CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM FOR SMALL-SCALE AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-SSC-AR-PDD)
(Version 02)

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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:

Small-scale and low-income community-based mangrove afforestation project on tidal flats of three small islands around Batam City, Riau Islands Province, Republic of Indonesia (Version 05; April 15, 2010)

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

This small scale afforestation project carries out mangrove afforestation in the tidal areas of Sekenah Island, Teraling Island and Tenggau Island in Batam City of Riau Islands Province, Indonesia. It is reported that mature mangrove forests in Indonesia and Australia have the biomasses of up to 500 ton/ ha (Clough, 1992; Basyuni et al., 2002), which exceeds that of tropical rainforests. These high carbon fixation capacity of mangrove trees are expected to sequester GHG (Greenhouse gas) (e.g. Okimoto et al., 2007, 2008; Komiyama et al., 2008)

Mangroves are trees or shrubs that grow in tidal flats of tropical and sub-tropical coastal regions that are inundated at high tide. Indonesia has the world's largest mangrove forests, with over 4.5 million hectares of mangrove forests, which is 25% of the total distribution in the world. However, in the last three decades, these mangrove areas have been depleted because of land development for industrial purposes, prawn culture and illegal logging, resulting in 50 % reduction in the mangrove distribution area (FAO, 2002). The target areas for recovery now stand at 2 million hectares spurring an urgent need for environmental rehabilitation of the ecosystem in these coastal areas (JICA, 2008). Recently, several benefits of mangroves have been reported. These include increment of fish biomass (Munby et al., 2004; Tateda et al., 2007; Nyunja et al., 2009) and prevention of high tides and tsunamis (Danielsen et al., 2005; Kathiresen and Rajendran, 2005). For example, in Matang Malaysia where mangrove forests cover an area of about 400 km^2, fisheries activities dependent on these mangroves are estimated to be worth USD 1 million (Renner, 2006). In recognition of the economic importance on mangroves, the Indonesian government has enhanced the preservation of the mangrove trees since the 1980's.

Indonesia is the largest archipelagic country in the world consisting of over 17,000 islands with coastlines bordering the Indian and Pacific oceans. Due to sea-level rise resulting from global warming, 24 small Islands sunk between 2005 and 2007, and about three decades from now, 2000 other small islands are said to be in danger of sinking (Renner, 2006). In recognition of the danger posed by global warming, in 2007, the Indonesia government established a policy to reduce domestic GHG by 40 % by the year 2030. The government also proposed REDD (Reducing Emissions from Deforestation and Degradation in Developing countries) with Brazil, a country admired for its forest cover, for carbon trading in the post-Kyoto Protocol.
This exemplifies a positive attitude and commitment of the Indonesia government towards global warming issues, including rehabilitation of mangrove forests.
This project is fully funded by YL Invest Co., Ltd. and it implements mangrove afforestation in the coastal areas where mangrove trees have never existed. The main objectives are:

1. To accomplish the reduction of CO_2 gas by establishing carbon sinks by mangrove afforestation, which contributes towards reversal of global warming.
2. To rehabilitate coastal ecosystems with mangrove afforestation thereby, establishing new fish breeding areas. This will bring about a gradual but permanent reduction of

poverty levels in the coastal community as the increased fish catch will be a source of income.

3. To provide employment opportunities in mangrove cultivation and management as a result of which increased income will be realized by the local communities. This is also an opportunity to do technology transfer and capacity building in the field of mangrove afforestation and management and encourage sustainable community participation in the project.
4. Afforested mangrove trees will be utilized as dykes to prevent land erosion and disasters caused by high tides and tsunamis.

To accomplish the objectives above, this project will carry out mangrove afforestation in four areas of three islands totaling 115 ha. The species to be planted, *Rhizophora mucronata* and *Rhizophora apiculata*, are the major species in South-East Asia. They were selected by the Ministry of Forestry (MoF) of Batam City and based on our previous research reports, they are suitable for this site.

The project is led by YL Invest Co., Ltd., Japan, and the practical work will be collaborated between the MoF of Batam City, the Republic of Indonesia, PT. Yamamoto Asri (the Indonesian subsidiary of YL Invest Co., Ltd., Japan) and the local community. Additional expertise will be provided by Prof. Shigeyuki Baba, University of the Ryukyus and Executive Secretary of ISME (International Society for Mangrove Ecosystems) and Prof. Akihiro Nose, Faculty of Agriculture, Saga University. MoF (project host) has demonstrated their willingness to collaborate and fully support the project excluding provision of funds. In July 2006, a memorandum of understanding (MoU) between YL Invest Co., Ltd. and MoF of Batam City was signed. The MoU, which sighted the project objectives as being in line with the government's policy towards coastal rehabilitation by mangrove afforestation, gave YL Invest Co., Ltd. land utilization authorization.

A.3. Project participants:

Name of Party involved (*) [(host) indicates a host party]	Private and/or public entity(ies) project participants (*) (as applicable)	Indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Republic of Indonesia (host)	the Ministry of Forestry (MoF) of Batam City	No
	PT. Yamamoto Asri	
Japan	YL Invest Co., Ltd..	No
(*) At the time of making the CDM-SSC-AR-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

The Ministry of Forestry (MoF) of Batam City: partners with YL Invest Co., Ltd, in this AR-CDM project and plays a role to support the project from the local government's standpoint. The collaborating officials in MoF are federal officers, and sufficiently understand the laws of domestic forests. Indonesia encourages mangrove afforestation as one of their national policies, and shows understanding and willingness to support this project. Many of the staff members have knowledge and experience in afforestation activities. The MoF of Batam City will keep in contact with the local residents around the project areas in

collaboration with YL Invest Co., Ltd and PT. Yamamoto Asri. In July 2006, a memorandum of understanding (MoU) between YL Invest Co., Ltd. and MoF of Batam City was signed.

YL Invest CO., Ltd: conducts mangrove afforestation activities as their main business, and takes entire responsibility for the launch, implementation, management and monitoring of this project. The company initiated mangrove afforestation in various other regions in Indonesia in 2003, and has been authorized to leverage the land totaling 101,500 ha for mangrove afforestation, 100,000 ha around Sumatra Island and 1,500 ha in Batam Island, from the Indonesian government. At present they manage afforested stands in collaboration with PT. Yamamoto Asri, local residents and a forest cultivation community. Most of the YL Invest Co., Ltd. staff have engaged in afforestation activities in Indonesian for many years and understand the local social conditions and the living environment, and so do the members of PT. Yamamoto Asri. Language will not be an issue during technical transfer and meetings with local people as two of the staff members are fluent in Indonesian language. Furthermore, mangrove experts affiliated with ISME and Agriculture Faculty, Saga University provide technical support.

PT. Yamamoto Asri: was established by YL Invest Co., Ltd to implement this particular project. Indonesian members in PT. Yamamoto Asri are mangrove experts with experience of mangrove afforestation in various regions in Indonesia. They collaborate with the local community in management, survey and monitoring of afforested stands, and work on technical skill transfer to local people regarding afforestation and raising seedling.

Team Permanent Mangrove: was formed by local residents and fishermen with fishing rights residing in two villages around the forested site of this project in 2006. In Indonesia, they traditionally do not form unions, but leave decisions to village chiefs or elderly. This local community called Team Permanent Mangrove consisting of 40 people was established by low-income local residents for the implementation of this project (Annex 3). This community was established for the purpose of local residents' personnel training as requested by the government indicated in "3.2. Proposal" in Environmental assessment report. The necessity of this community for the project implementation was confirmed through discussions with the government. Mr. Idoris, the current chief of Bagan village, will be the leader, and Mr. Acung, who is highly trusted by people in Tanjung Piayu Laut, will be the deputy leader. These two have closely worked with PT. Yamamoto Asri since 2006, and have engaged in afforestation, management and preservation prior to this project. Thus, a trusting relationship between local people and the project implementers has already been developed and the implementation structure of this project has also been established. The joint implementation of this project between this local community and PT. Yamamoto Asri is indicated in Memorandum of Agreement. Team Permanent Mangrove is responsible for collection of propagules, afforestation and management and will also cooperate in monitoring (Fig. B. 8.3.).

A.4. Description of location and boundary 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 Indonesia

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

Riau Islands Province

A.4.1.3. City/Town/Community etc:

Riau Islands province, Batam City, SEI. Beduk district, Tanjung Piayu Laut
（In Indonesian: Kelurahan, Tanjung Piayu. Kecamatan Sei. Beduk. Kota Batam. Provinsi Kepulauan Riau.）

A.4.2. Detail of geographical location and project boundary, including information allowing the unique identification(s) of the proposed small-scale A/R CDM project activity:

This small scale AR-CDM project is a mangrove afforestation project in tidal areas covering a total of 115 ha. The boundaries of the project site were decided in a meeting with Batam City officials and the local community. The site was divided into 4 areas around 3 islands namely, Sekenah Island (01°00'45.3" N, 104°06'25.1" E), Teraling Island (01°01'00.3" N, 104°05'50.5" E), Tenggau Island (01°01'16.1" N, 104°5'19.8" E) (Fig. A.4.2.a.), which lie south-east of Batam Island (approx. 20 km south of Singapore, 01°07'N, 104°07'E), Riau Islands Province Indonesia. The 4 areas in decreasing order are east side of Sekenah Island (55 ha), south side of Sekenah Island (29 ha), east side of Tenggau Island (22 ha), and south side of Teraling Island (9 ha) (Fig. A.4.2.b).

