Transforming Rwanda's Eastern Proving through Adaptation (TREPA)

Annex 22: GHG emissions reduction

Version 11

Contents

1. Methodology for calculation GHG emission reductions

1.1 Choice of methodology

The main source of emission reductions from project activities is sequestration due to land use, land use change, and forestry activities. Specifically, the project will achieve emission reductions by restoring degraded forest land and supporting afforestation on farms and pasture. GHG reductions are calculated using the methodology presented in the IPCC Good Practice Guidance for LULUCF, Chapter 3.2 “Forest Land”, specifically Equation 3.2.3. This methodology was chosen due to its widespread recognition, general applicability in both the baseline and with-project scenarios, and the availability of relevant data. Secondary emission reductions come from reducing stocking density for cattle in silvopastoral activities.

1.2 Formulae for calculating GHG emission reductions from forest land

Equation 3.2.3 as indicated below:

EQUATION 3.2.3

ANNUAL CHANGE IN CARBON STOCKS IN LIVING BIOMASS IN FOREST LAND REMAINING FOREST LAND (STOCK CHANGE METHOD)

$\Delta C_{FFLB} = (C_{t2} - C_{t1}) / (t_2 - t_1)$

and $C = [V \bullet D \bullet BEF_2] \bullet (1 + R) \bullet CF$

Where:

ΔC_{FFLB} = annual change in carbon stocks in living biomass (includes above- and belowground biomass) in forest land remaining forest land, tonnes C yr^{-1}

C_{t2} = total carbon in biomass calculated at time t2 , tonnes C

C_{t1} = total carbon in biomass calculated at time t1 , tonnes C

V = merchantable volume, m3 ha^{-1}

D = basic wood density, tonnes d.m. m^{-3} merchantable volume

BEF_2 = biomass expansion factor for conversion of merchantable volume to aboveground tree biomass, dimensionless

R = root-to-shoot ratio, dimensionless

CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonne d.m.)$^{-1}$

The formula for calculating GHG emission reductions from cattle is:

CH4 Emissions = Number of Animals ● CH4 Emissions Factor ● CH4/CO2 radiative forcing equivalent

1.3 Summary of parameters, values and data sources

GHG sequestration figures are estimated according to the following parameters:

- 1 m^3 above ground = 1 x (1+0.29) = 1.29 m^3 above and underground woody biomass, using the **root-shoot ratio of 0.29**[1]
- 1.29 m^3 woody biomass = 1.8 x 0.5075 tonne / m^3 = 0.655 tonne of dry woody biomass (average **oven dry wood density of 0.5075** ton/m^3)[2];
- 0.655 tonne of dry woody biomass = 0.655 x 0.5 = 0.327 tonne of carbon (**1 tonnes of dry wood = 0.5 tonnes of carbon**[3]); and finally
- 0.327 tonne of carbon = 0.327 x 3.67 = circa 1.2 tonne of CO_2 sequestered (**1 tonne of carbon = 3.667 tonne of CO_2**).

The aggregated conversion factor is therefore: <u>1 m^3 of woody biomass above the ground is associated to 1.2 tone of CO_2 sequestered.</u>

Based on IPCC Chapter 4 "Enteric Fermentation"[4], GHG emission reductions from a change in the number and type of cattle held per hectare by farmers is estimated according to the following parameters:

- 1 head of dairy cattle (cross breed) = 36 kg/year of CH_4 emissions
- 1 head of non-dairy cattle (Ankoke) = 32 kg/year of CH_4 emissions
- Methane (CH4) to CO2 radiative forcing equivalence = 21

[1] 0.29 according to the IPCC table 4.4 (internationally accepted default value

[2] "Allometric equations, wood density and partitioning of aboveground biomass in the arboretum of Ruhande, Rwanda", *Trees, Forest, People* (3) 2021. https://www.sciencedirect.com/science/article/pii/S2666719320300509

[3] 50% is the IPCC default value for carbon content of dry biomass. https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/Chp3_2_Forest_Land.pdf

[4] https://www.ipcc-nggip.iges.or.jp/public/gp/bgp/4_1_CH4_Enteric_Fermentation.pdf, page 312.

2. Description of baseline scenario and results of emission reduction calculations

Net greenhouse gas emissions are associated with the business-as-usual scenario in each of Outputs 1.1 through 1.4, while net carbon sequestration is associated with each of these outputs in the with-project scenario. As noted previously, the promotion of clean and efficient cooking energy technologies is intended to reduce the demand for fuelwood and thereby contributes to the sequestration totals presented in the other Outputs.

