) Option 2: Use biomass expansion factors and stem volume as follows:

$$B_{AB,ij,t} = SV_{ij,t} * BEF_{2,j} * D_j \quad (19)$$

where:

$B_{AB,ij,t}$ = above-ground biomass of trees of species j in stratum i at time t; t dm ha^{-1}

$SV_{ij,t}$ = stem volume of species j in stratum i at time t; m^3 ha^{-1}

D_j = basic wood density for species or groups of species j ; t d.m. m^{-3})

$BEF_{2,j}$ = biomass expansion factor (over bark) from stem to total aboveground biomass for species or group of species j ; dimensionless

35. Stem volume $SV_{ij,t}$ shall be estimated from the on-site measurements of diameter at breast height and tree height performed in step 2 above. Consistent application of $BEF_{2,j}$ should be secured on the definition of stem volume (e.g. total stem volume or thick wood stem volume requires different *BEF*s).

36. Documented local values for D_j should be used. In the absence of such values, national default values shall be consulted. If national default values are also not available, the values should be obtained from Reyes et al. 1992; Wood Density database http://www.worldagroforestrycentre.org/Sea/Products/AFDbases/WD/Index.htm or from table 3A.1.9 of the IPCC good practice guidance for LULUCF. If no information is available from any of the above sources, the project proponents should conduct sampling to generate such value using common standardized method.

37. The same values for $BEF_{2,j}$ and D_j should be used in the *ex-post* and in the *ex-ante* calculations.

38. The above-ground biomass of trees in the stratum shall be estimated as follows:

$$B_{AB,i,t} = \sum_{j=1}^{Sps} B_{AB,ij,t} \quad (20)$$

where:

$B_{AB,i,t}$ = above-ground biomass of trees in stratum i at time t; t dm ha^{-1}

$B_{AB,ij,t}$ = above-ground biomass of trees of species j in stratum i at time t; t dm ha^{-1}

j = index for species (Sps = total number of species in stratum)

Below-ground biomass

39. Carbon stocks in below-ground biomass at time *t* achieved by the project activity during the monitoring interval $C_{BB\,i,\,t}$ shall be estimated for each stratum *i* as follows:

$$C_{BB,i,t} = \sum_{j=1}^{Sps} C_{BB,ij,t} \qquad (21)$$

$$C_{BB,ij,t} = B_{AB,ij,t} * R_j * 0.5 \qquad (22)$$

where:

$C_{BB\,i,\,t}$ = carbon stocks in below-ground biomass of trees for stratum *i*, at time *t*; t C ha^{-1}

$C_{BB\,ij,\,t}$ = carbon stocks in below-ground biomass of trees of species *j* for stratum *i*, at time *t*; t C ha^{-1}

$B_{AB,ij,t}$ = above-ground biomass of trees of species *j* in stratum *i* at time *t*; t dm ha^{-1}

R_j = root to shoot ratio for species or groups of species *j*; dimensionless

0.5 = carbon fraction of dry matter; t C $(t\ dm)^{-1}$

40. Documented local or national values for R_j should be used. If national values are not available, the default value of 0.1 should be used.

C. Ex post estimation of leakage

41. As indicated in paragraph 19, if it is demonstrated that there is no leakage due to displacement of grazing activities or agricultural activities or fuel wood collection then:

$$L_{tv} = 0 \qquad (23)$$

where:

L_{tv} = total leakage at the time of verification; t CO_2-e

42. In order to estimate leakage due to displacement of agricultural activities, during the first crediting period project participants shall monitor the area used for agricultural activities within the project boundary displaced due to the project activity.