The boundaries of the project area were decided in a meeting with Batam City government officials based on environmental research done in September 2006, by MoF Batam City (Fig. A.4.2.c, d, e, f and Table A.4.2.). Land for afforestation was given by Batam City free of charge, under a MoU of land supply to YL Invest Co., Ltd., in July 2006. According to the MoU, Batam city government requested YL Invest Co., Ltd. to start planting within a year of signing the MoU. YL Invest Co., Ltd. did a plantation of 2,000 trees in September 2006 based on Indonesian law and applicable procedures of AR-CDM projects. This project was explained to the Designated National Authority (DNA) in Indonesia, which approved it. Presently, the successful 1st stage plantation consisting of healthy trees of up to 1.3 m stand height, covers an area of 29 ha.

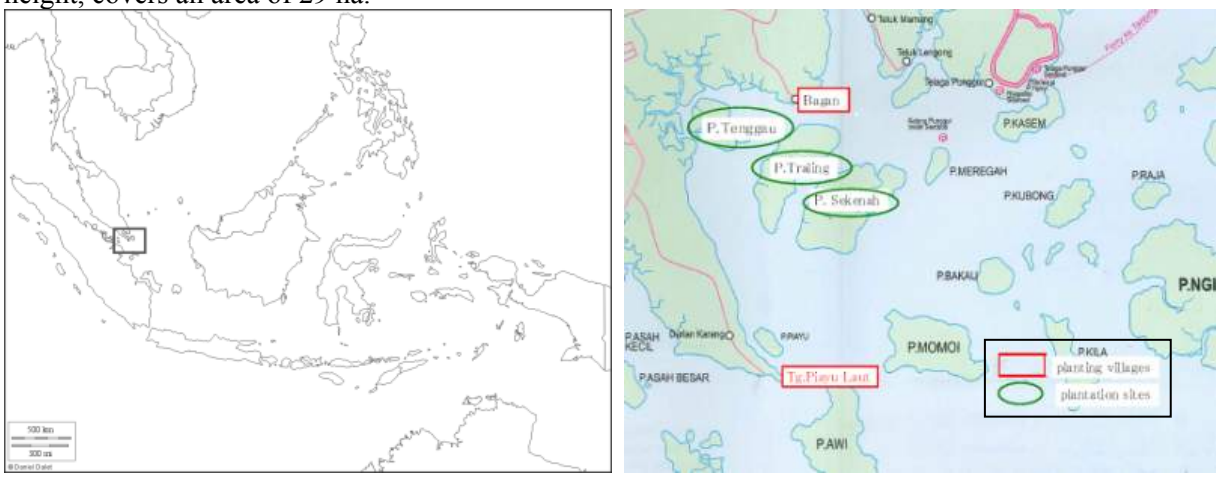


Fig. A.4.2.a. Map showing the location of Sekenah, Tenggau and Teraling Islands in Batam, Indonesia

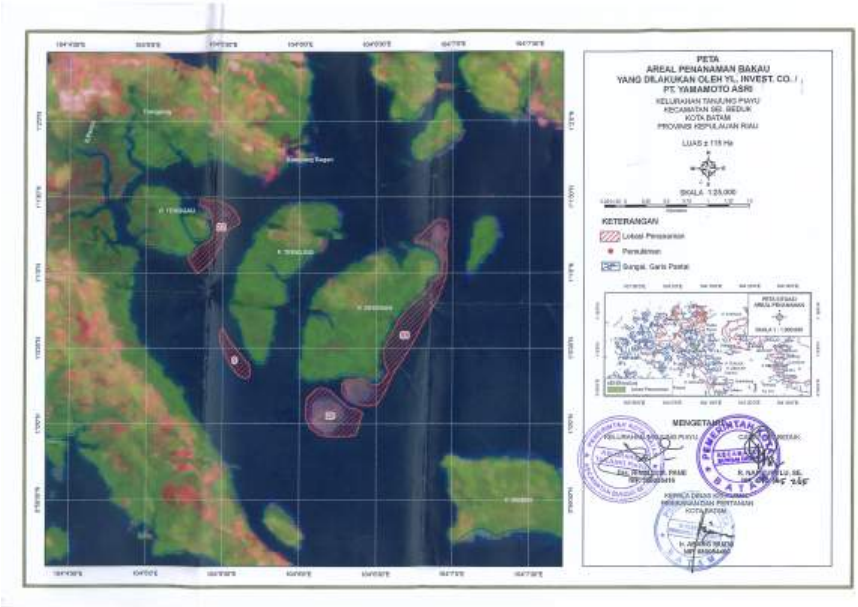


Fig. A.4.2.b. Map showing the location of tidal flats where mangrove planting has been done. Numbers in the each marked (diagonal lined) area on the map show area in hectare.

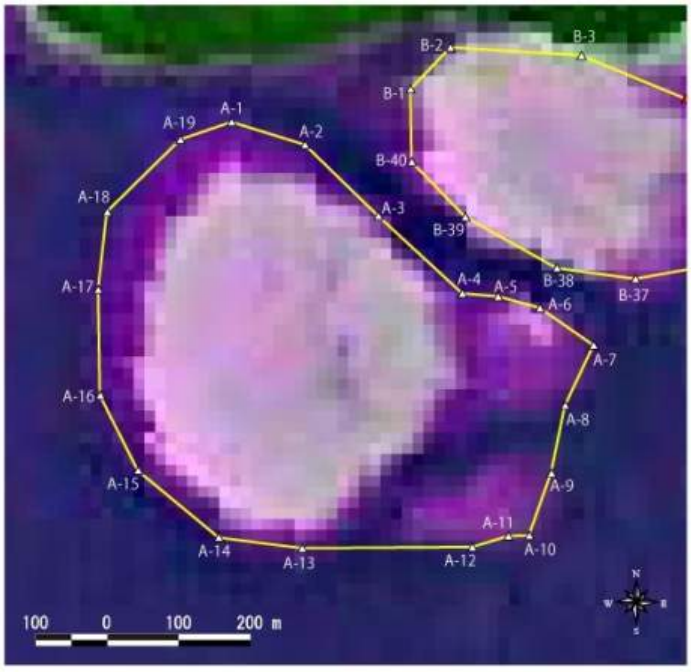


Fig. A.4.2.c. Map showing the location of the project boundaries and coordinate plots designated as Section A, of the 29 ha planned afforestation site neighboring Sekenah Island. The latitude and longitude of each plot are indicated in Table 4.2.

Fig. A.4.2.d. Map showing the location of the project boundaries and coordinate plots designated as Section B of the 55 ha planned afforestation site neighboring Sekenah Island. The latitude and longitude of each plot are indicated in Table 4.2.

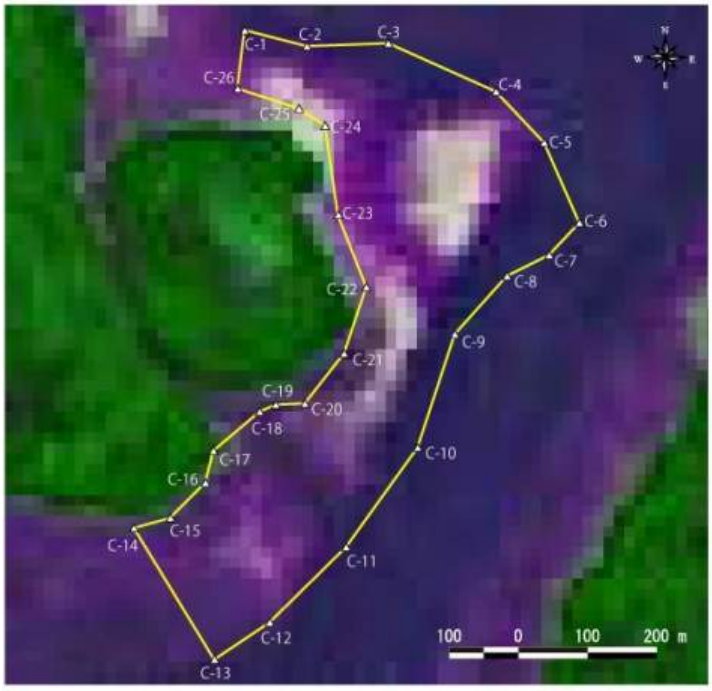


Fig. A.4.2.e. Map showing the location of the project boundaries and coordinate plots designated as Section C of the 22 ha planned afforestation site neighboring Tenggau Island. The latitude and longitude of each plot are indicated in Table 4.2.

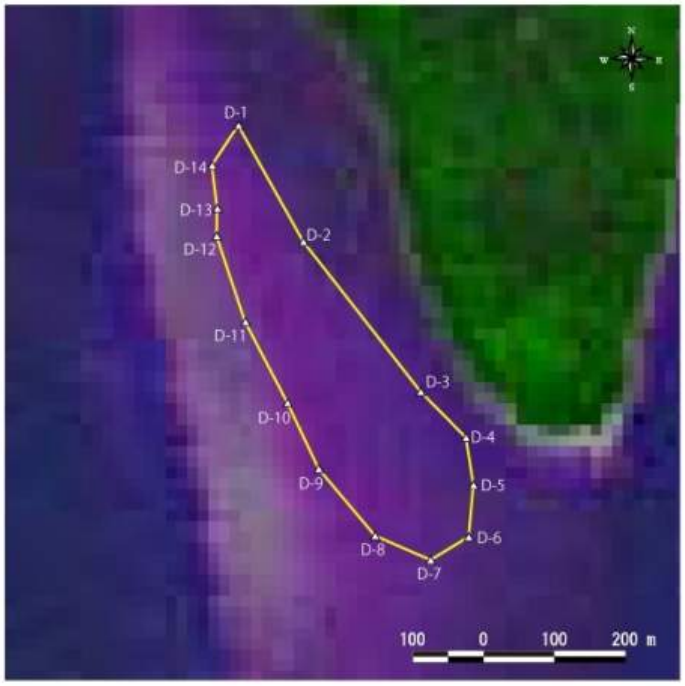


Fig. A.4.2.f. Map showing the location of the project boundaries and coordinate plots designated as Section D of the 9 ha planned afforestation site neighboring Teraling Island. The latitude and longitude of each plot are indicated in Table 4.2.

