Low Income Community Mangrove Reforestation Project in Fiji
Executive Summary

1. Project Name
Low Income Community Mangrove Reforestation Project in Fiji

2. Participant Name
Taishi Design Office Co. Ltd

3. Host country/ Region
Republic of the Fiji Islands/ South-West of Vitilevu Island/ neighborhood of Lomawai village

4. Project Description

4.1. CDM approval regime and definitions related to A/R CDM in host country
This project is conducted along the coastal zones near Lomawai village, south west of Vitilevu Island, Fiji's main island where erosion is progressing. Its objective is to conserve the environment by mangrove reforestation. 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 100,892 tCO_2.

At the same time, a park, accessible for eco-tourism in the area in which mangrove plantation will be conducted, will be built and low income communities in host country will become subjects for management. With the environmental reforestation of mangrove as a core, increase of the incentive for continuous sustainable environment protection is aimed by establishing scheme to contribute social economy, such as creating local employment, and activating local economy. Followings are the main effectiveness of the reforestation of mangrove at target site.

(a) Conservation of coastal ecosystem
(b) Removal of GHG
(c) Creation of employment (attraction of eco-tourist by creating park at mangrove reforestation area, restitution of the benefit to the societies)
(d) Amelioration of living aquatic resources (contribution to the foundational stability by augmentation of the population of fish and shell-fish)
(e) Breakwater effect in case of the rise in sea level

4.2. Contribution of the proposed project to the sustainable development of the host country
This project accomplishes two main subjects "Adaptation", whose necessity has been recognized while no effective measures were implemented, and "CDM", which provide benefit to the society. Hence, its contribution to the sustainable development is expected to be significant. It is also anticipated that participation of the community to the project as a main body will help them recognizing its benefit and will lead to the conservation of forest, encouragement of reforestation and effective use of the mangrove forest. Followings are the contribution to the host country and sustainable development at this region.

(a) Contribution of CDM
    1) Augmentation of the income of local residents (Restitution from revenue gained from CERs)
    2) Capacity-building to the locals
(b) Contribution by reforestation of mangrove
    1) Improvement of fish catch and the living aquatic resources accompany with the creation of the mangrove forest
    2) Creation of the employment (forestation and management)
    3) Increase in the income (land credit-debit cost) when land-leasing is necessary
    4) Adaptation to the global warming (alleviation of vulnerability against the erosion caused by sea-level rise)
    5) Dissolution of the threat from Tsunami or out sea (breakwater had a great effect against the hazard at earthquake at Sumatra).
    6) Conservation and amelioration of diversity of the ecosystem
    7) Capacity-building (acquirement of knowledge and technique of forestation and management)

8) Effective use as tourist resources

(c) Contribution by Eco-tourism

1) Creation of employment and continuous income generation
2) Succession of the traditional culture accompany with the eco-tourism
3) Capacity-building (acquirement of knowledge and technique of tour business)

5. Outline of the research

5.1. CDM approval regime and definition of A/R CDM in Host country

Ministry of Local Government, Housing, Squatter Settlement& Environment is set as DNA. "Vaturu and Wainikasou Hydro Projects" is already approved as a small scale CDM and registered by the CDM Executive Board. The research on its relevance with national policy (Ramsar agreement、Forest management policy, etc) will be continued as well.

(Legal issues and Concerns of CDM Implementation)

(a) Suggested plan for the mangrove management committee

First of all, it is necessary to be approved that this project is a sustainable development of a mangrove habitat by Mangrove Management Committee. A series of deliberations will be expected to be carried out based on consolidated project plan and reflection of the opinions of related institutions.

(b) CDM relevant matters

Definition of forest (FCCC/CP/2003/6/Add.2, Annex, Art. F.8) which is necessary for A/R CDM, definition of low-income community related to small scale A/R CDM, and necessary terms which are not officially announced by the host country is continuously investigated. At the moment, Fiji has not officially defined "forest" (i. A single minimum land area value between 0.05-1.0 ha, ii. A single minimum tree crown cover value between 10-30%, iii. A single minimum tree height value between 2-5 (m)). Investigation will be continuously carried out; however, proposed reforestation candidate area is 250 ha and crown cover with high density reforestation activity, 90% is expected. Although, height of mature tree is expected to be 4-5m, since Fiji defines collective mangroves as a forest, DNA is expected to officially define the height at its threshold so that the mangroves could be defined as a forest.

(Eligibility of the land in terms of A/R CDM)

This project is defined as a reforestation project. More specifically, the proposed project area has to be demonstrated that those lands did not contain forest on 31 December 1989. The project activity followed PRA method for demonstration of land eligibility.