2.1 Analysis of Output 1.1

Output 1.1 activities include planting and managing an additional 100 trees per hectare on 40,000 ha of agricultural land, and contribute indirectly to the planting of 100 additional trees on another 80,000 ha as a result of scale-up during the intervention period and after project closure by neighboring farmers. The spreadsheet included with this Annex 22 presents the BAU and with-project changes in productivity and wood stock (above-ground volume) in m^3 over the period of analysis, taking into account periodic harvesting and replanting. The underlying assumptions driving the productivity and stock growth analysis are presented below:

Wood product growth/yield	Decrease of 2% per year due to soil erosion from climate-induced weather variability	Yield increase from 0.48 to 2.3 m3/ha/year due to 100 tree plantation per ha (density from 21 to 121 tree/ha)
Annual harvest of wood product	Equal to the annual growth + stock decrease by over-exploitation 85% firewood and 15% service wood	In restored area, continuous harvesting (15% of volume per year) on pre-existing trees + progressive harvesting of new planted trees until reaching 100% of the growth. As species will be mixed with different rotation and regime, tree will be progressively and partly replaced every year from year 10.

Table 1 below summarizes the change in above ground wood volume in the BAU vs TREPA scenarios, and resulting carbon benefit:

Table 1 - Output 1.1 Carbon sequestration

Cumulative results	6 year total	20 year total
Output 1 - Total stock progress - BAU (m3)	-49,423	-100,367
Output 1.1 - Total stock progress - TREPA (m3)	21,530	329,694
Output 1.1 - Net change in above ground wood volume (m3)	70,954	430,061
Output 1.1 - Net CO2 reduction, tCO2	85,169	516,223

2.2 Analysis of Output 1.2

Output 1.2 activities include direct restoration and management of 17,245 ha of District and State-owned forest in the Eastern Province, and indirect impacts on another 11,966 ha due to scaling up during the project intervention and after project completion. The project supports four types of forest land and the results are modeled separately for each:

Case of targeted degraded District owned tree plantations to be managed by local private actor/institution

- The **Business As Usual (BAU)** scenario: **without any restoration** nor good management, and subject to over-exploitation and encroachment. These very degraded forests (8 m3/ha of stock with an average yield of 3 m^3/ha/year) are not restored and, considering the high wood supply/demand gap, continue to be subject to over-exploitation, with an average stock decrease assumed at 50% over the next 20 years (with a related yield decrease of 30% over the same period). As these small and scattered areas become even less productive and stocked, without any clear demarcation on the field (often local forest officers don't know the boundaries), they will be highly exposed to encroachment and easily converted to other land uses (assumption of 35% land conversion over the 20 next years), either by neighbouring farmers establishing their crops or by local authorities affecting these lands with public infrastructure.

- The **project scenario**: these areas are **restored**[5] **by local private actors** contracted to manage the forest. The new established productive tree plantation is well demarcated on the field (differentiating species on border line) and protection against encroachment is ensured. Contracted forests are managed by local actors according to agreed SFMPs, mainly with Eucalyptus spp. under coppice regime at 8 years rotation (local actors need a quick return) with an average yield[6] assumed to be 9 m^3/ha/year (yield is limited due to forest location on marginal poor soil).

Case of targeted very degraded State owned tree plantations to be contracted to investors

- The **Business As Usual (BAU)** scenario: **without any restoration** nor good management, and subject to over-exploitation and encroachment. These very degraded forests (10 m^3/ha of stock with an average yield of 3 m^3/ha/year) are not restored and, considering the high wood supply/demand gap, continue to be subject to over-exploitation, with an average stock decrease assume at 40% over the 20 next years (related yield decrease of 30% over the same period). As these in general small areas will become still very less productive and stocked, they will be also exposed to encroachment and easily converted to another land use (assumption of 20% land conversion over the 20 next years), even by neighbouring farmers establishing their crops or by local authority affecting these lands with public infrastructure.

[5] Establishment of anti-erosive ditches (AED) and firebreak where required, removal of old forest and old stump reduction/debarking, high quality tree seedling production and planting/beating-up, weeding /maintenance.

[6] MAI: Mean Annual Increment over the full rotation duration of the forest.