Table A.4.2. Latitudes and longitudes of four different afforestation plots on project boundaries shown in Fig. 4.2.c.d.e.f.

Area ID	Area (ha)	Point ID	Longitude (E)	Latitude (S)
A	29	A-1	104° 06′ 09″	1° 00′ 14″
		A-2	104° 06′ 12″	1° 00′ 13″
		A-3	104° 06′ 15″	1° 00′ 10″
		A-4	104° 06′ 19″	1° 00′ 07″
		A-5	104° 06′ 21″	1° 00′ 06″
		A-6	104° 06′ 23″	1° 00′ 06″
		A-7	104° 06′ 25″	1° 00′ 04″
		A-8	104° 06′ 24″	1° 00′ 01″
		A-9	104° 06′ 23″	0° 59′ 58″
		A-10	104° 06′ 22″	0° 59′ 56″
		A-11	104° 06′ 21″	0° 59′ 56″
		A-12	104° 06′ 19″	0° 59′ 55″
		A-13	104° 06′ 12″	0° 59′ 55″
		A-14	104° 06′ 08″	0° 59′ 56″
		A-15	104° 06′ 04″	0° 59′ 59″
		A-16	104° 06′ 03″	1° 00′ 02″
		A-17	104° 06′ 03″	1° 00′ 07″
		A-18	104° 06′ 03″	1° 00′ 10″
		A-19	104° 06′ 06″	1° 00′ 13″

Area ID	Area (ha)	Point ID	Longitude (E)	Latitude (S)
B	55	B-1	104° 06′ 17″	1° 00′ 16″
		B-2	104° 06′ 19″	1° 00′ 18″
		B-3	104° 06′ 24″	1° 00′ 17″
		B-4	104° 06′ 29″	1° 00′ 15″
		B-5	104° 06′ 32″	1° 00′ 16″
		B-6	104° 06′ 35″	1° 00′ 21″
		B-7	104° 06′ 33″	1° 00′ 24″
		B-8	104° 06′ 33″	1° 00′ 30″
		B-9	104° 06′ 36″	1° 00′ 34″
		B-10	104° 06′ 39″	1° 00′ 41″
		B-11	104° 06′ 42″	1° 00′ 45″
		B-12	104° 06′ 50″	1° 00′ 52″
		B-13	104° 06′ 50″	1° 00′ 54″
		B-14	104° 06′ 52″	1° 00′ 57″
		B-15	104° 06′ 55″	1° 00′ 59″
		B-16	104° 06′ 56″	1° 01′ 04″
		B-17	104° 06′ 55″	1° 01′ 07″
		B-18	104° 06′ 52″	1° 01′ 10″
		B-19	104° 06′ 47″	1° 01′ 12″
		B-20	104° 06′ 45″	1° 01′ 12″
		B-21	104° 06′ 46″	1° 01′ 15″
		B-22	104° 06′ 49″	1° 01′ 16″
		B-23	104° 06′ 51″	1° 01′ 19″
		B-24	104° 06′ 54″	1° 01′ 21″
		B-25	104° 06′ 58″	1° 01′ 21″
		B-26	104° 06′ 58″	1° 01′ 16″
		B-27	104° 06′ 57″	1° 01′ 11″
		B-28	104° 06′ 58″	1° 01′ 05″
		B-29	104° 06′ 57″	1° 00′ 58″
		B-30	104° 06′ 54″	1° 00′ 49″
		B-31	104° 06′ 49″	1° 00′ 40″
		B-32	104° 06′ 43″	1° 00′ 29″
		B-33	104° 06′ 37″	1° 00′ 21″
		B-34	104° 06′ 35″	1° 00′ 16″
		B-35	104° 06′ 33″	1° 00′ 12″
		B-36	104° 06′ 30″	1° 00′ 08″
		B-37	104° 06′ 27″	1° 00′ 07″
		B-38	104° 06′ 23″	1° 00′ 08″
		B-39	104° 06′ 19″	1° 00′ 10″
		B-40	104° 06′ 17″	1° 00′ 12″

Area ID	Area (ha)	Point ID	Longitude (E)	Latitude (S)
C	22	C-1	104° 05′ 21″	1° 01′ 29″
		C-2	104° 05′ 24″	1° 01′ 29″
		C-3	104° 05′ 28″	1° 01′ 29″
		C-4	104° 05′ 33″	1° 01′ 27″
		C-5	104° 05′ 35″	1° 01′ 24″
		C-6	104° 05′ 37″	1° 01′ 20″
		C-7	104° 05′ 35″	1° 01′ 19″
		C-8	104° 05′ 33″	1° 01′ 18″
		C-9	104° 05′ 31″	1° 01′ 15″
		C-10	104° 05′ 29″	1° 01′ 10″
		C-11	104° 05′ 26″	1° 01′ 05″
		C-12	104° 05′ 22″	1° 01′ 02″
		C-13	104° 05′ 20″	1° 01′ 00″
		C-14	104° 05′ 16″	1° 01′ 06″
		C-15	104° 05′ 18″	1° 01′ 07″
		C-16	104° 05′ 19″	1° 01′ 08″
		C-17	104° 05′ 20″	1° 01′ 10″
		C-18	104° 05′ 22″	1° 01′ 12″
		C-19	104° 05′ 23″	1° 01′ 12″
		C-20	104° 05′ 24″	1° 01′ 12″
		C-21	104° 05′ 26″	1° 01′ 14″
		C-22	104° 05′ 27″	1° 01′ 17″
		C-23	104° 05′ 26″	1° 01′ 21″
		C-24	104° 05′ 25″	1° 01′ 25″
		C-25	104° 05′ 24″	1° 01′ 26″
		C-26	104° 05′ 21″	1° 01′ 27″

Area ID	Area (ha)	Point ID	Longitude (E)	Latitude (S)
D	9	D-1	104° 05′ 30″	1° 00′ 38″
		D-2	104° 05′ 33″	1° 00′ 33″
		D-3	104° 05′ 38″	1° 00′ 26″
		D-4	104° 05′ 41″	1° 00′ 24″
		D-5	104° 05′ 41″	1° 00′ 21″
		D-6	104° 05′ 41″	1° 00′ 19″
		D-7	104° 05′ 39″	1° 00′ 18″
		D-8	104° 05′ 36″	1° 00′ 19″
		D-9	104° 05′ 34″	1° 00′ 22″
		D-10	104° 05′ 32″	1° 00′ 25″
		D-11	104° 05′ 30″	1° 00′ 29″
		D-12	104° 05′ 29″	1° 00′ 33″
		D-13	104° 05′ 29″	1° 00′ 34″
		D-14	104° 05′ 29″	1° 00′ 36″

A.5. Technical description of the small-scale A/R CDM project activity:

A.5.1. Type(s) of small-scale A/R CDM project activity:

From wetland to forest (select from Decision 14/CP. 10)

A.5.2. A concise description of 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:

Mangrove distribution area in Indonesia was 4.5 million ha in the 1970's but decreased to 2.5 million by the year 2000 (FAO, 2002). The Indonesian government, anxious of the decrease of mangrove forests and subsequent degradation of coastal ecosystems started a strong countermeasure to rehabilitate and preserve mangrove forests in the1980's. In 1997 the government launched a national policy to manage mangrove forests funded by the Asian Development Bank. Recently Indonesia has played a key role in promulgating the importance of mangrove preservation following the Conference of Parties (COP) held in Bali in December 2007 and World Ocean Conference held in Manado in May 2009. In addition, domestically, Indonesians have started paying attention to mangrove rehabilitation and other ecosystems as a way of preventing environmental degradation and as a countermeasure against global warming. This afforestation project together with the successful 1st stage plantation is highly regarded by the MoF of Batam City.

Climate:

The climate of the project site is equatorial. Based on monthly meteorological data of 2007 (Meteorological and Geophysical Agency, Indonesia. 2008), average temperature were 27.1 ^{o}C with 32.6 ^{o}C and 22.1 ^{o}C as maximum and minimum average temperatures respectively and total annual precipitation was 2,929 mm. Average precipitation was 244 mm with December and January having double the amount of precipitation (500 mm) compared to the other monthly averages and February had the least (66 mm). Monthly averages of relative humidity ranged from 80 % to 86 % and did not vary much throughout the year.

Soils:

Soils in the tidal areas targeted for afforestation are a mixture of sand, mud and coral reef fragments (Fig. A.5.2.a.b.). These areas have soft earth. In the southern part of Sekenah Island, about 70 % of the mud contains lime sand originating from coral reefs, making the soil firm enough for people to walk without sinking into. Both of these soils make it possible for mangrove propagules to be planted. The recent rises in sea level and high tides have eroded land in the coastal area. Since mangroves have an intricate root system that can grasp mud/ soil to prevent land erosion, mangrove plantation has emerged as a good way of coastal preservation.

Geography:

The island is at a low altitude with accumulated sediment deposition from tidal flats. Tidal flats in the afforestation site appear above the sea level and the soil surface is exposed to air for about half a day, everyday.

Fig. A.5.2.a. Tidal flats appeared at low altitudes in the afforestation site

Land:
The land to be afforested is coastal marsh with tidal fluctuation. Soils are a mixture of marine sand, mud and coral fragments (Fig. A.5.2.b.).

Fig. A.5.2.b. Soil conditions of the project site.

