8. 方法論及びプロジェクト設計書 (英文)

8.1. 新ベースライン方法論 (NMB) 及び新モニタリング方法論 (NMM)

※今後、リーケージの議論の内容によっては、FODやMulti-phaseモデルへの言及を削除する可能性あり。

8.2. PDD

※添付資料参照

Baseline net greenhouse gas removals by sinks

Simplified methodologies for estimating the baseline net GHG removals by sinks are based on the baseline approach specified by paragraph 22 (a) of the modalities and procedures for A/R under the CDM:

"Existing or historical, as applicable, changes in carbon stock in the carbon pools within the project boundary".

According to decision 14/CP.10:

"*If project participants can provide relevant information that indicates that, in the absence of the small-scale afforestation or reforestation project activity under the CDM, no significant changes in the carbon stocks within the project boundary would have occurred, they shall assess the existing carbon stocks prior to the implementation of the project activity. The existing carbon stocks shall be considered as the baseline and shall be assumed to be constant throughout the crediting period..*"

"If significant changes in the carbon stocks within the project boundary would be expected to occur in the absence of the small-scale afforestation or reforestation project activity, project participants shall" use this simplified baseline methodology.

In order to assess if significant changes in the baseline carbon stocks within the project boundary have occurred in absence of the project activity, project participants shall assess whether changes in carbon stocks in the baseline land-use type (wetland), in particular the living biomass of woody perennials[5] (above- and below-ground biomass) and below-ground biomass of wetlands, are expected to be significant and provide documentation to prove this, for example, by expert judgement. Based on the results of this assessment:

a) If significant changes in the carbon stocks, in particular the living biomass of woody perennials (above- and belowground biomass) and below-ground biomass in wetlands, are not expected to occur in the absence of the project activity, the changes in carbon stocks shall be assumed to be equal to zero.
b) If the carbon stock in the living biomass of woody perennials (above- and belowground biomass) or below-ground biomass in wetlands is expected to decrease in the absence of the project activity, the baseline net greenhouse gas removals by sinks shall be assumed to be equal to zero,

[5] Woody perennials consist of the non-tree vegetation and shrubs that are present in wetlands below the threshold (in terms of canopy cover, minimum area and tree height) used to define forests.

In above case, the baseline carbon stocks in the carbons pools are constant at the level of existing carbon stock measured at the start of the project activity.

c) Otherwise, baseline net greenhouse gas removals by sinks shall be equal to the changes in carbon stocks from the living biomass of woody perennials (above- and below-ground biomass) or belowground biomass in wetlands that are expected to occur in the absence of the project activity and shall be estimated using the methodology below.

Estimating the baseline net GHG removals by sinks

Baseline net GHG removals by sinks will be determined by the equation:

$B_{(t)} = \Sigma_i (B_{A(t),t} + B_{B(t),i}) * A$ (1)

where:

$B_{(t)}$ = Carbon stock in the living biomass pools within the project boundary at time "t" that would have occurred in the absence of the project activity (t C)

$B_{A(t)\,i}$ = Carbon stocks in aboveground biomass at time "t" of stratum i that would have occurred in the absence of the project activity (t C/ha)

$B_{B\,(t)\,i}$ = Carbon stocks in belowground biomass at time "t" of stratum i that would have occurred in the absence of the project activity (t C/ha)

A_i = Project activity area of stratum i (ha)

Stratification of the project activity for the purposes of estimating the baseline net GHG removals by sinks shall proceed in accordance with section 4.3.3.2 of the "Good Practice Guidance for Land Use, Land-Use Change and Forestry" of the Intergovernmental Panel on Climate Change (2003) (hereafter referred as IPCC GPG for LULUCF). For each stratum, the following calculations shall be performed:

For above-ground biomass

$B_{A(t)}$ is calculated as follows:

$B_{A(t)} = M_{(t)} * 0.5$ (2)

where:

$M_{(t)}$ = Above-ground biomass at time "t" that would have occurred in the absence of the project activity (t dry matter/ha)

0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter

14. Values for $M_{(t)}$ shall be estimated using average biomass growth rates specific to the region and the age of the woody perennial using the following equation:

if $a < m$, then $M_{(t)} = g * a$ (3)

else, $M_{(t)} = g * m$

where:
"g" is the annual biomass growth rate of the woody perennial (t dry matter/ha/yr)
"m" is the time to maturity of the woody perennial (years)
"a" is the average age of the woody perennial (years)

Documented local values for "g" 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 table 3.3.2 of IPCC GPG for LULUCF.
Values for "m" considered by the project activity shall be specified by project participants for each species considered to be part of the baseline. These values shall be identified in the CDM-SSC-AR-PDD.

For below-ground biomass
$B_{B(t)}$ is calculated as follows:

$B_{B(t)} = M_{(t)} * R * 0.5$ (4)

where:
R = Root to shoot ratio (t d.m./ t d.m.)
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter
Documented local values for R 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 table 3.4.3 of IPCC CPG for LULUCF.

Actual net greenhouse gas removals by sinks
"Actual net GHG removals by sinks" only considers the changes in carbon pools for the project scenario (please refer to paragraph 8 above). The stocks of carbon for the project scenario at the starting date of the project activity[6] (i.e. t=0) shall be the same as for the projection of the baseline net greenhouse gas removals by sinks at t=0. For all other years, the carbon stocks within the project boundary at time "t" ($N_{(t)}$) shall be calculated as follows:

$N_{(t)} = \Sigma((N_{A(t)\,i} + N_{B\,(t)\,i}) * A_i)$ (5)

where:
$N_{A(t)\,i}$ = Carbon stocks in aboveground biomass at time "t" of stratum i under the project scenario (t C/ha)
$N_{B(t)\,i}$ = Carbon stocks in belowground biomass at time "t" of stratum i under the project scenario (t

[6] The starting date of the project activity should be considered to be the point in time when the land is prepared for the initiation of the afforestation or reforestation project activity. 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 or reforestation project activity under the CDM.

C/ha)
A_i = Project activity area of stratum i (ha)
Stratification for the project scenario shall be undertaken in accordance with section 4.3.3.2 of the IPCC GPG for LULUCF. The following calculations shall be performed for each stratum:

For above-ground biomass

$N_{A(t)} = T_{(t)} * 0.5$ (6)

where:
$T_{(t)}$ = Above-ground biomass at time "t" under the project scenario (t dry matter/ha)
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter
$T_{(t)} = SV_{(t)} * BEF * WD$ (7)

where:
$SV_{(t)}$ = Stem volume at time "t" for the project scenario (m^3/ha)
WD = Basic wood density (t dry matter/ m^3).
BEF = Biomass expansion factor (over bark) from stem volume to total volume (dimensionless)

Values for $SV_{(t)}$ shall be obtained from national sources (e.g. standard yield tables). Documented local values for BEF 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 table 3A.1.10 of IPCC GPG for LULUCF. Documented local values for WD 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 table 3A.1.9 of IPCC GPG for LULUCF.

For below-ground biomass

$N_{B(t)} = T_{(t)} * R * 0.5$ (8)

where:
R = Root to shoot ratio (dimensionless)
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter
22. Documented national values for R should be used. If national values are not available, appropriate values should be obtained from table 3A.1.8 of IPCC GPG for LULUCF

Leakage
According to decision 14/CP.10*:*
"*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."

For the wetland reforestation project in intertidal zones, project participants are required to address the issue of leakage from organic matter decomposition under water.
The methodology requires default discount rate for the leakage arising from anaerobic decomposition of organic matter fallen into water. From leaf production of mangrove and turn over rate of leaves, conservative assumption would result in 38 tons per ha to 76 tons per ha of leaves falling into water, assuming all leaves would fall after one year. This would result in GHG emissions of less than 1 t CO_2 /ha/year using multi-phase model. To be conservative, the methodology suggests 15% default leakage for actual net GHG removals by sinks as explained below.