43. If the project participants cannot demonstrate that the displacement of agricultural activities and fuel wood collection does not result in leakage (as provided in para 19) then leakage shall be determined at the time of verification using the following equations:

For the first verification period of the first crediting period:

(a) *Leakage due to displacement of agricultural activity* (L_{tv_A}) equals to:

$$L_{tv\_A} = 0.20 * (C_{tv} - C_{t=0}) \qquad (24)$$

(b) *Leakage due to displacement of fuel wood collection* (L_{tv_FW}) equals to:

$$L_{tv\_FW} = 0.05 * (C_{tv} - C_{t=0}) \qquad (25)$$

(c) Total Leakage (L_{tv}) equals to:

$$L_{tv} = L_{tv\_A} + L_{tv\_FW} \qquad (26)$$

For subsequent verification periods of the first crediting period:

(a) *Leakage due to displacement of agricultural activity (L_{tv_A})* equals to:

$$L_{tv\_A} = 0.20 * (C_{tv} - C_{tv\text{-}k}) \quad (27)$$

(b) *Leakage due to displacement of fuel wood collection (L_{tv_FW})* equals to:

$$L_{tv\_FW} = 0.05 * (C_{tv} - C_{tv\text{-}k}) \quad (28)$$

(c) *Total leakage (L_{tv}) equals to:*

$$L_{tv} = L_{tv\_A} + L_{tv\_FW} \quad (29)$$

where:

L_{tv_A}	=	Leakage due to displacement of agricultural activities at time of verification; t CO_2-e
L_{tv_FW}	=	Leakage due to displacement of fuel wood collection at time of verification; t CO_2-e
L_{tv}	=	Total leakage at the time of verification; t CO_2-e
C_{tv}	=	carbon stocks in the above and below ground carbon pools for trees at time of verification ; t CO_2-e
$C_{(t=0)}$	=	carbon stocks in the above and below ground carbon pools for trees at time t= 0 (calculated as in paragraph 32); t CO2-e
tv	=	time of verification
κ	=	time span between two verifications; year

At the end of the first crediting period the total leakage equals to:

$$L_{CP1} = 0.20 * (C_{tc} - C_{t=0}) + 0.05 * (C_{tc} - C_{t=0}) \quad (30)$$

where:

L_{CP1}	=	total leakage at the end of the first crediting period; t CO_2-e
C_{tc}	=	carbon stocks in the above and below ground carbon pools for trees at the end of crediting period; t CO_2-e
$C_{t=0}$	=	carbon stocks in the above and below ground carbon pools for trees at time *t=0* ; t CO_2-e
tc	=	duration of the crediting period

D. *Ex-post* estimation of the net anthropogenic GHG removals by sinks

44. Net anthropogenic greenhouse gas removals by sinks is the actual net greenhouse gas removals by sinks minus the baseline net greenhouse gas removals by sinks minus leakage as appropriate.

45. The resulting tCERs at the year of verification *tv* are calculated as follows

For the first crediting period:

$$tCER_{(tv)} = C_{tv} - L_{tv} \quad (31)$$

For subsequent crediting periods:

$$tCER_{(tv)} = C_{tv} - L_{CP1} \quad (32)$$

where:

C_{tv} = carbon stocks in the above and below ground carbon pools for trees at time of verification ; t CO_2-e

L_{tv} = total leakage at the time of verification; t CO_2-e

L_{CP1} = total leakage at the end of the first crediting period; t CO_2-e

tv = year of verification

46. The resulting lCERs at the year of verification *tv* are calculated as follows:

For the first crediting period:

$$lCER_{(tv)} = C_{tv} - L_{tv} - lCER_{(tv-k)} \quad (33)$$

For subsequent crediting periods:

$$lCER_{(tv)} = C_{tv} - L_{CP1} - lCER_{(tv-k)} \quad (34)$$

where:

C_{tv} = carbon stocks in the above and below ground carbon pools for trees at time of verification ; t CO_2-e

L_{tv} = total leakage at the time of verification; t CO_2-e

L_{CP1} = total leakage at the end of the first crediting period; t CO_2-e

$lCER_{(tv-k)}$ = units of *lCER*s issued following the previous verification

tv = time of verification

κ = time span between two verifications (year)

E. Monitoring frequency

47. Monitoring frequency for each variable is defined in the Tables 1 and 2.

Table 1. Data to be collected or used to monitor the verifiable changes in carbon stock in the carbon pools within the project boundary from the proposed afforestation and reforestation project activity under the clean development mechanism, and how these data will be archived.