Ecosystems:
In the target site, natural mangrove vegetation is as a matter of fact so little that it is actually possible to count the few remaining stands. This destruction of the mangrove forest has occurred naturally over time and does not fit the definition of forests in Indonesia (See A.7 Assessment of the eligibility of land for details).
Mangrove trees are generally called "ocean's forests" or "ocean's cradle" because they play a key role in coastal ecosystems. Mangrove trees support various biodiversity like prawns, crabs and small fishes which feed and breed around the intricate root system, and monkeys and birds which settle on the branches. Mangrove trees are distributed mostly in brackish areas in the tropical and subtropical regions including Indonesia. The region neighboring the planned afforestation site also has mangrove trees. The main species in South East Asia are *Rhizophora apiculata*, (Bakau Biasa in Indonesia) and *Rhizophora mucronata* (Bakau Blukap in Indonesia). Fishermen settled around the target area have confirmed that no vegetation has been seen in the tidal area in the last five decades including the date when the project got started (September 6, 2006) shown in A.9.1.

Hydrology:
Tidal variation is about 1 m and average salinity at spring tide is 2.8%. In each of the three islands, there is unrestricted flow of several brackish water creeks and water influent and effluent fluctuate. According to the sea tide table of 2008, the sea tide in Batu Ampar, Batam City (01^{o}09'59" N, 103^{o}59'49" E) did not fluctuate much averaging about 2.7-3.0 m throughout the year (Meteorological and Geophysical Agency, Indonesia. 2008).

Rare and endangered species:
There is no record of rare and endangered species of flora and fauna in all the three islands.

A.5.3. Species and varieties selected:

Above-ground biomass (AGB) of mature mangrove forest in Asia and Pacific areas is reported to be 500-550 ton/ ha (Paijmans and Rollet, 1977; Putz and Chan, 1986), which exceeds that of tropical rain forests. This huge productivity of mangrove forest plays an important role as a CO_2 sink to sequester greenhouse gases (GHG) (Gong and Ong, 1995), and for that mangrove afforestation is expected to expand the forest area.
The selected species are the predominant species in South-East Asia, and include *Rhizophora apiculata*, (Bakau Biasa in Indonesia, Fig. A.5.3.a.) and *Rhizophora mucronata* (Bakau Blukap in Indonesia, Fig. A.5.3.b), which are found naturally occurring around the target site. These predominant species support high productivity of marine resources and they have a higher possibility of being rooted therefore, their propagules will be directly planted in the mud.

Fig. A.5.3.a. *Rhizophora apiculata*

Fig. A.5.3.b. *Rhizophora mucronata*

A.5.4. Technology to be employed by the proposed small-scale A/R CDM project activity:

Mangrove afforestation has been done in various regions in Indonesia since 1980's, however, the proper nurturing and management of the rehabilitated forests is not practiced most of the time. With the initiative of Team Permanent Mangrove, this project plans to nurture the rehabilitated forests thereby launching an organized method of management comprising management/complementary planting of afforested stands and seaweed removal.

Collection of propagules:
R. apiculata and *R. mucronata* flower throughout the year although the most frequent seasons are in December to January and October to December which have the most precipitation in the year, respectively. During these periods, propagule collection will be carried out by visually checking maturity of propagules hanging down from trees and pulling them out from the stands by hand. For the maturity of propagules, suitability can be assessed by examining the cap-color which is red-brown in *R. apiculata* and yellow in *R. mucronata*. Besides direct collection, propagules falling down naturally and floating in the seawater can be collected using sea nets. Propagules shown in Fig. A.5.4.a. total 30,000 *R. apiculata*. The local community has been engaged through collaboration to do collection and tend to the propagules.

Storage of propagules:

Collected propagules will be temporarily stored under shade such as beneath stilt houses belonging to workers and kept moist by natural tidal inundation (Fig. A.5.4.a.). Under these conditions, the propagules can be maintained near natural environment with no negative impact on germination for about a week or more.

Fig. A.5.4.a. Propagules stored beneath stilt houses at the riverside

Direct planting:

Direct planting of propagules will be conducted by teams of two persons. The process involves making a hole of 10 cm in depth in the soil with a small stick (ϕ approx. 1.5cm) before inserting the propagules along the lines drawn. Planting is done by inserting the propagules along the predetermined lines at 1.5 m x 1.5 m spacing (4,500 propagules/ha). No fertilizer will be applied in this project.

Tending:

Dead seedlings will be replaced with new propagules. The main participants in the plantation activity will consist of fishermen because they can tend to the propagules as they carry on their daily tasks (Fig. A.5.4.b.). Seaweed entangled onto seedlings due to the fluctuation of tides will be removed periodically with the collaboration of local people, so that they can grow healthily under protection. The local community will be trained on how to replace lost propagules and how to monitor propagules.

Fig. A.5.4.b. Staff from PT. Yamamoto Asri checking planted seedlings in the site

This project will provide on-the-job training on afforestation skills. Technical expertise on the project implementation such as management and monitoring will be provided by ISME (International Society for Mangrove Ecosystems) and Saga University as described in the project participants. Their activities include research on mangrove ecosystems, education, holding of international conferences and admittance of interns from JICA. They have experienced in rehabilitation of coastal ecosystems through mangrove afforestation all over the world, and have accumulated data and knowledge regarding biomasses and CO_2 fixation of mangrove forests in Indonesia, Thailand, Vietnam and Okinawa, Japan.

In September 2006, the first stage afforestation was carried out. By April 2007, the 29 ha plantation of *R. apiculata* at Sekenah Island (01°00'41" N, 104°06'25" E) had been developed into a site. Two years after the afforestation, 60 % stand growth was reported (Fig. A.5.4.c.d.). It has been agreed that the planted mangrove forests will be managed by the Project for 30 years (the project period) and then returned to Batam City to be designated as a Protected Area.

Fig. A.5.4.c. Six-month-old of *R. apiculata* stands in the site. Fig. A.5.4.d. Mud crab living in the site.

A.5.5. Transfer of technology/know-how, if applicable:

Local people in Tanjung Piayu Laut and Bagan villages are mainly fishermen and do not have any experience in mangrove plantation. As mentioned in A.3, Team Permanent Mangrove leader and his deputy have acquired all the knowledge necessary for the project implementation such as seed handling, afforestation and related management through collaborative work since 2006. From then on, the two have taken initiatives in technology transfer to members in the local communities through on-the-job-training. Their cooperation made it possible that stands of 1.3 m average height were at presently spread across 29 ha of land as shown in A.5.5.

Mr. Akune, Mr. Buhari and some local staffs of PT. Yamamoto Asri will provide training to the local people involved in the project with support from ISME and Saga University. Training activities include collection, handling, storage and replanting of propagules. Further training will include follow-up activities such as replanting and tending. The PT. Yamamoto Asri staff members have already established good working relationships with the local community since 2006 and the two supervising staffs can speak the Indonesian language so there is no problem in technology transfer.

The local people were reassured that the project is environmentally friendly and that the establishment of mangrove plantations will support their livelihood and enhance their fish catch in the foreseeable future. They were also told that the planted mangrove forests will be returned to Batam City after completion of the project.

Fig. A.5.5. *Rhizophora mucronata* stands growing in Sekenah Island (the 1st stage plantation).

A.5.6. Proposed measures to be implemented to minimize potential leakage as applicable:

There is no farm or crop area on this project site, as is shown in Fig. A.4.2.b., the location of tidal flats, and Fig.A.7, the satellite image. According to the conditions indicated in (a), (b) and (c) of Section 19 in AR-AMS0003/Version 01, the leakage is expected to be zero as this project does not include cutting and thinning.

A.6. A description of legal title to the land, current land tenure and land use and rights to tCERs / lCERs issued:

The target site is a tidal area with tidal fluctuation, namely, the sea area. In Indonesia, the sea area is government-owned land which is under the jurisdiction of municipalities. MoU was signed between Batam city and YL Co., Ltd., allowing YL Co., Ltd to use land for this project, whose site is under the jurisdiction of Batam City. As stipulated in the MoU, YL Invest Co., Ltd. will establish mangrove plantations on the tidal flats of Sekenah, Teraling and Tenggau islands around Batam City. The company, through its subsidiary, holds the right to establish and manage 500 ha of mangrove plantations over a tenure period of 30 years for the purpose of carbon trading as well as environmental conservation. During this period, YL Invest Co., Ltd. will be responsible for planting, maintaining and managing the mangrove forests and will return the established forests and their associated ecosystems to Batam City at the end of the 30-year period.
It is agreed under the MoU that all emission rights arising out of this project should belong to YL Invest Co., Ltd.

A.7. Assessment of the eligibility of land:

According to Ministry of Forestry Regulation Number 14/2004 (http://www.dephut.go.id/index.php?q=id/node/1619), forests in Indonesia are defined as lands having growing trees with:

- A minimum area of 0.25 ha
- A minimum tree crown cover of 30%
- A minimum height of 5 m

The wetland (tidal flat) where the project activities will be carried out is not designated as a Protected Area or Ramsar site as there are very few mangrove trees a situation that doesn't fit the definition of forests according to the Indonesian government. As shown above, this project activity can be treated as afforestation. Also, according to Decision 6/CMP.1, Annex, Appendix C2, a, b and c, this project site doesn't satisfy conditions necessary for designation as a Protected Area, so it is clear that the land is not a part of debundled area in larger scale of

afforestation.

In addition, witnesses from the local community (Mr. Acung from Piayu Laut Village, Mr. Idris from Bagan Village and several residents over 70 years of age living in either of the villages) and Landsat analysis from satellite pictures taken in 1989 and 2006 showed vegetation cover had not changed for the last 50 years leading up to September 6th 2006, the project start date. This means that there was no expansion of the tidal flat in the project site around this period. In addition, eligibility of land is evaluated in the following papers from field study using GPS (Global Positioning System) and data analysis using GIS (Geographical Information System);

- A survey conducted by YL Invest Co., Ltd. and Batam City
- Latitude and longitude of project boundaries (Fig. A.4.2.c-f)
- Local Government's View on this project

Fig. A.7. Satellite images of the project area in 1989 (Landsat TM on the left) and in 2006 (Aster on the right). Comparison between the two images shows no changes around the area from 1989 to 2006.

