Ministry of Agriculture and Rural Development
The Socialist Republic of Vietnam

No.

BASIC DESIGN STUDY REPORT
ON
THE AFFORESTATION PROJECT
ON
SANDY AREA
IN
THE SOCIALIST REPUBLIC OF VIETNAM

MARCH 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN FOREST ENGINEERING CONSULTANTS

GM
JR
07 – 072

Ministry of Agriculture and Rural Development
The Socialist Republic of Vietnam

BASIC DESIGN STUDY REPORT
ON
THE AFFORESTATION PROJECT
ON
SANDY AREA
IN
THE SOCIALIST REPUBLIC OF VIETNAM

MARCH 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN FOREST ENGINEERING CONSULTANTS

PREFACE

In response to a request from the Government of the Socialist Republic of Vietnam, the Government of Japan decided to conduct a basic design study on the Afforestation Project on Sandy Area and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Vietnam a study team from July 30 to September 16, 2006.

The team held discussions with the officials concerned of the Government of Vietnam, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Vietnam in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Socialist Republic of Vietnam for their close cooperation extended to the teams.

March, 2007

MASAHUMI KUROKI

Vice-President
Japan International Cooperation Agency

March, 2007

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Afforestation Project on Sandy Area in the Socialist Republic of Vietnam.

This study was conducted by Japan Forest Engineering Consultants, under a contract to JICA, during the period from July, 2006 to March, 2007. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Vietnam and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

TAKAO ISOBE

Project manager,
Basic design study team on
the Afforestation Project on Sandy Area
Japan Forest Engineering Consultants

SUMMARY

1 Overview of the Country

The Socialist Republic of Vietnam (hereinafter referred to as "Vietnam") has a national land area of 329,314.5 km^2 of which approximately two-thirds consists of mountain and hilly areas. As of 2005, the total population is 83.12 million, most of which (73%) live in agricultural, fishing or mountain villages. Those engaged in agriculture, forestry or fisheries account for 57% of the total working population in various industries in the said year.

The socioeconomic development strategy is renewed every 10 years in Vietnam and a five year national development plan is formulated to implement the strategy. The current Eighth Five Year National Development Plan (2006 – 2010) aims at Vietnam breaking away from the category of a developing country through sustainable economic development while continually upholding the Doi Moi Policy adopted in 1986. Special emphasis is placed on the reform of the economic structure, improvement of the labor composition, modernization of industries, promotion of science and technology and achievement of high quality education. At the same time, the achievement of poverty reduction is sought to establish a culturally rich and safe society in order to provide a secure social environment for the people.

Since the adoption of the Doi Moi Policy, Vietnam has been pushing economic reform through a shift toward a market economy and the macro economy of Vietnam has been achieving certain positive results in terms of the continuance of a high economic growth rate, containment of inflation and job security. However, from the viewpoint of microscopic economic and fiscal management relating to the reform of state enterprises and reform of the administrative structure and government finance, the national economy still significantly relies on state enterprises. In regard to government finance, tax and oil-related revenue is the main revenue but the expenditure far exceeds the revenue, resulting in an annual deficit of some VND 300 billion. Foreign aid plays an important role in filling this huge revenue shortfall.

Vietnam is attracting much world attention as a promising country for foreign aid. It has become a pilot country for the Comprehensive Development Framework (CDF) advocated by the World Bank and has been actively attempting to achieve institutional improvement, capacity building and improved aid effects through active participation in policy dialog and joint work with donors utilizing the partnership and other frameworks. Vietnam prepared the Comprehensive Poverty Reduction and Growth Strategy (CPRGS) as a Poverty Reduction Strategy Paper (PRSP) based on the CDF in May,

2005 and was the first country in Asia to do so. This CPRGS has been integrated in the Eighth Five Year National Development Plan (2006 – 2010) which determines the basic policies of Vietnam. This means that two policies which used to exist in parallel have been unified to promote economic growth and poverty reduction simultaneously.

Since 1992, Japan has been providing full-scale aid for Vietnam and has been the top donor since 1995. Japan has adopted a stance of assisting the development of Vietnam notably from the viewpoint of a mutually dependent economic relationship but also from the humanitarian as well as social viewpoints and has identified three priority areas, i.e. the promotion of growth, livelihood and social improvement and institutional development.

2 Background, History and Outline of the Requested Japanese Assistance

While Vietnam was once endowed with abundant forest resources, the forest area was substantially reduced from 14.3 million ha in 1945 to as low as 9.3 million ha in 1995 due to the long war, the creation of farmland due to a rapid population increase and extensive felling prompted by the promotion of the forest product processing industry. This drastic decline of the forest area has had a number of negative outcomes, including a decline of the sustainable wood production function, frequent flooding in the rainy season, outflow of a massive amount of sediment from mountainous areas, shifting sand caused by strong winds in coastal sandy areas and the emergence of tidal damage. In short, the decline of the forest function of conserving the national land is causing damages throughout the country. In the face of such a situation, the National Assembly passed a resolution in 1997 to urge the Government of Vietnam to implement the National Five Million Hectare Reforestation Program (5MHRP) aimed at the reforestation of 14.3 million ha by 2010. Although active efforts are being made in terms of forest conservation and planting, the creation of 100,000 ha of coastal protection forests is said to be urgently required.

Vietnam has a long coastline stretching from north to south and the coast in the southern central part of the country is lined with a series of sandy areas. Agricultural crops and infrastructure facilities are damaged by strong winds and shifting sand caused by typhoons and monsoons, severely affecting the lives of local residents. To improve the situation, the Government of Vietnam made a request for Japanese assistance for the afforestation/reforestation of these coastal sandy areas and this request resulted in the commencement of "the Project for Afforestation on the Coastal Sandy Area in Southern Central Viet Nam (PACSA)", a grant aid project of the Government of Japan. Under PACSA, 3,652.88 ha (actual planted area of 3,167.11 ha) of coastal protection forests were created in Quang Nam

Province and Phu Yen Province before its completed in April, 2005.

The Government of Vietnam has since been promoting the creation of coastal protection forests using PACSA as the model. However, as no planting has been conducted at difficult planting sites, such as wind erosion sites and shifting sand sites, many difficult planting sites remain in the southern central part of Vietnam where damage by strong winds and shifting sand still frequently occurs due to the lack of coastal protection forests.

In view of the historical background described above, the Government of Vietnam has made a new request to the Government of Japan to assist the creation of 9,480 ha of coastal protection forests in Quang Nam Province, Quang Ngai Province, Binh Dinh Province and Khanh Hoa Province with many sites where planting is technically difficult as part of its drive to promote 5MHRP.

Because of the high level of technical difficulty of planting to respond to this request, the determination of an appropriate scope of cooperation by means of checking the requested sites, necessary planting techniques and implementation system was essential. For this reason, a preparatory study was conducted in the period from December, 2005 to February, 2006. As a result of this preparatory study, it was decided to conduct a basic design study featuring 5,200 ha of coastal areas in the four provinces to check the necessity, relevance and urgency of the requested project in detail.

Meanwhile, 5MHRP is considered to be a priority Program of the Ten Year Socioeconomic Development Strategy (2001 – 2010) which is the medium to long-term development policy of Vietnam, the Eighth Five Year National Development Program (2006 – 2010) and the Forest Development Strategy 2001 – 2010 (the revised Forest Development Strategy (draft) 2006 – 2020 is currently being debated) which is based on the above strategy and Program. Coordinated aid is being provided for 5MHRP as well as the Forest Development Strategy 2001 – 2010, the higher program of 5MHRP, by the partnership group for the Forest Sector Support Program and Partnership (FSSP). The request project does not, therefore, overlap with the aid projects of other donors and will directly contribute to 5MHRP as a complementary project to other projects.

The Eighth Five Year National Development Program (2006 – 2010) states that 5MHRP is integrated to the Hunger Eradication and Poverty Reduction Programmes (HEPR) implemented by MARD to promote agriculture and rural development as part of reviews to increase the efficiency of 5MHRP.

3 Outline of the Study Results and Project Components

Under the circumstances described above, the Government of Japan decided to conduct a basic design study for "the Afforestation Project on Sandy Area (hereinafter referred to as "APSA")" and entrusted the Japan International Cooperation Agency (JICA) to conduct this study. Accordingly, JICA sent the Basic Design Study Team to Vietnam for the period from 30th July to 16th September, 2006. The Study Team conducted a field survey at the requested sites and held a series of discussions with officials of the Government of Vietnam. On its return to Japan, the Study Team conducted the work to prepare the draft basic design study report. JICA then sent a mission to Vietnam to explain the contents of this draft report for the period from 28th January to 8th February, 2007 and agreement was reached with the Vietnamese side. The present report has been finalized through the process mentioned above.

The activities under the basic design study included surveys and discussions on the finalization of the target planting sites, types of planting techniques to be introduced, confirmation of the maintenance system, scope of responsibility against latent defects, procurement of general-purpose equipment, etc. In the course of the basic design study, some of the requested sites (those in Khanh Hoa Province) were withdrawn because of their overlapping with other development projects in Vietnam and unsuitable sites for planting were excluded from the scope of the Japanese assistance. Consequently, the finalized target area for afforestation is 2,598.47 ha of coastal areas in three provinces, i.e. Quang Nam Province, Quang Ngai Province and Binh Dinh Province.

The outline of the Project is described in the table below.

Overall Goal :	Creation of coastal protection forests in coastal areas in Vietnam using the Project as a model
Project Purpose :	Reduction of the damage caused by shifting sand, strong winds, sand movement, etc. to agricultural as well as fishing villages in the coastal areas of Quang Nam Province, Quang Ngai Province and Binh Dinh Province.
Activities :	i Creation of temporary facilities (operation roads, temporary nurseries, etc.) ii Procurement (production and purchase) of fine seedlings iii Ancillary planting works (measures to prevent/reduce damage by shifting sand, flooding, etc.) iv Planting of fine seedlings v Tending of the planted trees vi Patrolling and guarding of the coastal protection forests, primarily by local residents vii Construction of lookout towers viii Erection of project information signboards
Outputs :	Creation of coastal protection forests to block shifting sand, strong winds, sand movement, etc. in the coastal areas of Quang Nam Province, Quang Ngai Province and Binh Dinh Province.

Inputs :	Japanese Side Grant aid cooperation by the Government of Japan Vietnamese Side a. Required manpower b. Preparation of electric power lines and access roads c. Financial inputs relating to the maintenance and protection of newly created coastal protection forests and the operation and maintenance of the Project.

The components of the original application for Japanese assistance and the components of the basic plan are compared in the table below.

Component			Application	Basic Plan
Project Sites	Compartment Area	Total	9,480 ha	2,598.47 ha
		Quang Nam Province	800 ha	594.82 ha
		Quang Ngai Province	1,400 ha	414.06 ha
		Binh Dinh Province	5,280 ha	1,589.59 ha
		Khanh Hoa Province	2,000 ha	0.00 ha
	Planting Area of the Above	Total	9,480 ha	2,463.75 ha
		Quang Nam Province	800 ha	570.52 ha
		Quang Ngai Province	1,400 ha	409.61 ha
		Binh Dinh Province	5,280 ha	1,483.62 ha
		Khanh Hoa Province	2,000 ha	0.00 ha
Major Components	Afforestation	Planting Area	9,480 ha	2,463.75 ha
		Operation Roads (Vehicle Roads)	60 km	19.8 km
		Operation Roads (Footpaths)	0 km	15.1 km
		Temporary Nurseries with Auxiliary Facilities	11	1
		Lookout towers	18	4
		Project Information Signboards (L)	0	6
		Project Information Signboards (S)	0	17
	Equipment Procurement	4 WD Wagons	5	0
		4 WD Pick-Up Trucks	4	0
		Motorbikes	18	0
		Personal Computers	14	0
		Printers	14	0
		Scanners	5	0
		GIS Software	14 sets	0 sets
		Digital Cameras	14	0
		Copy Machines	14	0

Each component is briefly described next.

Casuarina and acacia are the target planting species while cashew and neem will be used as supplementary species. The relationship between the characteristics of the planting sites and the planting methods is shown in the table below.

Primary Category	Degradation Type	Standard of Mixing Ratio	Planting Density	Planting Area
High technical difficulty	Severe moving sand area A	Pure forest of Casuarina	2,500 trees/ha	95.40 ha
	Severe moving sand area B			340.21 ha
	Severe moving sand area C			108.91 ha
	Moving sand area			217.94 ha
	Area adjacent to the shoreline			194.19 ha
	Frequently flooded area	Pure forest of Acacia		323.96 ha
Low technical difficulty	Ordinary sandy area (Quang Nam Province)	Mixed forest of Casuarina : 30 % Acacia : 50 % Cashew : 10 % Neem : 10 %	1,600 trees/ha	246.56 ha
	Ordinary sandy area (Quang Ngai Province) (Binh Dinh Province)	Mixed forest of Casuarina : 50 % Acacia : 30 % Cashew : 10 % Neem : 10 %		437.48 ha
	Poorly growing scattered tree area			181.82 ha
	Dying forest area			317.28 ha

Planting will be conducted in two months (60 days) in the first half of the rainy season to ensure a sufficient period of growth after planting. The planting area by province and term is shown in the table below.

Province	Term-2	Term-3	Total
Quang Nam	287.63 ha	282.89 ha	570.52 ha
Quang Ngai	136.08 ha	273.53 ha	409.61 ha
Binh Dinh	620.71 ha	862.91 ha	1,483.62 ha
Total	1,044.42 ha	1,419.33 ha	2,463.75 ha

At sites where planting is technically difficult, the following types of ancillary planting work will be conducted to reduce a fall of the survival rate due to strong winds, shifting sand and flooding.

Degradation Type	Type of Ancillary Planting Work	Quantity			
		Total		Term-2	Term-3	Term-4
Severe Moving Sand Area A	Sand Deposition Fence（H=1.5m）	12,103.00	m	8,603.00	0.00	3,500.00
	Straw Covering Work	0.00	m^2	0.00	0.00	0.00
	Sand Control Hedge（H=1.7m, 25×30m）	67,447.80	m	67,447.80	0.00	0.00
	Sheild Stick Work	95.40	ha	95.40	0.00	0.00
Severe Moving Sand Area B	Sand Deposition Fence（H=1.5m）	11,152.00	m	7,051.00	4,101.00	0.00
	Straw Covering Work	84,982.00	m^2	47,836.00	37,146.00	0.00
	Sand Control Hedge（H=1.7m, 25×30m）	240,528.47	m	169,008.35	71,520.12	0.00
	Sheild Stick Work	340.21	ha	239.05	101.16	0.00
Severe Moving Sand Area C	Sand Deposition Fence（H=1.5m）	6,823.00	m	6,823.00	0.00	0.00
	Straw Covering Work	0.00	m^2	0.00	0.00	0.00
	Sand Control Hedge（H=1.7m, 30×50m）	56,633.20	m	56,633.20	0.00	0.00
	Sheild Stick Work	108.91	ha	108.91	0.00	0.00
Moving Sand Area	Sand Deposition Fence（H=1.5m）	0.00	m	0.00	0.00	0.00
	Straw Covering Work	0.00	m^2	0.00	0.00	0.00
	Sand Control Hedge（H=1.7m, 30×50m）	113,328.80	m	20,009.60	93,319.20	0.00
	Sheild Stick Work	217.94	ha	38.48	179.46	0.00
Area Adjacent to Shoreline	Sand Deposition Fence（H=1.5m）	0.00	m	0.00	0.00	0.00
	Straw Covering Work	0.00	m^2	0.00	0.00	0.00
	Sand Control Hedge（H=1.7m, 30×50m）	0.00	m	0.00	0.00	0.00
	Sheild Stick Work	194.19	ha	83.50	110.69	0.00
Frequnetly Flooded Area	Ridge Work (H=0.4m)	323.96	ha	160.65	163.31	0.00
	Drainage Ditch Work	10,000.00	m	4,960.00	5,040.00	0.00
Total	Sand Deposition Fence（H=1.5m）	30,078.00	m	22,477.00	4,101.00	3,500.00
	Straw Covering Work	84,982.00	m^2	47,836.00	37,146.00	0.00
	Sand Control Hedge（H=1.7m, 25×30m）	307,976.27	m	236,456.15	71,520.12	0.00
	Sand Control Hedge（H=1.7m, 30×50m）	169,962.00	m	76,642.80	93,319.20	0.00
	Sheild Stick Work	956.65	ha	565.34	391.31	0.00
	Ridge Work (H=0.4m)	323.96	ha	160.65	163.31	0.00
	Drainage Ditch Work	10,000.00	m	4,960.00	5,040.00	0.00

Tending will be conducted in tandem with the planting for the purpose of reducing the death rate of the planted trees and improving the growth rate. The types of tending to be conducted under the Japanese assistance will be supplementary planting and top dressing.