Data variable	Source	Data unit	Measured, calculated or estimated	Frequency (years)	Propor-tion	Archiving	Comment
Location of the areas where the project activity has been implemented	Field survey or cadastral informati on or aerial photograp	Latitude and longitude	Measured	5	100 per cent	Electronic, paper, photos	GPS can be used for field survey

Data variable	Source	Data unit	Measured, calculated or estimated	Frequency (years)	Propor-tion	Archiving	Comment
	hs or satellite imagery						
A_i - Size of the areas where the project activity has been implemented for each type of strata	Field survey or cadastral informatio n or aerial photograp hs or satellite imagery or GPS	ha	Measured	5	100 per cent	Electronic, paper, photos	GPS can be used for field survey
Location of the permanent sample plots	Project maps and project design	Latitude and longitude	Defined	5	100 per cent	Electronic, paper	Plot location is registered with a GPS and marked on the map
Diameter of tree at breast height (1.30 m)	Permanent plot	cm	Measured	5	Each tree in the sample plot	Electronic, paper	Measure diameter at breast height (DBH) for each tree that falls within the sample plot and applies to size limits
Height of tree	Permanent plot	m	Measured	5	Each tree in the sample plot	Electronic, paper	Measure height (H) for each tree that falls within the sample plot and applies to size limits
Basic wood density	Permanent plots, literature	Tonnes of dry matter per m^3 fresh volume	Estimated	Once		Electronic, paper	
Total CO_2-e	Project activity	Tons	Calculated	5	All project data	Electronic	Based on data collected from all plots and carbon pools

Table 2. Data to be collected or used in order to monitor leakage and how these data will be archived.

Data variable	Source	Data unit	Measured, calculated or estimated	Frequency (years)	Proportion	Archiving	Comment
Area used for agricultural activities within the project boundary displaced due to the project activity	Survey	Hectares or other area units	Measured or estimated	One time after project is established but before the first verification	30%	Electronic	

Table 3. Abbreviations and parameters (in order of appearance)

Parameter or abbreviation	Refers to	Units
$\Delta C_{PROJ,t}$	Removal component of actual net GHG removals by sinks at time *t*	t CO_2-e yr^{-1}
C_t	Carbon stocks in the above and below ground carbon pools for trees at time *t*	t C
T	Time difference between *t* and *t-1*	years
$C_{t=0}$	Carbon stocks in the above and below ground carbon pools for trees at time of start of the project activity	t C
$C_{AB,\ i,\ t}$	Carbon stocks in above-ground biomass of trees for stratum *i* at time *t*	t C ha^{-1}
$C_{BB\ i,\ t}$	Carbon stocks in below-ground biomass of trees for stratum *i*, at time *t*	t C ha^{-1}
A_i	Area of stratum *i*	ha
i	Index for stratum (I=total number of strata in project area)	
$B_{AB,i,t}$	Above-ground biomass of trees in stratum *i* at time *t*	t dm ha^{-1}
$B_{AB,ij,t}$	Above-ground biomass of trees of species *j* in stratum *i* at time *t*	t dm ha^{-1}
$B_{ABj,t=0}$	Above-ground biomass of trees of species *j* at time *t*=0	t dm ha^{-1}
$SV_{ij,t}$	Stem volume of species *j* in stratum *i* at time *t*	m^3 ha^{-1}
$SV_{j,t=0}$	Stem volume of species *j* at time *t*=0	m^3 ha^{-1}
$BEF_{2,j}$	Biomass expansion factor (over bark) from stem to total aboveground biomass for species or group of species *j*	dimensionless
D_j	Basic wood density for species or group of species *j*	t d.m. m^{-3}
j	Index for species (Sps= total number of species in stratum)	
g	Annual increment in biomass	t d.m. ha^{-1} $year^{-1}$