A.8. Approach for addressing non-permanence:

Issuance of 1CERs

A.9. Duration of the proposed small-scale A/R CDM project activity / Crediting period:

This projects credit period as well as its implementation period will be 30 years.

A.9.1. Starting date of the proposed small-scale A/R CDM project activity and of the (first) crediting period, including a justification:

September 6th 2006, the same date that mangrove afforestation started. A copy of receipt proving that local workers were paid for the first plantation activity was shown.

A.9.2. Expected operational lifetime of the proposed small-scale A/R CDM project activity:

30 years

A.9.3. Choice of crediting period and related information:

2. Fixed crediting period

A.9.3.1. Duration of the first crediting period (in years and months), if a renewable crediting period is selected:

Not applicable.

A.9.3.2. Duration of the fixed crediting period (in years and months), if selected:

30 years and 0 month

A.10. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

Year	Estimated net anthropogenic annual GHG absorption (ton CO_2-e/115 ha/yr)
2006	0
2007	20.8
2008	35.9
2009	147
2010	323
2011	741
2012	1,573
2013	3,021
2014	5,192
2015	7,937
2016	10,756
2017	12,909
2018	13,774
2019	13,199
2020	11,531
2021	9,348
2022	7,155
2023	5,248
2024	3,734
2025	2,601
2026	1,785
2027	1,213
2028	819
2029	550
2030	368
2031	246
2032	164
2033	110
2034	73.0
2035	48.6
Estimated total amount of net anthropogenic GHG absorption (ton CO_2-e/115 ha/30 yrs)	114,623
Mean value of estimated net	3,821

anthropogenic annual GHG absorption (ton CO_2-e/115 ha/ yrs)	
Total credit years（yrs）	30
Annual mean value of net anthropogenic GHG absorption during the credit years (ton CO_2-e /ha/yr)	32.2

A.11. Public funding of the proposed small-scale A/R CDM project activity:

No public funding such as ODA (Official Development Assistance) will be provided for this Project (Annex 2). All the project funds will be invested by YL Invest Co., Ltd.

A.12. Confirmation that the small-scale A/R CDM project activity is not a debundled component of a larger project activity:

According to Decision 6/CMP.1, Annex, Appendix C2, a, b and c, this project site doesn't satisfy these conditions, so it is clear that the land is not a part of debundled area in a larger scale afforestation project. Up to now, it is the only CDM project in Batam in which Batam City has authorized the use of designated islands for A/R CDM project.

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:

This project used the simplified baseline and monitoring methodology (AR-AMS0003, Version 01) for small-scale CDM afforestation and reforestation projects activities implemented in wetlands.

B. 2. Justification of the applicability of the baseline and monitoring methodology to the proposed small-scale A/R CDM project activity:

This project will carry out mangrove afforestation on tidal areas. For the past 50 years, there has been no change in land use and no woods or herbaceous species have grown. No agriculture, no farm animals. There will be no penetration of natural forest without establishment of plowing or drainage for this afforestation activity. They can be proved by seeing GIS analysis results in Fig. A.4.2.c and satellite images in Fig. A.7. Thus, it has been decided to apply the baseline and monitoring methods in AR-AMS0003 Version 01, due to the fact that the elements paragraph 1 (a)–(g) in AR-AMS0003 Version 01 match the circumstances.

B.3. Specification of the greenhouse gases (GHG) whose emissions will be part of the proposed small-scale A/R CDM project activity:

The aim of this project is to sequester CO_2. Mangroves have a higher fixation capacity at their growth peaks compared to tropical forests and therefore CO_2 sequestering from the atmosphere will be done using mangrove trees.

As for emergency measures, the Ministry of Forestry in Indonesia has been reinforcing laws on prevention of illegal logging. Risks of being destroyed in a fire are low because the mangroves will be growing in tidal flats. This indicates unintended CO_2 emission shall be avoided.

B.4. Carbon pools selected:

Carbon pools selected in this suggested small scale A/R CDM project following AR-AMS0003 Version 01are AGB (Above-ground biomass) and roots (living biomass) (Table B-

1).

Table B.4. Selected carbon pool

Carbon Pool	Selected (select yes or no)
Above ground	Yes
Below ground	Yes
Dead wood	No
Litter	No
Soil organic carbon	No

B.5. Description of strata applied for ex ante estimations:

In this project, mangrove afforestation will be implemented in tidal flats around Sekenah, Teraling and Tenggau Islands. The project area, (three islands), is arranged into four strata. Stratification helps improve the accuracy of the biomass estimates. Paragraph 31 (iii) in the methodology 003 requires an estimation of biomass stocks targeting precision level of ± 10 % of the mean at the 95 % confidence level for the stratification approach. However, this target can be achieved not only by stratification but also by the combination of stratification, the number and the size of the permanent sample plots. This point is described in section B.8.1.1.. Time, tree species, distribution are shown in Table 1.

Table B.5. Afforestation schedule in the target site.

	Island	Area	Village	Time	Species	Distribution
1	Sekenah	29 ha	Piayu Laut	September, 2006	*R. apiculata* 40% *R. mucronata* 60%	1.5m x 1.5m
2	Sekenah	55 ha	Bagan	April, 2008	*R. apiculata* 40% *R. mucronata* 60%	1.5m x 1.5m
3	Tenggau	22 ha	Bagan (same village with the one in Sekenah Island)	May, 2008	*R. apiculata* 40% *R. mucronata* 60%	1.5m x 1.5m
4	Teraling	9 ha	Bagan	December, 2009	*R. mucronata* 100%	1.5m x 1.5m
	Total	115 ha				

B.6. Application of baseline methodology to the proposed small-scale A/R CDM project activity:

It has been proven that the tidal marsh in the project site has not changed for the past 50 years according to satellite images and GIS analysis in A.4.2 and statements by local people. According to AR-AMS0003 Version 01, the baseline of the project can be taken as zero as carbon stocks are stabilized in the land prior to the project implementation.

B.7. 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:

The approved methodology AR-AMS0003 Version 01 was used. The average annual sequestration of each small-scale AR CDM project activity is below the small-scale threshold of 16,000 tCO_2-e per year.
The demonstration of additionality follows the AR-AM0003 Version 01. The project activity would not have occurred without the CDM component due to the following barriers:

Investment barriers:
The two villages (Piayu Laut and Bagan) taking part in the project are considered low-income communities as documented in Statement of Declaration of Low Income Communities and Individuals issued by Batam City, and they cannot afford the investment funds necessary for mangrove afforestation (Annex 3), and neither can Batam City (Section F). As shown in the MoU contracted in July 2006, there is no funding support from Batam City government. Batam city would not invest in environmental conservation, which they do not see as an appealing investment option.

Institutional barriers:
Batam Island, located approximately 20 km south of Singapore, is a special administrative region, which is directly controlled by the Indonesian President. The city proactively attracts foreign capital with its preferential tax treatment. Based on the government's city plan, this has led to increased land development with the growth of industrialization and tourism.

***Technological barriers*:**
Local communities are mainly fishermen who lack the custom of planting mangroves for conservation and sustainable management of mangrove ecosystems. It is difficult to grow mangroves from propagules, while raising seedlings is also difficult as they are easily affected by environmental factors such as tidal levels, salt levels and so on. Being inexperienced in afforestation, and lacking the knowledge and means to collect information, it would be hard for the local communities to establish mangrove ecosystems by themselves.

***Barriers relating to local traditions*:**
Not applicable as there is no tradition inhibiting tree planting in the area.

Barriers due to prevailing practice:
The small-scale AR CDM project activity is the "first of its kind" in Indonesia. No project activity of this type is currently running in the country. This means the initial learning curve is steep and transaction costs to get the project on the ground will be very high. This pilot project activity will level the playing field for other investors to establish CDM forestry project.

Barriers due to local ecological conditions:
Not applicable.

Social barriers:
Local communities are mainly fishermen and recognize the importance of mangrove forests for their daily catchments. However, they lack awareness of forest conservation and rehabilitation, and they cut mangrove trees for subsistence. Mangrove afforestation requires vast amount of manpower for collection, transportation, planting, and management, however, local people are not accustomed to organizing themselves into unions and working together as a team. It is necessary to provide proper environmental education in order to actualize sustainable usage of the ecosystem, development of infrastructure and continuous management of this project.

B.8. Application of monitoring methodology and monitoring plan to the small-scale A/R CDM project activity:

B.8.1. Data to be monitored: Monitoring of the actual net GHG removals by sinks and leakage.

B.8.1.1. Actual net GHG removals by sinks data:

Monitoring of baseline net GHG removals by sinks is not necessary according to the applied methodology AR-AMS003. All data will be kept for two years after the end of the last crediting period in the paper and electronic files. The provision for quality assurance (QA) and quality control (QC) will be applied.

Monitoring of forest establishment

a. Location of the project boundary and strata
   Location of the area where the project activity has been implemented will be measured in the field using GPS. This will be conducted every 5 years before verification. Stratification for monitoring will be conducted following Section B.5.
b. Size and location of permanent sample plot
   The size of the permanent sample plot is to be at least 20 m x 20 m which is considered the standard area for a sample plot. The number of permanent sample plots of each stratum that will be needed to estimate the project biomass stocks to target precision of level ± 10 % of the mean at 95 % confidence level will be determined according to the methodological tool, "Calculation of the number of sample plots for measurements within AR-CDM project activity" or "Sourcebook for Land Use, Land-Use Change and Forestry Projects (Pearson T., Walker S. and Brown S., 2005)." Pre-monitoring will be conducted to obtain the parameters necessary for the calculations with this tool such as standard deviation of the diameters at breast height of trees for each stratum before the first monitoring.