- The **project scenario**: these areas are **restored**[7] **by private actors** contracted to manage the forest. The new established productive tree plantation is well demarcated on the field (differentiating species on border line) and protection against encroachment is ensure. Contracted forests are managed by investor according to agreed SFMPs, mainly under High-Forest[8] regime with an average yield[9] assume to 9 m^3/ha/year (not so high due to forest location on marginal poor soil).

Case of normal State owned tree plantations to be contracted to investors
The graphic and table below are presenting main elements of financial analysis for 3 scenarios:

- The **Business As Usual (BAU)** scenario: **without any restoration** nor good management, and subject to over-exploitation and encroachment. These not so bad forests (54 m3/ha of stock with an average yield of 6 m^3/ha/year) are not restored and, considering the high wood supply/demand gap, continue to be subject to over-exploitation, with an average stock decrease assume at 40% over the 20 next years (related yield decrease of 30% over the same period). As these areas will become less productive and stocked, they will be also exposed to encroachment and easily converted to another land use (assumption of 20% land conversion over the 20 next years), even by neighbouring farmers establishing their crops or by local authority affecting these lands to public infrastructure.

- The **project scenario**: these areas are **restored**[10] **by private investors** contracted to manage the forest. The new established productive tree plantation is well demarcated on the field (differentiating species on border line) and protection against encroachment is ensure. Contracted forests are managed by investor according to agreed SFMPs, mainly under High-Forest[11] regime with an average yield[12] assume to 11 m^3/ha/year.

Case of degraded small-holder private tree plantations to be managed by owner's cooperatives
The graphic and table below are presenting main elements of financial analysis for 3 scenarios:

- The **Business As Usual (BAU)** scenario: **without any restoration** nor good management, and subject to over-exploitation and encroachment. These very degraded forests (8 m^3/ha of stock with an average yield of 3 m^3/ha/year) are not restored and, considering the high wood supply/demand gap, continue to be subject to over-exploitation, with an average stock decrease assume at 50% over the 20 next years (related yield decrease of 30% over the same period). As these small areas will become still very less productive and stocked, they will be highly exposed to easy conversion to crops or another land use (assumption of 40% over the 20 next years).

A)

[7] Establishment of anti-erosive ditches (AED) and firebreak where required, removal of old forest and old stump reduction/debarking, high quality tree seedling production and planting/beating-up, weeding /maintenance.

[8] According to national policy, State forest are priority area that should contribute to the national supply of timber/construction wood;

[9] MAI: Mean Annual Increment over the full rotation duration of the forest.

[10] Establishment of anti-erosive ditches (AED) and firebreak where required, removal of old forest and old stump reduction/debarking, high quality tree seedling production and planting/beating-up, weeding /maintenance.

[11] According to national policy, State forest are priority area that should contribute to the national supply of timber/construction wood;

[12] MAI: Mean Annual Increment over the full rotation duration of the forest.

- The **project scenario**: these areas are **restored**[13] **by the owner's cooperatives**. These forest are managed according to agreed SFMPs, mainly with Eucalyptus spp. under coppice regime at 8 years rotation (need quick return) with an average yield[14] assume to 10 m^3/ha/year.

Impact of TREPA on wood stock increase and carbon sequestration in EP

The impact of the TREPA output 1.2 on the overall EP can be seen in two ways:

- The direct impact **(Direct TREPA)** on 17,245 ha (37% of total forest of EP) due to:
    - Direct restoration and long term concession to local actors of 700 ha of degraded District forests, managed according to "TREPA support" scenario assumption described in the feasibility study;
    - Direct restoration and long term concession to private investors of 700 ha of very degraded State forest, managed according to "TREPA support" scenario;
    - Additional long term concession to private operators of 9,300 ha of State FMUs, managed according to "without TREPA" scenario;
    - Direct restoration and management by cooperatives under SFMPs of 6,545 ha of small-holder forest, managed according to "TREPA support" scenario.

- The indirect impact **(Indirect TREPA)** on 11.966 ha (26% of total forest of EP), considering the additional scaling-up (during the project intervention) and the continuation after its closure[15] of the newly initiated good forest management practices, to be done with government and eventually other partner support on the remaining forest areas not directly targeted by TREPA:
    - Additional long term concession of 50% (4,831 ha) of remaining State forests, where 70% constituted by degraded/over mature forest will be restored by the contractors, while the remaining 30% still productive is put under good management with harvesting of 5% per year of the stock (equivalent to a sustainable full rotation of 20 years).
      These forest are assumed with a MAI of 11 m^3/ha/year in average, managed under SFMP in High Forest regime for timber/pole production essentially (residue for firewood).