Parameter or abbreviation	**Refers to**	**Units**
Δt	Time increment = 1 (year)	
n	Running variable that increases by Δt for each iterative step	
$C_{BB,ij,t}$	Carbon stocks in below-ground biomass of trees of species *j* in stratum *i*, at time *t*	t C ha^{-1}
$B_{BBj,t=0}$	Below-ground biomass of trees of species *j* at time *t*=0	t dm ha^{-1}
R_j	Root to shoot ratio for species or groups of species *j*;	dimensionless
$\Delta\ C_{ACTUAL,t}$	Annual actual net greenhouse gas removals by sinks at time *t*	t CO_2-e yr^{-1}
L_{t_A}	Annual leakage due to displacement of agricultural activity attributable to the project activity at time *t;*	t CO_2-e yr^{-1}
L_{t_FW}	Annual leakage due to displacement of fuel wood collection attributable to the project activity at time *t;*	t CO_2-e yr^{-1}
L_t	Annual leakage attributable to the project activity at time *t*	t CO_2-e yr^{-1}
$ER_{AR\ CDM,t}$	Annual net anthropogenic GHG removals by sinks at time *t*	t CO_2-e yr^{-1}
$tCER_{tv}$	Temporary certified emission reductions (tCERs) at the time of assumed verification t_v	t CO_2-e
t_v	Assumed year time of verification	
$lCER_{tv}$	Long-term certified emission reductions (lCERs) at the time of verification *tv*	t CO_2-e
κ	Time span between two verifications	year
tc	Duration of the crediting period	years
L_{tv}	Total leakage at the time of verification	t CO_2-e
L_{tv_A}	Leakage due to displacement of agricultural activities at time of verification	t CO_2-e
L_{tv_FW}	Leakage due to displacement of fuel wood collection at time of verification	t CO_2-e
$C_{\ tv}$	Carbon stocks in the above and below ground carbon pools for trees at time of verification	t CO_2-e
C_{tc}	Carbon stocks in the above and below ground carbon pools for trees at the end of crediting period	t CO_2-e
L_{CPI}	Total leakage at the end of the first crediting period	t CO_2-e
tv	Time of verification	

Appendix A

Procedure for demonstration of wetlands that are degraded and degrading with respect to vegetation cover

Analyze the historical and existing land use/cover changes in the context of climate and socio-economic conditions for the project area and/or surrounding similar wetlands, and identify key factors that influence vegetation degradation over time. In this procedure project participants may use multiple sources of data including archived information, maps, or remote sensing data of land use/cover to demonstrate the changing status of vegetation occurring over a reasonable period of time since 31 December 1989 as selected by the project participants and before the start of the proposed A/R project activity. Supplementary field investigation, land-owner and public interviews, as well as collection of data from other sources may also be used, to demonstrate that the project area is degraded with respect to vegetation cover and is likely to continue to degrade in absence of the project activity.

A degraded or degrading state is confirmed if there is evidence that one or more of the following conditions are commonly present within the proposed project boundary and are likely to continue to occur in absence of the project activity:

1. Vegetation degradation:
    - For degraded condition show that, for example: The cover and/or health of vegetation as determined by visual assessment or similar indicator-based approach has decreased by at least 25% below that of similar undisturbed wetlands with similar ecological conditions.
    - For degrading condition show that, for example: The cover and/or health of vegetation as determined by visual assessment or similar indicator-based approach has decreased by at least 25% occurring over a reasonable period of time since 31 December 1989 as selected by the project participants and before the start of the proposed A/R project activity.
2. Anthropogenic influences leading to degradation, for example:
    - There is a documented history of on-going loss of vegetation cover due to anthropogenic influences; or
    - Evidence can be provided that anthropogenic actions, which are likely to continue in the absence of the small scale A/R project activity, can be documented as the cause of on-going loss of vegetation cover on similar lands elsewhere.
3. Provision of any other evidence that transparently demonstrates project lands are degraded or degrading.