Carbon stock

Monitoring of the carbon stock in the above and below ground biomass pools will be conducted according to the applied methodology AR-AMS0003. Calculation of carbon stock is shown in C.2.

Above ground biomass

To estimate the above ground biomass, DBH (diameter at breast height; i.e. 1.3 m) will be measured every 5 years before verification. At the same time, the mortality rate will be checked. Above ground biomass will be calculated using the allometric equation (Clough and Scott, 1989), an approved methodology.

Below ground biomass

Below ground biomass will be calculated by using the T/R (top/root biomass) ratio (2.0 - 3.0) reported on common mangrove forest (Komiyama et al., 2008). The most conservative value of the T/R ratio of 3.0 was selected. This T/R ratio can be converted into the Rj value (R/T ratio) to become 0.33, shown in AR-AMS0003.

B.8.1.1.1. Data to be collected or used in order to monitor the verifiable changes in carbon stock in the carbon pools within the project boundary resulting from the proposed small-scale A/R CDM project activity, and how this data will be archived:

Data variable	**Source of data**	**Data unit**	**Measured, calculated or estimated**	**Recording frequency**	**Proportion of data to be monitored**	**How will the data be archived?**	**Comment**
Location of the areas where the project activity has been implemented	Government-issued map attached to MoU signed by Batam City	Latitude/longitude	Measured	Every 5 years	100 %	Electronic, paper and picture	Field work using GPS
Size of the areas where the project activity has been implemented	Government-issued map attached to MoU signed by Batam City	Hectares	Measured	Every 5 years	100 %	Electronic, paper and picture	Field work using GPS
Location of the permanent sample plots	Map, specification and field work of the project	Number of plots	Measured	Every 5 years	100 %	Electronic, paper and picture	Field work using GPS
Number of stands and live trees	Permanent sample plots	Number of trees	Measured	Every 5 years	All of those included in sample plots	Electronic, paper	Measure DBH for each tree that falls within the sample plot and applies to size limits
DBH (Diameter at breast height)	Permanent sample plots	cm	Measured	Every 5 years	All of those included in sample plots	Electronic, paper	Measure height (H) for each tree that falls within the sample plots and applies to size limits
CO_2 fixation	Project activity	tonCO_2-e	Calculated	Every 5 years	All the project data	Electronic, paper	Based on data collected from all plots and carbon pools

B.8.1.2. Data for monitoring of leakage (if applicable)

As shown in A.5.6, project sites are tidal areas and according to the conditions indicated in (a), (b) and (c) of Section 19 in AR-AMS0003/Version 01, leakage is expected to be zero.

B.8.1.2.1. If applicable, please describe the data and information that will be collected in order to monitor leakage of the proposed small-scale A/R CDM project activity

B.8.2. Describe briefly the proposed quality control (QC) and quality assurance (QA) procedures that will be applied to monitor actual GHG removals by sinks:

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 will be part of project documentation and will 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. This point is especially important for small-scale A/R CDM project activities, as time scales of project activities are much longer than technological improvements of electronic data archiving can allow. Each point of importance for small-scale A/R CDM project activities is treated in the following section.

Procedures to ensure reliable field measurements

Collecting reliable field measurement data is an important step in the QA plan. Those responsible for the measurement work are 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 procedures to be followed in 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:

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 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 archived for the re-measurements for comparison with the original measurements:

- Missed or extra trees no error within the plot
- Tree species or groups no error
- D.B.H. < ± 0.5 cm or 3 % whichever is greater
- Height < ± 10/ and -20%
- Circular plot radius/sides of rectangular plot < ± 1% of horizontal (angle-adjusted)

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

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.

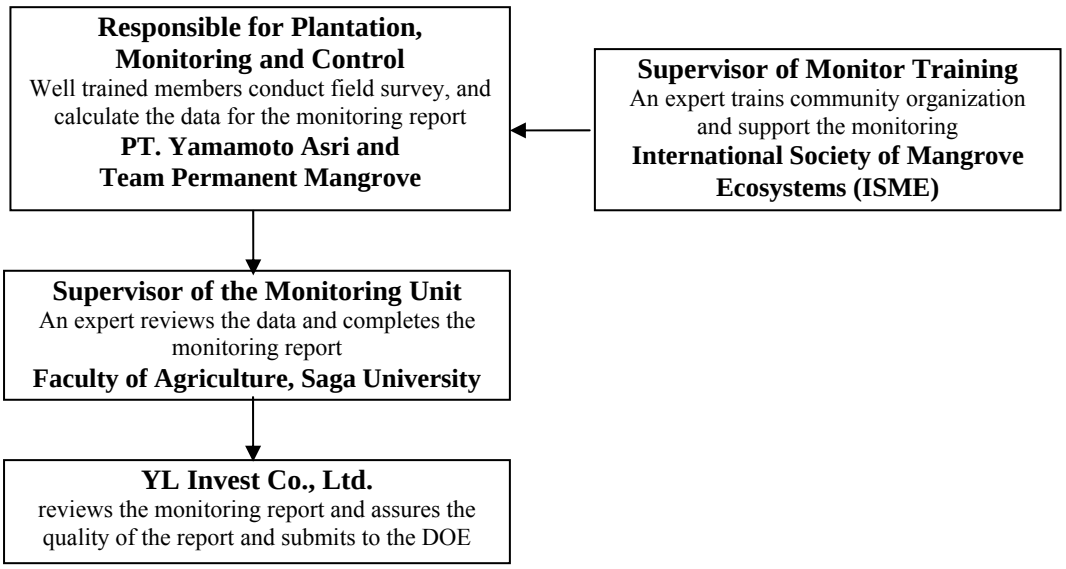
Copies (electronic and/or paper) of all field data, data analyses, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports should all be stored in a dedicated and safe place, preferably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

Training

Training on how to monitor quality control (QA) and quality assurance (QA) will be provided through "On the job training" by PT. Yamamoto Asri, YL Invest Co., Ltd., and their academic partners in ISME and Saga University as shown in A.5.5..

B.8.3. 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:

- Staff from PT. Yamamoto Asri will provide on-the-job training to the local community, Team Permanent Mangrove, under the supervision of ISME and Saga University.
- Staff of PT. Yamamoto Asri and trained members of the local communities will monitor actual GHG removal by sinks every 5 years.



- Fig. B.8.3. Operational and management structure of the monitoring.

B.9. Date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline and the monitoring methodology:

Both measurements of baseline and monitoring were done in September 2006. The table below shows personnel who measured the values, and both of them are members of this project.
Studies of baseline and monitoring performed by:

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

C. 1. Estimated baseline net GHG removals by sinks:

As indicated in B.6, the wetlands of the tidal areas in the project sites have had no change in land use for the past 50 years as witnessed by the local people. According to paragraph 5 of the methodology AR-AMS0003 (Version. 01), the baseline of the project can be taken as zero as carbon stocks are stabilized in the land.

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

Actual GHG removals by this project are estimated to be 114,623 tonCO_2-e. The average value of annual CO_2 fixation is estimated to be 3,821 tonCO_2-e/115 ha/ yr.

Actual net greenhouse gas removals by sinks (*ex ante*)

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

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

where:

$\Delta C_{PROJ,t}$ = Removal component of actual net GHG removals by sinks at time t; ton CO_2-e yr^{-1}.
C_t = Carbon stocks in the above and below ground carbon pools for trees at time t; ton CO_2-e
T = Time difference between t and t-1; years.

For above-ground biomass

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

$C_{AB,i,t} = B_{AB,i,t} * 0.5$

where:
$C_{AB,i,t}$ = Carbon stocks in above-ground biomass of trees for stratum *i*, at time *t*; ton C ha^{-1}.
$B_{AB,i,t}$ = Above-ground biomass of trees in stratum *i* at time *t*; ton dry matter ha^{-1}.
0.5 = Carbon fraction of dry matter; ton C $(t\ dm)^{-1}$.

Small scale AR-CDM projects fall into three categories depending on locations of the projects, which are grasslands, croplands and wetlands. Applicable methodologies for these three locations are AR-AMS0001, 0002 and 0003 respectively. In the three methodologies, calculation method for CO_2 fixation estimation using stand volume and wood density is introduced.
Methodology AR-AMS0003 was adopted because this project will take place in wetlands where mangroves grow. This methodology also describes estimation of biomass using stand volume and wood density and calculations to estimate CO_2 fixation. Unlike in terrestrial forests, though, stand volume data for the above calculations for mangrove do not exist, which makes it impossible to calculate CO_2 fixation with stand volume-applied method.
Instead, the allometry equation described in the methodology AR-AMS0003 was employed for the estimation of CO_2 fixation in the newly-afforested mangrove forest. This equation needs DBH (diameter at breast height) to calculate biomass. Although changes in DBH over time are uncertain, growth of DBH was forecasted by adopting the growth curve reported by Okimoto et al (2008). The growth curve is perceived as the most conservative estimation method. DBH changes obtained through the growth curve are substituted into the allometry equation in order to evaluate biomass amount, then annual CO_2 fixation is estimated from annual biomass stocks calculated by incremental biomass amounts from one year to the next. CO_2 fixation each year for the 30-year project period is evaluated this way, and then grand total of the 30-year long CO_2 fixation is estimated.

Methodology (AR-AMS0003, Version 01) introduces both Option 1 and Option 2 for biomass estimation regarding prediction of annual net anthropogenic GHG removals by sinks. Option 2 was selected in this project because data of stand volume on mangrove are lacking, and which we cannot use Option 1.