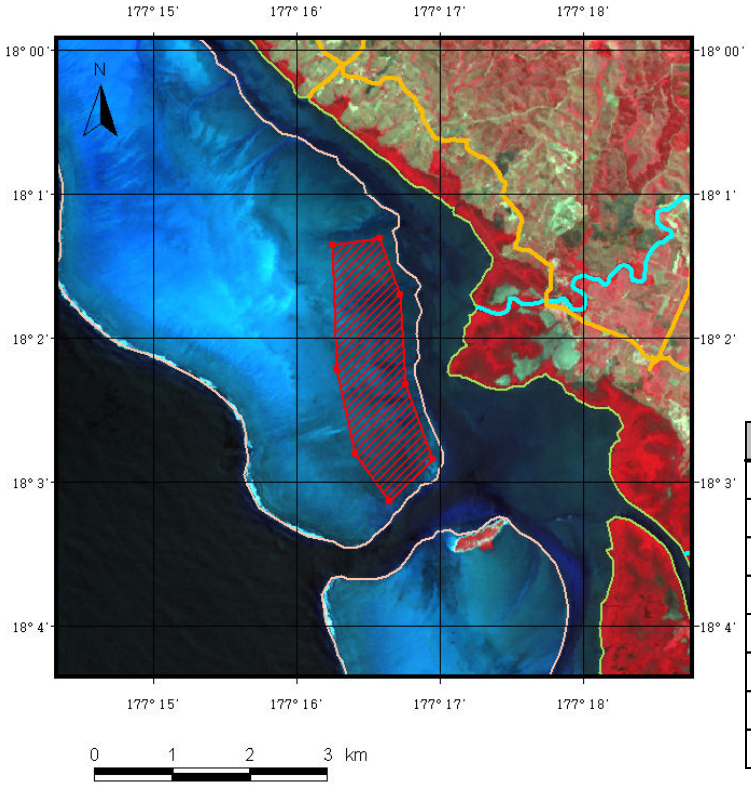
Targeted areas of this project were mostly mud land where outcrop and submersion repeatedly occurs because of the change in the level of the tides, and it becomes clear with interviews that the target areas were not forest at 1989. Several local communities have already offered lands for mangrove reforestation for this project, and no major problem for the proof with application of PRA is envisioned. Although, further detail affirmation is necessary hereafter, we expect that the vegetation area of mangrove has not significantly changed, by looking at ancient maps.

5.2. Environmental Impact Assessment (EIA) System

It is necessary to carry out EIA along with the Fijian act. EIA system has decreed in Environment Management Act 2005 at Section 4 which passed in 2005. However, this act is not operated because the detail of the act has not been settled yet, and on November 26, 2006, workshop for final draft of EIA regulation, facilitated by Fijian Ministry of Environment, was held. At present, it has not been clear whether the project activity is in the scope of EIA

5.3. Project Boundary

The proposed project site for mangrove reforestation is determined with the satellite images, and project boundary has decided by using GIS. Area of the project site is 250.0 ha.



NO	Lon.	Lat.
1	177.275866	-18.021895
2	177.278234	-18.028334
3	177.278896	-18.038700
4	177.281965	-18.047343
5	177.276925	-18.052141
6	177.272965	-18.046643
7	177.270854	-18.037026
8	177.270440	-18.022722

5.4. Carbon pools

The carbon pools selected for the project activity are shown in the table below. They are namely above-ground biomass (CO_2), below-ground biomass (CO_2) and soil organic carbon (CO_2 and N_2O) after desiccated.

Carbon pools selected	GHGs
above-ground biomass	CO_2
below-ground biomass	CO_2
soil organic carbon (after desiccation)	CO_2、N_2O

5.5. Leakages

Followings are leakages (negative effect: Increase in the amount of GHG emission) of this project. Amount of (a) and (b) is small and thought to give small impact on this project: yet, detail investigation will be held again before the implementation of this project.

(a) Amount of GHGs emitted from vehicle, when necessary materials are carried in.

(b) Amount of CH_4, N_2O emitted from the fallen litter in the water when it decomposes. (this is applicable for the case where litter runs off from project boundary because of the change in the tide)

[Leakage from organic matter in the water]

At coastal line, it is expected that the litter will be accumulated in the water or carried out from project boundary with sea current. This litter will become ground substances of CH_4 and N_2O; hence, the study conducted interviews for specialist, reviewed literature about the possibility of emission of CH_4, N_2O and effects on the GHG removal.