Appendix B

Demonstration of land eligibility

1. Eligibility of the A/R CDM project activities under Article 12 of the Kyoto Protocol shall be demonstrated based on definitions provided in paragraph 1 of the annex to the Decision 16/CMP.1 ("Land use, land-use change and forestry"), as requested by Decision 5/CMP.1 ("Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol"), until new procedures to demonstrate the eligibility of lands for afforestation and reforestation project activities under the clean development mechanism are recommended by the EB.

Appendix C

Assessment of additionality

1. Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

2. **Investment barriers, other than economic/financial barriers**, inter alia:

(a) Debt funding not available for this type of project activity;

(b) No access to international capital markets due to real or perceived risks associated with domestic or foreign direct investment in the country where the project activity is to be implemented;

(c) Lack of access to credit.

3. **Institutional barriers**, inter alia:

(a) Risk relating to changes in government policies or laws;

(b) Lack of enforcement of legislation relating to forest or land-use.

4. **Technological barriers**, inter alia:

(a) Lack of access to planting materials;

(b) Lack of infrastructure for implementation of the technology.

5. **Barriers relating to local tradition**, inter alia:

(a) Traditional knowledge or lack thereof, of laws and customs, market conditions, practices;

(b) Traditional equipment and technology;

6. **Barriers due to prevailing practice**, inter alia:

(a) The project activity is the "first of its kind". No project activity of this type is currently operational in the host country or region.

7. **Barriers due to local ecological conditions**, inter alia:

(a) Degraded soil (e.g. water/wind erosion, salination);

(b) Catastrophic natural and/or human-induced events (e.g. land slides, fire);

(c) Unfavourable meteorological conditions (e.g. early/late frost, drought);

(d) Pervasive opportunistic species preventing regeneration of trees (e.g. grasses, weeds);

(e) Unfavourable course of ecological succession;

(f) Biotic pressure in terms of grazing, fodder collection, etc.

8. **Barriers due to social conditions**, inter alia:

(a) Demographic pressure on the land (e.g. increased demand on land due to population growth);

(b) Social conflict among interest groups in the region where the project activity takes place;

(c) Widespread illegal practices (e.g. illegal grazing, non-timber product extraction and tree felling);

(d) Lack of skilled and/or properly trained labour force;

(e) Lack of organization of local communities.