    - Additional contracting to local actors of 50% (541 ha) of remaining District forests, where 80% constituted by degraded/over mature forest will be restored by the local actors (with facilities provided for access to finance), while the remaining 20% still productive is put under good management with harvesting of 12% per year of the stock (equivalent to a coppicing rotation of 8 years). These forests are assumed with a MAI of 10 m^3/ha/year in average, managed under SFMP in coppice or coppice with standard regime for firewood/service wood production essentially.

    - Additional restoration and management by cooperatives under private FMUs of 35% (6,594 ha) of remaining small-holder forests, where 80% constituted by degraded/over mature forest will be restored by cooperatives (with facilities

[13] Establishment of anti-erosive ditches (AED) and firebreak where required, removal of old forest and old stump reduction/debarking, high quality tree seedling production and planting/beating-up, weeding /maintenance.

[14] MAI: Mean Annual Increment over the full rotation duration of the forest.

[15] Local actors/neighboring forest owners convinced to engage and invest in new management practices due to TREPA success stories and demonstration.

provided for access to finance and /or additional support from partners), while the remaining 20% still productive is put under good management with harvesting of 12% per year of the stock (equivalent to a coppicing rotation of 8 years). These forests are assumed with a MAI of 10 m^3/ha/year in average, managed under SFMP in coppice or coppice with standard regime for firewood/service wood production essentially.

Productivity and stock growth models per type of forest have been developed (see joined excel file in annex 3) to calculate the wood stock (above ground volume in m3) evolution over the 40 next years (full forest cycle rotation). However, the period of analysis for this GCF funding proposal has been limited to 20 years.

The table below presents the impact of TREPA Output 1.2 on the carbon sequestration of the overall forest areas of the EP:

Table 2 Output 1.2 Carbon sequestration

Cumulative results	6 year total	20 year total
Output 1.2 - Total stock progress - BAU (m3)	-157,399	-526,663
Output 1.2 - Total stock progress - TREPA (m3)	-189,959	1,348,448
Output 1.2 - Net change in above ground wood volume (m3)	-32,559	1,875,112
Output 1.2 - Net CO2 reduction, tCO2	- 39,082	2,250,784

2.3 Analysis of Output 1.3

Output 1.3 includes silvopastoral activities that contribute to increased climate resilience for livestock farmers. As part of these activities, tree density on pastureland will increase from 10 trees per hectare under business-as-usual to 100 trees per hectare in the project scenario. The stock growth calculation model assumes the following parameters:

Tree Density	10 tree/ha	100 tree/ha: cost taken fully by farmers	100 tree/ha: 100 % cost taken by TREPA
Wood product growth/yield	0.0625 baseline with decrease of 5% per year due to soil pressure	Yield increase from 0.0625 in Y1 to 1.16 m^3/ha/year in Y5 (remain constant afterward). Annual growth for silvopastoral tree species such as Acacia spp (indigenous), Feiderbhia, etc. which have a not so high growth rate.	
Annual harvest of wood product	Equal to the annual growth + stock decrease by over-exploitation 100% firewood	In restored area, continuous harvesting (5% of volume per year) on pre-existing trees + progressive harvesting of new planted trees until reaching 100% of the growth. As species will be mixed with different rotation and regime, tree will be progressively and partly replaced every year from year 15.	

The traditional practice of free open grazing with local Ankole cows leads to overgrazing due to cattle densities (1.5 head/ha) that exceed the land capacity. This practice will be replaced by fenced ranches using cross-breed dairy cows at a carrying density of 0.5 head/ha. This will provide a higher return for farmers due to higher milk productivity while avoiding overgrazing and reducing methane (CH_4) emissions per hectare.

Impact of TREPA silvopastoral actions (output 1.3) on carbon sequestration in Eastern Province

The impact of the TREPA output 1.3 on the overall EP can be seen in two ways:

- The direct impact **(Direct TREPA)** on 10,000 ha managed under improved silvopastoral technics (diminution of number of head per ha, introduction of cross-breed cows, tree planting, pasture management through fencing and parcel rotation, etc.);

- The indirect impact **(Indirect TREPA)** on additional 20,000 ha managed under same improved silvopastoral technics due to the additional scaling-up during the project intervention and after its closure by neighbouring farmers themselves. For 1 farmer directly supported, we assume that easily 2 neighboring farmers will be convinced to invest in improved silvopastoral practices, thanks to the good results/success stories in the above directly targeted 10,000 ha, thanks to the continuous sensitization and thanks to the enabling environment (access to finance and seedlings) established by the TREPA intervention.