*** CH_4**

Existence of newly provided organic materials in the sea water from plantation of mangrove is assumed in the project case. Sulfate reducing bacteria dominates methane generating bacteria since sea water contains large amount of sulfate ion, and sulfuric reduction of ground substances takes place （Organic materials+SO_4^{2-}+$2H^+$→nCO_2+mH_2O+H_2S） ;thus, emission of CH_4 is deemed minimal and could be assumed negligibly small. In this methodology, we consider the emission of CH_4 is Zero (0).

*** N_2O (N_2O is generated during the process of denitrification or nitrification)**

↑ ↑$\underline{N_2O}$

Denitrification: $NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow \underline{N_2O} \rightarrow N_2$ **nitrification**: $NH_4^+ \rightarrow NH_2OH \rightarrow NO_2^- \rightarrow NO_3^-$

N_2O is generated from existing mangrove forest, yet whether it is arose from the existing mangroves is not clear, and difficult to prove. On the other hand, concentration of the salt does not affect the generation of N_2O. Given these factors, generation of N_2O in this project is assumed to be the same amount of N_2O generated from the forestation at dry land.

Emission of N_2O by forestation is generated from nitrogen fertilizer and soil drainage according to GPG-LULUF and the emission of N_2O from this project is thought to be equal to the emission of N_2O from soil drainage. However, the method for measuring N_2O from soil drainage in GPG-LULUF is explained in Appendix and its uncertainty has been pointed out. Also, the measuring method shown in Appendix is based on project area multiplied by emission coefficient which would overestimate impact, since emission of N_2O other than the additional emission of N_2O from the reforestation is included. For those reasons, we decided not to handle the emission of N_2O.

5.6. Baseline

(Baseline scenario of small-scale A/R CDM)

Baseline scenario for normal-scale A/R CDM is defined as a scenario which reasonably represents the sum of changes of carbon stock at carbon pools in the project boundary in the absence of registered A/R CDM.

In this project activity, since net anthropogenic GHG removals by sinks are less than 8,000 t- CO_2 per annum, PDD will be developed in line with small-scale A/R CDM project. If no significant changes of carbon stock can be demonstrated, the amount of carbon stock before the implementation of project is considered as a baseline(considered to be stable during credited period).

(Baseline scenario of this project)

The project site, for its implementation, is scattered at the area which are owned by multiple land holders. Thus, it is possible that there will be a necessity to divide the area into several strata, to identify baseline scenario for each stratum, and to examine net GHG removals for each baseline. However, since the result of the examination of the field shows project site for reforestation is homogeneous; thus enabling to apply the same baseline scenario for all strata. From the contents of examination described below, net GHG removals of baseline of this project are presumed to be Zero (0).

(a) Alternative scenario 1: Reforestation of mangrove is carried out.
   1) Reforestation by private enterprise/ NGO: In project area, multilateral enterprise and NGO carries out mangrove forestation as part of greening and CSR activities.
   2) Reforestation by private enterprise/ local residents: Possibility of reforestation activity to collect fuel wood, building material seems to be low, for the reason described below.

In Fiji, environmental reforestation is done voluntary by private enterprise/ NGO, however, the case is rare. Also, as described before, for the option 2), replacement of fuel wood by petrochemical product is advancing. Thus it is not realistic option at this site.

Proposed project site has a bad access to arterial road, and the fact that there is no traditional practice of forestation in vicinal community, suggests the project activity is unlikely to be carried out in the absence of CDM.

(b) Alternative scenario 2: Revegetation brings about constant GHG removal

The project site located on coastal area has high concentration of salt in the soil. Also, because it is facing coastal line, with the tidal change, most of the time, the land surface is submerged under water. In this environment, it is extremely difficult for normal plant to live, and expected no plants can be rooted in except mangroves.

Increase in net GHG removals at project site can be occurred because of the expansion of neighboring mangrove forest. However, when comparing a current satellite imegery and past satellite imegery, no significant changes are observed, thus the site is expected to stay the same.

(c) Alternative scenario 3: Continuation of status quo/ no forestation nor spontaneous recovery of vegetation

At the project site, there is no traditional practice of forestation, and from the result of the study above, “continuation of status quo and no spontaneous recovery of vegetation” is the most realistic scenario.

(d) Alternative scenario 4: No forestation is done while the land used for different purposes (aqua farming, etc.)

(Result of the study)

For Alternative scenario 1, there was no practical example of the environmental reforestation by

enterprise at project site, nor by local residents. At the same time, from interview to local residents, no traditional practice for reforestation exists nor aqua farming has done nor planned before. Considering all the elements, alternative scenraio 3: (continuation of status quo/ no reforestation nor spontaneous recovery of vegetation) is the most realistic scenario.