Appendix D

Default allometric equations for estimating above-ground biomass

Annual rainfall	DBH limits	Equation	R^2	Author
Broad-leaved species, tropical dry regions				
<1500 mm		Use the biomass expansion approach with volume estimates (see Option 2 in section IV)		
Broad-leaved species, tropical humid regions				
< 1500 mm	5–40 cm	$AGB = 34.4703 – 8.0671*DBH + 0.6589*(DBH^2)$	0.67	Brown et al. (1989)
1500–4000 mm	< 60 cm	$AGB = \exp\{-2.134 + 2.530 * \ln(DBH)\}$	0.97	Brown (1997)
1500–4000 mm	60–148 cm	$AGB = 42.69 – 12.800*(DBH) + 1.242*(DBH)^2$	0.84	Brown et al. (1989)
1500–4000 mm	5–130 cm	$AGB = \exp\{-3.1141 + 0.9719*\ln(DBH^2*H)$	0.97	Brown et al. (1989)
1500–4000 mm	5–130 cm	$AGB = \exp\{-2.4090 + 0.9522*\ln(DBH^2*H*WD)\}$	0.99	Brown et al. (1989)
Broad-leaved species, tropical wet regions				
> 4000 mm	4–112 cm	$AGB = 21.297 – 6.953*(DBH) + 0.740*(DBH^2)$	0.92	Brown (1997)
> 4000 mm	4–112 cm	$AGB = \exp\{-3.3012 + 0.9439*\ln(DBH^2*H)\}$	0.90	Brown et al. (1989)
Coniferous trees				
<u>Taxodium distichum</u>		$AGB = -1.398 + 2.731 \log(DBH)$	0.99	Brown (1978)
Palms				
n.d.	> 7.5 cm	$AGB = 10.0 + 6.4 * H$	0.96	Brown (1997)
n.d.	> 7.5 cm	$AGB = 4.5 + 7.7 * WD*H$	0.90	Brown (1997)
Mangrove (General equations)				
Mangrove	5-42 cm	$\ln(ABG) = -1.265 + 2.009 \ln(DBH) + 1.7 \ln(WD)$, or $\ln(ABG) = -1.786 + 2.471 \ln(DBH) + \ln(WD)$	0.99	Chave et al. (2005)
Mangrove (Specific equations: Location at 25° N in South Florida)				
Avicennia germinans (L.): black mangrove	0.7-21.5 cm	$\log_{10} AGB = 1.934 \log_{10} (DBH) – 0.395$	0.95	Smith and Whelan (2006)
Languncularia racemosa (L.): white mangrove	0.5-18.0 cm	$\log_{10} AGB = 1.930 \log_{10} (DBH) – 0.441$	0.98	Smith and Whelan (2006)
Rhizophora mangle (L.): red mangrove	0.5-20.0 cm	$\log_{10} AGB = 1.731 \log_{10} (DBH) – 0.112$	0.94	Smith and Whelan (2006)

Annual rainfall	DBH limits	Equation	R^2	Author
Mangrove (Location in Mexico)				
Avicennia germinans (L.): black mangrove	1-10 cm	Log_{10} AGB = 2.507 log_{10} (DBH) – 1.561		Day et al (1987)
Languncularia racemosa (L.): white mangrove	1-10 cm	Log_{10} AGB = 2.192 log_{10} (DBH) – 0.592		Day et al (1987)
Rhizophora mangle (L.): red mangrove	1-10 cm	Log_{10} AGB = 2.302 log_{10} (DBH) – 1.580		Day et al (1987)
Mangrove (Location in Indo-West Pacific; Tropical wet region)				
Rhizophora apiculata	5-31 cm	Log_{10} AGB = 2.516 log_{10} (DBH) – 0.767		Putz and Chan (1986)
Rhizophora spp	3-25 cm	Log_{10} AGB = 2.685 log_{10} (DBH) – 0.979		Clough and Scott (1989)

Note: AGB = above-ground biomass; DBH = diameter at breast height; H = height; WD = basic wood density

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Appendix E

Calculating average grazing capacity

A. Concept

1. Sustainable grazing capacity is calculated by assuming that the grazing animals should not consume more biomass than is annually produced by the site

B. Methodology

2. The sustainable grazing capacity is calculated using the following equation:

$$GC = \frac{ANPP * 1000}{365 * DMI} \quad (1)$$

where:

GC = Grazing capacity (head/ha)

ANPP = Above-ground net primary productivity in tonnes dry biomass (t d.m.)/ha/yr)

DMI = Daily dry matter intake per grazing animal (kg d.m./head/day)

3. Annual net primary production *ANPP* can be calculated from local measurements or default values from Table 3.4.2 of IPCC good practice guidance LULUCF can be used. This table is reproduced below as Table 1.

4. The daily biomass consumption can be calculate from local measurements or estimated based on the calculated daily gross energy intake and the estimated dietary net energy concentration of diet:

$$DMI = \frac{GE}{NE_{ma}} \quad (2)$$

where:

DMI = Dry matter intake (kg d.m./head/day)

GE = Daily gross energy intake (MJ/head/day)

NE_{ma} = Dietary net energy concentration of diet (MJ/kg d.m.)