Supplementary planting intends the replacement of those trees which have died after planting. This will be conducted in a two month period at the beginning of the rainy season one year after initial

planting. The planned supplementary planting area by province and term is shown in the table below based on a supplementary planting rate of 15%.

Province	Term-3	Term-4	Total
Quang Nam	287.63 ha	282.89 ha	570.52 ha
Quang Ngai	136.08 ha	273.53 ha	409.61 ha
Binh Dinh	620.71 ha	862.91 ha	1,483.62 ha
Total	1,044.42 ha	1,419.33 ha	2,463.75 ha

Top dressing will be conducted one year after the initial fertilizer application at the time of planting or supplementary planting or the previous top dressing as the effects of fertilizer application and top dressing wears out for a period of three years. As the best timing for top dressing should coincide with the plant growth season, it will be conducted in the first half of the rainy season. The type of fertilizer to be used will be either organic fertilizer or manure. The top dressing area by province and term is shown in the table below.

Province	Term-3	Term-4			Term-5				Total (ha)
	Term-2 Planting Area (ha)	total (ha)	Term-2 Planting Area (ha)	Term-3 Planting Area (ha)	total (ha)	Term-2 Planting Area (ha)	Term-3 Planting Area (ha)	Term-3 Planting Area (ha)	
Quang Nam	287.63	570.52	287.63	282.89	853.41	287.63	282.89	282.89	1,711.56
Quang Ngai	136.08	409.61	136.08	273.53	683.14	136.08	273.53	273.53	1,228.83
Binh Dinh	620.71	1,483.62	620.71	862.91	2,346.53	620.71	862.91	862.91	4,450.86
Total	1,044.42	2,463.75	1,044.42	1,419.33	3,883.08	1,044.42	1,419.33	1,419.33	7,391.25

The total number of seedlings required for planting and supplementary planting is shown in the table below.

Province	Species	Term-2			Term-3			Term-4			Total		
		Total	Planting	Supplementary Planting	Total	Planting	Supplementary Planting	Total	Planting	Supplementary Planting	Total	Planting	Supplementary Planting
Quang Nam	Casuarina	57,904	57,904	0	63,211	54,528	8,683	8,177	0	8,177	129,292	112,432	16,860
	Acasia	478,053	478,053	0	550,451	478,746	71,705	71,808	0	71,808	1,100,312	956,799	143,513
	Cashew	19,296	19,296	0	21,069	18,176	2,893	2,725	0	2,725	43,090	37,472	5,618
	Neem	19,296	19,296	0	21,069	18,176	2,893	2,724	0	2,724	43,089	37,472	5,617
	Total	574,549	574,549	0	655,800	569,626	86,174	85,434	0	85,434	1,315,783	1,144,175	171,608
Quang Ngai	Casuarina	193,640	193,640	0	181,592	152,549	29,043	22,876	0	22,876	398,108	346,189	51,919
	Acasia	15,744	15,744	0	62,761	60,400	2,361	9,058	0	9,058	87,563	76,144	11,419
	Cashew	5,248	5,248	0	20,931	20,144	787	3,019	0	3,019	29,198	25,392	3,806
	Neem	5,248	5,248	0	20,931	20,144	787	3,019	0	3,019	29,198	25,392	3,806
	Total	219,880	219,880	0	286,215	253,237	32,978	37,972	0	37,972	544,067	473,117	70,950
Binh Dinh	Casuarina	1,182,717	1,182,717	0	1,340,392	1,162,991	177,401	174,403	0	174,403	2,697,512	2,345,708	351,804
	Acasia	54,576	54,576	0	194,649	186,464	8,185	27,967	0	27,967	277,192	241,040	36,152
	Cashew	18,192	18,192	0	64,886	62,160	2,726	9,321	0	9,321	92,399	80,352	12,047
	Neem	18,192	18,192	0	64,886	62,160	2,726	9,321	0	9,321	92,399	80,352	12,047
	Total	1,273,677	1,273,677	0	1,664,813	1,473,775	191,038	221,012	0	221,012	3,159,502	2,747,452	412,050
Total	Casuarina	1,434,261	1,434,261	0	1,585,195	1,370,068	215,127	205,456	0	205,456	3,224,912	2,804,329	420,583
	Acasia	548,373	548,373	0	807,861	725,610	82,251	108,833	0	108,833	1,465,067	1,273,983	191,084
	Cashew	42,736	42,736	0	106,886	100,480	6,406	15,065	0	15,065	164,687	143,216	21,471
	Neem	42,736	42,736	0	106,886	100,480	6,406	15,064	0	15,064	164,686	143,216	21,470
	Total	2,068,106	2,068,106	0	2,606,828	2,296,638	310,190	344,418	0	344,418	5,019,352	4,364,744	654,608

Of those seedlings to be planted in Phu My District in Binh Dinh Province, some 930,000 casuarina seedlings will be produced at a temporary nursery as these will be beyond the supply capacity of the existing nurseries. All other seedlings will be procured from the existing nurseries. The breakdown of the seedlings to be produced at the temporary nursery is shown in the table below.

Term	Species	Total			Planting			Supplementary Planting		
		Sub-Total	Seedlings from Seeds	Seedlings from Cutting	Sub-Total	Seedlings from Seeds	Seedlings from Cutting	Sub-Total	Seedlings from Seeds	Seedlings from Cutting
Term-2	Required Number of Seedlings	741,650	370,850	370,800	741,650	370,850	370,800	0	0	0
	Produced Number of Seedlings	927,062	463,562	463,500	927,062	463,562	463,500	0	0	0
Term-3	Required Number of Seedlings	643,694	321,863	321,831	532,451	266,238	266,213	111,243	55,625	55,618
	Produced Number of Seedlings	804,616	402,328	402,288	665,563	332,797	332,766	139,053	69,531	69,522
Total	Required Number of Seedlings	1,385,344	692,713	692,631	1,274,101	637,088	637,013	111,243	55,625	55,618
	Produced Number of Seedlings	1,731,678	865,890	865,788	1,592,625	796,359	796,266	139,053	69,531	69,522

The seedling standards by species regardless of the supply source are shown in the table below.

Species	Type	Height	Nursing Period	Minimum Pot Size
C. equisetifolia	Sowed seedlings Rooted cuttings	60 - 100 cm	6-8 months	Ø 10cm × 20cm (H)
Acacia	Sowed seedlings	25 - 45 cm	2.5-3 months	Ø 4cm × 10cm (H)
A. occidentale	Grafts	50 - 70 cm	3 months after grafting	Ø 10cm × 20cm (H)
M. azadirachta	Sowed seedlings	25 - 45 cm	4-5 months	Ø 10cm × 20cm (H)

Operation roads will be constructed at the project target areas to efficiently conduct planting, tending and maintenance (as well as post-planting protection). Such roads will be either vehicle roads or footpaths depending on the shape and topographical conditions of each project site. The construction length of the operation vehicle roads is shown in the table below.

Province	District	Compartment(s)	Construction Length (km)			
			Total	Term-1	Term-2	Term-3
Quang Nam	Thang Binh	BM-1～3、 BD-1～3、 BH-1～2	7.00	1.50	4.70	0.80
Binh Dinh	Phu My	MTh-1	9.40	1.60	6.60	1.20
	Phu Cat	CT-1	3.40	0.00	2.00	1.40
	Subtotal		12.80	1.60	8.60	2.60
Total			19.80	3.10	13.30	3.40

The construction length of the footpaths is shown in the table below.

Province	District	Compartment	Construction Length (km)			
			Total	Term-1	Term-2	Term-3
Quang Ngai	Duc Pho	PA-1	4.70	0.00	1.50	3.20
		PV-1	2.80	0.60	2.20	0.00
		PK-1	4.70	1.70	3.00	0.00
		PK-2	2.90	0.00	1.30	1.60
Total			15.10	2.30	8.00	4.80

One temporary nursery capable of producing some 930,000 casuarina seedlings will be set up in Phu My District in Binh Dinh Province.

Lookout towers are planned as monitoring facilities for the prevention and early detection of forest fire and the prevention of invasion by farm animals, illegal cutting and the spread of disease and insect damage at the newly created coastal protection forests. They will also function as fixed point observation facilities for the monitoring of plant growth and also as viewing platforms to increase the demonstration effect of the model forests. A total of four lookout towers, i.e. one in Quang Nam Province, one in Quang Ngai Province and two in Binh Dinh Province, will be constructed.

A total of 23 project information signboards will be erected. These will consist of six large signboards (5 m x 10m; two in each province along National Road No. 1) and 17 smaller signboards (3 m x 6 m; two in Quang Nam Province, six in Quang Ngai Province and nine in Binh Dinh Province) along suitable access roads.

Under the Project, it will be necessary for the Vietnamese side to conduct the work listed in the table below.

Item	Work to be Conducted by the Vietnamese Side
At the detailed design stage	i Establishment of a MB in all related organizations ii Signing of the B/A iii Issue of the A/P iv Detailed design contract (Agreement) with the Japanese consultant based on the E/N v Distribution of the planned forests to local residents vi Approval of the tender documents
Prior to the signing of the contract for the main work (Japanese assistance)	i Signing of the B/A ii Issue of the A/P iii Work supervision contract (Agreement) with the Japanese consultant based on the E/N iv Implementation of the tender v Signing of the work contract (Contract)
During the main work	
Work in General	
Permission and approval	i Permission and approval required for the implementation of the Japanese assistance
Maintenance	i Procurement of equipment (vehicles etc.) required for maintenance ii Patrolling and safeguarding of the planting sites, temporary facilities, permanent facilities after their handing over
Titanium mine	i Completion of the closure of the titanium mine prior to the commencement of the work (including the work to restore the original state) = removal of any obstacles to the work at the sites in question
Various awareness raising (educational) activities	i Preparation of pamphlets etc. ii Meetings to explain the Project to local residents iii Forest Day events

Work supervision	i Issue of the Notice of Commencement ii Witnessing of the various inspections and issue of the certificates of completion of the work and the service
Afforestation Work	
Planting and tending	i Distribution of the planned forests to local residents ii Removal of obstacles at the sites iii Coordination of labor supply iv Measures to reduce feeding damage by cattle and other farm animals (coordination work) v Measures to combat disease and pests vi Measures to combat forest fires vii Measures to combat the theft of the planted trees viii Explanation of the Project to and request for the cooperation of local residents
Procurement of seedlings	i Coordination with existing nurseries and related organizations
Construction of operation roads	i Construction of access roads (construction and maintenance) Quang Nam Province : 600 m (two sites) Quang Ngai Province : none Binh Dinh Province : none
Creation of temporary nursery	i Removal of obstacles from the planned nursery site ii Extension of power supply to auxiliary facilities
Construction of lookout towers	i Maintenance of the towers after handing over
Installation of project information signboards	i Provision of land ii Maintenance of the signboards after handing over
After the completion of the main work	i Maintenance (protection) of the created coastal protection forests ii Maintenance of the constructed facilities iii Maintenance of the temporary facilities (if necessary) iv Extension of and awareness raising activities on the techniques to create coastal protection forests v Witnessing of the inspection for warranty against defects and issue of the certificate of inspection completion

4 Project Period and Estimated Project Cost

The Project is a long-term project stretching over a period of 25 years. However, the Japanese assistance will feature the first five years constituting the initial investment period. The expected length of each type of work required for the implementation of the Japanese assistance is shown below. The Japanese assistance will be classified as a Type A contract resulting in a treasury obligation.

Detailed Design	5.50 months
Tender	3.50 months
Construction and Procurement	54.00 months
Total	63.00 months

The total project cost to implement the requested Japanese assistance is estimated to be ¥1,169 million (Japanese portion of ¥1,092 million and Vietnamese portion of ¥77.84 million). However, this cost estimation is provisional and will be further examined by the Government of Japan for approval of the Grant.

5 Relevance of the Project

With the implementation of the Project, 2,598.47 ha (actual planting area: 2,463.73 ha) of forests will be created in coastal sandy areas in the three target provinces, alleviating the damage to farming or fishing villages due to shifting sand, strong winds, sand movement, etc. The following indicators will be used to measure the positive effects of the Project.

Objectively Verifiable Indicators for the Outputs	More than 2,000 ha (approximately 80% of the total project area and 0 ha under the present situation) of coastal protection forests with a mean tree height of 1 m or more will have been created one year after (in the first rainy season) the completion of the Japanese assistance.
Objectively Verifiable Indicators for the Project Purpose	i The number (ratio) of local households damaged by strong winds will be found to have decreased in a questionnaire survey to be conducted at least five years after the completion of the Japanese assistance (at the time of the Basic Design Study, 86.5% or 386 households out of 446 households were damaged by strong wind every year). ii The number (ratio) of local households damaged by shifting sand will be found to have decreased in a questionnaire survey to be conducted at least five years after the completion of the Japanese assistance (at the time of the Basic Design Study, 68.8% or 307 households out of 446 households were damaged by shifting sand every year).

The size of the population benefiting from the Project is shown in the table below and the positive effects of the Project will be measured by conducting a questionnaire survey with representatives of

local residents five years after the completion of the Japanese assistance.

Residents of three Communes in Thang Binh District, Quang Nam Province	20,985
Residents of five Communes in Duc Pho District, Quang Ngai Province	37,283
Residents of six Communes in Phu My and Phu Cat Districts, Binh Dinh Province	60,904
Total	119,172

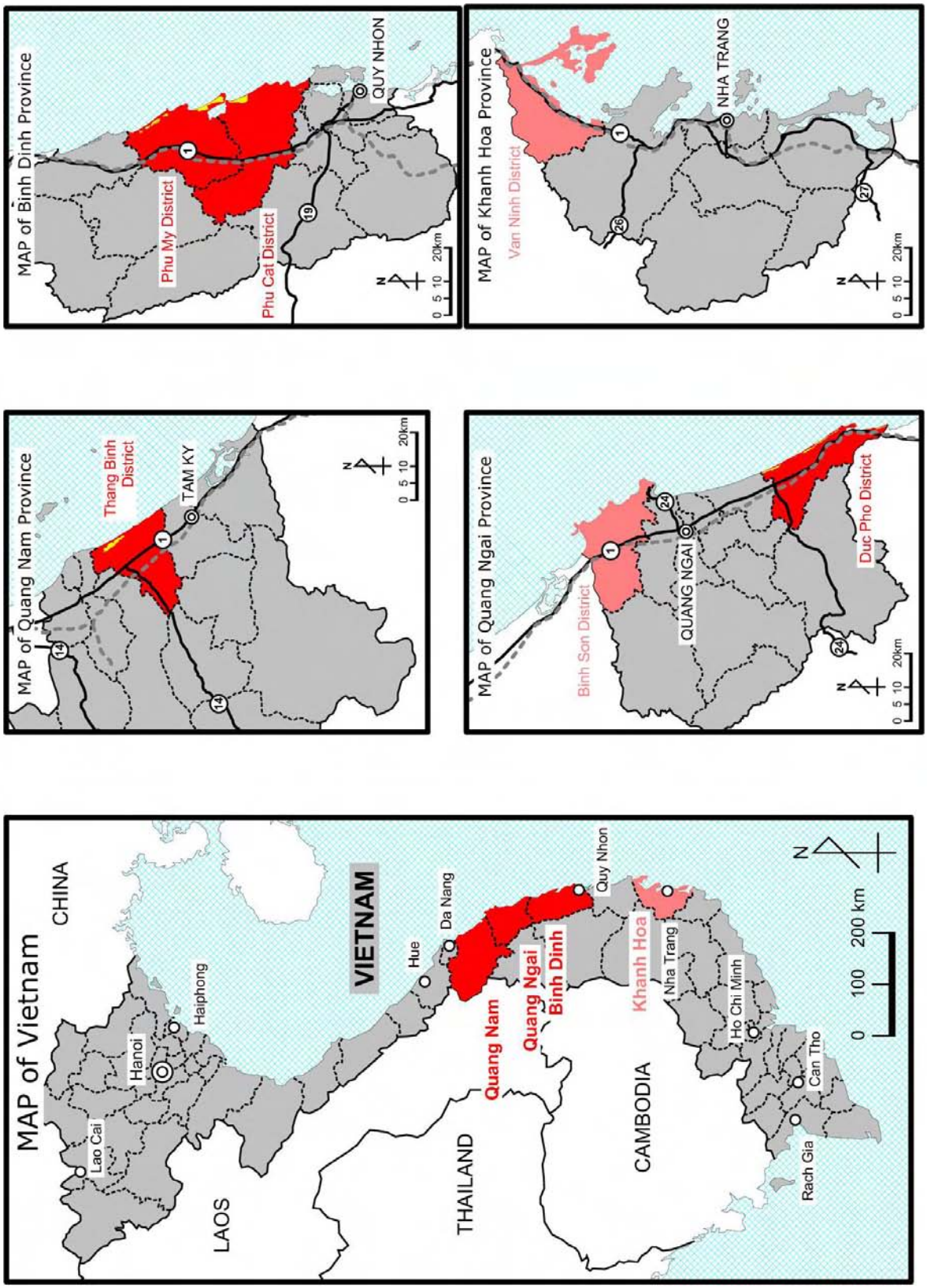
The pending tasks which must be tackled by the Vietnamese side to realize and preserve the project effects are described below along with recommendations regarding technical cooperation and collaboration with other donors.