(Estimation of net GHG removals for Baseline)

Base line net GHG removals is calculated as follows:

$$B_{(t)} = \sum_{i}^{I} (B_{A(t)i} + B_{B(t)i}) * A_i$$

where:

$B_{(t)}$ = carbon stocks in the living biomass pools within the project boundary at time t in the absence of the project activity (t C)

$B_{A(t)\,i}$ = carbon stocks in above-ground biomass at time t of stratum i in the absence of the project activity (t C/ha)

$B_{B(t)\,i}$ = carbon stocks in below-ground biomass at time t of stratum i in the absence of the project activity (t C/ha)

A_i = project activity area of stratum i (ha)

i = stratum i (I = total number of strata)

Formula above is to calculate baseline net GHG removals through multiplying total area of classified strata I by carbon stock per unit area (removal coefficient). For the estimation of baseline net GHG removals, above-ground biomass, and below-ground biomass in the absence of project activity is estimated.

Target of this project is coastal line at intertidal area, and no formation of plant community is seen at the site. Moreover, since Baseline scenario estimates there is no forestation or spontaneous recovery, baseline net GHG removals are estimated to be zero (0).

5.7. Additionality

As it is shown in the 6th AR Working Group Report Annex 2 (Attachment B), for small-scale A/R CDM, it is allowed to demonstrate the additionality by analyzing barriers to which this project is facing. This project has several barriers such as, “investment barriers”, “Institutional barriers”, “Technological barriers”, “Barriers relating to local tradition”, “Barriers due to prevailing practice,”, “Barriers due to local ecological conditions” and “Barriers due to social conditions”. In PDD “Investment barriers” is used to demonstrate addtinonality. Investment barriers, which this project faces, are derived from Country risk or business profitability.

(a) Investment barriers from country risk

On December 5th 2006, coup d’etat has occurred in Fiji. Armed force besieged the official residence of prime minister and government offices at capital Suva, so the political situation is very unstable. After the coup d’etat, Moody’s has continuously put the Ba2 rating (Sovereign ceiling) to government bonds at December 2006, but the forecast is negative and expected that most developed countries do not see Fiji as country for an investment target.

(b) Investment barrier derived from profitability of the project

Since this project is not aiming at the production of lumber or pulp and chips as normal forestation business, earnings are unlikely to be made if the project is not approved as CDM. There will be great influence for the finance if no earnings are made from underlying part of the project (Forestation part).

In the first place, bank will not finance a project which does not generate profits, so financing for this project will be difficult.

Moreover, the local residents, who are mainly in charge of this project, belong to low income group which made it difficult to self-finance this project. In addition, it is nearly impossible to borrow money from domestic and international financial market.

Also, with the augmentation of country risks, it becomes harder to call in investment from international financial market.

5.8. Monitoring

Monitoring methodology of small-scale A/R CDM as a base, new methodology to estimate project GHG removals is created.

Amount of carbon stock after the implementation of project (Ex post) is calculated as follows by using random sampling at each stage.

$$P_{(t)} = \sum_{i}^{I} (P_{A(t)i} + P_{B(t)i}) * A_i$$

where:

$P_{(t)}$ = carbon stocks within the project boundary at time *t* achieved by the project activity (t C)

$P_{A(t)\,i}$ = carbon stocks in above-ground biomass at time *t* of stratum *i* achieved by the project activity during the monitoring interval (t C/ha)

$P_{B(t)\,i}$ = carbon stocks in below-ground biomass at time *t* of stratum *i* achieved by the project activity during the monitoring interval (t C/ha)

A_i = project activity area of stratum *i* (ha)

i = stratum *i* (I = total number of strata)

GHG emissions from desiccation of soil shall be estimated through the following equations:

$$P_{E(t)} = \left(EF_{drain\_C} * 44/12 + EF_{drain\_N} * (44/28) * 310/1000\right) * A_{drain(t)}$$

where:

$P_{E(t)}$ = GHG emissions from desiccation of soil at time *t* by the project activity (t $CO_{2\text{-}e}$/yr)

EF_{drain_C} = C emission from desiccation of soil (t-C/ha/yr)

EF_{drain_N} = N emission as N_2O from desiccation of soil (kg-N_2O-N/ha/yr)

$A_{drain(t)}$ = Desiccated project activity area at time *t* under the project scenario (ha)

44/12 = Conversion factor from ton C to ton CO_2 equivalent (t CO_2/t C)

44/28 = Conversion factor from ton N to ton N_2O equivalent (t N_2O/t N)

310 = GWP for N_2O (t CO_2/t N_2O)

(Concerns of monitoring)

(a) Possibility of obtaining data

When commercial timber is employed, stem volume of timber, harvest yield table, expansion factor, root-to-shoot ratio, and other basic data and statistical documents are easily obtained. On the contrary, it is difficult to obtain abovementioned data of mangroves from this investigation.