If project activities cause any leakage that may result from litter falling into ocean, and if tidal wave carries it outside the project boundary, possible emissions of CH_4 shall be considered as leakage. The estimation of CH_4 emissions arising from litter shall be assumed 15% of the total actual net GHG removals by sinks, or if the data is available, the project participants can also apply the following procedure to estimate its leakage:

Step 1: Estimation of fallen litter into water body
Porject participants shall establish randam sampling plots in each stratum to collect fallen litter (e.g. through 1m square nets) for appropriate representation for appropriate time period. The collected litter then shall be converted to tones of organic matter per ha per annum.

Step 2: Estimation of potential CH_4 emission
The amount of CH_4 that would be emitted from organic matter shall be estimated using FOD method or multi-phase decay model approved in AM0025 (organic composting).

Step 3: Conversion of CH_4 to CO_2
The tons of CH_4 shall be converted to tons of CO_2 through multiplying GWP of 21.

If the derived amount of CO_2 is greater than 10% and less than 50% of actual net GHG removals by sinks, then leakage shall be equal to 15% of the actual net GHG removals by sinks as shown in the formula (9) below.

Project participants should assess the possibility of leakage from the displacement of activities or people considering the following indicators:

a) Percentage of families/households of the community involved in or affected by the project activity displaced due to the project activity, and
b) Percentage of total production of the main produce (e.g. fish, crabs, etc) within the project boundary displaced due to the CDM A/R project activity.

If the value of these two indicators is lower than 10%, then
$L_{(t)} = 0$
where:
$L_{(t)}$ = Leakage attributable to the project activity within the project boundary at time "t".

If the value of any of these two indicators is higher than 10% and less than or equal to 50%, then leakage shall be equal to 15% of the actual net GHG removals by sinks, that is:

$L_{(t)} = N_t * 0.15$ (9)

where:
$L_{(t)}$ = Leakage attributable to the project activity within the project boundary at time "t".
scenario (ton C)

As indicated in section I, paragraph 4, if the value of any of these two indicators is larger than 50% net anthropogenic removals by sinks cannot be estimated.

If project participants consider that the use of fertilizers would be significant leakage of N_2O (>10% of the net anthropogenic GHG removals by sinks) emissions should be estimated in accordance with the "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories" of the Intergovernmental Panel on Climate Change (2000) (hereafter referred as IPCC GPG).

Ex ante estimation of net anthropogenic GHG by sinks

"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.

Net anthropogenic GHG removals = actual net GHG removals by sinks– baseline net GHG removals - leakage

The resulting t-CERs at the year of verification "tv" are calculated as follows:

$t\text{-}CER_{(tv)} = 44/12 * (N_{(tv)} - B_{(tv)} - L_{(tv)})$ (10)

if changes in carbon stock are considered to be equal to zero, then $B_{(tv)} = B_{(t=0))}$ and

$L_{(tv)} = 0.15 * N_{(tv)}$ (11)

The resulting l-CERs at the year of verification "tv" are calculated as follows:

$l\text{-}CER_{(tv)} = 44/12 * [(N_{(tv)} - N_{(tv-\kappa)}) - L_{(tv)}]$ (12)

with $L_{(tv)} = 0.15 * (N_{(tv)} - N_{(tv-\kappa)})$ (13)
and $N_{(tv-\kappa)} = N_{(t=0)}$ for the first verification (14)

where:
$t\text{-}CER_{(tv)}$ = t-CERs emitted at time of verification "tv" (t CO_2)
$l\text{-}CER_{(tv)}$ = l-CERs emitted at time of verification "tv" (t CO_2)
$N_{(tv)}$ = Carbon stocks in the living biomass pools within the project boundary at time of verification "tv" under project scenario (t C)

$B_{(tv)}$ = Carbon stock in the living biomass pools within the project boundary at time of verification "tv" that would have occurred in the absence of the project activity (t C)
$L_{(tv)}$ = Leakage attributable to the project activity within the project boundary at time of verification "tv" (t C)
tv = Year of verification
κ = Time span between two verifications
44/12 = Conversion factor from ton C to ton CO_2 equivalent (t CO_2/t C)

Project participants should provide in the CDM-SSC-AR-PDD a projection of the net anthropogenic GHG removals as t-CERs or l-CERs for all crediting periods.

Simplified Monitoring Methodology for Small-scale AR-CDM Projects

Ex post estimation of the baseline net GHG removals by sinks

In accordance with paragraph 6 of appendix B to decision 14/CP.10, no monitoriNGOf the baseline is requested. Baseline net greenhouse gas removals by sinks for the monitoring methodology will be the same as the projection of this element using the simplified baseline methodology above.

Ex post estimation of the actual net GHG removals by sinks

Before performing the sampling to determine any changes in carbon stocks, project participants need to measure and monitor the area that has been planted. This can be performed through, for example, on-site visits, analysis of cadastral information, aerial photographs or satellite imagery of adequate resolution.

Once project participants have selected the method to monitor the area that has been planted, this method should be used to monitor the performance of the planted areas throughout the project activity. If significant underperformance is detected, changes in carbon stock from such areas shall be assessed as a separate stratum.

Carbon stocks shall be estimated through stratified random sampling procedures and the following equations:

$P_{(t)} = \Sigma((P_{A(t)\,i} + P_{B(t)\,i}) * A_i)$ (15)

where:
$P_{(t)}$ = Carbon stocks within the project boundary at time “t” achieved by the project activity (ton C)
$P_{A(t)\,i}$ = Carbon stocks in aboveground biomass at time “t” of stratum i achieved by the project activity during the monitoring interval (ton C/ha)
$P_{B(t)\,i}$ = Carbon stocks in belowground biomass at time “t” of stratum i achieved by the project activity during the monitoring interval (ton C/ha)
A_i = Project activity area of stratum i (ha)

Stratification for sampling shall be the same as the stratification for the ex ante estimation of the actual net GHG removals by sinks, above. The following calculations will be performed for each stratum:

For above-ground biomass

$P_{A(t)} = E_{(t)} * 0.5$ (16)

where:

$E_{(t)}$ = Above-ground biomass (tonnes of dry matter/ha) at time "t" achieved by the project activity
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter

$E_{(t)}$ shall be estimated through the following steps:

a) **Step 1:** Design a statistically sound sampling procedure. Such procedures should be designed according to the standard methods described in the IPCC GPG for LULUCF section 4.3.3.4. Additional strata should be considered subsequently for areas affected by fires and pests. This procedure includes the specification of the number, type and size of permanent plots and should be described in the CDM-SSC-AR-PDD. In doing so, the allowed precision target for monitoring shall be not larger than +/- 10% , at a 95% confidence level for the mean.
b) **Step 2:** Establish and mark permanent plots and document their location in the first monitoring report.
c) **Step 3**: Perform measurements of DBH or DBH and tree height, as appropriate, which should be reflected in the monitoring reports.
d) **Step 4:** Estimate the above ground biomass (AGB) using allometric equations developed locally or nationally. If these allometric equations are not available:

   i) Option 1: Use of allometric equations included in Attachment C to this report or in Annex 4A.2 of IPCC GPG for LULUCF.
   ii) Option 2: Use of Biomass Expansion Factors and stem volume as follows:

$E_{(t)} = SV * BEF * WD$ (17)

where:
SV = Stem volume (in m^3/ha)
WD = Basic wood density (in tonnes of dry matter/m^3).
BEF = Biomass expansion factor (over bark) from stem volume to total volume (dimensionless)

Project participants shall use the default BEF proposed by IPCC GPG for LULUCF, specifically for tropical broad-leaved species, in order to obtain a conservative estimate of total biomass.