5. Daily gross energy intake for cattle and sheep can be calculated using equations 10.3 through 10.16 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and Other Land Use (AFOLU)[8]. Sample calculations for typical herds in various regions of the world are provided in Table 2; input data stems from Table 10A.2 of the same 2006 IPCC Guidelines. Dietary net energy concentrations as listed in Table 3 can be calculated using the formula listed in a footnote to Table 10.8 of the same 2006 IPCC Guidelines.

[8] Paustian, K., Ravindranath, N.H., and van Amstel, A., 2007. *2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and Other Land Use (AFOLU)*. Intergovernmental Panel on Climate Change (IPCC)

Table 1: Table 3.4.2 from GPG LULUCF

TABLE 3.4.2
DEFAULT ESTIMATES FOR STANDING BIOMASS GRASSLAND (AS DRY MATTER) AND ABOVEGROUND NET PRIMARY PRODUCTION, CLASSIFIED BY IPCC CLIMATE ZONES.

IPCC Climate Zone	**Peak above- ground live biomass Tonnes d.m. ha^{-1}**			**Above-ground net primary production (ANPP) Tonnes d.m. ha^{-1}**		
	Average	**No. of studies**	**Error[#]**	**Average**	**No. of studies**	**Error[1]**
Boreal-Dry & Wet[2]	1.7	3	±75%	1.8	5	±75%
Cold Temperate-Dry	1.7	10	±75%	2.2	18	±75%
Cold Temperate-Wet	2.4	6	±75%	5.6	17	±75%
Warm Temperate-Dry	1.6	8	±75%	2.4	21	±75%
Warm Temperate-Wet	2.7	5	±75%	5.8	13	±75%
Tropical-Dry	2.3	3	±75%	3.8	13	±75%
Tropical-Moist & Wet	6.2	4	±75%	8.2	10	±75%

Data for standing live biomass are compiled from multi-year averages reported at grassland sites registered in the ORNL DAAC NPP database [http://www.daac.ornl.gov/NPP/html_docs/npp_site.html]. Estimates for above-ground primary production are from: Olson, R. J.J.M.O. Scurlock, S.D. Prince, D.L. Zheng, and K.R. Johnson (eds.). 2001. NPP Multi-Biome: NPP and Driver Data for Ecosystem Model-Data Intercomparison. Sources available on-line at [http://www.daac.ornl.gov/NPP/html_docs/EMDI_des.html].

[1]Represents a nominal estimate of error, equivalent to two times standard deviation, as a percentage of the mean.

[2]Due to limited data, dry and moist zones for the boreal temperate regime and moist and wet zones for the tropical temperature regime were combined.

Table 2: Data for typical cattle herds for the calculation of daily gross energy requirement

Cattle - Africa

	Weight (kg)	Weight Gain (kg/day)	Milk (kg/day)	Work (hrs/day)	Pregnant	DE	Coefficient for NE_m equation	Mix (of grazing)
Mature Females	200	0.00	0.30	0	33%	55%	0.365	8%
Mature Males	275	0.00	0.00	0	0%	55%	0.370	33%
Young	75	0.10	0.00	0	0%	60%	0.361	59%
Weighted Average	**152**	**0.06**	**0.02**	**0**	**3%**	**58%**	**0.364**	**100%**

Cattle - Asia

	Weight (kg)	Weight Gain (kg/day)	Milk (kg/day)	Work (hrs/day)	Pregnant	DE	Coefficient for NE_m equation	Mix (of grazing)
Mature Females	300	0.00	1.10	0	50%	60%	0.354	18%
Mature Males	400	0.00	0.00	0	0%	60%	0.370	16%
Young	200	0.20	0.00	0	0%	60%	0.345	65%
Weighted Average	**251**	**0.13**	**0.20**	**0**	**9%**	**60%**	**0.350**	**100%**