Growth rate of biomass for mangrove is very important data to estimate GHG removals. On the other hand, since the data of mangrove biomass is limited, it is necessary to estimate the figure from past data of GPG-LULUF.

(b) Concerns for the execution of monitoring

Based on formulated monitoring plan, investigation of the number of standing trees、the height, and diameter at breast height (DBH）,amount of biomass or other necessary data will be done. However, for the monitoring, it is necessary to have an aid of institute of host country or NGO, who possesses ability for management.

5.9. Project period/ Crediting period

Following reasons, project implementation period is decided 30 years.

(a) Considering the age of the stakeholders who are engaged in the experimental forestation for CDM and the investigation for local area, 30 years is appropriate for the range which generation change will not take place.

(b) If peak of the growth of forested mangroves is estimated as 20 years, 30-year is appropriate for the implementation period. (It is expected to take 5 years to finish foresting through all the area of the boundary)

5.10. Additionality (selection of types of CERss)

On of the most contentious issues of A/R CDM is non-permanence. There are two ways to address non-permanence by selecting types of CERs explained below.

(a) Temporary CER (tCERs)

(b) Long-term CER (lCERs)

To achieve efficient operation of the project, lCERs are chosen to put forward obligation of replacement duty.

5.11. Information concerning the formula to calculate amount of reduction (or removals) of GHG

(Formula to find net anthropogenic GHG removals by the project activity)

Net anthropogenic GHG removals is calculated from actual net GHG removals by sinks – baseline net GHG removals – leakage. The carbon stocks within the project boundary at time t ($N_{(t)}$) shall be

calculated as follows:

$$N_{(t)} = \sum_{i}^{I} (N_{A(t)i} + N_{B(t)i}) * A_i$$

where:

$N_{(t)}$ = total carbon stocks in biomass at time *t* under the project scenario (t C)
$N_{A(t)\,i}$ = carbon stocks in above-ground biomass at time *t* of stratum *i* under the project scenario (t C/ha)
$N_{B(t)\,i}$ = carbon stocks in below-ground biomass at time *t* of stratum *i* under the project scenario (t C/ha)
A_i = project activity area of stratum *i* (ha)
i = stratum *i* (*I* = total number of strata)

GHG emissions from desiccation of soil shall be estimated through the following equations:

$$N_{E(t)} = \left(EF_{drain\_C} * 44/12 + EF_{drain\_N} * (44/28) * 310/1000\right) * A_{drain(t)}$$

where:

$N_{E(t)}$ = GHG emissions from desiccation of soil at time *t* under the project scenario (t $CO_{2\text{-}e}$/yr)
EF_{drain_C} = C emission from desiccation of soil (t-C/ha/yr)
EF_{drain_N} = N emission as N_2O from desiccation of soil (kg-N_2O-N/ha/yr)
$A_{drain(t)}$ = Desiccated project activity area at time *t* under the project scenario (ha)
44/12 = Conversion factor from ton C to ton CO_2 equivalent (t CO_2/t C)
44/28 = Conversion factor from ton N to ton N_2O equivalent (t N_2O/t N)
310 = GWP for N_2O (t CO_2/t N_2O)

In the actual net GHG removals concerning of *Rhizophora*, which is planned to be planted for this project, biomass data according to stand age is collected from literature and used for estimation. Since there was no data to estimate *Bruguiera*, which is also planned to be planted, data from *Rhizophora* is used for estimation.

Applies Gompertz Curve to collected data, formula to estimate age of tree-biomass is created. The result of the estimation is shown below. Real net GHG removals are estimated with this formula in this project.