SV shall be estimated from on site measurements using the appropriate parameters (such as DBH or DBH and height). Consistent application of BEF should be secured on the definition of stem volume (e.g. total stem volume or thick wood stem volume require different BEFs).

Documented local values for WD 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 table 3A.1.9 of IPCC GPG for LULUCF.

For below-ground biomass
$P_{B(t)}$ shall be estimated as follows:

$P_{B(t)} = E_{(t)} * R * 0.5$ (18)

where:
R = Root to shoot ratio (dimensionless)
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter

Documented national values for R should be used. If national values are not available, the values should be obtained from table 3A.1.8 of IPCC GPG for LULUCF.

If root-to-shoot ratios for the species concerned are not available, project proponents shall use the allometric equation developed by Cairns et al. (1997):

$P_{B(t)} = \exp(-7747 + 0.8836 * \ln E_{(t)}) * 0.5$ (19)

Ex post estimation of leakage

Exept for the default leakage from anaerobic decomposition of organic matter, the following leakage shall be estimated.
In order to estimate leakage, project participants shall monitor, for each monitoring period, each of the following indicators:
a) Percentage of families/households of the community involved in or affected by the project activity displaced due to the implementation of the project activity;
b) Percentage of total production of the main produce (e.g.fish, crab) within the project boundary displaced due to the CDM A/R project activity.

If the value of these two indicators for the specific monitoring period is lower than 10%, then
$L_{(t)} = 0$

where:
$L_{(t)}$ = Leakage attributable to the project activity within the project boundary at time "t".

If the value of any of these two indicators is higher than 10% and less than or equal to 50%, then leakage shall be equal to 15% of the actual net GHG removals by sinks, that is:

$L_{(t)} = P_{(t)} * 0.15$ (20)

where:
$L_{(t)}$ = Leakage attributable to the project activity within the project boundary at time "t".
$P_{(t)}$ = Carbon stocks in the living biomass pools within the project boundary at time "t" under project scenario (ton C)

As indicated in section I, paragraph 4, if the value of any of these two indicators is larger than 50%

net anthropogenic removals by sinks cannot be estimated.

If project participants consider that the use of fertilizers would be significant leakage of N_2O (>10% of the net anthropogenic removals by sinks) emissions should be estimated in accordance with the IPCC GPG.

Ex post estimation of the net anthropogenic GHG removals by sinks

"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.

Net anthropogenic GHG removals = Actual net GHG removals by sinks– baseline net GHG removals -leakage

The resulting t-CERs at the year of verification "tv" are calculated as follows:

$t\text{-}CER_{(tv)} = 44/12 * (P_{(tv)} - B_{(tv)} - L_{(tv)})$ (21)

if the changes in carbon stock in the baseline are considered to be zero, then $B_{(tv)} = B_{(t=0)}$ and

$L_{(tv)} = 0.15 * P_{(tv)}$ (if required; see paragraph 27 above) (22)

The resulting l-CERs at the year of verification "tv" are calculated as follows:

$l\text{-}CER_{(tv)} = 44/12 * [(P_{(tv)} - P_{(tv-\kappa)}) - L_{(tv)}]$ (23)
with $L_{(tv)} = 0.15 * (P_{(tv)} - P_{(tv-\kappa)})$ (if required; see paragraph 27 above) (24)
and $P_{(tv-\kappa)} = P_{(t=0)} = B_{(t=0)}$ for the first verification (25)

where:
$t\text{-}CER_{(tv)}$ = t-CERs emitted at time of verification "tv" (t CO_2)
$l\text{-}CER_{(tv)}$ = l-CERs emitted at time of verification "tv" (t CO_2)
$P_{(tv)}$ = Carbon stocks in the living biomass pools within the project boundary at time of verification "tv" under project scenario (t C)
$B_{(tv)}$ = Carbon stock in the living biomass pools within the project boundary at time of verification "tv" that would have occurred in the absence of the project activity (t C)
$L_{(tv)}$ = Leakage attributable to the project activity within the project boundary at time of verification "tv" (t C)
tv = Year of verification
κ = Time span between two verifications
44/12 = Conversion factor from ton C to ton CO_2 equivalent (t CO_2/t C)

Monitoring frequency

A 5-year monitoring frequency of the permanent sample plots established within the project boundary is needed for an appropriate monitoriNGOf above-ground and below-ground biomass.

Data collection

Data collection shall be organized taking into account the carbon pools measured, the sample frame used and the number of permanent plots to be monitored in accordance with the section on QA/QC below.

Table 1 and 2 outline the data to be collected to monitor the actual net GHG removals by sinks and leakage.

Table 1. Data to be collected or used in order to monitor the verifiable changes in carbon stock in the carbon pools within the project boundary from the proposed small-scale AR-CDM project activity, and how this data will be archived:

Data variable	Source	Data unit	Measured (m), calculated (c) or estimated (e)	Frequency	Proportion	Archiving	Comment
Location of the areas where the project activity has been implemented	Field survey or cadastral information or aerial photographs or satellite imagery	Lat-long	(m)	5 years	100%	Electronic, paper, photos	GPS can be used for field survey.
Ai - Size of the areas where the project activity has been implemented for each type of strata	Field survey or cadastral information or aerial photographs or satellite imagery or GPS	ha	(m)	5 years	100%	Electronic, paper, photos	GPS can be used for field survey.
Location of the permanent sample plots	Project maps and project design	Lat-long	defined	5 years	100%	Electronic, paper	Plot location is registered with a GPS and marked on the map.
Diameter at breast height (1.30 m)	Permanent plot	cm	(m)	5 years	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	Permanent plot	m	(m)	5 years	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 m3 fresh volume	(e)	once	3 samples per tree from base, middle and top of the stem of three individuals	Electronic, paper	
Total CO_2	Project activity	Mg	(c)	5 years	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 this data will be archived:

Data variable	Source	Data unit	Measured (m), calculated (c) or estimated (e)	Frequency	Proportion	Archiving	Comment
Percentage of families/households of the community involved in or affected by the project activity displaced due to the implementation of the project activity	Participatory survey	Number of families or households	(e)	5 years	%	Electronic	
Percentage of total production of the main produce (e.g. meat, corn) within the project boundary displaced due to the CDM A/R project activity.	Survey	Quantity (volume or mass)	(e)	5 years	%	Electronic	

Quality Control and Quality Assurance

As stated in the IPCC GPG for LULUCF (page 4.111) monitoring requires provisions for quality assurance (QA) and quality control (QC) to be implemented via a QA/QC plan. The plan shall become part of project documentation and cover procedures as described below for:

a) Collecting reliable field measurements;
b) Verifying methods used to collect field data;
c) Verifying data entry and analysis techniques; and
d) Data maintenance and archiving. Especially this point is important, also for small-scale AR-CDM project activities, as time scales of project activities are much longer than technological improvements of electronic data archiving. Each point of importance for small-scale AR-CDM project activities are treated in the following section.

Procedures to ensure reliable field measurements

Collecting reliable field measurement data is an important step in the quality assurance plan. Those responsible for the measurement work should be trained in all aspects of the field data collection and data analyses. It is good practice to develop Standard Operating Procedures (SOPs) for each step of the field measurements, which should be adhered to at all times. These SOPs describe in detail all steps to be taken of the field measurements and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the measurements in a consistent fashion. To ensure the collection and maintenance of reliable field data, it is good practice to ensure that:

a) Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible;
b) Field teams install test plots if needed in the field and measure all pertinent components using the SOPs to estimate measurement errors;
c) The document will list all names of the field team and the project leader will certify that the team is trained;
d) New staff are adequately trained.