The formulation of a long-term and rational forest management plan to ensure the proper maintenance and protection of forests is necessary. Intensive discussions with the organizations concerned on appropriate forest maintenance and utilization methods, including the procedure to permit the conversion of land use from forest in certain cases in connection with other development activities, are also necessary.
To positively contribute to 5MHRP, the higher program, the continuous implementation of projects similar to the present Project throughout Vietnam using the techniques adopted under the Project as well as those which have been modified and improved to reflect the local conditions is necessary. As the Vietnamese side will be entirely responsible for education and extension activities, sufficient capacity on the Vietnamese side to effectively conduct extension activities and to formulate plans is required to make the best use of the Project as a model for future projects.
The need for technical cooperation for rural development around the project sites must be examined with a view to determining how to utilize the coastal protection forests created under the Project from the viewpoint of integrated regional development which incorporates not only issues related to forestry but also issues related to agriculture, fisheries, irrigation, health care, poverty reduction, industrial development and gender.
It is necessary to examine the possibility of using the experience obtained through the implementation of the Project to bring about the further creation of coastal protection forests based on ODA loans linked to small-scale AR-CDM projects and/or small-scale AR-CDM projects by private (afforestation) companies so that the creation of coastal protection forests will become widespread in Vietnam.

CONTENTS

[Appendices]

LOCATION MAP



PERSPECTIVE (IMAGE)

3 years later

Note: These photographs show the image of creation of coastal protection forest under APSA as well as actual results of afforestation work at the compartment number P-6-2 (1) under PACSA.

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

The Study	Basic Design Study on the Afforestation Project on Sandy Area in the Socialist Republic of Vietnam
The Project	The general term for the project which includes Japan's grant aid project (APSA below) and forest maintenance and protection for a period of 20 years after the completion of APSA
APSA	A project implemented as a grant aid project of the Government of Japan and part of the Project referred to above. The full title is the Afforestation Project on Sandy Area in the Socialist Republic of Vietnam.
Vietnam	The Socialist Republic of Vietnam
5MHRP	National Five Million Hectare Reforestation Program
A/P	Authorization to Pay
AR-CDM	Afforestation/Reforestation-CDM
B/A	Banking Arrangement
C/P	Counter Part
CDF	Comprehensive Development Framework
CDM	Clean Development Mechanism
CPRGS	Comprehensive Poverty Reduction and Growth Strategy
DARD	Department of Agriculture and Rural Development
DBH	Diameter at Breast Height
E/N	Exchange of Notes
FE/FC	Forest Enterprise / Forest Company
FSIV	Forest Science Institute of Vietnam
FSSP	Forest Sector Support Program and Partnership
GPS	Global Positioning System
HEPR	Hunger Eradication and Poverty Reduction Programmes
IP	Intersection Point or Point of Intersection
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteers

KFW	Kreditanstalt Fuer Wiederaufbau
M/D	Minutes of Discussion
MARD	Ministry of Agriculture and Rural Development
MB	Management Board
MBFP	Management Board for Forestry Project
MPI	Ministry of Planning and Investment
ODA	Official Development Assistance
OJT	On-the-Job Training
P'C	People's Committee
PACSA	The Project for Afforestation on the Coastal Sandy Area in Southern Central Viet Nam
PQ	Pre-Qualification
QC	Quality Control
UNDP	United Nations Development Programme
US$	United States Dollar
VND	Vietnamese Dong
WB	World Bank

Chapter 1 Background of the Project

Chapter 1 Background of the Project

1-1 Overview of the Country

The Socialist Republic of Vietnam (hereinafter referred to as "Vietnam") has a national land area of 329,314.5 km^2 of which approximately two-thirds consists of mountain and hilly areas. As of 2005, the total population is 83.12 million, most of which (73%) live in agricultural, fishing or mountain villages. Those engaged in agriculture, forestry or fisheries account for 57% of the total working population in various industries in the same year.

The socioeconomic development strategy is renewed every 10 years in Vietnam and a five year national development plan is formulated to implement the strategy. The current "Eighth Five Year National Development Plan (2006 – 2010)" aims at Vietnam breaking away from the category of a developing country through sustainable economic development while continually upholding the "Doi Moi Policy" adopted in 1986. Special emphasis is placed on the reform of the economic structure, improvement of the labor composition, modernization of industries, promotion of science and technology and achievement of high quality education. At the same time, the achievement of poverty reduction is sought to establish a culturally rich and safe society in order to provide a secure social environment for the people.

Since the adoption of the "Doi Moi Policy", Vietnam has been pushing economic reform through a shift toward a market economy and the macro economy of Vietnam has been achieving certain positive results in terms of the continuance of a high economic growth rate, containment of inflation and job security. However, from the viewpoint of microscopic economic and fiscal management relating to the reform of state enterprises and reform of the administrative structure and government finance, the national economy still significantly relies on state enterprises. In regard to government finance, tax and oil-related revenue is the main revenue but the expenditure far exceeds the revenue, resulting in an annual deficit of some VND 300 billion. Foreign aid plays an important role in filling this huge revenue shortfall.

Vietnam is attracting much world attention as a promising country for foreign aid. It has become a pilot country for the "Comprehensive Development Framework (hereinafter referred to as "CDF")" advocated by the "World Bank (hereinafter referred to as "WB")" and has been actively attempting to achieve institutional improvement, capacity building and improved aid effects through active participation in policy dialog and joint work with donors utilizing the partnership and other frameworks. Vietnam prepared the "Comprehensive Poverty Reduction and Growth Strategy (hereinafter referred to as "CPRGS")" as a "Poverty Reduction Strategy Paper (hereinafter referred to as "PRSP")" based on the CDF in May, 2005 and was the first country in Asia to do so. This CPRGS has been integrated in "the Eighth Five Year National Development Plan (2006 – 2010)" which

determines the basic policies of Vietnam. This means that two policies which used to exist in parallel have been unified to promote economic growth and poverty reduction simultaneously.

Since 1992, Japan has been providing full-scale aid for Vietnam and has been the top donor since 1995. Japan has adopted a stance of assisting the development of Vietnam notably from the viewpoint of a mutually dependent economic relationship but also from the humanitarian as well as social viewpoints and has identified three priority areas, i.e. the promotion of growth, livelihood and social improvement and institutional development.

1-2 Background of the Project

While Vietnam was once endowed with abundant forest resources, the forest area was substantially reduced from 14.3 million ha in 1945 to as low as 9.3 million ha in 1995 due to the long war, the creation of farmland due to a rapid population increase and extensive felling prompted by the promotion of the forest product processing industry. This drastic decline of the forest area has had a number of negative outcomes, including a decline of the sustainable wood production function, frequent flooding in the rainy season, outflow of a massive amount of sediment from mountainous areas, shifting sand caused by strong winds in coastal sandy areas and the emergence of tidal damage. In short, the decline of the forest function of conserving the national land is causing damages throughout the country. In the face of such a situation, the National Assembly passed a resolution in 1997 to urge the Government of Vietnam to implement the "National Five Million Hectare Reforestation Program (hereinafter referred to as "5MHRP")" aimed at the reforestation of 14.3 million ha by 2010. Although active efforts are being made in terms of forest conservation and planting, the creation of 100,000 ha of coastal protection forests is said to be urgently required.

Vietnam has a long coastline stretching from north to south and the coast in the southern central part of the country is lined with a series of sandy areas. Agricultural crops and infrastructure facilities are damaged by strong winds and shifting sand caused by typhoons and monsoons, severely affecting the lives of local residents. To improve the situation, the Government of Vietnam made a request for Japanese assistance for the afforestation/reforestation of these coastal sandy areas and this request resulted in the commencement of "the Project for Afforestation on the Coastal Sandy Area in Southern Central Viet Nam (hereinafter referred to as "PACSA")", a grant aid project of the Government of Japan. Under PACSA, 3,652.88 ha (actual planted area of 3,167.11 ha) of coastal protection forests were created in Quang Nam Province and Phu Yen Province before its completed in April, 2005.

The Government of Vietnam has since been promoting the creation of coastal protection forests using PACSA as the model. However, as no planting has been conducted at difficult planting sites, such as wind erosion sites and shifting sand sites, many difficult planting sites remain in the southern central

part of Vietnam where damage by strong winds and shifting sand still frequently occurs due to the lack of coastal protection forests.

In view of the historical background described above, the Government of Vietnam has made a new request to the Government of Japan to assist the creation of 9,480 ha of coastal protection forests in Quang Nam Province, Quang Ngai Province, Binh Dinh Province and Khanh Hoa Province with many sites where planting is technically difficult as part of its drive to promote 5MHRP.

Because of the high level of technical difficulty of planting to respond to this request, the determination of an appropriate scope of cooperation by means of checking the requested sites, necessary planting techniques and implementation system was essential. For this reason, a preparatory study was conducted in the period from December, 2005 to February, 2006. As a result of this preparatory study, it was decided to conduct a basic design study for "the Afforestation Project on Sandy Area (hereinafter referred to as "APSA")" featuring 5,200 ha of coastal areas in the four provinces to check the necessity, relevance and urgency of the requested project in detail.

The activities under the basic design study included surveys and discussions on the finalization of the target planting sites, types of planting techniques to be introduced, confirmation of the maintenance system, scope of responsibility against latent defects, procurement of general-purpose equipment, etc. In the course of the basic design study, some of the requested sites (those in Khanh Hoa Province) were withdrawn because of their overlapping with other development projects in Vietnam and unsuitable sites for planting were excluded from the scope of the Japanese assistance. Consequently, the finalized target area for afforestation is 2,598.47 ha of coastal areas in three provinces, i.e. Quang Nam Province, Quang Ngai Province and Binh Dinh Province.

Meanwhile, 5MHRP is considered to be a priority Program of "the Ten Year Socioeconomic Development Strategy (2001 – 2010)" which is the medium to long-term development policy of Vietnam, "the Eighth Five Year National Development Program (2006 – 2010)" and "the Forest Development Strategy 2001 – 2010 (the revised Forest Development Strategy (draft) 2006 – 2020 is currently being debated)" which is based on the above strategy and Program. Coordinated aid is being provided for 5MHRP as well as "the Forest Development Strategy 2001 – 2010", the higher program of 5MHRP, by the partnership group for the "Forest Sector Support Program and Partnership (hereinafter referred to as "FSSP")". The request project does not, therefore, overlap with the aid projects of other donors and will directly contribute to 5MHRP as a complementary project to other projects.

"The Eighth Five Year National Development Program (2006 – 2010)" states that 5MHRP is integrated to the "Hunger Eradication and Poverty Reduction Programmes (hereinafter referred to as "HEPR")" implemented by MARD to promote agriculture and rural development as part of reviews to

increase the efficiency of 5MHRP.

1-3 Situation Surrounding the Project

1-3-1 Project Implementation System

The responsible body for the implementation of the Project is MARD of the central government, of which the Forestry Department in charge of the promotion of afforestation projects etc. and the Forestry Protection Department in charge of forest management and protection as well as the management of the national parks are responsible for the forestry sector. The organizational chart of MARD is given in Fig. 4-1 in the Appendices.

The provincial level implementation body is DARD which is controlled by P'C in each province. The Forestry Development Division of DARD is in charge of guidance and supervision related to the creation, management and protection of forests in the province with the support and guidance of MARD. The organizational structure of DARD differs from one province to another and that of DARD in the three target provinces of the Project is shown in Fig. 4-2 through Fig. 4-4 in the Appendices.

For the implementation of the requested Japanese assistance, i.e. APSA, the relationship between these organizations in Vietnam and the Japanese organizations is shown in Fig. 1-1.

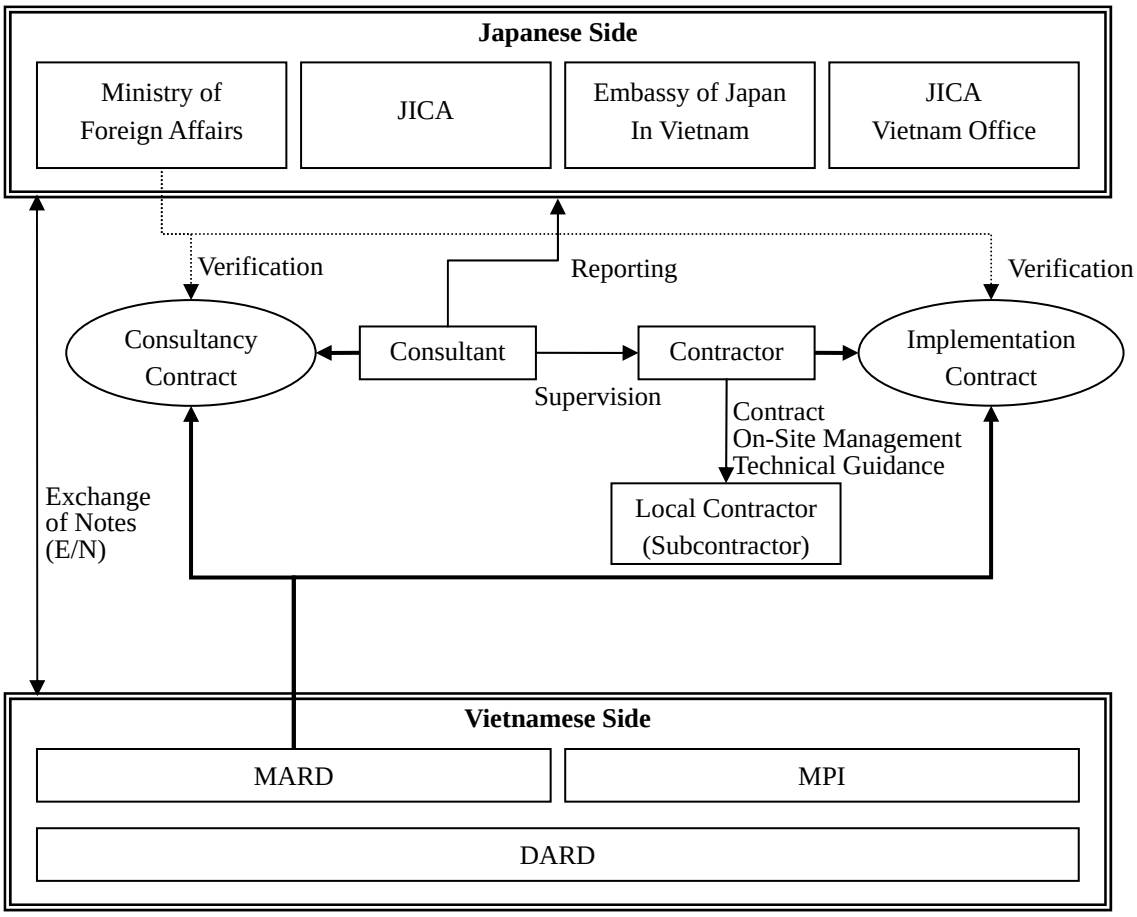


Fig. 1-1 Relationship between the Various Organizations Involved in the Implementation of APSA

A management board (MB) will be set up at each Vietnamese organization involved in APSA to act as a window (functioning as an implementation body in practice) for such organization. Each MB will consist of 2 – 5 full-time engineers and clerical workers and will be directly involved in the implementation of APSA. In all, hierarchical implementation with close collaboration between those on the upper level and those on the lower level as shown in Fig. 1-2 will be established in Vietnam.