Graph 1 Relationship of tree age and biomass

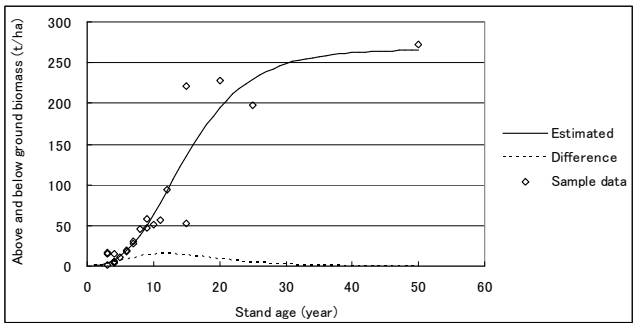


Table 1 GHG removals by the project activity

Unit for removal and emission: tCO_2/年

	Site 1	Site 2	Site 3	Site 4	Site 5	Emission	Net removal
Area (ha)	50	50	50	50	50		250
1st year	104.3					0.0	104.3
2nd year	186.7	104.3				0.0	291.0
3rd year	301.4	186.7	104.3			0.0	592.4
4th year	445.5	301.4	186.7	104.3		0.0	1,038.0
5th year	610.3	445.5	301.4	186.7	104.3	0.0	1,648.3
6th year	783.2	610.3	445.5	301.4	186.7	0.0	2,327.1
7th year	949.9	783.2	610.3	445.5	301.4	0.0	3,090.4
8th year	1,097.7	949.9	783.2	610.3	445.5	0.0	3,886.6
9th year	1,216.7	1,097.7	949.9	783.2	610.3	0.0	4,657.8
10th year	1,301.1	1,216.7	1,097.7	949.9	783.2	0.0	5,348.5
11th year	1,349.3	1,301.1	1,216.7	1,097.7	949.9	0.0	5,914.6
12th year	1,362.6	1,349.3	1,301.1	1,216.7	1,097.7	0.0	6,327.3
13th year	1,345.1	1,362.6	1,349.3	1,301.1	1,216.7	0.0	6,574.8
14th year	1,302.1	1,345.1	1,362.6	1,349.3	1,301.1	0.0	6,660.3
15th year	1,239.5	1,302.1	1,345.1	1,362.6	1,349.3	0.0	6,598.6
16th year	1,163.0	1,239.5	1,302.1	1,345.1	1,362.6	0.0	6,412.4
17th year	1,077.7	1,163.0	1,239.5	1,302.1	1,345.1	0.0	6,127.5
18th year	988.1	1,077.7	1,163.0	1,239.5	1,302.1	0.0	5,770.5
19th year	897.7	988.1	1,077.7	1,163.0	1,239.5	0.0	5,366.0
20th year	809.1	897.7	988.1	1,077.7	1,163.0	0.0	4,935.6
21st year	724.4	809.1	897.7	988.1	1,077.7	0.0	4,496.9
22nd year	644.7	724.4	809.1	897.7	988.1	0.0	4,064.0
23rd year	571.0	644.7	724.4	809.1	897.7	0.0	3,646.9
24th year	503.5	571.0	644.7	724.4	809.1	0.0	3,252.8
25th year	442.4	503.5	571.0	644.7	724.4	0.0	2,886.1
26th year	387.5	442.4	503.5	571.0	644.7	-2,221.0	328.2
27th year	338.4	387.5	442.4	503.5	571.0	-2,221.0	21.9
28th year	294.9	338.4	387.5	442.4	503.5	-2,221.0	-254.2
29th year	256.5	294.9	338.4	387.5	442.4	-2,221.0	-501.3
30th year	222.7	256.5	294.9	338.4	387.5	-2,221.0	-721.0
Total	22,917.1	22,694.4	22,438.0	22,143.0	21,804.6	-11,104.8	100,892.4

Since the project site is at low level, it is exposed to the air only two hours per day, therefore, it is unlikely that the site will be completely desiccated during 30 year period. For the conservativeness sake, the study assumes that the whole area of the project site will be desiccated after 25 years, and CO_2 and N_2O will be emitted from 26th year to 30th year of the crediting period. CO_2 and N_2O emissions will be calculated based on emission coefficient from GPG-LULUCF, "DEFAULT VALUES FOR CO_2-C EMISSION FACTOR FOR DRAINED ORGANIC SOILS IN MANAGED FORESTS" (tropical forest: 1.36tC/ha/yr) and "DEFAULT EMISSION FACTORS N_2O EMISSIONS FROM DRAINAGE OF

FOREST SOILS" (tropical: 8kgN_2O-N/ha/yr). GWP of N_2O is set to be 310.

For base line GHG removals as described at the "Baseline" section, it is determined to be zero (0) and for leakage, as described at the "Leakage" section, it is thought to be negligible, and hypothesized as zero (0) as well.

(Net artificial GHG removals during 30 years)

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

$=100{,}892$ t-$CO_2 - 0 - 0$

$=100{,}892$ t-CO_2

(The average reduction rate par annum for 30 years)

$100{,}892$ t-$CO_2 \div 30 = 3{,}363$ t-CO_2

5.11. Information on ecological impact and other indirect impact

From the result of this investigation (Collecting documents, and analysis, Interview for specialists, investigation of the field, etc.), ecological impact and socio-economical impact from this project activity, following elements are expected. As a conclusion, there are many beneficial impacts on host country and local community, and it lead to the sustainable development.