Option 2:
Alternatively, local, national, or regional sources on aboveground biomass accumulation through time for the species planted in the project area that can be fitted into standard biomass growth equations (biomass in ton ha^{-1} versus time) may exist. These can be used directly for $B_{AB,i,t}$:

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

$$B_{AB,i,j,t=n} = B_{AB,i,j_{(t=n-1)}} + g * \Delta t$$

where:
$B_{AB,i,t}$ = Above-ground biomass of trees in stratum *i* at time *t*; ton dry matter ha^{-1}
$B_{AB,i,j,t=n}$ = Above-ground biomass of trees of species *j* in stratum *i* at time *t*=*n*; ton dry matter ha^{-1}
g = Annual increment in biomass; ton dry matter ha^{-1} yr^{-1}
Δt = Time increment; years
n = Running variable that increases by Δt for each iterative step
j = Index for species (*Sps* = total number of species in stratum)
In this project, the following allometric equation was used to calculate biomass growth:
Log_{10} (AGB) = 2.685 Log_{10} (DBH) – 0.979 (Clough and Scott, 1989)

where:
AGB = Above-ground biomass (ton dry matter $stand^{-1}$)
DBH = Diameter at breast height measured at a height of approximately 1.5 m, or above the highest prop-root of *Rhizophora* species.

In regards to biomass growth equation, we applied allometric method approved in Appendix D of AR-AMS0003 version 01. The allometric method consists of ten equations and is divided into categories based on each mangrove species and location. In this project, we selected the allometric equation reported by Clough and Scott (1989) for three reasons: (1) Indonesia is located in tropical wet region; (2) there are only two species of mangroves, *R. mucronata* and *R. apiculata* used in this project and (3) to avoid over-estimation of biomass. Detailed calculation method of predicted CO_2 fixation value by allometric method was explained.

For below-ground biomass

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

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

$$C_{BB,ij,t} = B_{AB,i,j,t} * R_j * 0.5$$

where:

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

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

$B_{AB,i,j,t}$ = Above-ground biomass of trees of species *j* in stratum *i* at time *t;* ton dry matter ha^{-1}

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

0.5 = Carbon fraction of dry matter; ton C (ton dry matter)$^{-1}$

The rule is that documented local or national values of R_j should be used. T/R (top to root) ratios of 2.0 - 3.0 of mangrove trees in general were reported by Komiyama et al. (2008). R_j is equal to the reciprocal of the T/R ratio, so the most conservative value was taken as the R_j value of 0.33.

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

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

where:

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

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

Predicted value of CO_2 fixation in the final analysis was corrected with predicted number of remaining trees in the end of project, 3,262 trees/ha, which is 27.3% smaller that the planted trees at the beginning of the project, 4,500 trees/ha. The details are explained.

Uncertainty of prediction of CO_2 fixation value

It is considered that uncertainty in this project could be found in prediction of variations of DBH value during the project, which is used for estimation of CO_2 fixation value. However, according to a report by JICA (1999), local data of the DBH values of mangrove trees in Indonesia follow a sigmoid curve during their growth. This data supports our estimation method and reduces uncertainty. This uncertainty can also be reduced by the QA&QC procedures of as shown in B.8.2. The other uncertainty is on natural mortality and how many stands can survive at the end of the project. This is explained to account for the method to pre-calculated value of CO_2 fixation.

Table C.2. Predicted values of CO_2 fixation (tonCO_2-e/site/year) in each stratified project area.

Year	Sekenah Piayu Laut	Sekenah Bagan	Tenggau Bagan	Teraling Bagan	Total
	29 ha	55 ha	22 ha	9 ha	115 ha
2006	0	---	---	---	0
2007	21	---	---	---	21
2008	36	0	0	---	36
2009	92	39	16	0	147
2010	221	68	27	6.5	323
2011	486	174	70	11	741
2012	959	419	167	29	1,573
2013	1,663	921	368	68	3,021
2014	2,495	1,818	727	151	5,192
2015	3,226	3,153	1,261	298	7,937
2016	3,616	4,732	1,893	516	10,756
2017	3,570	6,117	2,447	774	12,909
2018	3,173	6,857	2,743	1,001	13,774
2019	2,597	6,771	2,709	1,122	13,199
2020	1,997	6,018	2,407	1,108	11,531
2021	1,469	4,925	1,970	985	9,348
2022	1,046	3,788	1,515	806	7,155
2023	729	2,785	1,114	620	5,248
2024	501	1,984	794	456	3,734
2025	340	1,383	553	325	2,601
2026	230	949	380	226	1,785
2027	154	645	258	155	1,213
2028	103	435	174	106	819
2029	69	293	117	71	550
2030	46	196	78	48	368
2031	31	131	52	32	246
2032	20	87	35	21	164
2033	14	58	23	14	110
2034	9.1	39	16	10	73
2035	6.1	26	10	6.4	49
Total ($tonCO_2$-e/site/30yrs)	28,917	54,814	21,926	9,567	114,623
Annual average ($tonCO_2$-e/site/yr)	964	1,958	783	332	3,821 ($tonCO_2$-e/115ha/yr)
Maximum value of annual CO_2 fixation (< 16,000 $tonCO_2$-e/site/yr; Limit of small AR-CDM)	3,616	6,857	2,743	1,122	13,774 ($tonCO_2$-e/115ha/yr)

C. 3. Estimated leakage:

Leakage will be zero according to Section 19 in AR-AMS0003/Version 01 as shown in A.5.6. and

B.1.2.

C. 4. The sum of C. 2. minus C.1. minus C.3. representing the net anthropogenic GHG removals by sinks of the proposed small-scale A/R CDM project activity:

Actual net GHG removal by sinks is estimated to be 114,623 tonCO_2-e. The average value of annual CO_2 fixation is estimated to be 3,821 tonCO_2-e/115ha/yr.

C. 5. Table providing values obtained when applying equations from the approved methodology:

The following is a table of standing stacks of above ground and below ground calculated using the method indicated in A.10. (Option 2, Version 01, AR-AMS0003).

Year	Estimation of baseline net GHG removals by sinks (ton CO_2-e /115ha/yr)	Estimation of actual net GHG removals by sinks (ton CO_2-e /115ha/yr)	Estimation of leakage (ton CO_2-e /115ha/yr)	Estimation of net anthropogenic GHG removals by sinks (ton CO_2-e /115ha/yr)
2006	0	0	0	0
2007	0	20.8	0	20.8
2008	0	35.9	0	35.9
2009	0	147	0	147
2010	0	323	0	323
2011	0	741	0	741
2012	0	1,573	0	1,573
2013	0	3,021	0	3,021
2014	0	5,192	0	5,192
2015	0	7,937	0	7,937
2016	0	10,756	0	10,756
2017	0	12,909	0	12,909
2018	0	13,774	0	13,774
2019	0	13,199	0	13,199
2020	0	11,531	0	11,531
2021	0	9,348	0	9,348
2022	0	7,155	0	7,155
2023	0	5,248	0	5,248
2024	0	3,734	0	3,734
2025	0	2,601	0	2,601
2026	0	1,785	0	1,785
2027	0	1,213	0	1,213
2028	0	819	0	819
2029	0	550	0	550
2030	0	368	0	368
2031	0	246	0	246
2032	0	164	0	164
2033	0	110	0	110
2034	0	73.0	0	73.0
2035	0	48.6	0	48.6

Total (ton CO_2-e /115ha/30 yrs)	0	114,623	0	114,623
Total (ton CO_2-e /ha/ yr)	0	33.2	0	33.2

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

D.1. Provide analysis of the environmental impacts, including transboundary impacts (if any):

It can be assumed that biological and ecological disturbances in the coastal area will not be caused due to mangrove afforestation arising from this project. The mangrove species selected in this project, *Rhizophora apiculata*, and *Rhizophora mucronata,* are widely distributed in South East Asia and areas bordering the plantation site. In addition, there are no new species introduced in this project.
In September 2006, prior to the implementation of this project, officials from MoF of Batam City and staff of YL Invest Co., Ltd. had a joint study on the environment of the plantation site and they reported the findings in October 2006. MoF of Batam City confirmed that the findings showed that mangrove afforestation would not affect the environment in and around the plantation site.

D.2. 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:

This project has taken into consideration the impact to the environment of the large-scale mobilization of labor through community participation and there will not be significant negative impact to the coastal environment.

D.3. Description of planned monitoring and remedial measures to address significant impacts referred to in section D.2. above:

Not applicable.

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

E.1. Provide analysis of the socio-economic impacts, including transboundary impacts (if any):

According to Annex 3 of the Decree No. 206/2005 by Ministry of Environment of Indonesia, analysis on the environmental and socio-economic impacts of the AR-CDM project activities shall be conducted under the criteria regulated in the Decree. Based on the criteria, staff of YL Invest Co., Ltd. and its local subsidiary PT. Yamamoto Asri undertook a study prior to the implementation of the project with the officials from MoF Batam City, by issuing direct questionnaires to the local communities. Based on the study results, reports on both local governments' view and social economic impacts were prepared.

Most members of the local communities settled around the project boundaries are involved in fisheries activities. Marine fisheries resources such as fish and shellfish are expected to increase around the mangrove forests, consequently, increasing the harvest and incomes of the local communities, as well as protect the coastal lines. Furthermore, new job opportunities in propagules collection, plantation and management will be available for the fishermen during their recess from fisheries activities.

Coastal ecosystems with mangrove forest comprise of both marine fauna and land fauna including birds, reptiles and mammals like monkeys. Rehabilitation of ecosystems with mangrove forests will improve conservation and expansion of the biodiversity especially in Indonesia, the country with the greatest biological diversity in the world. Furthermore, a new environmentally friendly industry called eco-tourism has been established, which appreciates mangrove trees as objects for sightseeing. This is expected to initiate new sources of income in these coastal areas where fisheries are the only economic activities.