Productivity and stock growth models have been developed (see linked excel file in Annex 3) to calculate the wood stock (above ground volume in m^3) evolution over the 40 next years (around two 18 years cycle rotation).

The reduction of methane emissions due to the reduction of number of cattle per ha has been calculated based on the following assumptions:

- CH_4 emissions are converted into CO_2 equivalents (CO_2eq) using the potential for atmosphere warming for the next 100 years (IPCC Fifth Assessment Report, 2014), as follow:

  1 Gg CH_4 = 21Gg CO_2eq

- IPCC Chapter 4 Enteric Fermentation, 1 head of dairy cattle in Africa emits 36 kg of CH_4/year, while 1 head of non-dairy cattle emits 32 kg of CH_4/year.

The table below presents the change in carbon sequestration/emission on silvopastoral/grazing lands of EP directly and indirectly impacted by the TREPA silvopastoral actions (output 1.3):

Table 3 Output 1.3 Emission reductions

Cumulative results	6 year total	20 year total
Output 1.3 - Total stock progress - BAU (m3)	-9,750	-19,800
Output 1.3 - Total stock progress - TREPA (m3)	966	109,038
Output 1.3 - Net change in above ground wood volume (m3)	10,716	128,838
Output 1.3 - Net change in number of cattle	-13,067	-65,333
Output 1.3 - Net CO2 reduction, tCO2e	22,741	204,042

2.4 Analysis of Output 1.4

Output 1.4 will climate-proof fragile, ecologically sensitive ecosystems and erosion prone areas upon which populations are dependent for ecosystem services, and increasing water demand from large scale irrigation projects, by scaling up protective restoration measures and addressing the lack of investment funds and access to climate resilient technologies. The aim is to protect or restore approximately 700 hectares of riverbanks, lakes or marshland shorelines, approximately 700 kilometres of roadside areas through activities such as tree planting and approximately 400 hectares of Akagera National Park buffer zone through natural regeneration and planting native species. Restoration activities will be coupled with community management approaches such as the establishment and support of Community Vigilance Committees (CVC), a participatory silvopastoral plan and community nurseries to ensure long term sustainability of interventions. National and international experts in protective restoration will provide technical assistance to RWFA to design required regulation for management and integrating climate resilience into the specific protected areas by the project as well as integrate new M&E in the DFMP database.

Case of targeted roadside & river/lake shore plantation

The graphic and table below are presenting main elements of financial analysis for 3 scenarios:

- The **Business As Usual (BAU)** scenario: **without any restoration** nor good management, with a limited existing stock (only around 8m3/ha) and productivity (0.4 m3/ha/year) and subject to over-exploitation and encroachment. This existing stock, considering the high wood supply/demand gap, is subject to over-exploitation, with a decrease assume at 40% over the 20 next years (related yield decrease of 30% over the same period). Around 20% of the volume harvested is for service (sticks, small construction poles, etc.) while the remaining is for firewood. For the harvested products, no VAT payment is considered as the business remain informal.
- The **project scenario**: these areas are **restored**[16] **by TREPA**. The new established productive tree plantations are well managed by CVCs, with multipurpose species mainly under high forest regime, with 4 pruning period every 5 years with 10 to 15% volume removal. An average full rotation of 22 years with an MAI of 8 m^3/ha/year (tree generally located on good soil near river/lake and or on cropping areas. Fruit production is assuming to start in year 4 and reaching its maximum of 200 kg per ha (considering 10% fruit trees) in year 8.

Case of Akagera buffer zone area

The graphic and table below are presenting main elements of financial analysis for 3 scenarios:

- The **Business As Usual (BAU)** scenario: **without any restoration** nor good management, with a limited existing stock (only around 18m^3/ha) and productivity (0.625 m^3/ha/year) and subject to over-exploitation and encroachment. This existing stock, considering the high wood supply/demand gap and use of land for grazing, is subject to over-exploitation, with a decrease assume at 80% over the 20 next years (related yield decrease of 60% over the same period). Around 20% of the volume harvested is for service (sticks, small construction poles, etc.) while the remaining is for firewood. For the harvested products, no VAT payment is considered as the business remain informal.
- The **"TREPA support" scenario**: these areas are **restored**[17] **by TREPA**. The new established productive tree plantations are well managed by CVCs, with multipurpose species mainly under high forest regime, with 4 pruning period every 5 years with 10 to 15% volume removal. An average full rotation of 22 years with an MAI of 6 m^3/ha/year (tree generally located on dry and degraded rocky land). Fruit and fodder production is assumed to start in year 4 and reaching its maximum of respectively 100 kg per ha/year (considering 5% fruit trees) and 600 kg per ha per year (considering 30% fodder trees) in year 8.