(a) Socio-Economical impact
   1) Raising aqua firming resources (Crab, Shrimp, Fish, etc),
   2) Improvement of the value of forestry (Preservation of forest by using sustainable management) and
   3) Improvement of the value of tourist resources (Eco-tourism, etc)

(b) Ecological impacts
   1) Preservation of ecosystem at coastal line (Appropriate supply of organic carbon),
   2) Enhancement effect of mangrove root system to settle particles in the water,
   3) Denitrification and dephosphorization effects for water quality improvement,
   4) Protection against coastal erosion caused by tidal waves
   5) Protection against coastal erosion caused by sea level rise

5.12. Investigation of the comment from stakeholders

Local residents at targeted site (Low-income group), academic institutions, NGOs and government institutions are interviewed. Regarding to the mangrove plantation, majority of opinion was favorable. Increase in the fish catch, amelioration of the quality of soil, and stabilization of the living of local residents (in mid/ long-term incentive) are the main reason for the favorable opinion. For the implementation of Eco-tourism, direct and short-term incentive is high because of the possibility of cash earnings.

5.13. Investigation for financing, Budget plan to get in operation

(Financing)

As of April 2006, Taishi design office co. ltd. will operate fund raising activity as a fund raising corporation (100%) for the examination on feasibility and project facilitation.

This project contains number of beneficial elements, such as economical contribution, social contribution and GHG-reduction. It received offers for supporting methodology submission and CDM implementation by several companies, who has strong interest in CSR. The project receives support from two companies at the moment.

Moreover, there exist several major private enterprises who show their interest on supporting the project, depending on the progress of the project (preparation of PDD, approval from host country, etc).

From the result of this investigation, the group of enterprises, who actively seek CERs nowadays, are interested in buying them from large-scale projects (emission reduction projects), however, they do not have interest on small-scale A/R CDM projects. This owes to "non-pemanece", and "replacement obligation" unique to A/R CDM projects. The enterprises who consider supporting the project positively and place value on CSR focus attention on "usability of mangrove" and "capacity building on developing regional community". As shown, the difficulty of financing for A/R CDM projects is the characteristics of the scheme of CERs for A/R CDM, therefore, following elements are considered to promote investments from enterprises with in this investigation.

(a) Significance of obtaining CERs by means of A/R CDM by investing firms

(b) Merit and demerit of obtaining credits by investing firms themselves (Buying, holding, offsetting own emission, etc.)

(Investment offer from public institute and emission buying institute to the project activity, or possibility of purchasing CER from A/R CDM project)

(1)JBIC (2)JCF/JGRF (3)Direct financing by JICA is revealed to be difficult (4)NEDO/ also officially announced to limit the acquisition target for the credits which do not generate the obligation of compensation, and CERs from A/R CDM project is excluded.

The most probable credit-buyer at the moment is World Bank's Bio Carbon Fund (BFC). BCF is functioned as Introductory Agent of Narsource Japan and CO2e.com in Japan, and it is possible to negotiate credit acquisition by themselves. Because BCF guarantees credit compensation generated from A/R CDM project, major corporations, such as electronic company, invest.

(Profitability of project)

This project is environmental reforestation CDM by mangrove; therefore, cashable product (timber, pulp, fruit, etc) is not generated and lacks profitability. If CERs are not generated as a CDM project, it is impossible to calculate economical indicators such as IRR. Below indicators are shown for two possibilities (1)With CERs from CDM project (2)With earnings from credit and operation of conservation plan for project continuation (Eco-tourism).

<Profitability (IRR)>

	CERs only	CERs and Eco-tourism
1US$/t-$CO_2$	—	14.8%
3US$/t-$CO_2$	—	17.0%
5US$/t-$CO_2$	—	18.9%
7US$/t-$CO_2$	6.0%	20.6%

<Evaluation for profitability>

For the base of investment evaluation "CDM technical guidance for CDM forestation investment in 2004 Appendix <business evaluation by Sink-CDM investment model>" as a reference, when (1)IRR below 10%, (2)IRR, Above "10 year-average of LIBOR + 2%" is estimated, following credit price is needed.