Although these MBs will be dismantled after the completion of APSA, their members will remain at MARD or respective DARD to be continually responsible for conducting practical operation and maintenance work under the Project.

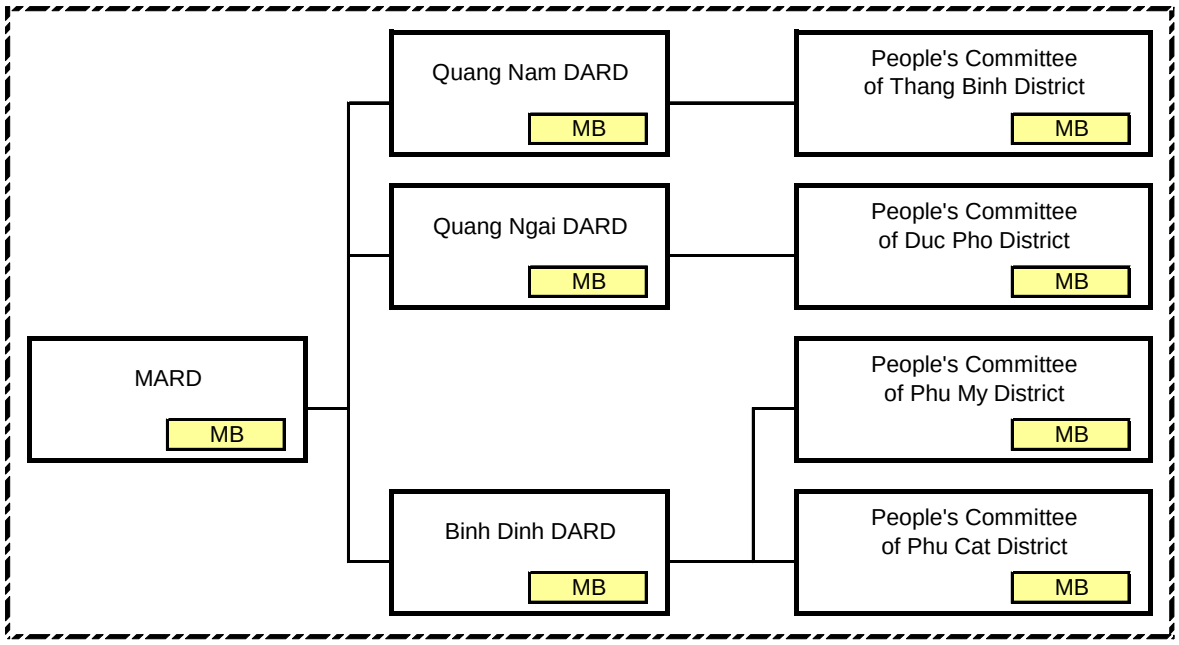


Fig. 1-2 Project Implementation System on the Vietnamese Side

1-3-2 Natural Conditions

(1) Topography

Vietnam is a S-shaped country situated on the eastern side of the Indochinese Peninsula facing the East China Sea and has a national land area of 329,314.5 km^2. Its exact location is between 8°30′N and 23°22′N and between 102°10′E and 109°24′E. It stretches long in the north – south direction and borders China to the north and Laos and Cambodia to the west.

The country is generally classified into seven regions, i.e. "Northern Mountain and Midland", "Red River Delta", "North Central Coast", "South Central Coast", "Central Highlands", "South-East" and "Mekong River Delta" (see Fig. 1-3). The Northern Mountain and Midland Region and the Red River Delta Region are combined to form the northern part, while the North Central Coast Region, the South Central Coast Region and the Central Highlands Region form the central part. The remaining South-East Region and the Mekong River Delta Region form the southern part. The project sites are located in the South Central Coast Region.

Quang Nam Province has two relatively large river systems, i.e. the Cai River and Thu Bon River System and the Tam Ky River System. Even though the area of the province exceeds 10,000 km^2, plains account for just over 10%. These plains widen toward the sea and their immediate hinterland consists of gentle hilly areas with an elevation of 200 m to 600 m. Further inland, these hills rise to form the Truong Son Range which rises above an elevation of 1,000 m at the border with Laos, forming the watershed. The project sites are scattered on the alluvial plains where lagoons created by blockage of the mouth of rivers by abundant sediment transported through the Thu Bon River System

eventually form sand dunes.

In Quang Ngai Province, a long and narrow plain covering an area of 1,200 km^2 spreads along the coast. This plain was formed by the Tra Bong River system, the Tra Khuc River system and the Ve River system. Despite this, the plain only accounts for 20% of the total area of the province. The formulation process of this plain is almost identical to that of the plains in Quang Nam Province and, from a geological point of view, this plain consists of sandy soil. As the southern part of the Truong Son Range gradually nears the coastline, the plain in the southern part of the province has mountainous hinterland. The project sites are scattered in narrow sandy areas which are sandwiched by the mountain range and the sea in the southern part of the province.

In Dinh Binh Province, the Truong Son Range runs near the coastline. As a result, there is no major plain except for small plains and sand pits. The project sites are located (i) in a lagoon where the mouth of Chau Truc River is clogged at the southern coastline, (ii) between Nuoc Ngot Lake situated at the mouths of Bau Da River and other river and the sea and (iii) at a site with well developed sand dunes between Dap Lang River located to the south of the outlet of the said lake and the sea. At these sites, sand dunes are formed as the abundant sediment transported and discharged by local rivers to the sea shift due to the sea current as well as strong winds. The movement of sand is especially noticeable at My Thanh Commune, forming a severe moving sand area.

In Khanh Hoa Province, although sizable plains covering a total of some 400 km^2 exist, this figure represents less than 8% of the total area of the province. The largest plain is Nha Trang Plain where the provincial capital is located. The originally proposed sites (later withdrawn) are located on sand dunes forming sand pit topography on the peninsular stretching southwards from the boundary with Phu Yen Province in the northernmost part of the province. The unevenness of the topography is far more prominent at these sites compared to the sites in other provinces. As there is no local river which prompts sedimentation, it is apparent that these sand dunes have been formed by the sea current and wind.

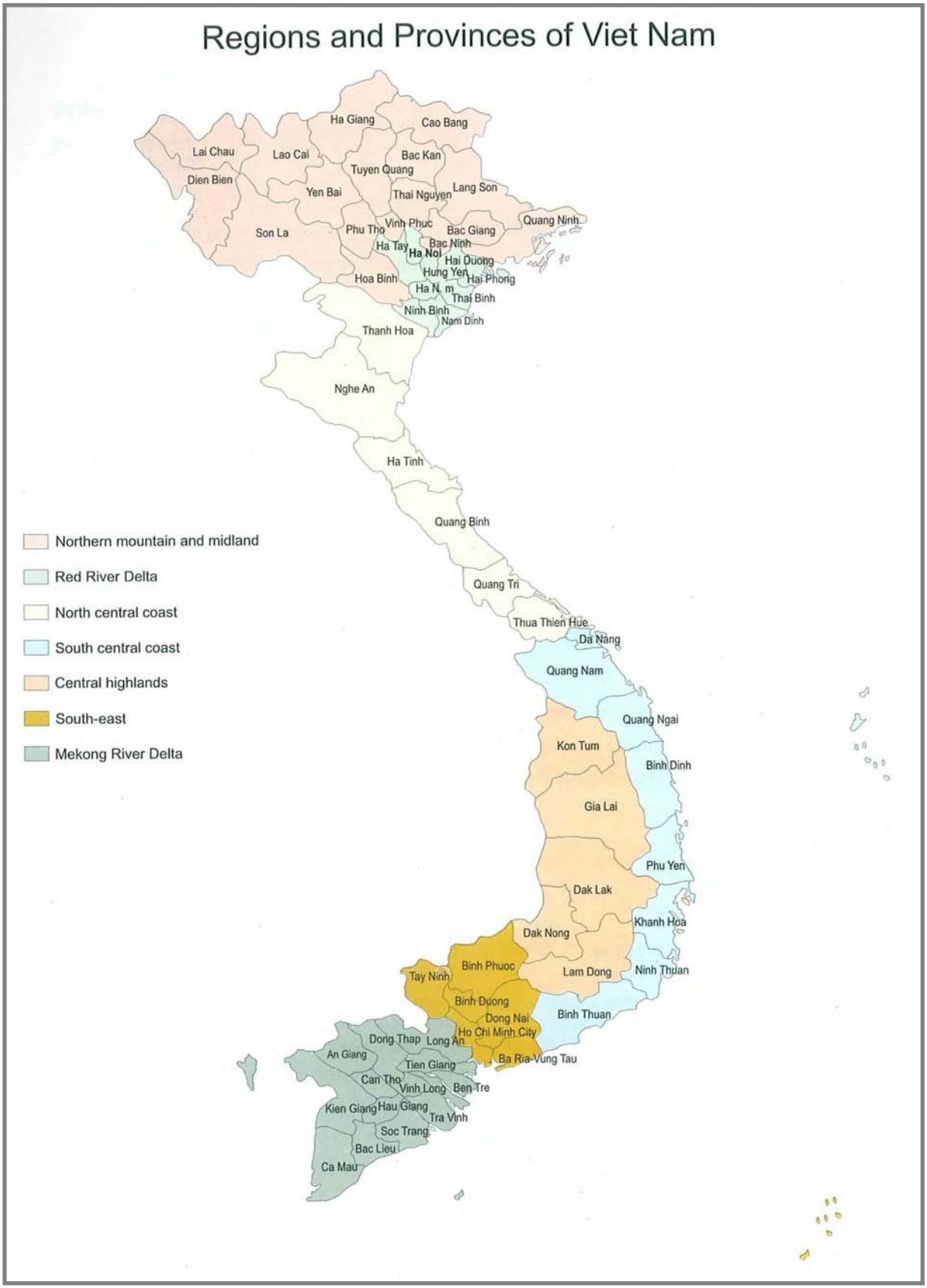


Fig. 1-3 Regions and Provinces of Vietnam
Source: UNDP: Viet Nam Development Cooperation Report 2004 – Hanoi, 2005

(2) Soils and Geology

The sandy soil areas distributed in the coastal sandy areas in the central part are formed by sandy soil discharged by rivers to the sea and then transported back to the land by the sea current and wind. Accordingly, local soils are classified as soils affected by the topography. By color, these soils can be described as white, yellow, red, gray, etc. but soil of any color contains hardly any organic matter and is sterile with more than 85% being made up of SiO_2. These soils are, therefore, extremely unsuitable for plant growth. When the proportion of Fe_2O_3 is relatively high, the soil color approaches pale yellow. When the proportion of Al_2O_3 is high, the soil color becomes red. When the proportions of these two substances are low, the soil color becomes white because of the influence of SiO_2. From a geological point of view, red sandy soil belongs to the Pleistocene of 150,000 – 600,000 years ago, white sandy soil belongs to the early Holocene (alluvial period) of 5,000 – 15,000 years ago, and yellow sandy soil belongs to the recent epoch. The project sites are characterized by sandy soil belonging to the present epoch with quartz being the main constituent originating from granite, the parent rock. The color tone is white and the sand grains principally made up of SiO_2 are roundish. In places, the color is extremely pale yellow or brown. One thing worthy of special note is the presence of titanium in a manner similar to iron sand in the coastal soils in the four provinces, especially Binh Dinh Province.

(3) Climate

Vietnam is strongly affected by the South China Sea and belongs to the tropical monsoon zone and sub-tropical monsoon zone. The level of the annual rainfall, seasonal changes and arrival of typhoons are determined by the conditions of the southwesterly and northeasterly monsoons, resulting in many climate differences from one region to another.

In the central part where the project sites are located, winter (from mid-November to late March) comes at the end of the rainy season unlike other parts of the country. In winter, the wind blows from the north or northwest and the level of rainfall is high. Dry hot wind from Laos starts to blow in spring (from April to mid-May) and a hot wind from the west of southwest strongly prevails in summer (from mid-May to late September) to characterize the fully developed dry season in contrast to other parts. The hot wind is accompanied by the föhn phenomenon characterized by hot and dry air. In autumn (from October to mid-November), unlike other parts which move into the dry season from the rainy season, the central part has a heavy rainy season. Typhoons which are born in the western Pacific Ocean or the South China Sea move due west, directly hitting the central part of Vietnam. Some of these have a radius of 200 – 300 km and move at a speed of 90 – 120 km/hr, causing torrential rainy and flooding everywhere. In particular, Typhoon No. 6 (internationally numbered 15; Xangsane) which landed in the central part on the 1st October, 2006 had an atmospheric pressure of 955 hPa at the center and a maximum wind velocity of 40 m/s, causing extensive damage to the coastal areas of Quang Nam Province with a high tide etc.

The following observations can be made based on meteorological data recorded at three weather stations located in Tam Ky City in Quang Nam Province, Quang Ngai City in Quang Ngai Province and Quy Nhon City in Binh Dinh Province.

In terms of rainfall, some rain is observed in August by all three weather stations and the amount of rainfall sharply increases in September, reaching a peak in October. There is a lot of rain until December but the amount of rainfall quickly declines in January. As such, the rainy season lasts from September to December in these provinces. The total rainfall in the rainy season is 2,026.8 mm in Tam Ky City, accounting for 76% of the city's annual rainfall of 2,674.3 mm, 1,854.0 mm in Quang Ngai City, accounting for 75% of the city's annual rainfall of 2,484.4 mm, and 1,502.4 mm in Quy Nhon City, accounting for 79% of the city's annual rainfall of 1,911.2 mm.

The wind directions in winter (from October to March) differ from those in summer (from April to September) at each weather station. In winter, the wind mainly blows from the directions between the north and the east in Tam Ky City and the prevailing wind comes from the northeast. In Quang Ngai City, the wind mainly blows from the directions between the northwest and the northeast and the prevailing wind comes from the north. In Quy Nhon City, the wind directions range from the north to the northeast with a northerly wind being the most frequent. In summer, the wind mainly blows from the directions between the northwest and the southwest as well as the directions between the northeast and the southeast in Tam Ky City and the frequency of westerly and easterly winds is almost the same. In Quang Ngai City, the wind mainly blows from the southeast, the east and the northwest. In Quy Nhon City, a westerly, northwesterly, northerly or southeasterly wind is frequent with the prevailing wind coming from the west.

The mean temperature, maximum temperature and minimum temperature are 25.6°C, 40.1°C and 12.0°C respectively for Tam Ky City, 26.0°C, 40.5°C and 12.4°C for Quang Ngai City and 27.1°C, 39.9°C and 15.5°C for Quy Nhon City.

The project sites are located on sand dunes and the highest temperature recorded during the field survey was 39.8°C under a scorching sun (around 16:00 on 19th August in fair weather at a site in Binh Dinh Province).