Procedures to verify field data collection

To verify that plots have been installed and the measurements taken correctly, it is good practice to re-measure independently every 10 plots and to compare the measurements. The following quality targets should be achieved for the re-measurements, compared to the original measurements:

Missed or extra trees	no error within the plot
Tree species or groups	no error
D.B.H.	$< \pm$ 0,1 cm or 1% whichever is greater

Height	< ± 5%
Circular plot radius/sides of rectangular plot	< ± 1% of horizontal (angle-adjusted)

At the end of the field work check independently 10-20% of the plots. Field data collected at this stage will be compared with the original data. Any errors found should be corrected and recorded. Any errors discovered should be expressed as a percentage of all plots that have been rechecked to provide an estimate of the measurement error.

Procedures to verify data entry and analysis

Reliable carbon estimates require proper entry of data into the data analyses spreadsheets. Possible errors in this process can be minimized if the entry of both field data and laboratory data are cross-checked and, where necessary, internal tests incorporated into the spreadsheets to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data should be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot should not be used in the analysis.

Data maintenance and storage

Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) will be an important component of the work. Data archiving should take several forms and copies of all data should be provided to each project participant.

copies (electronic and/or paper) of all field data, data analyses, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports should all be stored in a dedicated and safe place, preferably offsite.

Given the time frame over which the project activity will take place and the pace of production of updated versions of software and new hardware for storing data, it is recommended that the electronic copies of the data and report be updated periodically or converted to a format that could be accessed by any future software application.

CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM FOR SMALL-SCALE AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-SSC-AR-PDD)
Once amendments or new simplified methodologies have been approved this document needs to be updated

CONTENTS

Annexes

SECTION A. General description of the proposed small-scale A/R CDM project activity:

A.1. Title of the proposed small-scale A/R CDM project activity:

Low income community mangrove reforestation project in Fiji

A.2. Description of the proposed small-scale A/R CDM project activity:

The project activity aims to remove CO_2 through reforestation of mangrove along coastal zones in Lomawai village, south west of Vitilevu Island. The expected area subject to plantation is 250 ha, and estimated amount of CO_2 removal during the 30 year period for this project is 112,608 t CO_2. The project activity well qualifies for small scale AR CDM scheme since the expected annual removal of the project activity is estimated to be 3,750 tCO_2 under the threshold value of 8,000 t CO_2 per annum. It also satisfies the other requirement of SS AR CDM project activity for involvement of low income community.

This project scheme is expected to provide a number of benefits to its surrounding environment, society, and economy. Planting mangrove could result in not only removal of CO2 but alleviate erosion of coastal line. The project activity will produce synergetic effects by fulfilling both “countermeasures against global warming” and “adaptation” at the same time. In other words, addressing socioeconomic issues and environmental conservation will mutually create a positive cycle, and the continuance of project activity will contribute to the sustainable development of the host country especially the local communities.

In addition to the abovementioned benefits, the project activity would contribute to the following benefits:

1) Improving fish catches (fish, prawn, crabs etc) with habitat formation through mangrove forests,
2) Creation of employment from plantation and management,
3) Increase revenue (land lease costs) for land owner from land lease income,
4) Adaptation to global warming (dissolve the vulnerability caused by coastal erosion due to sea level rise),
5) Breakwater against Tsunamis (demonstrated by Sumatra earthquake),
6) Protection and improvement of biodiversity,
7) Building capacity (acquiring knowledge and skills necessary for plantation and management),
8) Effective use as tourism resource

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*)	Kindly indicate if the Party involved wishes to be considered as project

	(as applicable)	participant (Yes/No)
Republic of the Fiji Islands (host)	Salt Committee of Lomawai village	No
Japan	Taishi Design Office Co. Ltd	No

A.4. Technical description of the small-scale A/R CDM project activity:

A.4.1. Location of the proposed small-scale A/R CDM project activity:

A.4.1.1. Host Party(ies):

Republic of the Fiji Islands

A.4.1.2. Region/State/Province etc.:

Viti Levu Island

A.4.1.3. City/Town/Community etc:

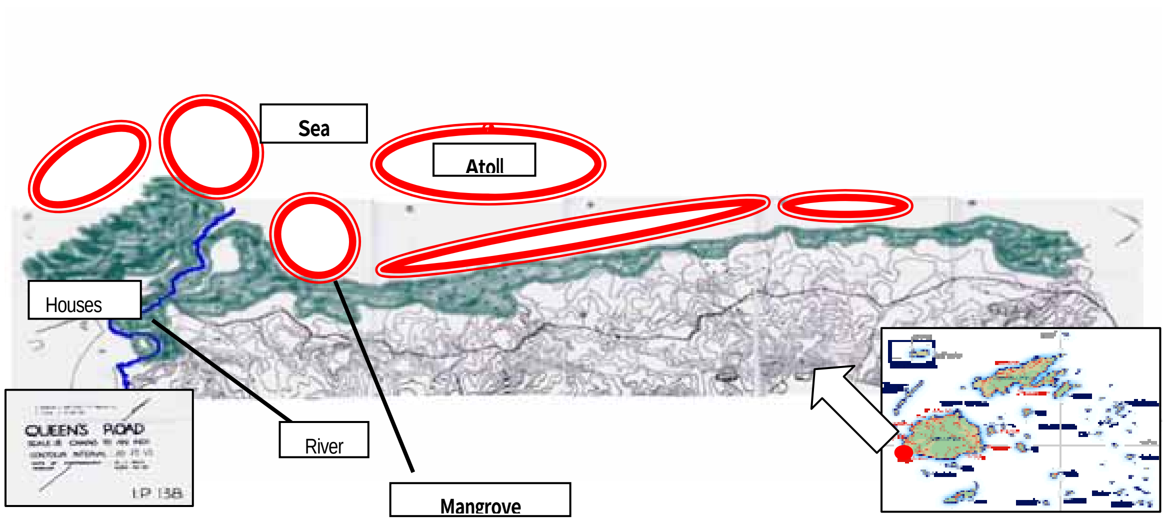
Lomawai village

Figure 1: Map of the project site

Source: Fiji Government Online Portal (http://www.fiji.gov.fj/publish/fiji_map.shtml)

A.4.1.4. Detail of geographical location and project boundary, including information allowing the unique identification(s) of the proposed small-scale A/R CDM project activity:

The project activity covers five different sites totaling 250 ha along the coastal area of Lomawai village. The figure below shows candidate sites for reforestation of mangrove. The coordinates of the exact project sites will be recorded with unique ID numbers on each. The boarders will be either clearly marked on the ground with stakes or with other physical borders including sea shore lines and rivers.



A.4.1.5. A description of items on present environmental conditions of the area, which include information on climate, soils, main watershed, ecosystems, and the possible presence of rare or endangered species and their habitats:

Fiji lies in the center of the Pacific Ocean midway between the Equator and the South Pole and between longitudes 174°East and 178°West of Greenwich and latitudes 12° S and 22° south. Fiji's Exclusive Economic Zone contains approximately 330 islands of which about a - third are inhabited. It covers about 1.3 million square kilometers of the South Pacific Ocean. Fiji's total land area is 18,333 square kilometers. There are two major islands - Viti Levu which is 10,429 square kilometers and Vanua Levu 5.556 square kilometers. Other main islands are Taveuni (470 sq km), Kadavu (411 sq km), Gau (140 sq km) and Koro (104 sq km). 87.9% of land is owned by indigenous Fijians while 3.9% is State land. Freehold land comprises 7.9% and Rotuman land is 0.3%. The capital is Suva and it is one of the two cities in Fiji. The other city is Lautoka and both are located on the island of Viti Levu.

Climate:

Fiji has tropical marine climate with only slight seasonal temperature variation. Maritime climate moderates the temperature of Fiji. It has rainy season during months of November to April and dry season during May to October. The temperature drops slightly during the dry season with the trade wind.

Precipitation in Fiji varies in areas. The notable characteristics are higher precipitation in eastern part and lower in western part of the country. In the eastern part, squall frequently brings abundant rainfall amounts up to 3,000mm per annum while in western part, drier climate persists with precipitation ranges 1,600 - 2,000mm per annum.