Standard of investment	CERs only	CERs and Eco-tourism
IRR10%	9.9 US$/t-$CO_2$	5.2 US$/t-$CO_2$
IRR6.7%	7.4 US$/t-$CO_2$	2.9 US$/t-$CO_2$

<Cost effectiveness> (Cost needed to reduce 1t of CO_2)

Case: CERs as a unique cash-earning	4.3 US$/t-$CO_2$
Case: Eco-tourism complementary done	28.7 US$/t-CO2

6. General outline of the result of the investigation

6.1. Technical issue for implementing CDM project

A. (Estimation for leakage)

It is necessary to create new methodology for forestation at wet-land, based on the recent methodology of small-scale A/R CDM (redaction of existing methodology) especially, leakage from the pile of fallen leaves and fallen branches in the water becomes technical issue, and possibility of CH_4 and N_2O generation are inspected in this investigation. As a result of the investigation, generation of CH_4 is considered as zero, since it is negligible, and N_2O is excluded as an object, since there is no measuring methodology. Hereafter, it is necessary to watch the discussion made by AR Working Group and CDM Executive Board, and the moves of study of quantitative measurement method.

B. (Estimation of GHG removals)

In this investigation, GHG removal estimation model is created with the sample data of *Rhizophora* applied to Gompertz curve, and estimated the after-forestation GHG removals of each year. Amount of data of mangrove is fewer than the other beneficial (Commercial) woods; thus it is necessary to collect existing data more to estimate higher accuracy. Especially, it is important to collect biomass data for each age of tree. Additionally, it is a task to collect biomass data of *Bruguiera*, which could not be collected with this investigation.

6.2. Administrative issue of A/R CDM

A. (Problems of compensation and non-permanence of A/R CDM CERs (tCER and 1CER)

The largest issue for promoting A/R CDM is the problem of compensation occurred from

countermeasure of CER's non-permanence. At the moment, correspondence for non-permanence of A/R CDM is done by issuing CERs on a temporary basis. Hence, once the CERs is retired, there is an obligation to replace with alternative credits, and it is important to operate smoothly without having any problem for project.

B. (Eligibility of Land)

Showing map data, such as aerial photo is the best method to demonstrate the land eligibility according to "procedures to define the eligibility of lands for afforestation and reforestation project activities", decided at EB22, but since it is difficult to obtain, PRA (Participatory Rural Appraisal) will be necessary for the proof.

C. (System and criteria for project approval of A/R CDM in Fiji)

In Fiji, the government has already approved 1 CDM project, but for small-scale A/R CDM, definition of forest and low-income group, or approval process for forestation project is unclear. Hereafter, it is necessary to obtain confirmation

6.3. Perspectives, Issues, and problems of realizing project

(A) Project profitability

As this project has low economical efficiency, project support requesting activities, based on CSR is continuously operated. Since this project is not operated by NGOs, Host County and regional community, project operators, and investors (Private enterprise) chasing their own merit will boost project's continuality. Followings are themes of pending issue at when assistance is requested

(a) Low price of CERs (tCER, 1CER) is expected.
(b) Additional to general forestation expenses, expenses for CDM is needed.
(c) It is new scheme (included explanation of CDM), and the precedent example is limited.

Even though negative elements for profitability exist for the prjoect, there are many private enterprises who understand its benefit of this project and showed interests in supporting it. Hereafter, promotion of A/R CDM (especially small-scale) concept of CSR affect positively. Hence, prospect/ research of the merit for private enterprise are fully needed.

(B) Specific risks for forestation

Even though GHG removal by forestation is a base to establish A/R CDM, there is a specific risk arises from the forestation project. And the specific risk for forestation project is "non-permanence" which is the most important issue for project operators. It is connected to the core of project since the error and forecast of growth is directly linked and influences the amount of CERs obtaining. These risks include:

(a) Technical risk,
(b) Human risk,
(c) Climate risk,
(d) Natural hazard risk

(C) Political issue of Fiji (Country risk)

The country's fourth coup d'etat took place on 5th December, 2006. Although after the coup d'etat, high-level government officials were dismissed and some confusion was seen, it did not develop to civil war. In January 2007, interim administration was established having the commander of the national army as a prime minister.

The coup d'etat brought down the credibility of the country and investment attractiveness from the overseas lessened. This situation could affect the project activity in negative manner.

(D) Ambiguity of A/R CDM in the future framework

a. Future movement until the end of 2012

b. Price movement of A/R CDM (Consideration of forecasting CER price)

<Emissions trading based on system construction>

*EU-ETS/ EU Emission Trading Scheme *UK Emission Trading scheme *CCX/ Chicago Climate Exchange *RGGI/ Regional Greenhouse Gas Initiative (7 north-east states in the USA)

<VERs/ Verified Emission Reductions: Voluntary emission credit by the certification of third party >

*Emission trading for CSR or off-set program

<Credit issue by CDM Executive Board: CERs>

*CDM credit (CERs) trading after October 2005