Cattle - India

	Weight (kg)	Weight Gain (kg/day)	Milk (kg/day)	Work (hrs/day)	Pregnant	DE	Coefficient for NE_m equation	Mix (of grazing)
Mature Females	125	0.00	0.60	0.0	33%	50%	0.365	40%
Mature Males	200	0.00	0.00	2.7	0%	50%	0.370	10%
Young	80	0.10	0.00	0.0	0%	50%	0.332	50%
Weighted Average	**110**	**0.05**	**0.24**	**0.3**	**13%**	**50%**	**0.349**	**100%**

Cattle - Latin America

	Weight (kg)	Weight Gain (kg/day)	Milk (kg/day)	Work (hrs/day)	Pregnant	DE	Coefficient for NE_m equation	Mix (of grazing)
Mature Females	400	0.00	1.10	0	67%	60%	0.343	37%
Mature Males	450	0.00	0.00	0	0%	60%	0.370	6%
Young	230	0.30	0.00	0	0%	60%	0.329	57%
Weighted Average	**306**	**0.17**	**0.41**	**0**	**25%**	**60%**	**0.337**	**100%**

Sheep

	Weight (kg)	Weight Gain (kg/day)	Milk (kg/day)	Wool (kg/year)	Pregnant	DE	Coefficient for NE_m equation	Mix (of grazing)
Mature Females	45	0.00	0.70	4	50%	60%	0.217	40%
Mature Males	45	0.00	0.00	4	0%	60%	0.217	10%
Young	5	0.11	0.00	2	0%	60%	0.236	50%
Weighted Average	**25**	**0.05**	**0.28**	**3**	**20%**	**60%**	**0.227**	**100%**

Table 3: Daily energy requirement and dry matter intake calculation

Cattle

Region	Average Characteristics							Energy (MJ/head/day)										Consumption	
	Weight	Weight gain	Milk	Work	Preg-nant	DE	CF	Mainte-nance	Activity	Growth	Lactation	Power	Wool	Preg-nancy	REM	REG	**Gross**	NE_{ma}	**DMI**
	(kg)	(kg/day)	(kg/day)	(hrs/day)					(note 1)		(note 2)							(MJ/kg - note 5)	(kg/head/day)
Africa	152	0.06	0.02	0.0	3%	58%	0.364	15.7	5.7	1.2	0.0	0.0	0	0.0	0.49	0.26	**84.0**	5.2	**16.2**
Asia	251	0.13	0.20	0.0	9%	60%	0.350	22.1	8.0	2.8	0.3	0.0	0	0.2	0.49	0.28	**119.8**	5.5	**21.9**
India	110	0.05	0.24	0.3	13%	50%	0.349	11.8	4.3	1.0	0.4	0.3	0	0.2	0.44	0.19	**87.6**	4.0	**21.6**
Latin America	306	0.17	0.41	0.0	25%	60%	0.337	24.6	8.9	3.8	0.6	0.0	0	0.6	0.49	0.28	**139.5**	5.5	**25.5**

Sheep

Region	Average Characteristics							Energy (MJ/head/day)										Consumption	
	Weight	Weight gain	Milk	Work	Preg-nant	DE	CF	Mainte-nance	Activity	Growth	Lactation	Power	Wool	Preg-nancy	REM	REG	**Gross**	NE_{ma}	**DMI**
	(kg)	(kg/day)	(kg/day)	(hrs/day)					(note 3)		(note 4)							(MJ/kg - note 5)	(kg/head/day)
All regions	25	0.05	0.28	3.0	20%	60%	0.227	2.5	0.6	1.5	1.29	0	0.2	0.0	0.49	0.28	**25.0**	5.5	**4.6**

Notes

1. Assumes grazing
2. Assumes 4% milk fat
3. Assumes grazing on hilly terrain
4. Assumes 7% milk fat
5. Calculated using equation listed in Table 10.8

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