Geology:
Before the Late Miocene, roughly 8 million years (Ma) ago, the Pacific crust was subducted from the east along this plate boundary, with Fiji forming part of an extended Outer Melanesian island arc system, the Vityaz arc, that incorporated the Solomon Islands, New Hebrides, Fiji and Tonga island arcs. Remnants of this subduction zone are preserved as part of the Vityaz Trench, whilst Eocene-Miocene cores of the ancient arc system form part of the geological basement in Tonga ('Eua), Fiji (Viti Levu) and Vanuatu.

Subduction along the Vityaz arc-trench system was partially blocked through the arrival of a thick sequence of oceanic crust (Ontong Java Plateau) at the portions of the trench along the Solomon Islands and northern New Hebrides. Subduction was effectively immobilized and later reversed in the areas to the north and west of the Fiji arc. Shortly after this reversal, back-arc spreading began to the west of Fiji, forming the North Fiji Basin, with clockwise rotation of the New Hebrides Arc to the southwest, away from Fiji, and anticlockwise rotation of the Fiji Platform.

Further breakup of the arc occurred in more recent times (about 5.5 Ma) with the initiation of intra-arc extension behind the Tonga Trench. This caused the opening of the Lau Basin, separating the remnant Lau Ridge from the active Tofua Arc in Tonga.

Flora/Fauna:
Fiji's flora and fauna are relatively few in number but are of exceptional scientific interest because of the higher proportion of endemic forms - i.e. those found no where else in the world. Ten per cent of the 476 indigenous Fijian plant species identified are endemic. Fiji also has a few rare reptiles and birds. Notable of this, is the Crested Iguana, found only in some parts of Fiji namely Yadua Taba in Bua and the Yasawas. Other rare species include the Fiji burrowing snake, Fiji petrel, the pink billed parrot finch, the red throat lorikeet and the long legged warbler.

A.4.2. Species and varieties selected:

In the project activity, the following mangrove species are planned to be used for reforestation over 250 ha.
Bruguiera gymnorrhiza (local name: Lai Lai),
Rhizophora samoensis(local name: Togo dina) and
Rhizophora stylosa (local name: Togo voli)

A.4.3. Specification of the greenhouse gases (GHG) whose emissions will be part of the proposed small-scale A/R CDM project activity:

The potential sources of GHG emissions resulting from project activity are CO_2 and CH_4 (methane). Those gases would result from the following activities:

- CO_2: It would be emitted from transportation of seedlings and labor to atolls and intertidal zones of project sites. It would be calculated from fuel consumption of using a boat.
- CH_4: Methane emissions would result from anaerobic digestion of organic matter which fall into water. The calculation of the methane emissions would be done applying default leakage calculation proposed in the attached simplified methodology, which is 15% of the actual GHG removals by the project.

	Source	Gas		Justification / Explanation
Project Activity	On-site fossil fuel consumption due to the project activity	CO_2	Included	May be an important emission source
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Decomposition of organic material under water	CO_2	Excluded	Excluded for simplification.
		CH_4	Included	Default value is applied to estimate the amount.
		N_2O	Excluded	Excluded for simplification.

A.4.4. Carbon pools selected:

AGB and BGB

A.4.5. Assessment of the eligibility of land:

According to the result of participatory rural appraisal study conducted by the project participants, the areas of the land have not been forest since the end of 1989 till present. Therefore, the project sites are eligible for AR CDM project activity.

Although Fijian government has not released its values for forest definition, the area which will be forested has no trees and would not be classified as forest land. At the same time, mangrove forest reforested through this project activity will have crown density of more than 90% and tree height of around 5 meters in pieces of land which has more than 1 ha at minimum. This would satisfy the forest definition of the government in any ways.

A.4.6. A description of legal title to the land, current land tenure and land use and rights of access to the sequestered carbon:

The land is owned by the near by community Lomawai village. The representative for the communal management for the land is the local Salt Committee which has communal right over the sites.

A.4.7. Type(s) of small-scale A/R CDM project activity:

Reforestation project in wetland

A.4.8. Technology to be employed by the proposed small-scale A/R CDM project activity:

The project activity employs the direct seeding method for planting mangrove seeds. The seeds are collected from nearby seed orchards and the collected seeds are directly planted into intertidal zones with in the project boundary.
Depending on species, the project participants plan to establish a nursery to grow seedlings to be able to harden them to have more adaptability of the mangrove when planting.

The below photo shows planted seeds of mangrove in an intertidal zone.

Figure 2: Planted seeds in an intertidal zone

A.4.9. Approach for addressing non-permanence:

In addressing the issue of non-permanence, project participants have chosen the issuance of lCERs for the net anthropogenic GHG removals by sinks achieved by the proposed A/R CDM project activity.

A.4.10. Duration of the proposed small-scale A/R CDM project activity / Crediting period:

Duration of the proposed project activity: 30 years
Crediting period: 30 years

A.4.10.1. Starting date of the proposed small-scale A/R CDM project activity and of the (first) crediting period, including a justification:

2006

A.4.10.2. Expected operational lifetime of the proposed small-scale A/R CDM project activity:

At least 30 years

A.4.10.3. Choice of crediting period and related information:

The crediting period chosen for the project is 30-years.

A.4.10.3.1. Renewable crediting period, if selected:

This option is not selected.

A.4.10.3.1.1. Starting date of the first crediting period:

This option is not selected.

A.4.10.3.1.2. Length of the first crediting period:

This option is not selected.

A.4.10.3.2 Fixed crediting period, if selected:

A.4.10.3.2 .1. Starting date:

2006

A.4.10.3.2.2. Length:

30 years

A.4.11. Brief explanation of how the net anthropogenic GHG removals by sinks are achieved by the proposed small-scale A/R CDM project activity, including why these would not occur in the absence of the proposed small-scale A/R CDM project activity, taking into account

national and/or sectoral policies and circumstances:

* How the net anthropogenic GHG removals by sinks are achieved:
The project sites are barren coastal land where no vegetation has been recognized. The project activity are to reforest the area where no vegetation exists and this would result in net anthropogenic GHG removals by sinks.

*Why these would not occur in the absence of the proposed small-scale A/R CDM project activity:
This would not occur in the absence of the proposed small-scale A/R CDM project activity because in the project area, there is no custom to plant mangroves and planting mangroves would cost labor, time and money to the local people who live off subsistence economy. The Lomawai village is not connected to the grid system and most people engage in fishery and agriculture and would not be able to afford spending time and labor to planting mangroves which would not give them direct and benefits in the short term.
Without incentives to gain income from sales of lCERs, it would be impossible to implement project activity.

A.4.11.1. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

Expected net anthropogenic GHG removals by the sinks during the crediting period (30 years) are 112,608 t CO_2. The annual net anthropogenic GHG removals by the sinks are expected to be 3,754 t CO_2.

Years	Annual net anthropogenic GHG removals by sinks in tonnes of CO_2e
2006	979
2007	1,958
2008	2,938
2009	3,917
2010	4,896
2011	4,896
2012	4,896
2013	4,896
2014	4,896
2015	4,896
2016	4,896
2017	4,896
2018	4,896
2019	4,896
2020	4,896
2021	4,896
2022	4,896

2023	4,896
2024	4,896
2025	4,896
2026	4,896
2027	4,896
2028	4,896
2029	4,896
2030	4,896
2031	0
2032	0
2033	0
2034	0
2035	0
Total estimated net anthropogenic GHG removals by sinks (tonnes of CO2e)	112,608
Total number of crediting years	30
Annual average over the crediting period of estimated net anthropogenic GHG removals by sinks (tonnes of CO2e)	3,754

A.4.12. Public funding of the proposed small-scale A/R CDM project activity:

No public funding is involved in the project activity.