Impact of TREPA output 1.4 on carbon sequestration in Eastern Province

[16] Establishment of anti-erosive ditches (AED) and firebreak where required, removal of old forest and old stump reduction/debarking, high quality tree seedling production and planting/beating-up, weeding /maintenance.

[17] Establishment of anti-erosive ditches (AED) and firebreak where required, removal of old forest and old stump reduction/debarking, high quality tree seedling production and planting/beating-up, weeding /maintenance.

Productivity and stock growth models per type of buffer plantation have been developed (see joined excel file in annex 3) to calculate the wood stock (above ground volume in m3) evolution over the 40 next years (full forest cycle rotation).

The six, and twenty-year emission reduction totals for Output 1.4 are presented below:

Table 4 Output 1.4 Carbon sequestration

Cumulative results	6 year total	20 year total
Output 1.4 - Total stock progress - BAU (m3)	-2,560	-9,728
Output 1.4 - Total stock progress - TREPA (m3)	966	109,038
Output 1.4 - Net change in above ground wood volume (m3)	3,526	118,766
Output 1.4 - Net CO2 reduction, tCO2	31,881	276,814

2.5 Analysis of Output 1.5

Output 1.5 responds to the beneficiaries' needs identified in the 2018 survey and will contribute to climate resilience in the Eastern Province by promoting the use of high-efficiency biomass cook stove technologies aligned with the Government of Rwanda's BEST Strategy (MININFRA, April 2019), which aims to:

- Increase supply of woody biomass through improved sustainable management of wood biomass resources
- Reduce the demand of wood biomass by *institutional consumers* by shifting to alternative fuels, primarily LPG
- Reduce the consumption of wood by *urban households* through:
    - switching to alternative fuels, primarily LPG
    - replacing traditional charcoal with improved charcoal technologies
- Improve efficiency of biomass usage by *rural households* by:
    - strengthening woody pellets gasifier and briquettes value chains (for households with problems in accessing wood)
    - increasing penetration of high efficiency Improved Cook stoves (ICS) for firewood (for households with easy access to wood)
- Strengthen coordination and capacity building, monitoring and evaluation, to effectively manage the biomass energy sector.

While the restoration activities described in Outputs 1.1-1.4 above will take time to reduce climate vulnerability, the transition to efficient cooking technologies will immediately reduce the rate at which forested areas are cleared and thereby contribute to reduced vulnerability in the short term.

In line with BEST targets (indicated in annex 9), the project aims to increase average rural cookstove efficiency in the project areas from approximately 16% in 2018 to over 40%, with a commensurate decrease in per-household woodfuel consumption. The GHG calculations for this output assume that 82% of fuelwood at the beginning of the project period is harvested unsustainably from non-renewable sources. This figure decreases over time as the project's restoration activities close the supply-demand gap for fuelwood.

The table below summarizes the wood fuel savings, and associated GHG emissions reductions from the adoption of ICS.

Table 5 Output 1.5 GHG reductions

Cumulative results	6 year total	20 year total
Output 1.5 - tonnes of wood saved	921,290	5,248,238
Output 1.5 - Net CO2 reduction, tCO2e	**1,207,354**	**6,414,579**

2.6 Summary of project emission reduction potential

Total carbon sequestration / emission avoidance over these four outputs is presented below. Note that the 20-year period of analysis does not cover the entire tree cycle rotation of 22 years. These figures therefore underestimate the project's emission reduction potential.

Table 6 - Summary of project emission reductions

Summary - cumulative GHG benefits, tCO2e	6 year total	20 year total
Output 1.1 – Agroforestry	85,169	516,223
Output 1.2 – Reforestation	- 39,082	2,250,784
Output 1.3 – Silvopastoralism	22,741	204,042
Output 1.4 – Protected areas management	31,881	276,814
Output 1.5 – Improved cook stoves	1,207,354	6,414,579
Total	**1,308,063**	**9,662,441**