(4) Vegetation

No vegetation is observed at severe moving sand areas and at moving sand areas at the project sites. Several species of herbaceous plants capable of growing on sand dunes are observed at ordinary sandy areas, frequently flooded areas and areas adjacent to the shoreline. The ground coverage of these plants is less than 1% but the subterranean stems of these plants are well developed. Dying forest areas consist of casuarinas forests planted in the past. Their growth performance is poor and treeless land is observed here and there.

(5) State of Forests in the Target Provinces and Near the Project Sites

The forest area by each target province of the Project is listed in Table 1-1 along with the total forest area in Vietnam which is included in the table for reference purposes. In each of the three provinces, while the forest area has been increasing, a closer look reveals a tendency for a decrease of the natural forests to be compensated for by the creation of man-made forests. As described in "2-1-1 – Overall Goal and Project Purpose", 5MHRP aims at planting 14.3 million ha nationwide by 2010 to increase the forest ratio to 43.4% but the achievement of this target continues to appear to be difficult.

Large-scale afforestation projects have been implemented in the three target provinces of the Project based on the assistance of WB, KFW, JBIC, etc. With the efforts of the parties concerned, 5,400 – 10,600 ha of man-made forests have been created in the last two years alone. Nevertheless, these large-scale afforestation projects are restricted to mountainous areas and no afforestation project is in progress in the coastal plains or hillsides of areas adjacent to the project sites. As such, forests in the said areas are rather poor in terms of both quality and quantity. To be fair, however, minor afforestation work is in progress by DARD and other bodies in areas adjacent to the project sites using domestic funds and funds from other master development plans. Most of the target sites of such work are characterized by a low level of technical difficulty for planting.

Table 1-1 Forest Area in Vietnam and Three Target Provinces

Unit: ha

Primary Category	Secondary Category	2003	2004
Vietnam	Forest Area	11,974,600	12,418,500
	Forest Ratio	36.4%	37.7%
Total Area	Man-Made Forest Area	2,100,900	2,889,100
32,931,450	Natural Forest Area	9,873,700	9,529,400
Quang Nam Province	Forest Area	443,900	448,100
	Forest Ratio	42.7%	43.1%
Total Area	Man-Made Forest Area	54,200	59,600
1,040,740	Natural Forest Area	389,700	388,500
Quang Ngai Province	Forest Area	159,400	169,600
	Forest Ratio	31.0%	33.0%
Total Area	Man-Made Forest Area	55,500	66,100
513,760	Natural Forest Area	103,900	103,500
Binh Dinh Province	Forest Area	204,300	210,300
	Forest Ratio	33.9%	34.9%
Total Area	Man-Made Forest Area	49,900	55,900
602,500	Natural Forest Area	154,400	154,400

Source: Statistical Year Book 2003
Statistical Year Book of Vietnam 2005

The forests seen in areas adjacent to the project sites include casuarina forests created since the late

1970's, cashew orchards, copses composed of eucalyptus and shrubs and orchards of coconut palms and others near residential areas. All of these are geographically restricted to sites with relatively good soil and other conditions, and some forests appear to have degraded due to aging.

The results of the fact-finding survey on a casuarinas forest created since the 1970's show that the average tree height is reasonably high at 11.4 m in places which are at least 180 m away from the shoreline and enjoy better conditions. Nevertheless, the tree density of 531 trees/ha is fairly sparse. Meanwhile, at places within 115 m of the shoreline, the average tree height is low at 3.0 m but the tree density is high at 1,594 trees/ha (see Fig. 1-4). This particular stand is one of the most well-established existing casuarina forests in areas adjacent to the project sites and the physiognomy of most local stands is poorer than this.

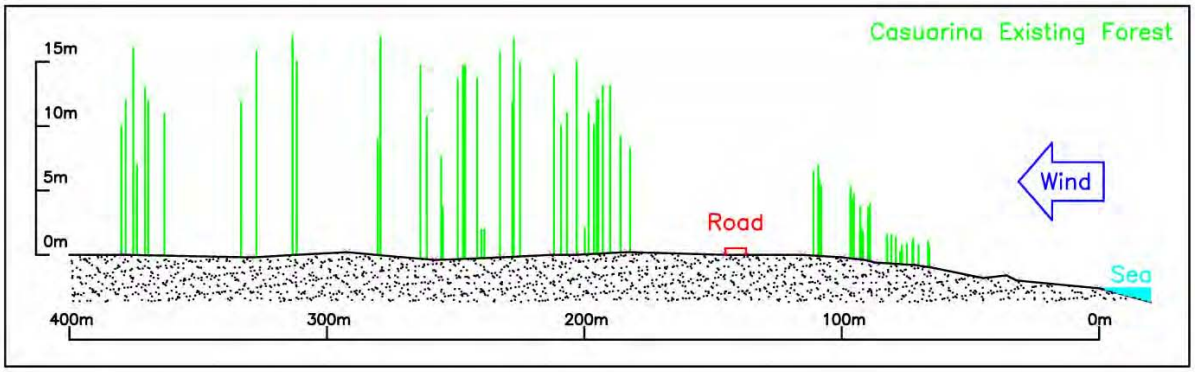


Fig. 1-4 Conceptual Profile of Existing Casuarina Forest

Although casuarinas forests and shrubs are observed in the potential target areas, the remaining stands in the project sites are generally poor with sporadic high trees, dwarf trees and old trees because of the practice of designated sites as left-over areas if the general assessment results of the tree height, tree density, tree health, etc. meet certain criteria. In fact, there are many sites where not only trees but also herbaceous plants cannot grow.

1-3-3 Environmental and Social Considerations

(1) Present Conditions of the Social Environment

The population size and area by type of land use in the 14 target communes are compiled in Table 1-2 and Table 1-3 respectively. According to these tables, the total population of the target communes in the areas subject to conservation efforts under the Project is 20,985 in Quang Nam Province, 37,283 in Quang Ngai Province and 60,904 in Binh Dinh Province, totaling 119,172. The total area subject to conservation is 9,464 ha when only residential areas (2,445 ha), paddy fields (2,904 ha) and other farmland (3,815 ha) are considered. As the area of roads and industrial premises can be added to the above figure, the actual area subject to conservation is inferred to be at least 15,000 ha.

Table 1-2 Demographic Composition of 14 Target Communes

省 Province	県 District	村 Commune	人口 Population				
			世帯数 No. of Households	人口 Population	男性人口 Population of Men	女性人口 Population of Women	生産年齢人口 Working Population (age: 16-65)
Quang Nam	Thang Binh	Binh Minh	1,525	7,360	3,601	3,759	3,672
		Binh Dao	1,876	7,673	3,684	3,989	3,862
		Binh Hai	424	5,952	2,903	3,049	3,058
	Subtotal		3,825	20,985	10,188	10,797	10,592
Quang Ngai	Duc Pho	Pho An	2,337	10,327	5,139	5,188	5,946
		Pho Quang	1,821	7,595	-	-	3,985
		Pho Vinh	1,759	8,762	4,281	4,481	6,354
		Pho Khanh	1,197	5,033	2,651	2,382	2,780
		Pho Chau	1,145	5,566	2,718	2,848	3,208
	Subtotal		8,259	37,283	14,789	14,899	22,273
Binh Dinh	Phu My	My Duc	1,780	7,365	3,403	3,962	4,110
		My Thang	2,281	10,349	5,075	5,274	5,390
		My An	2,673	8,183	-	-	5,706
		My Thanh	1,948	10,181	5,013	5,168	5,364
		Subtotal	8,682	36,078	13,491	14,404	20,570
	Phu Cat	Cat Khanh	2,543	16,300	6,460	9,840	-
		Cat Thanh	2,071	8,526	4,102	4,424	4,337
		Subtotal	4,614	24,826	10,562	14,264	4,337
	Subtotal		13,296	60,904	24,053	28,668	24,907
Grand Total			25,380	119,172	49,030	54,364	57,772

Table 1-3 Area by Land Use in 14 Target Communes

省 Province	県 District	村 Commune	面積 Area (ha)					
			全面積 Whole Area	居住地面積 Residential Area	稲作地面積 Paddy Fields	水田以外の農耕地 Other Farmlands	森林 Forests	水産施設数 Fisheries Facilities
Quang Nam	Thang Binh	Binh Minh	1,180	230	0	36	678	35
		Binh Dao	1,150	214	580	144	290	12
		Binh Hai	1,246	328	356	132	252	89
	Subtotal		3,576	772	936	312	1,220	136
Quang Ngai	Duc Pho	Pho An	-	80	329	-	300	24
		Pho Quang	987	34	87	820	110	-
		Pho Vinh	1,575	53	357	-	290	17
		Pho Khanh	566	42	115	311	96	-
		Pho Chau	1,985	23	160	1,392	410	-
	Subtotal		5,113	232	1,048	2,523	1,206	41
Binh Dinh	Phu My	My Duc	3,258	37	186	151	1,559	11
		My Thang	3,060	57	95	34	460	-
		My An	1,009	31	237	309	397	35
		My Thanh	3,498	38	162	266	273	-
		Subtotal	10,825	163	680	760	2,689	46
	Phu Cat	Cat Khanh	3,122	1,278	240	220	657	89
		Cat Thanh	531	-	-	-	-	-
		Subtotal	3,653	1,278	240	220	657	89
	Subtotal		14,478	1,441	920	980	3,346	135
Grand Total			23,167	2,445	2,904	3,815	5,772	312

Table 1-4 lists the public facilities in the communes where the project sites are located. The main facilities are those related to education, administration and health care.

Table 1-4 Public Facilities in 14 Target Communes

省 Province	県 District	村 Commune	公共施設数 No. of Public Facilities					
			小学校 Elementary School	中学校 Junior High School	高等学校 High School	大学 University	役所・官署等 Government Offices	医療施設 Medical Offices
Quang Nam	Thang Binh	Binh Minh	1	1	0	0	1	2
		Binh Dao	1	1	1	0	1	1
		Binh Hai	1	1	0	0	1	1
	Subtotal		3	3	1	0	3	4
Quang Ngai	Duc Pho	Pho An	5	1	0	0	0	1
		Pho Quang	5	1	0	0	1	1
		Pho Vinh	6	1	0	0	5	1
		Pho Khanh	4	0	0	0	4	0
		Pho Chau	4	1	0	0	0	1
	Subtotal		24	4	0	0	10	4
Binh Dinh	Phu My	My Duc	3	2	0	0	7	1
		My Thang	2	1	0	0	11	1
		My An	1	1	0	0	8	1
		My Thanh	3	2	0	0	11	2
		Subtotal	9	6	0	0	37	5
	Phu Cat	Cat Khanh	19	1	0	0	1	3
		Cat Thanh	3	1	0	0	0	-
		Subtotal	22	2	0	0	1	3
	Subtotal		31	8	0	0	38	8
Grand Total			58	15	1	0	51	16

During the field survey, the Study Team requested the Vietnamese side at the provincial, district and commune levels to provide records describing actual damage by shifting sand and strong winds so that such damage could be quantified. However, the Study Team was told that no constant surveying or checking of such damage locally was conducted and that a survey is only conducted when severe damage is caused by a typhoon etc. Quantitative assessment of the damage based on existing materials was judged to be practically impossible and it was decided to conduct a questionnaire survey with local residents in coastal sandy areas near the project sites to establish a picture of the damage.

The questionnaire survey results are shown in Table 1-5 and Table 1-6, and it is clear that the residents of agricultural or fishing villages near coastal sandy areas constantly suffer repeated damage by shifting sand and strong winds every year.

Table 1-5 Damage by Strong winds

	Total Number	Quang Nam	Quang Ngai	Binh Dinh	Khanh Hoa
Total Number of Respondents	446	99	84	187	76
Damage Experienced	386	89	72	149	76
	86.5%	89.9%	85.7%	79.7%	100.0%
(Frequency) 1 - 2 times/year	267	67	33	130	37
	59.9%	67.7%	39.3%	69.5%	48.7%
(Frequency) 3 - 4 times/year	56	13	30	12	1
	12.6%	13.1%	35.7%	6.4%	1.3%
(Frequency) 5 or more times/year	21	5	9	0	7
	4.7%	5.1%	10.7%	0.0%	9.2%
(Damage to) House	263	56	51	90	66
	59.0%	56.6%	60.7%	48.1%	86.8%
(Damage to) Agricultural Crops	107	13	10	62	22
	24.0%	13.1%	11.9%	33.2%	28.9%
(Damage to) Roads	59	7	9	26	17
	13.2%	7.1%	10.7%	13.9%	22.4%
(Damage to) Farmland	18	7	1	0	10
	4.0%	7.1%	1.2%	0.0%	13.2%
(Damage to) Fruit Trees	35	7	24	0	4
	7.8%	7.1%	28.6%	0.0%	5.3%

Note: Multiple selection is permitted.

Table 1-6 Damage by Shifting Sand

	Total Number	Quang Nam	Quang Ngai	Binh Dinh	Khanh Hoa
Total Number of Respondents	446	99	84	187	76
Damage Experienced	307	66	43	123	75
	68.8%	66.7%	51.2%	65.8%	98.7%
(Frequency) 1 - 2 times/year	176	45	13	92	26
	39.5%	45.5%	15.5%	49.2%	34.2%
(Frequency) 3 - 4 times/year	52	14	23	3	12
	11.7%	14.1%	27.4%	1.6%	15.8%
(Frequency) 5 or more times/year	49	5	7	0	37
	11.0%	5.1%	8.3%	0.0%	48.7%
(Damage to) House	91	12	32	3	44
	20.4%	12.1%	38.1%	1.6%	57.9%
(Damage to) Agricultural Crops	82	29	4	41	8
	18.4%	29.3%	4.8%	21.9%	10.5%
(Damage to) Roads	144	4	22	52	66
	32.3%	4.0%	26.2%	27.8%	86.8%
(Damage to) Farmland	41	10	4	3	24
	9.2%	10.1%	4.8%	1.6%	31.6%
(Damage to) Fruit Trees	28	3	21	0	4
	6.3%	3.0%	25.0%	0.0%	5.3%

Note: Multiple selection is permitted.

The number of respondents, their vocational background and distribution of the annual income are shown in Table 1-7 through Table 1-9. Although many farming and fishing households near coastal sandy areas are said to be poor, the questionnaire survey results indicate the sampling of relatively wealthy households with an average annual income of VND 17,199,673 /year (approximately US$ 1,075 /year). This finding is attributed to the relatively high proportion of fishing households which can expect to earn a higher income than households relying on farming. It is also possible that the heads of hamlets of guided the questioners selected wealthier households first, followed by the selection of less wealthy households to boost the quality of the questionnaire survey results.

Table 1-7 Number of Questionnaire Respondents

	Total Number	Quang Nam	Quang Ngai	Binh Dinh	Khanh Hoa
Total Number of Respondents (Households)	446	99	84	187	76
		22.2%	18.8%	41.9%	17.0%
Male	384	95	71	148	70
	86.1%	96.0%	84.5%	79.1%	92.1%
Female	59	3	13	37	6
	13.2%	3.0%	15.5%	19.8%	7.9%
Unknown	3	1	0	2	0
	0.7%	1.0%	0.0%	1.1%	0.0%

Table 1-8 Share by Vocation of Questionnaire Respondents

	Total Number	Quang Nam	Quang Ngai	Binh Dinh	Khanh Hoa
Total Number of Respondents	446	99	84	187	76
Farming	243	66	47	92	38
	54.5%	66.7%	56.0%	49.2%	50.0%
Fishing	262	30	61	129	42
	58.7%	30.3%	72.6%	69.0%	55.3%
Self-Employed	137	54	7	63	13
	30.7%	54.5%	8.3%	33.7%	17.1%
Employed	47	7	14	24	2
	10.5%	7.1%	16.7%	12.8%	2.6%
Other	152	39	17	43	53
	34.1%	39.4%	20.2%	23.0%	69.7%

Note: Multiple selection is permitted.