Mangrove trees can be used to mitigate the effects of high tides and tsunamis like the one that struck Sumatra Island in Indonesia in 2004. Mangrove trees can also be used to avert land erosion thus preventing disappearance of low lying islands caused by rising sea levels thereby, ensuring stability and prosperity of local communities.

As shown above, mangrove plantation encompassing community participation will contribute to among other things, increased incomes among members of the local communities. That being the case, for sustainability, it is necessary to educate the communities on technologies relating to the project and the environment. For this project, members of the local communities will be trained on propagules collection, storage, plantation and stands management. The aim is to sustain technology by forming a cooperative structure in the community. A steady afforestation activity and management will lead to sustainable preservation of mangrove forests.

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 socio-economic impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to support documentation:

No effect can be predicted.

E.3. Description of planned monitoring and remedial measures to address significant impacts referred to in section E.2. above:

Not applicable.

SECTION F. Stakeholders' comments:

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

Before any project implementation in Indonesia, depending on local municipalities' regulations, public hearings may be required in order to gather public opinions. However, this was not necessary for this project because Batam City partners with YL Invest Co., Ltd. in its implementation. Therefore, following the procedures described below, comments from stakeholders (residents in coastal areas) were collected.

1. A project concept was brought to Ministry of Forestry, Indonesia and Batam City.
2. The project concept was explained to village chiefs in Piayu Laut and Bagan villages, together with staff from MoF Batam City.
3. Summary of the project concept was explained by the village chiefs to villagers and was accepted for its implementation.
4. Further explanations and opinion exchanges took place when staff from PT. Yamamoto Asri and MoF Batam City joined village meetings held by village delegates.

Fig. F.1. Staff from ISME and PT. Yamamoto Asri interviewing villagers.

Staff of ISME and PT. Yamamoto Asri visited Piayu Laut and Bagan villages with officials from MoF Batam City and distributed questionnaires to both project participants and non-participants who included both fishermen and non-fishermen.

Meeting with Batam city officials and officials from MoF

Meetings between YL Invest Co., Ltd, Batam City and MoF Batam City were held several times in April 2006. Kyoto mechanism including UNFCCC (the United Nations Framework Convention on Climate Change), Kyoto Protocol and CEM was explained to the officials of Batam city and officials from MoF, who were not familiar with CDM projects, by staff of YL Invest Co., Ltd.. At the conclusion of the discussions, a MoU was signed between Batam city and YL Invest Co., Ltd. allowing YL Invest Co., Ltd. land use for this project.

Meeting with the local villagers from Piayu Laut and Bagan villages

There were two meetings with local stakeholders from both villages. The first meeting was with the representatives of the villages, and the second with the local villagers engaged in fisheries respectively. Comments regarding the project were gathered from both representatives and fishermen in the meetings.

In 2006 in Piayu Laut village, officials from MoF Batam City officials, Batam City and Staff from PT. Yamamoto Asri (Mr. Naoto Akune and Mr. Basri Buhari) explained to Mr. Acung (the afforestation representative) about the project activities which included the plantation site, benefits, and opportunities for training and employment. After which Mr. Acung and Staff from PT. Yamamoto Asri met with villagers to receive their comments after explaining the project.

In Bagan village, the same methodology as applied in Piayu Laut village was used , and comments were received. In Feb 2008, MoF Batam City, Batam City officials and Staff from PT. Yamamoto Asri (Mr. Naoto Akune and Mr. Basri Buhari) explained to Mr. Idris, chief of Bagan village, and Mr. Harmat about the project contents.

Mr. Idris had already seen the successful 29 ha pre-plantation of mangrove by YL Invest Co., Ltd. in Sekenah Island before the project implementation, and he secured the agreement and cooperation of village people and participants of the project.

F. 2. Summary of the comments received:

Batam city government recognizes the importance of mangrove ecosystems and the government is keen on mangrove preservation and rehabilitation. This justifies the cooperation granted by the city government to this small scale AR-CDM project which is the first ever project of its kind in the city.

Comments of Batam city government and MoF Batam city.

Person Mr. Abang Muzni, an official of Batam City and Mr. Abdul Muthalib, a MoF officer who are in chargeof this project presented some comments and requests on this project.

- They requested that the project site be selected in such a way as to avoid conflict or competition for human life resources with the local communities, and land development plans of Batam City in recognition of the duration of the project period (30 years).
- Batam City government will support this project although the government will not offer any financial support (as shown in the MoU).
- Sighting the difficult in keeping close contact between Japan and Indonesia, the City government requested YL Invest Co., Ltd. to establish a local subsidiary (PT. Yamamoto Asri) in Batam City.

Fishermen in Piayu Laut and Bagan villages depend on fisheries activities only and they usually cast their nets and crab traps in and around the mangrove plantation site in order to obtain their life resources. Although they recognize the importance of mangroves in the coastal ecosystem, they lack customs and techniques for sustainable planting and rehabilitation of mangrove trees.

Comments received from villagers from Piayu Laut and Bagan villages.
Perceptions of this project by the villagers were encouraging. They recognized the relationship between the rehabilitation of the coastal ecosystem by mangrove afforestation and increased catch from their fisheries activities in the long-term. Furthermore, they were pleased to have new job opportunities in mangrove plantation and the opportunities to be trained in breeding techniques, plantation and management. These are particularly useful on days when it's not possible for them to attend to their fisheries activities (e.g. due to vagaries of weather) as they could tend to the mangroves.

The flowing questions and comments were received from the villagers;

- Anxiety over the possible overlap of the mangrove plantation site and the fishing areas.
- Lack of expertise and experience in mangrove plantation and management and lack of education systems to solve them.
- The future plan for utilization and management of afforested mangrove trees after the end of the project.

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

Account and response to the comments from Batam City government:
Staff of PT. Yamamoto Asri has explained that this project will not only contribute to sequestration of GHG under the Kyoto protocol but is also in line with the Indonesian national policy of rehabilitating mangrove trees implemented by MoF. Staff of PT. Yamamoto Asri has repeatedly explained the main purposes of this project were to provide direct job opportunities, protect the coastal line that produces their life resources in the long-term by carrying out mangrove afforestation and sustainable management by encouraging community participation.
Selection of the project site was decided during the discussion with officials from MoF Batam City and villagers who will participate in this project. PT. Yamamoto Asri agreed on the following;

- All funds required in this project will be provided by YL Invest Co., Ltd. through PT. Yamamoto Asri.
- At the end of the project period (30 years), the mature mangrove forest will revert back to Batam city without any charges accruing.
- PT. Yamamoto Asri was established in July 1st 2006, in Batam city as a subsidiary of YL Invest Co., Ltd. and the main implementer of the project at the site.

Account and response to villagers comments:
In Piayu Laut and Bagan villages, mangrove plantation will be done through community participation. In the course of two meetings the perceptions, YL Invest Co., Ltd. staff addressed the anxieties and concerns of villagers. They eventually showed full understanding and willingness to cooperate in the project when staff of PT. Yamamoto Asri explained that this project will lead to the development of the two villages by increasing the fish catch in the long-term.

Reponses to the perception of project participants were as follows;

- There would be no restriction of fishing activities in the target areas including the plantation site and they were allowed to cast their nets and traps in these areas with care not to prevent the growth of /damage mangrove.
- YL Invest Co., Ltd. gave them a detailed plan of the propagules collection and storage, direct planting and management while delegating PT. Yamamoto Asri to take responsibility for technology transfer to project participants.
- No thinning and felling of the stands in the project site will be done. After 30 years, the forest will revert to Batam City free of charge.

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Annex 1

Contact information of the participants in the proposed small-scale A/R CDM project activity

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First Name:	
Department:	
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Annex 2
Information regarding public funding

As we documented in the PDD, all funds of this project will be given by YL Invest Co., Ltd..

Annex 3

Statement of Declaration of Low Income Communities and Individuals and the local community's cooperation in the implementation of the project.

According to the questionnaire results from village leader Mr. Acung of Piayu Laut village and Mr. Idris of Bagan village, it appeared that there were 750 residents in 200 families and 1000 residences in 450 families in the villages respectively. Statement of Declaration of Low Income Communities and Individuals around the plantation site was published by Batam City (Annex 3).

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KOTA BATAM

Jl. RAJA HAJI NO. 03 SEKUPAN-BATAM
TELP. (0778)323 429

January 30, 2008

STATEMENT OF DECLARATION OF LOW INCOME COMMUNITIES AND INDIVIDUALS

The Batam Forestry Department as the participant of the "Small-scale and low-income community-based mangrove afforestation project on tidal flats of three small islands at Batam, Indonesia" hereby declares that the proposed small scale A/R CDM project activity is developed and implemented in conjunction with low-income communities and individuals as determined by the host party in compliance with the requirements for Decision 6/CMP. 1 Annex section 15(b).

Ir. ABANG MUZNI
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Statement of Declaration of Low Income Communities and individuals

November 18, 2009

Dinas Kelautan, Perikanan, Pertanian dan Kuhutanan Kota Batam as the participant of the "Small-scale and low-income community-based mangrove afforestation project on tidal flats of three small islands around Batam City, Kepulauan Riau Province, Republic of Indonesia" wishes to declare that the proposed small-scale AR-CDM project activity is developed and implemented in conjunction with low-income communities and individuals as determined by the host Party in compliance with the requirements for Decision 6/ CMP. 1 Annex section 15 (b).

an. Kepala Dinas Kelautan, Perikanan,
Pertanian dan Kehutanan Kota Batam
Kabid Kehutanan

Ir. ADNAN ISMAIL
Nip. 19570305 198903 1009