A.4.12.1. Confirmation that the small-scale A/R CDM project activity is not a debundled component of a larger project activity:

None of the project participants has experience in developing small-scale A/R CDM project activity, therefore, there is no project occurring in the past developed by them or there is no project nearby the proposed project activity.

SECTION B. Application of a baseline and monitoring methodology :

B.1. Title and reference of the approved baseline and monitoring methodology applied to the proposed small-scale A/R CDM project activity:

Small scale baseline and monitoring methodology for afforestation and reforestation project in intertidal zone

B. 2. Justification of the choice of the methodology in Appendix B of the CDM simplified modalities and procedures for small-scale A/R project and its applicability to the proposed small-scale A/R CDM project activity:

The proposed A/R CDM project activity can apply the proposed methodology because:

- The baseline approach "Existing or historical, as applicable, changes in carbon stock in the carbon pools within the project boundary" is the most appropriate option for determination of the baseline scenario for the proposed project activity.
- The type of the proposed project activity is mangrove reforestation in intertidal zones and the methodology is designed for the same type of project activities.
- Changes expected in the carbon pools are limited to above-ground and below-ground biomass which meets the structure of the methodology.

B. 3. Application of baseline methodology to the proposed small-scale A/R CDM project activity:

Assessment of significant changes in carbon stocks

For the proposed project activity, baseline net GHG removals by sinks are assumed to be zero.
In order to assess if significant changes in the baseline carbon stocks within the project boundary have occurred in absence of the project activity, project participants shall assess whether changes in carbon stocks in the baseline land-use type (wetland), in particular the living biomass of woody perennials[7] (above- and below-ground biomass) and below-ground biomass of wetlands, are expected to be significant and provide documentation to prove this, for example, by expert judgement. Based on the results of this assessment:

d) If significant changes in the carbon stocks, in particular the living biomass of woody perennials (above- and belowground biomass) and below-ground biomass in wetlands, are not expected to occur in the absence of the project activity, the changes in carbon stocks shall be assumed to be equal to zero.
e) If the carbon stock in the living biomass of woody perennials (above- and belowground biomass) or below-ground biomass in wetlands is expected to decrease in the absence of the project activity, the baseline net greenhouse gas removals by sinks shall be assumed to be equal to zero,
In above case, the baseline carbon stocks in the carbons pools are constant at the level of existing carbon stock measured at the start of the project activity.
f) Otherwise, baseline net greenhouse gas removals by sinks shall be equal to the changes in carbon stocks from the living biomass of woody perennials (above- and below-ground biomass) or belowground biomass in wetlands that are expected to occur in the absence of the project activity and shall be estimated using the methodology below.

[7] Woody perennials consist of the non-tree vegetation and shrubs that are present in wetlands below the threshold (in terms of canopy cover, minimum area and tree height) used to define forests.

The project sites for the project activity have no vegetation and there would be no significant change of carbon pools as they had been constant over the decades.
The project activity has determined the baseline net GHG removals by sinks to be zero.

Stratification of the project area

As suggested in the methodology, estimating the baseline net GHG removals by sinks should proceed in accordance with section 4.3.3.2 of the "Good Practice Guidance for Land Use, Land-Use Change and Forestry" of the Intergovernmental Panel on Climate Change (2003). It suggests to collect basic background information and data about the important bio-physical, and socio-economic characteristics of the project area. The information and data include, e.g.,: land-use history; maps of soil, vegetation, and topography; and land ownership. The following formula is applied to estimate baseline net GHG removals by sinks.

For the project activity, all the areas subject to reforestation have high similarities as they are all intertidal zones of the coast line.
Land use history has been the same for all the sites. They have been barren land as tidal range rises and falls and no vegetation could have occupied the sites. Local community has not been using the sites as it is not suitable for agriculture or other uses.
The most sites have the similar soil property. Soil type can be classified as mud clay which contains reduced sulfides
Topography is also similar in many of the sites as they situate along the coastal line, the sites are flat with no inclination.

Estimating the baseline net GHG removals by sinks

Baseline net GHG removals by sinks will be determined by the equation:

$B_{(t)} = \Sigma_i (B_{A(t),t} + B_{B(t),i}) * A$ (1)

where:
$B_{(t)}$ = Carbon stock in the living biomass pools within the project boundary at time "t" that would have occurred in the absence of the project activity (t C)
$B_{A(t)\,i}$ = Carbon stocks in aboveground biomass at time "t" of stratum i that would have occurred in the absence of the project activity (t C/ha)
$B_{B\,(t)\,i}$ = Carbon stocks in belowground biomass at time "t" of stratum i that would have occurred in the absence of the project activity (t C/ha)
A_i = Project activity area of stratum i (ha)

Actual net greenhouse gas removals by sinks
"Actual net GHG removals by sinks" only considers the changes in carbon pools for the project scenario

(please refer to paragraph 8 above). The stocks of carbon for the project scenario at the starting date of the project activity[8] (i.e. t=0) shall be the same as for the projection of the baseline net greenhouse gas removals by sinks at t=0. For all other years, the carbon stocks within the project boundary at time "t" ($N_{(t)}$) shall be calculated as follows:

$$N_{(t)} = \Sigma((N_{A(t)\,i} + N_{B\,(t)\,i}) * A_i) \quad (5)$$

where:
$N_{A(t)\,i}$ = Carbon stocks in aboveground biomass at time "t" of stratum i under the project scenario (t C/ha)
$N_{B(t)\,i}$ = Carbon stocks in belowground biomass at time "t" of stratum i under the project scenario (t C/ha)
A_i = Project activity area of stratum i (ha)

Stratification for the project scenario shall be undertaken in accordance with section 4.3.3.2 of the IPCC GPG for LULUCF. The following calculations shall be performed for each stratum:

B. 3. 1. Description of how the actual net GHG removals by sinks are increased above those that would have occurred in the absence of the registered small-scale A/R CDM project activity:

As briefly mentioned in the Section, the followings are the reasons can be explained:

How the net anthropogenic GHG removals by sinks are achieved:
The project sites are barren coastal land where no vegetation has been recognized. The project activity is to reforest the area where no vegetation exists and this would result in net anthropogenic GHG removals by sinks.
As discussed in the previous section, the baseline net GHG removals by sinks are assumed to be zero since there has been no vegetation on the proposed project sites and would no vegetation in the future because the sites proposed are highly saline land where no plants can survive except mangrove. Mangroves would not be planted because of the following reasons.

Why these would not occur in the absence of the proposed small-scale A/R CDM project activity:
The reforestation of mangroves would not occur in the absence of the proposed small-scale A/R CDM project activity because of the following reasons:
1) In the project area, there is no custom to plant mangroves. There would be customary barrier in terms of planting mangroves which no body in the area has done. At the same time, local people do not have knowledge for regeneration of mangrove forest.

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8 The starting date of the project activity should be considered to be the point in time when the land is prepared for the initiation of the afforestation or reforestation project activity. 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 or reforestation project activity under the CDM.

2) There would be financial barrier to start the project activity. Planting mangroves would cost labor, time and money to the local people who live off subsistence economy. The local people would not have difficulty in obtaining loans for project activity which would not give them enough return to pay back the interest rates.

3) In addition, the Lomawai village is not connected to the grid system and most people engage in fishery and agriculture and would not be able to afford spending time and labor to planting mangroves which would not give them direct benefits in the short term.

For the small-scale A/R CDM project activity, project participants need to demonstrate that the project activity faces one barrier out of barriers listed in the Attachment B. Above barriers would satisfy the demonstration of additionality.
Without incentives to gain income from sales of lCERs, it would be impossible to implement project activity.