Table 1-9 Distribution of Annual Income among Questionnaire Respondents

	Total Number	Quang Nam	Quang Ngai	Binh Dinh	Khanh Hoa
Total Number of Respondents	446	99	84	187	76
～ VND 10,000,000 /year	83	28	6	43	6
	18.6%	28.3%	7.1%	23.0%	7.9%
～ VND 20,000,000 /year	213	36	32	118	27
	47.8%	36.4%	38.1%	63.1%	35.5%
～ VND 30,000,000 /year	89	23	27	18	21
	20.0%	23.2%	32.1%	9.6%	27.6%
～ VND 40,000,000 /year	39	9	11	7	12
	8.7%	9.1%	13.1%	3.7%	15.8%
VND 40,000,001 /year or more	22	3	8	1	10
	4.9%	3.0%	9.5%	0.5%	13.2%

Although many of the respondents are considered to be relatively wealthy, they appear to be constantly seeking employment opportunities. This observation is backed by the fact that when the possibility of their cooperation for and/or participation in the Project is questioned, the proportion of those citing an economic effect (and increase of income) increases compared to their more varied answers featuring the various advantages based on the multi-functionality of forests when asked about the necessity for coastal protection forests (see Table 1-10 and Table 1-11).

Table 1-10 Necessity for Coastal Protection Forests

< Reason for Necessity >	Total Number	Quang Nam	Quang Ngai	Binh Dinh	Khanh Hoa
Total Number of Respondents	446	99	84	187	76
Necessity felt	443	99	81	187	76
	99.3%	100.0%	96.4%	100.0%	100.0%
Windbreak Effect	351	55	78	145	73
	78.7%	55.6%	92.9%	77.5%	96.1%
Shifting Sand Prevention Effect	310	62	72	105	71
	69.5%	62.6%	85.7%	56.1%	93.4%
Water Retention Effect	47	27	5	1	14
	10.5%	27.3%	6.0%	0.5%	18.4%
Climate Mitigation Effect	86	40	1	37	8
	19.3%	40.4%	1.2%	19.8%	10.5%
Tidal Water Control Effect	28	0	1	23	4
	6.3%	0.0%	1.2%	12.3%	5.3%
Others	88	48	10	25	5
	19.7%	48.5%	11.9%	13.4%	6.6%

Note: Multiple selection is permitted.

Table 1-11 Cooperation for the Project

< Reason for Cooperation >	Total Number	Quang Nam	Quang Ngai	Binh Dinh	Khanh Hoa
Total Number of Respondents	446	99	84	187	76
Willing to Cooperate	431	97	81	177	76
	96.6%	98.0%	96.4%	94.7%	100.0%
Windbreak Effect	67	29	5	15	18
	15.0%	29.3%	6.0%	8.0%	23.7%
Shifting Sand Prevention Effect	41	11	4	7	19
	9.2%	11.1%	4.8%	3.7%	25.0%
Increase of Income and Other Economic Effects	81	13	21	47	0
	18.2%	13.1%	25.0%	25.1%	0.0%
Environmental Improvement	76	32	12	11	21
	17.0%	32.3%	14.3%	5.9%	27.6%
Many Advantages of the Project and Protection Forests	66	0	8	24	34
	14.8%	0.0%	9.5%	12.8%	44.7%
Backing by the local government	52	0	0	52	0
	11.7%	0.0%	0.0%	27.8%	0.0%
Responsibility of the local community	38	14	24	0	0
	8.5%	14.1%	28.6%	0.0%	0.0%
Other	99	40	11	31	17
	22.2%	40.4%	13.1%	16.6%	22.4%

Note: Multiple selection is permitted.

When asked about the preferred species for planting under the Project, the answers varied from one province to another (see Table 1-12). In Quang Nam Province where PACSA was implemented, many of the respondents proposed casuarinas, acacia and cashew. In the other three provinces, casuarinas is clearly the favorite, presumably because of the unfamiliarity of other species for planting and the tendency to plant cashew trees near the home rather than at a coastal sandy site.

Table 1-12 Preferred Species for Planting under the Project

	Total Number	Quang Nam	Quang Ngai	Binh Dihn	Khanh Hoa
Total Number of Respondents	446	99	84	187	76
Casuarina	397	54	82	186	75
	89.0%	54.5%	97.6%	99.5%	98.7%
Acacia	71	63	1	4	3
	15.9%	63.6%	1.2%	2.1%	3.9%
Cashew	36	30	3	3	0
	8.1%	30.3%	3.6%	1.6%	0.0%
Eucalyptus	18	11	7	0	0
	4.0%	11.1%	8.3%	0.0%	0.0%
Pine	3	3	0	0	0
	0.7%	3.0%	0.0%	0.0%	0.0%
Mango	3	3	0	0	0
	0.7%	3.0%	0.0%	0.0%	0.0%

Note: Multiple selection is permitted.

(2) Consideration of the Social Environment

Based on the questionnaire survey results described above, the following considerations were given to the basic plan.

i Difficult planting sites should be actively incorporated in the Project. These sites are typically windy sites and shifting sand areas where damage by strong winds and shifting sand frequently occurs.

ii Design features promising tree growth (use of fertilizer and soil improvement agent, introduction of ancillary planting work, etc.) should be adopted to minimize damage by strong winds and shifting sand.

iii The planting work should not require advanced technologies or skills so that local residents can easily participate in the planting work.

iv Design features incorporating the requests of local residents (selection of preferred species etc.) should be adopted so that local residents can actively participate in the planting work and

the subsequent maintenance (protection) of coastal protection forests.

The field reconnaissance which was conducted separately from the questionnaire survey discovered that some unpaved access roads will become muddy in the rainy season. As PACSA experienced objections by local residents to the use of this kind of road around the target compartments by the work vehicles, resulting in problems at some sites, the design for the Project excludes the use of this type of access road.

v The design for the Project should exclude those unpaved roads around the target compartments which become muddy in the rainy season as access roads for the work vehicles.

(3) Present Situation of the Natural Environment

As the Project will not only improve the habitat for wild animals but will also contribute to the conservation of biodiversity through planting at coastal sandy sites, extensive consideration of any possible adverse impacts on the natural environment is unnecessary. Accordingly, the question included in the questionnaire simply asked about the present situation of animals and plants at coastal sandy sites and in the vicinity of residential areas. In the case of plant species, however, no replies were made regarding native species or wild species, presumably because of the fact that the target sites are located on coastal lowland which is much more developed compared to mountain areas. Because of this, the question on plant species is not dealt with in this report.

In regard to wild animals in the project areas, most of the respondents said that there has not been a conspicuous decline. However, valuable responses regarding the decline of certain animal species were made as shown in Table 1-13.

While a quantitative survey was not conducted under PACSA, there is an impression that the number of insects, frogs, snakes and wild birds have increased since this project. It may well be necessary in the future to check whether or not the number of wild animals has increased because of the implementation of the Project.

Table 1-13 Noticeably Decreasing Wild Animals in Coastal Sandy Areas and Near Residential Areas

	Total Number	Quang Nam	Quang Ngai	Binh Dinh	Khanh Hoa
Total Number of Respondents	446	99	84	187	76
None	166	27	51	55	33
	37.2%	27.3%	60.7%	29.4%	43.4%
Rabbits	25	7	1	5	12
	5.6%	7.1%	1.2%	2.7%	15.8%
Sea Turtles	39	5	4	1	29
	8.7%	5.1%	4.8%	0.5%	38.2%
Tortoises	19	0	16	3	0
	4.3%	0.0%	19.0%	1.6%	0.0%
Foxes	15	3	12	0	0
	3.4%	3.0%	14.3%	0.0%	0.0%
Salamanders	154	46	5	94	9
	34.5%	46.5%	6.0%	50.3%	11.8%
Deer	16	0	0	0	16
	3.6%	0.0%	0.0%	0.0%	21.1%
Mice	43	0	0	43	0
	9.6%	0.0%	0.0%	23.0%	0.0%
Snakes	53	18	21	10	4
	11.9%	18.2%	25.0%	5.3%	5.3%
Squirrels	15	0	0	1	14
	3.4%	0.0%	0.0%	0.5%	18.4%
Others	45	4	6	17	18
	10.1%	4.0%	7.1%	9.1%	23.7%

Source: Multiple selection is permitted.

As the opinion was expressed in the course of the questionnaire survey that the number of sea turtles had decreased, another questionnaire survey was conducted on the sighting of sea turtles. Although the findings were inconclusive at the preparatory study stage, it was discovered that many people have actually sighted sea turtles (see Table 1-14).

According to this questionnaire result, more than half of the respondents have sighted a sea turtle(s) once or twice a year. This finding suggests the possibility that sea turtles may land at the target coastal sandy areas to lay their eggs even though the number of individuals may have decreased.

One frequently stated reply to the reason for the decline of individuals is that it is natural to catch and eat the animals when sighted. This answer is common for most animals, including sea turtles. While various restrictions are being strengthened in Vietnam to stop the decline of wild animals, the actual

situation is that many people still catch and eat them. This situation implies a difficulty of ensuring the permanent conservation of some species without the introduction of protective measures even if the biodiversity increases with the implementation of the Project.

Table 1-14 Landing and Laying of Eggs by Sea Turtles

	Total Number	Quang Nam	Quang Ngai	Binh Dinh	Khanh Hoa
Total Number of Respondents	446	99	84	187	76
No reply	54	12	1	8	33
	12.1%	12.1%	1.2%	4.3%	43.4%
Not Sighted	160	44	28	81	7
	35.9%	44.4%	33.3%	43.3%	9.2%
Sighted	232	43	55	98	36
	52.0%	43.4%	65.5%	52.4%	47.4%
(Annual Frequency) 1 - 2 times	194	34	38	90	32
	43.5%	34.3%	45.2%	48.1%	42.1%
(Annual Frequency) 3 - 4 times	28	7	15	3	3
	6.3%	7.1%	17.9%	1.6%	3.9%
(Annual Frequency) 5 - 6 times	2	0	1	0	1
	0.4%	0.0%	1.2%	0.0%	1.3%
(Annual Frequency) 7 times or more	2	1	1	0	0
	0.4%	1.0%	1.2%	0.0%	0.0%
(Annual Frequency) No Reply	6	1	0	5	0
	1.3%	1.0%	0.0%	2.7%	0.0%

(4) Consideration of the Natural Environment

The following considerations are given to the planning of the Project based on the questionnaire survey results.

i At those planting sites with low technical difficulty, the creation of mixed forests should be planned to ensure biodiversity.

ii No work (relating to ancillary planting work and the temporary introduction of operation roads) should be conducted in the zone between frontal sand dunes and the shoreline to avoid any adverse impacts on the egg laying environment for sea turtles.

Chapter 2　Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Purpose

In Vietnam, the forest area has been substantially reduced due to the long war and rapid population growth. To be more precise, the forest area of 14.3 million ha in 1945 fell to 9.3 million ha in 1993 and the forest area per capita in Vietnam is now the lowest among Southeast Asian countries.

To restore the green-rich national land, the Government of Vietnam formulated "the Forestry Development Strategy 2001 – 2010" as a long-term policy for the forestry sector and has been implementing 5MHRP as a priority program as part of its active commitment to forest conservation and afforestation/reforestation. This 5MHRP aims at implementing afforestation/reforestation work over an area of 5 million ha from 1998 to 2010. In particular, the urgent afforestation of 100,000 ha of coastal areas is called for to create coastal protection forests.

There are many sandy areas or sand dunes in the South Central Coast Region of Vietnam and agricultural crops and infrastructure facilities are often damaged by strong winds and shifting sand caused by typhoons and monsoons, severely affecting the lives of local residents. While the said areas with a high population density are believed to have high development potential, the damage caused by strong winds and shifting sand has been an obstacle for development efforts.

Table 2-1 shows the implementation situation of 5MHRP for the period from 1998 to 2005. Coastal protection forests fall in the category of "Protection Forests and Special Use Forests". The results have exceeded the mid-term plan by 3%, indicating the active commitment of the Government of Vietnam.

In April, 2005, the Government of Japan completed the grant aid cooperation named PACSA for the creation of 2,079.88 ha and 1,573.00 ha of protection forests in coastal sandy areas in Quang Nam Province and Phu Yen Province respectively in the South Central Coast Region as part of 5MHRP. Since the completion of PACSA, the Government of Vietnam has been conducting the creation of coastal protection forests in other areas using the planting techniques employed under PACSA. However, as PACSA excluded difficult planting sites (shifting sand sites, wind erosion sites, frequently flooded sites, etc.) where planting work would require advanced planting techniques, the Government of Vietnam is finding it difficult to conduct afforestation without external assistance at these difficult planting sites.

Under these circumstances, the Government of Vietnam fully recognizes the importance of successfully implementing coastal afforestation projects through ancillary planting works at difficult

planting sites and of extending nationwide the experience of creating protection forests at such sites in order to promote 5MHRP.

The Project aims at reducing the damage to agricultural and fishing villages due to shifting sand, strong winds, sand movement, etc. by means of creating coastal protection forests at those coastal sandy sites with a high technical difficulty, including difficult planting sites excluded from PACSA, in the South Central Coast Region of Vietnam.

Overall Goal :	Creation of coastal protection forests in coastal areas in Vietnam using the Project as a model
Project Purpose :	Reduction of the damage caused by shifting sand, strong winds, sand movement, etc. to agricultural as well as fishing villages in the coastal areas of Quang Nam Province, Quang Ngai Province and Binh Dinh Province

Table 2-1 Interim Results of 5MHRP

Type of Forest	Target Area for 2010 (ha)	Target Area of Mid-Term Plan (1998-2005) (ha)	Result (1998-2005) (ha)	Achievement Rate of Mid-Term Plan (%)	Achievement Rate of 2010 Target (%)
Natural Regeneration Forest	1,000,000	1,000,000	723,450	72	36
Afforestation	4,000,000	2,000,000	1,401,667	70	35
Protection Forests and Special Use Forests	1,000,000	610,000	631,317	103	63
Production Forests	2,000,000	1,390,000	683,396	49	34
Industrial Material Forests and Fruit Forests	1,000,000	-	86,954	-	9
Total	5,000,000	3,000,000	2,125,117	71	43

2-1-2 Basic Concept of the Project

The main components of the Project are afforestation work mainly conducted with the grant aid cooperation by the Government of Japan and the maintenance and protection of the newly created forests by mainly the Vietnamese side. The target areas are coastal sandy sites in three provinces, i.e. Quang Nam Province, Quang Ngai Province and Binh Dinh Province.

The afforestation work will also involve the construction of operation roads and a temporary nursery. The main components of the afforestation work will be the production of fine seedlings at the temporary nursery, purchase of seedlings from existing nurseries, planting at difficult planting sites accompanied by ancillary planting works to mitigate the effects of shifting sand and strong winds on the planted trees and tending (supplementary planting and top dressing (additional fertilization)) of the planted trees. In addition, look-out towers and project information signboards will be constructed or erected for the purpose of maintaining/protecting the newly created coastal protection forests and introducing the Project.

The main components of the maintenance and protection work will be the forest patrol and guard which will be primarily conducted by local residents for the purpose of preserving and protecting the newly created protection forests.

Such work is expected to create healthy coastal protection forests at difficult planting sites. The scope of the Japanese assistance, i.e. APSA, for the Project are to cover the initial investment (for approximately the first five years of the Project) relating to the creation and improvement of coastal protection forests in three target provinces and to contribute to 5MHRP, the higher program for the Project, through such assistance.

Inputs :	Japanese Side Grant aid cooperation by the Government of Japan Vietnamese Side i Required manpower ii Preparation of electric power lines and access roads iii Financial inputs relating to the maintenance and protection of newly created coastal protection forests and the operation and maintenance of the Project.
Activities :	i Creation of temporary facilities (operation roads, temporary nurseries, etc.) ii Procurement (production and purchase) of fine seedlings iii Ancillary planting works (measures to prevent/reduce damage by shifting sand, flooding, etc.) iv Planting of fine seedlings v Tending of the planted trees

	vi Patrolling and guarding of the coastal protection forests, primarily by local residents vii Construction of lookout towers viii Erection of project information signboards
Outputs :	Creation of coastal protection forests to block shifting sand, strong winds, sand movement, etc. in the coastal areas of Quang Nam Province, Quang Ngai Province and Binh Dinh Province

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

The basic design of the requested Japanese assistance is conducted in accordance with the design policies described below based on the field survey results to fully achieve the objective of the Project while verifying the outcomes of PACSA.