B.3.2. Detailed baseline information, including the date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline:

Completion of the baseline study:
Date of 1 March 2006

Name of person(s)/entity(ies) determining the baseline:
- Namio Tani
  Taishi Design Office Co. Ltd

- Pacific Consultants Co., Ltd.

B.4. Application of monitoring methodology and plan to the small-scale A/R CDM project activity:

Ex post estimation of the baseline net GHG removals by sinks

In accordance with paragraph 6 of appendix B to decision 14/CP.10, no monitoriNGOf the baseline is requested. Baseline net greenhouse gas removals by sinks for the monitoring methodology will be the same as the projection of this element using the simplified baseline methodology above.

Ex post estimation of the actual net GHG removals by sinks

Before performing the sampling to determine any changes in carbon stocks, project participants need to measure and monitor the area that has been planted. This can be performed through, for example, on-site visits, analysis of cadastral information, aerial photographs or satellite imagery of adequate resolution.

Once project participants have selected the method to monitor the area that has been planted, this method should be used to monitor the performance of the planted areas throughout the project activity. If significant underperformance is detected, changes in carbon stock from such areas shall be assessed as a separate stratum.

Carbon stocks shall be estimated through stratified random sampling procedures and the following equations:

$P_{(t)} = \Sigma((P_{A(t)\,i} + P_{B(t)\,i}) * A_i)$ (15)

where:
$P_{(t)}$ = Carbon stocks within the project boundary at time "t" achieved by the project activity (ton C)
$P_{A(t)\,i}$ = Carbon stocks in aboveground biomass at time "t" of stratum i achieved by the project activity during the monitoring interval (ton C/ha)
$P_{B(t)\,i}$ = Carbon stocks in belowground biomass at time "t" of stratum i achieved by the project activity during the monitoring interval (ton C/ha)
A_i = Project activity area of stratum i (ha)

B.4.1 Data to be monitored: Monitoring of the actual net GHG removals by sinks and leakage.

B.4.1.1. Actual net GHG removals by sinks data:

Table 1. Data to be collected or used in order to monitor the verifiable changes in carbon stock in the carbon pools within the project boundary from the proposed small-scale AR-CDM project activity, and how this data will be archived:

Data variable	Source	Data unit	Measured (m), calculated (c) or estimated (e)	Frequency	Proportion	Archiving	Comment
Location of the areas where the project activity has been implemented	Field survey or cadastral information or aerial photographs or satellite imagery	Lat-long	(m)	5 years	100%	Electronic, paper, photos	GPS can be used for field survey.
Ai - Size of the areas where the project activity has been implemented for each type of strata	Field survey or cadastral information or aerial photographs or satellite imagery or GPS	ha	(m)	5 years	100%	Electronic, paper, photos	GPS can be used for field survey.

Location of the permanent sample plots	Project maps and project design	Lat-long	defined	5 years	100%	Electronic, paper	Plot location is registered with a GPS and marked on the map.
Diameter at breast height (1.30 m)	Permanent plot	cm	(m)	5 years	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	Permanent plot	m	(m)	5 years	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 m3 fresh volume	(e)	once	3 samples per tree from base, middle and top of the stem of three individuals	Electronic, paper	
Total CO2	Project activity	Mg	(c)	5 years	All project data	Electronic	Based on data collected from all plots and carbon pools

B.4.1.2 Data for treatment of leakage (if applicable)

Leakage from fallen organic material into water is estimated to be 15% of the total estimated actual net GHG removals by sinks. Other data for leakage shall be collected following the data listed in the table below.

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

Data variable	Source	Data unit	Measured (m), calculated (c) or estimated (e)	Frequency	Proportion	Archiving	Comment
Percentage of families/households of the community involved in or affected by the project activity displaced due to the implementation of the project activity	Participatory survey	Number of families or households	(e)	5 years	%	Electronic	
Percentage of total production of the main produce (e.g. meat, corn) within the project boundary displaced due to the CDM A/R project activity.	Survey	Quantity (volume or mass)	(e)	5 years	%	Electronic	

B.4.2. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

As explained in the methodology, the following points shall be taken into consideration for QC and QA procedures.

Quality Control and Quality Assurance

As stated in the IPCC GPG for LULUCF (page 4.111) monitoring requires provisions for quality assurance (QA) and quality control (QC) to be implemented via a QA/QC plan. The plan shall become part of project documentation and cover procedures as described below for:

a) Collecting reliable field measurements;
b) Verifying methods used to collect field data;
c) Verifying data entry and analysis techniques; and
d) Data maintenance and archiving. Especially this point is important, also for small-scale AR-CDM project activities, as time scales of project activities are much longer than technological improvements of electronic data archiving. Each point of importance for small-scale AR-CDM project activities are treated in the following section.

Procedures to ensure reliable field measurements

Collecting reliable field measurement data is an important step in the quality assurance plan. Those responsible for the measurement work should be trained in all aspects of the field data collection and data analyses. It is good practice to develop Standard Operating Procedures (SOPs) for each step of the field measurements, which should be adhered to at all times. These SOPs describe in detail all steps to be taken of the field measurements and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the measurements in a consistent fashion. To ensure the collection and maintenance of reliable field data, it is good practice to ensure that:

a) Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible;

b) Field teams install test plots if needed in the field and measure all pertinent components using the SOPs to estimate measurement errors;
c) The document will list all names of the field team and the project leader will certify that the team is trained;
d) New staff are adequately trained.

Procedures to verify field data collection

To verify that plots have been installed and the measurements taken correctly, it is good practice to re-measure independently every 10 plots and to compare the measurements. The following quality targets should be achieved for the re-measurements, compared to the original measurements:

Missed or extra trees	no error within the plot
Tree species or groups	no error
D.B.H.	< ± 0,1 cm or 1% whichever is greater
Height	< ± 5%
Circular plot radius/sides of rectangular plot	< ± 1% of horizontal (angle-adjusted)

At the end of the field work check independently 10-20% of the plots. Field data collected at this stage will be compared with the original data. Any errors found should be corrected and recorded. Any errors discovered should be expressed as a percentage of all plots that have been rechecked to provide an estimate of the measurement error.

Procedures to verify data entry and analysis

Reliable carbon estimates require proper entry of data into the data analyses spreadsheets. Possible errors in this process can be minimized if the entry of both field data and laboratory data are cross-checked and, where necessary, internal tests incorporated into the spreadsheets to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data should be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot should not be used in the analysis.

Data maintenance and storage

Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) will be an important component of the work. Data archiving should take several forms and copies of all data should be provided to each project participant.

copies (electronic and/or paper) of all field data, data analyses, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports should all be stored in a dedicated and safe place, preferably offsite.

Given the time frame over which the project activity will take place and the pace of production of updated versions of software and new hardware for storing data, it is recommended that the electronic copies of the data and report be updated periodically or converted to a format that could be accessed by any future software application.

B.4.3. Please describe briefly the operational and management structure(s) that the project operator will implement in order to monitor actual GHG removals by sinks by the proposed small-scale A/R CDM project activity:

The proposed project activity will be implemented by the representative organization Salt Committee from the local communities in conjunction with local NGO, Peace International Association Fiji, Pacific Rim Cultural and Educational Exchange Foundation and academia.
A special managing unit will be formed to address the issue of management of the project activity to monitor actual GHG removals by sinks by the proposed small-scale A/R CDM project activity.

University of the South Pacific (USP) will assist forest management of the reforested mangrove and in monitoring actual GHG removals by sinks by the proposed small-scale A/R CDM project activity.

Japanese experts will consult the local management unit and other project participants to assure management and monitoring.

B.4.4. Name of person/entity determining the monitoring methodology:

Name of person(s)/entity(ies) determining the baseline:

- Namio Tani
  Taishi Design Office Co. Ltd

- Pacific Consultants Co., Ltd.