Table 2-2 List of Design Policies

No.	Item	Design Policies
01	Scope of Assistance	i The scope of assistance under the Project is the components of the original request which are judged to be appropriate for implementation as a grant aid project. ii The scope of assistance consists of the minimum activities and inputs required for the creation of coastal protection forests. iii Among the requested items, highly general-purpose equipment will not be provided under the Project.
02	Site Selection (Potential Target Areas)	i In principle, the sites of which the priority ranking was conducted in the Preparatory Study (Category A and B sites) will be considered the potential target areas. ii The total area of the potential target areas will basically be some 3,600 ha which corresponds to the total area of the Category A sites. iii In accordance with the site selection criteria (included in this report as an appendix) at the time of the Preparatory Study, land used (or planned to be used) for other purposes will be excluded. Meanwhile, the difficult planting sites excluded in PACSA will be actively included. iv Those sandy sites of which the technical difficulty for planting is as low as those included in PACSA will be considered potential target areas provided that their urgency, importance and suitability for project implementation are recognized. v Those Category C sites which are adjacent to a potential target area and of which the conditions have changed since the time of the Preparatory Study to become similar to those of Category A sites will be considered potential target areas as long as it is judged that the combined work for such a site and adjacent potential target area can achieve the targets. vi Because of a strong request made by Binh Dinh Province, coastal sites where titanium is currently mined will be considered potential target areas. (An official document stating that mining operations will cease prior to the commencement of the Project and that the future mining of titanium in protection forests will be permanently abandoned has already been obtained.) vii Because of a request made by the Vietnamese side, Khanh Hoh Province which was originally included in the scope of the Project has been entirely removed. (This is due to the overlapping use of the land with other development plans. As

		a result, the total area of the potential target areas will be approximately 2,400 ha.) viii Sites which clear the above design policies and which have clearly established perimeters by means of GPS surveying will be potential target areas.
03	Site Selection (Project Target Areas)	i Left-over areas adjacent to the boundary of the potential target areas of the Project will be removed. ii Sites with low cost effectiveness (i.e. sites with a very high cost) based on the project implementation cost analysis results will be removed. iii Sites of which the suitability for project implementation if judged to be low when checked against the required conditions for Japanese grant aid cooperation and other conditions will be removed.
04	Classification by Type of Degradation	i The project target areas will be classified into the following seven types based on the field reconnaissance results. Areas with a high level of technical difficulty a Severe moving sand areas b Moving sand areas c Areas adjacent to the shoreline d Frequently flooded areas Areas with a low level of technical difficulty e Ordinary sandy areas f Poorly growing scattered tree areas g Dying forest areas ii Severe moving sand areas will be further classified into the following three sub-types based on the degree of degradation, site conditions, etc.. Severe moving sand area A : steep slop areas near the shoreline Severe moving sand area B : moving sand areas at the peak of sand dunes Severe moving sand area C : former stable sand dune area near the shoreline
05	Establishment of Compartments, Sub-Compartments and Planting Area	i Each project target area will be divided by commune boundaries. ii An independent project target area established by "i" above will be a compartment. iii Each compartment will be further divided based on the degradation types to establish sub-compartments iv Sub-compartments exceeding 200 ha and extremely narrow and long sub-compartments will be further divided to create sub-compartments of a similar size to make the work easier. v A firebreak with a width of 20 m will be introduced along the compartment and sub-compartment boundaries in accordance with the general standards in Vietnam. vi The total planting area will be calculated by means of removing the area of firebreaks and left-over areas (depressed ground of a certain size, cemeteries, existing roads, etc. where planting cannot be conducted) from the total area of the project target areas.
06	Planting	i Knowledge, pending issues and recommendations based on the implementation of PACSA will be taken into consideration.

		ii The planting methods referred to in widely distributed documents (regulations, notifications, pamphlets, etc.) in Vietnam will be incorporated in APSA as much as possible. iii The opinions of the C/Ps and local residents will be incorporated in APSA as much as possible. iv The maximum planting area per year will be kept at around 1,500 ha to level the employment and procurement quantities of equipment and materials. v Based on the experience of PACSA, some ancillary planting works will be introduced when planting is conducted at project target areas of which the level of technical difficulty is high.
07	Ancillary Planting Works	i Ancillary planting works will have a structure which can be constructed with locally available materials and labor. ii Unique coastal forest creation techniques of Japan, typically represented by sand control hedging and sand deposition fencing, will be employed in accordance with the relevant technical standards in Japan.
08	Tending	i Based on the knowledge acquired in PACSA, tending under APSA will consist of only supplementary planting and top dressing. ii The tending period will be three years which is in line with the relevant standard in Vietnam. iii The tending methods referred to in widely distributed documents (regulations, notifications, pamphlets, etc.) in Vietnam will be incorporated in APSA as much as possible. iv The opinions of the C/Ps and local residents will be incorporated in the APSA as much as possible.
09	Procurement of Seedlings	i Priority will be given to the procurement (purchase) of seedlings from existing nurseries. Only when the supply volume from these nurseries is insufficient will temporary nurseries be created to produce seedlings. ii Regarding the types and standards of the seedlings, the relevant specifications referred to in widely distributed documents (regulations, notifications, pamphlets, etc.) in Vietnam will be adopted for APSA as much as possible. iii When a large quantity of clone seedlings, such as cuttings, is used, the actual quantity to be used will remain at approximately half of the required quantity to avoid risks, including disease and insect damage.
10	Production of Seedlings	i As in the case of PACSA, only seedlings of *C. equisetifolia* will be produced at the temporary nurseries. ii Equal quantities of seedlings will be produced from seeds and cuttings.
11	Operation Roads	i As in the case of PACSA, the operation road network density to minimize the planting and tending costs will be calculated to determine the total length for construction. ii At those sites where a vehicle road cannot be introduced due to the shape and/or topographical conditions of the project target area but where it is judged that the work efficiency will significantly decline without a road, a footpaths will be introduced. iii The standards and structure of operation vehicle roads will be identical to those

		adopted by PACSA and will correspond to "Public Road Class IV of Vietnam" or "Forest Road Class 2 of Japan". iv The standards and structure of operation footpaths will be employed in accordance with those of footpaths in general use in southern central Vietnam.
12	Temporary Nurseries	i As in the case of PACSA, new nurseries will not be permanent facilities, but temporary facilities. ii A new temporary nursery will be set up along an existing road or operation vehicle road in the compartment. iii Based on the experience of PACSA, the standard scale of each nursery will be capable of providing 700,000 seedlings a year. The production scale of even the largest nursery will be limited to some one million seedlings. iv The number and structure of the sowing beds, nursery beds, wells, reservoirs, etc. will be kept to the minimum but necessary number and structure.
13	Lookout Towers	i The lookout towers will be constructed as permanent facilities in view of the experience and pending tasks of PACSA. ii The lookout towers will be wooden structures in view of their easy maintenance after their handing-over and anti-rusting treated wood will be used to increase their durability.
14	Project Information Signboards	i In PACSA, while information signboards were erected as common temporary facilities, they have proved to be quite useful for introduction of the project in the post-project period although repair has been necessary from time to time. As it is important to publicize/inform of the joint creation of protection forests by Japan and Vietnam under the grant aid project of Japan, these signboards will be treated as permanent facilities under the Project. ii There are two types of signboards, i.e. large signboards erected along National Road No.1 and small signboards erected along the access road to each project target area from National Road No.1.
15	Project Implementation Schedule	i As in the case of PACSA, one type of work (the production of seedlings) stretches to two fiscal years. APSA is, therefore, classified as a contract resulting in Treasury obligation and the entire project period is regarded as constituting a single phase instead of a project based on a fiscal year. ii In Vietnam, APSA is treated as a successive project for PACSA (completed in April, 2005). As such, the continuity of the project from PACSA is called for. As it is essential to commence the Project as soon as possible, APSA is classified as a Type A contract resulting in Treasury obligation which covers the detailed design as single year Treasury obligation and allows the commencement of the main work from the previous year. iii The work flow of the Project stretches over five years, i.e. one year for the preparatory work, one year for planting and a subsequent three years for tending. As the planting must be conducted in two calendar years, the implementation period for this type of project is usually six years. However, the implementation period of APSA is set at five years (54 months) as the tending (top dressing only) in the final year will be forwarded to the previous year.

16	Policies Regarding the Use of Local Companies	i Local afforestation companies and seedling producers (FE/FC, MB for forestry protection, etc.) are judged to have sufficient capacity to conduct the planned work under APSA in view of their performance in PACSA even though their annual planting area and annual production quantity of seedlings vary from 20 ha to 317 ha and from 20,000 to 600,000 respectively depending on the existence of and their involvement in large-scale local afforestation projects. Accordingly, it is assumed that the planting work etc. under APSA will be conducted by local companies working as subcontractors for the Contractor. ii Similarly, the use of local companies for the road construction work, nursery construction work and building construction work is assumed as the vigorous activities of more than one company in each field have been confirmed in each province.
17	Policies Regarding Operation and Maintenance	i It has been confirmed that MARD and the provincial DARDs which will act as the implementation bodies as well as the responsible bodies for the Project have more than one engineer (graduate or equivalent) for afforestation, seedling production, etc. and these engineers are expected to be a member of MB in their own organization. The budget for MB management has already been requested and no problems are anticipated in regard to the operation and management capacity of the implementation bodies. ii Special Japanese techniques for the afforestation of coastal sandy areas, typically represented by ancillary planting works, will be extensively used for the Project. In Vietnam, however, there are not many engineers who are familiar with these techniques and there are hardly any such engineers in the three target provinces. It will, therefore, be necessary through the implementation of APSA to transfer techniques/skills by means of OJT and to provide technical training in Japan for the C/Ps.
18	Policies Regarding Environmental Considerations	i The project design will not feature the use of unpaved roads around the target compartments which become muddy during the rainy season as operation roads for the transportation of the work materials. ii The creation of mixed forests will be planned at those planting sites with a low technical difficulty to secure biodiversity. iii The questionnaire survey conducted with local residents has found that the possibility of sea turtles visiting the shoreline of the target coastal sandy areas to lay their eggs cannot be negated even though the number of individuals has plummeted. Therefore, no work (ancillary planting work and the temporary introduction of operation roads) will be conducted on the shoreline side of frontal sand dunes to secure the sites for sea turtles to lay their eggs.
19	Policies Regarding Facility Grade	i One pending issue regarding the recommendation resulting from the afforestation work under PACSA relates to the poor height growth of the planted trees. The field survey for APSA has found a document suggesting the need for fertilizer application and soil improvement and the relevant requests made by the C/Ps. Height growth of the planted trees is essential for coastal protection forests to fully perform their functions and the necessary measures to ensure height growth must be examined. Not only the survival rate but also the height

		growth is included in "the Objectively Verifiable Indicators for the Outputs" with a view to creating coastal protection forests of which the grade is higher than those under PACSA.
20	Policies Regarding Meteorological Conditions	i As the soil must be sufficiently moist for planting, the appropriate planting time will be determined based on local meteorological data. ii The planning of APSA corresponds to the characteristics of local winds (prevailing direction, season, etc.) iii As the seedlings will be produced to match the appropriate season for their planting, the construction of the temporary nurseries will take the meteorological conditions of such season into consideration.
21	Policies Regarding Maintenance (Protection) of Coastal Protection Forests	i The maintenance (protection) of the newly created forests which will commence during the implementation period of APSA will be conducted by local residents in view of the problems encountered under PACSA and also the general practices in Vietnam. For this reason, the planned forests will be distributed to local residents and the persons responsible for maintenance (protection) will be decided prior to the commencement of APSA. The Vietnamese side will be responsible for these arrangements. ii The cost of the maintenance (protection) by local residents during the implementation period of APSA will be borne by the Japanese side when individual work is in progress and by the Vietnamese side when individual work is not in progress. After the completion of APSA, the Vietnamese side will bear the entire maintenance and protection cost. iii By decided the individual persons to be responsible for the maintenance (protection) of coastal protection forests at an earlier stage than in the case of PACSA, it is intended to (i) develop a sense of ownership of coastal protection forests among local residents to facilitate their understanding of the necessity for these forests and (ii) stimulate public interest to create similar forests in areas adjacent to the project sites.

2-2-2 Basic Plan (Afforestation Plan)

2-2-2-1 Whole Picture of the Requested Japanese Assistance

The major components of the Japanese assistance are listed in Table 2-3 and the details of each component are described later. A major change from the original application made by the Government of Vietnam is the omission of equipment procurement from the scope of the Japanese assistance.

Table 2-3 Major Components

Component			Application	Basic Plan
Project Sites	Compartment Area	Total	9,480 ha	2,598.47 ha
		Quang Nam Province	800 ha	594.82 ha
		Quang Ngai Province	1,400 ha	414.06 ha
		Binh Dinh Province	5,280 ha	1,589.59 ha
		Khanh Hoa Province	2,000 ha	0.00 ha
	Planting Area of the Above	Total	9,480 ha	2,463.75 ha
		Quang Nam Province	800 ha	570.52 ha
		Quang Ngai Province	1,400 ha	409.61 ha
		Binh Dinh Province	5,280 ha	1,483.62 ha
		Khanh Hoa Province	2,000 ha	0.00 ha
Major Components	Afforestation	Planting Area	9,480 ha	2,463.75 ha
		Operation Roads (Vehicle Roads)	60 km	19.8 km
		Operation Roads (Footpaths)	0 km	15.1 km
		Temporary Nurseries with Auxiliary Facilities	11	1
		Lookout towers	18	4
		Project Information Signboards (L)	0	6
		Project Information Signboards (S)	0	17
	Equipment Procurement	4 WD Wagons	5	0
		4 WD Pick-Up Trucks	4	0
		Motorbikes	18	0
		Personal Computers	14	0
		Printers	14	0
		Scanners	5	0
		GIS Software	14 sets	0 sets
		Digital Cameras	14	0
		Copy Machines	14	0

2-2-2-2 Selection of the Project Sites (Compartments)

The detailed selection process of the project sites in accordance with the relevant design policies is given in Table 2-4. Refer to Design Policy 01 through 05 for those design policies which were applied to determine the planting area.

Table 2-4 Changes of the Area of the Project Sites

Province	District / City	Requested Area	Area in M/D in Preparatory Study	Area in M/D in Field Survey	Perimeter Survey Results	Area of the Potential Target Areas	Area of the Project Target Areas	Compartment Area	Planting Area
Design Policy Code		-	Category A,B	Category A Equivalent	02	02	03	04, 05	04, 05
Quang Nam	Thang Binh	800	810	570	595.0	595.0	594.82	594.82	570.52
Quang Ngai	Binh Son	340	205	160					
	Duc Pho	1,060	745	430	422.5	422.5	414.06	414.06	409.61
	Subtotal	1,400	950	590	422.5	422.5	414.06	414.06	409.61
Binh Dinh	Hoai Nhon	120							
	Phu My	2,590	1,425	1,053	1,086.3	1,086.3	1,031.45	1,031.45	972.73
	Phu Cat	860	239	182	561.5	561.5	558.14	558.14	510.89
	Tuy Phuoc	60							
	Quy Nhon	1,650							
	Subtotal	5,280	1,664	1,235	1,647.8	1,647.8	1,589.59	1,589.59	1,483.62
Khanh Hoa	Van Ninh	2,000	1,800	1,200	604.0				
Grand Total		9,480	5,224	3,595	3,269.3	2,665.3	2,598.47	2,598.47	2,463.75

The Map of Category A and B Sites (scale of 1:50,000) which corresponds to the "Area in the M/D in the Preparatory Study" and the Survey Results Map (scale reduced from 1:10,000 to 1:50,000) which corresponds to the "Perimeter Survey Results" are included in the "Appendix – Comparison between A and B Categories and Survey Results". Maps (scale of 1:50,000) indicating the location and shape of each compartment corresponding to the "Area of the Project target areas" and "Compartment Area" are given in "D-105" through "D-112" in "2-2-3 – Basic Design Drawing".