SECTION C. Estimation of net anthropogenic GHG removals by sinks:

C.1. Formulae used:

Net anthropogenic GHG removals = actual net GHG removals by sinks– baseline net GHG removals - leakage

The resulting l-CERs at the year of verification "tv" are calculated as follows:

$l\text{-}CER_{(tv)} = 44/12 * [(N_{(tv)} - N_{(tv-\kappa)}) - L_{(tv)}]$ (12)

with $L_{(tv)} = 0.15 * (N_{(tv)} - N_{(tv-\kappa)})$ (13)
and $N_{(tv-\kappa)} = N_{(t=0)}$ for the first verification (14)

where:
$t\text{-}CER_{(tv)}$ = t-CERs emitted at time of verification "tv" (t CO_2)
$l\text{-}CER_{(tv)}$ = l-CERs emitted at time of verification "tv" (t CO_2)
$N_{(tv)}$ = Carbon stocks in the living biomass pools within the project boundary at time of verification "tv" under project scenario (t C)

$B_{(tv)}$ = Carbon stock in the living biomass pools within the project boundary at time of verification "tv" that would have occurred in the absence of the project activity (t C)
$L_{(tv)}$ = Leakage attributable to the project activity within the project boundary at time of verification "tv" (t C)
tv = Year of verification
κ = Time span between two verifications
44/12 = Conversion factor from ton C to ton CO_2 equivalent (t CO_2/t C)

The estimated net anthropogenic GHG removals by sinks in tonnes of CO_2e are summarized in the table below.

Years	Annual net anthropogenic GHG removals by sinks in tonnes of CO_2e
2006	979
2007	1,958
2008	2,938
2009	3,917
2010	4,896
2011	4,896
2012	4,896
2013	4,896
2014	4,896
2015	4,896
2016	4,896
2017	4,896
2018	4,896
2019	4,896
2020	4,896
2021	4,896
2022	4,896
2023	4,896
2024	4,896
2025	4,896
2026	4,896
2027	4,896
2028	4,896
2029	4,896
2030	4,896
2031	0
2032	0
2033	0
2034	0
2035	0
Total estimated net anthropogenic GHG removals by sinks (tonnes of CO2e)	112,608
Total number of crediting years	30
Annual average over the crediting period of estimated net anthropogenic GHG removals by sinks (tonnes of CO2e)	3,754

C. 1.1. Description of formulae used for estimation of the actual net GHG removals by sinks due to the project activity within the project boundary:

The formula used to estimate the actual net GHG removals by sinks due to the project activity within the project boundary follow the method described in the methodology.

C. 1.2. Description of formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale A/R CDM project activities under CDM:

As described in the methodology, leakage is estimated using FOD method or multi-phase decay model which are both applied already in emission reduction projects especially for landfill gas recovery and organic composting. The following instructions, if amount of leakage falls within the defined range below, it can use the default value.

If project activities cause any leakage that may result from litter falling into ocean, and if tidal wave carries it outside the project boundary, possible emissions of CH_4 shall be considered as leakage.
The estimation of CH_4 emissions arising from litter shall be assumed 15% of the total actual net GHG removals by sinks, or if the data is available, the project participants can also apply the following procedure to estimate its leakage:

Step 1: Estimation of fallen litter into water body
Porject participants shall establish randam sampling plots in each stratum to collect fallen litter (e.g. through 1m square nets) for appropriate representation for appropriate time period. The collected litter then shall be converted to tones of organic matter per ha per annum.

Step 2: Estimation of potential CH_4 emission
The amount of CH_4 that would be emitted from organic matter shall be estimated using FOD method or multi-phase decay model approved in AM0025 (organic composting).

Step 3: Conversion of CH_4 to CO_2
The tons of CH_4 shall be converted to tons of CO_2 through multiplying GWP of 21.

If the derived amount of CO_2 is greater than 10% and less than 50% of actual net GHG removals by sinks, then leakage shall be equal to 15% of the actual net GHG removals by sinks

C. 1.3. Description of formulae used to estimate net anthropogenic GHG removals by sinks, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale A/R CDM project activities under CDM:

C. 2. Estimate of the actual net GHG removals by sinks:

Estimated sum of e actual net GHG removals by sinks is 132,480 t CO_2 over 30 years which result in annual removal of 4,416 t CO_2 /year.

C. 3. Estimated baseline net GHG removals by sinks:

As mentioned above, this equals to zero.

C. 4. Estimated leakage:

Estimated sum of leakage over 30 year period is 19,872 t CO_2 which result in annual emission of 662 CO_2.

C. 5.. The sum of C. 2. minus C.3 minus C.4 representing the net anthropogenic GHG removals by sinks of the proposed small-scale A/R CDM project activity:

The sum of C. 2 minus C.3 minus C.4 representing the net anthropogenic GHG removals by sinks of the proposed small-scale A/R CDM project activity is 112,608 t CO_2 over 30 years.

C. 6. Table providing values obtained when applying formulae above:

The table summarizing the results of the calculation is shown below.

Years	Estimation of baseline net GHG removals by sinks in tonnes of CO_2e	Estimation of actual net GHG removals by sinks in tonnes of CO_2e	Estimation of leakage in tonnes of CO_2e	Estimation of net anthropogenic GHG removals by sinks in tonnes of CO_2e
2006	0	1152	173	979
2007	0	2,304	346	1,958
2008	0	3,456	518	2,938
2009	0	4,608	691	3,917
2010	0	5,760	864	4,896
2011	0	5,760	864	4,896
2012	0	5,760	864	4,896
2013	0	5,760	864	4,896
2014	0	5,760	864	4,896
2015	0	5,760	864	4,896
2016	0	5,760	864	4,896
2017	0	5,760	864	4,896
2018	0	5,760	864	4,896
2019	0	5,760	864	4,896
2020	0	5,760	864	4,896
2021	0	5,760	864	4,896
2022	0	5,760	864	4,896
2023	0	5,760	864	4,896
2024	0	5,760	864	4,896
2025	0	5,760	864	4,896
2026	0	5,760	864	4,896
2027	0	5,760	864	4,896
2028	0	5,760	864	4,896
2029	0	5,760	864	4,896
2030	0	5,760	864	4,896
2031	0	0	0	0
2032	0	0	0	0
2033	0	0	0	0
2034	0	0	0	0
2035	0	0	0	0
Total (tonnes of CO2e)	**0**	**132,480**	**19,872**	**112,608**

SECTION D. Environmental impacts of the proposed small-scale A/R CDM project activity:

D. 1. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken an environmental impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to support documentation:

As mentioned in Section A.2, the project activity would not result in significant negative impact but result in the following positive impacts:

1) Improving fish catches (fish, prawn, crabs etc) with habitat formation through mangrove forests,
2) Adaptation to global warming (dissolve the vulnerability caused by coastal erosion due to sea level rise),
3) Breakwater against Tsunamis (demonstrated by Sumatra earthquake), and
4) Protection and improvement of biodiversity

SECTION E. Socio-economic impacts of the proposed small-scale A/R CDM project activity:

E. 2. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken a socioeconomic impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to support documentation:

From the socio-economic impact study conducted by the project participants, no negative impacts were found. The local community people are well aware of the climate change and faces sea level rise in everyday life. About 96% of the people have positive view on reforestation through the survey for 46 people. The reasons for this were mostly attributed to the image of reforestation conserving marine resources such as fish, crab and shrimps and expectation for new employment opportunities. The reasons for the motivation to participate in reforestation activity were the same.

SECTION F. Stakeholders' comments:

F. 1. Brief description of how comments by local stakeholders have been invited and compiled:

This section will be filled before validation.

F. 2. Summary of the comments received:

This section will be filled before validation.

F. 3. Report on how due account was taken of any comments received:

This section will be filled before validation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROPOSED SMALL-SCALE A/R CDM PROJECT ACTIVITY

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Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project activity does not involve public funding.

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