The main changes in connection with the selection of the project sites and their reasons are described below.

- The planting area in Binh Son District in Quang Ngai Province has become zero from 160 ha. The reason for this is the withdrawal of the application prior to the perimeter survey as the titanium development plan at the potential target area has been officially adopted under the changing circumstances after the Preparatory Study.
- The increase of the planting area from 182 ha to 561.5 ha in Phu Cat District in Binh Dinh Province is due to the inclusion of some 380 ha in the study area as sites qualifying for "iv" and "v" of Design Policy 02 have been newly recognized.
- The area of the project sites in the Van Ninh District of Khanh Hoa Province was firstly changed from 1,200 ha to 604 ha due to a request made by the Vietnamese side to half the study area at the time of commencing the perimeter survey. This was followed by the complete withdrawal of the application at the end of the field survey as a harbor and

industrial park development plan covering the potential target area was officially approved. As a result, the area of the project sites in Khanh Hoa Province has been entirely eliminated.

The finalized compartment/sub-compartment area and area by degradation type are shown in Table 2-5 and the locations of the compartments, sub-compartments and planting sites are given in "D-201" through "D-211" in "2-2-3 – Basic Design Drawing".

Table 2-5 Compartment/Sub-Compartment Area and Area by Degradation Type
(1/2)

Province	District	Commune	Compartment	Sub-Compartment	Area of Compartment/ Sub-Compartment	Planting Area	Degradation Type	Degradation Area
Quang Nam	Thang Binh	Binh Minh	BM-1		162.85	151.97	Total	151.97
					114.00		Freq.Flodded Area	106.38
					48.85		Ordinary Sandy Area	45.59
			BM-2		35.29	35.29	Total	35.29
					14.12		Freq.Flodded Area	14.12
					21.17		Ordinary Sandy Area	21.17
			BM-3		30.36	30.36	Total	30.36
					12.14		Freq.Flodded Area	12.14
					18.22		Ordinary Sandy Area	18.22
			Subtotal		228.50	217.62	Total	217.62
					140.26		Freq.Flodded Area	132.64
					88.24		Ordinary Sandy Area	84.98
		Binh Dao	BD-1		177.72	167.18	Total	167.18
					124.40		Freq.Flodded Area	117.03
					53.32		Ordinary Sandy Area	50.15
			BD-2		62.88	61.49	Total	61.49
					25.15		Freq.Flodded Area	24.60
					37.73		Ordinary Sandy Area	36.89
			BD-3		14.74	14.74	Total	14.74
					5.90		Freq.Flodded Area	5.90
					8.84		Ordinary Sandy Area	8.84
			Subtotal		255.34	243.41	Total	243.41
					155.45		Freq.Flodded Area	147.53
					99.89		Ordinary Sandy Area	95.88
		Binh Hai	BH-1		59.88	59.43	Total	59.43
					23.95		Freq.Flodded Area	23.77
					35.93		Ordinary Sandy Area	35.66
			BH-2		51.10	50.06	Total	50.06
					20.44		Freq.Flodded Area	20.02
					30.66		Ordinary Sandy Area	30.04
			Subtotal		110.98	109.49	Total	109.49
					44.39		Freq.Flodded Area	43.79
					66.59		Ordinary Sandy Area	65.70
		Subtotal			594.82	570.52	Total	570.52
					340.10		Freq.Flodded Area	323.96
					254.72		Ordinary Sandy Area	246.56
Quang Ngai	Duc Pho	Pho An	PA-1	(1)	69.82	69.82	Dying Forest Area	69.82
				(2)	13.63	13.63	Area Adjacent to Shoreline	13.63
				(3)	52.52	52.52	Dying Forest Area	52.52
				(4)	39.26	34.81	Dying Forest Area	34.81
				(5)	5.47	5.47	Area Adjacent to Shoreline	5.47
				Subtotal	180.70	176.25	Total	176.25
					19.10		Area Adjacent to Shoreline	19.10
					161.60		Dying Forest Area	157.15
		Pho Quang	PQ-1	(1)	2.11	2.11	Area Adjacent to Shoreline	2.11
				(2)	4.02	4.02	Area Adjacent to Shoreline	4.02
				(3)	2.08	2.08	Area Adjacent to Shoreline	2.08
				Subtotal	8.21	8.21	Area Adjacent to Shoreline	8.21
		Pho Vinh	PV-1	(1)	17.49	17.49	Area Adjacent to Shoreline	17.49
				(2)	82.33	82.33	Dying Forest Area	82.33
				Subtotal	99.82	99.82	Total	99.82
					17.49		Area Adjacent to Shoreline	17.49
					82.33		Dying Forest Area	82.33
		Pho Khanh	PK-1	(1)	12.19	12.19	Dying Forest Area	12.19
				(2)	65.61	65.61	Dying Forest Area	65.61
				Subtotal	77.80	77.80	Dying Forest Area	77.80
			PK-2	(1)	14.62	14.62	Area Adjacent to Shoreline	14.62
				(2)	10.38	10.38	Area Adjacent to Shoreline	10.38
				Subtotal	25.00	25.00	Area Adjacent to Shoreline	25.00
			Subtotal		102.80	102.80	Total	102.80
					25.00		Area Adjacent to Shoreline	25.00
					77.80		Dying Forest Area	77.80
		Pho Chau	PC-1	(1)	15.29	15.29	Area Adjacent to Shoreline	15.29
				(2)	7.24	7.24	Area Adjacent to Shoreline	7.24
				Subtotal	22.53	22.53	Area Adjacent to Shoreline	22.53
		Subtotal			414.06	409.61	Total	409.61
					92.33		Area Adjacent to Shoreline	92.33
					321.73		Dying Forest Area	317.28

Table 2-5 Compartment/Sub-Compartment Area and Area by Degradation Type
(2/2)

Province	District	Village	Compartment	Sub-Compartment	Area of Compartment/ Sub-Compartment	Planting Area	Degradation Type	Degradation Area
Binh Dinh	Phu My	My Duc	MD-1		29.59	29.59	Ordinary Sandy Area	29.59
		My Thang	MTg-1		54.65	54.65	Ordinary Sandy Area	54.65
			MTg-2	(1)	6.54	6.54	Ordinary Sandy Area	6.54
				(2)	2.88	2.88	Ordinary Sandy Area	2.88
				(3)	61.77	61.77	Ordinary Sandy Area	61.77
				Subtotal	71.19	71.19	Ordinary Sandy Area	71.19
			MTg-3	(1)	12.14	12.14	Ordinary Sandy Area	12.14
				(2)	21.54	20.38	Ordinary Sandy Area	20.38
				Subtotal	33.68	32.52	Ordinary Sandy Area	32.52
			Subtotal		159.52	158.36	Ordinary Sandy Area	158.36
		My An	MA-1		76.47	74.89	Ordinary Sandy Area	74.89
		My Thanh	MTh-1	(1)	15.36	13.03	Area Adjacent to Shoreline	13.03
				(2)	33.47	33.41	Severe Moving Sand Area_A	33.41
				(3)	21.96	21.79	Severe Moving Sand Area_A	21.79
				(4)	40.71	40.20	Severe Moving Sand Area_A	40.20
				(5)	103.63	101.16	Severe Moving Sand Area_B	101.16
				(6)	89.57	82.60	Severe Moving Sand Area_B	82.60
				(7)	161.42	156.45	Severe Moving Sand Area_B	156.45
				(8)	106.59	86.61	Area Adjacent to Shoreline	86.61
				(9)	193.16	174.64	Ordinary Sandy Area	174.64
				Subtotal	765.87	709.89	Total	709.89
					96.14		Severe Moving Sand Area_A	95.40
					354.62		Severe Moving Sand Area_B	340.21
					121.95		Area Adjacent to Shoreline	99.64
					193.16		Ordinary Sandy Area	174.64
		Subtotal			1,031.45	972.73	Total	972.73
					96.14		Severe Moving Sand Area_A	95.40
					354.62		Severe Moving Sand Area_B	340.21
					121.95		Area Adjacent to Shoreline	99.64
					458.74		Ordinary Sandy Area	437.48
	Phu Cat	Cat Khanh	CK-1	(1)	36.93	26.43	Severe Moving Sand Area_C	26.43
				(2)	45.52	38.48	Moving Sand Area	38.48
				Subtotal	82.45	64.91	Total	64.91
					36.93		Severe Moving Sand Area_C	26.43
					45.52		Moving Sand Area	38.48
		Cat Thanh	CT-1	(1)	90.12	82.48	Severe Moving Sand Area_C	82.48
				(2)	201.53	179.46	Moving Sand Area	179.46
				(3)	181.82	181.82	Poorly Growing Scattered Tree Area	181.82
				(4)	2.22	2.22	Area Adjacent to Shoreline	2.22
				Subtotal	475.69	445.98	Total	445.98
					90.12		Severe Moving Sand Area_C	82.48
					201.53		Moving Sand Area	179.46
					2.22		Area Adjacent to Shoreline	2.22
					181.82		Poorly Growing Scattered Tree Area	181.82
		Subtotal			558.14	510.89	Total	510.89
					127.05		Severe Moving Sand Area_C	108.91
					247.05		Moving Sand Area	217.94
					2.22		Area Adjacent to Shoreline	2.22
					181.82		Poorly Growing Scattered Tree Area	181.82
	Subtotal				1,589.59	1,483.62	Total	1,483.62
					96.14		Severe Moving Sand Area_A	95.40
					354.62		Severe Moving Sand Area_B	340.21
					127.05		Severe Moving Sand Area_C	108.91
					247.05		Moving Sand Area	217.94
					124.17		Area Adjacent to Shoreline	101.86
					458.74		Ordinary Sandy Area	437.48
					181.82		Poorly Growing Scattered Tree Area	181.82
Grand Total					2,598.47	2,463.75	Total	2,463.75
					96.14		Severe Moving Sand Area_A	95.40
					354.62		Severe Moving Sand Area_B	340.21
					127.05		Severe Moving Sand Area_C	108.91
					247.05		Moving Sand Area	217.94
					216.50		Area Adjacent to Shoreline	194.19
					340.10		Freq.Flodded Area	323.96
					713.46		Ordinary Sandy Area	684.04
					181.82		Poorly Growing Scattered Tree Area	181.82
					321.73		Dying Forest Area	317.28

2-2-2-3 Afforestation Plan

(1) Work Flow

The series of work related to afforestation is shown in Table 2-6. As far as the procurement of seedlings is concerned, there will be two patterns, i.e. 1) the purchase of seedlings from existing nurseries and 2) the production of seedlings at a newly created temporary nursery only when the required quantity of seedlings cannot be purchased.

The work flow at the planting sites will generally be 1) construction of an operation road(s) (vehicle road and/or footpath) depending on need, 2) installation of ancillary planting works (sand control hedging and sand deposition fencing) at difficult planting sites, 3) planting, 4) maintenance (protection) of newly created forests with Japanese funding as soon as the planting has been conducted, 5) inspection and handing over and 6) maintenance (protection) of newly created forests with Vietnamese funding after handing over.

From the second year onward, the process consisting of 1) tending (supplementary planting and/or top dressing), 2) maintenance (protection) of the coastal protection forests with Japanese funding alongside tending, 3) inspection and handing over and 4) maintenance (protection) of the coastal protection forests with Vietnamese funding after handing over will be repeated.

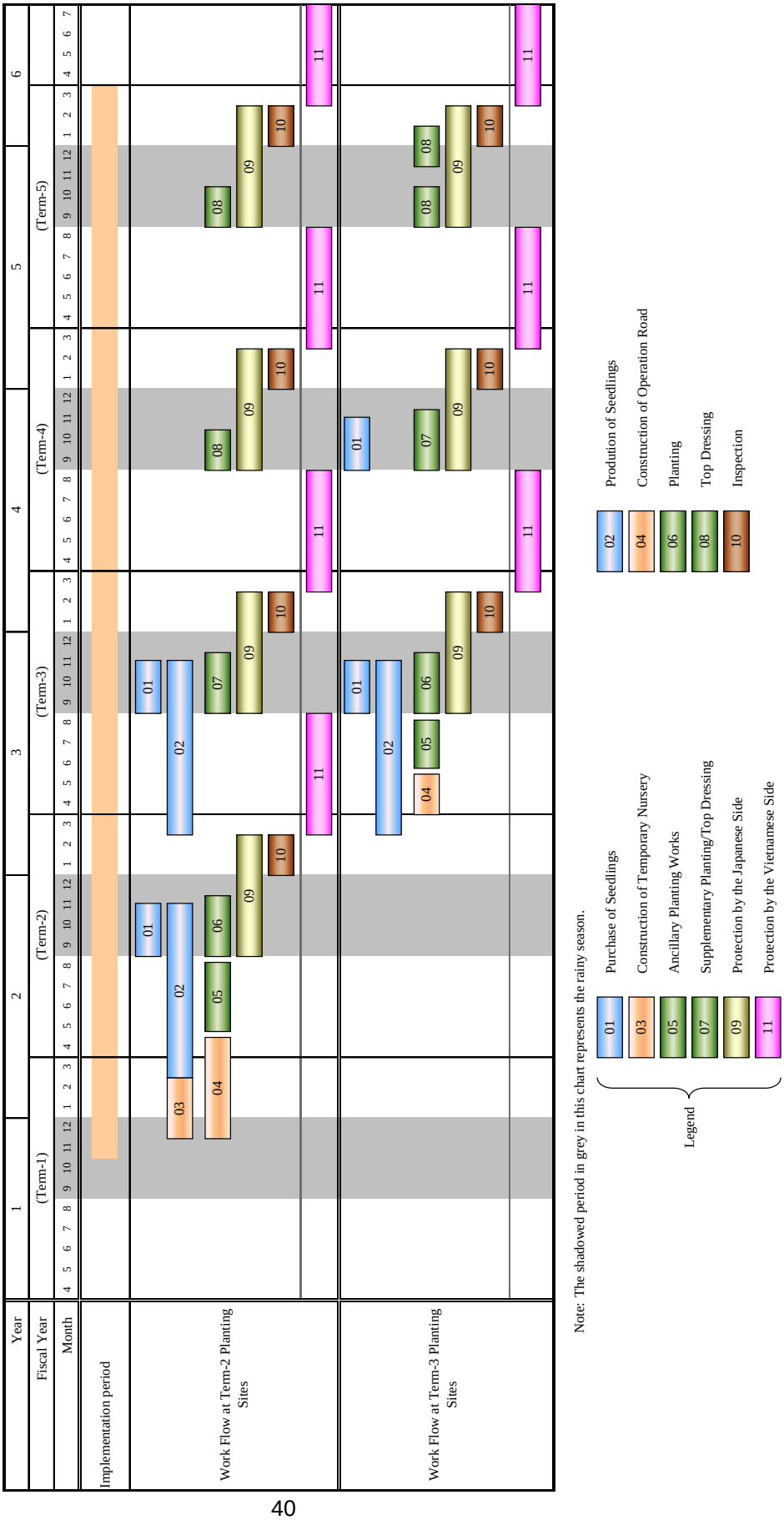
As the planting must be completed in two years (Term 2 and Term 3) in accordance with "iv" of Design Policy 06, there will be two sequences of work with one year apart.

The important points for the afforestation work are described below.

a) As the supplementary planting in Term 4 involves a fewer number of seedlings, the entire seedlings will be purchased.

b) Strictly speaking, the third top dressing at the Term 3 planting sites should be conducted in Term 6. Given the small scale of the work, two top dressing exercises will be conducted in the final year (Term 5) as in the case of PACSA to ensure the efficiency of this work. Consequently, the entire project period will be five years.

Table 2-6 Flow Chart for Afforestation Work



(2) Planting

In PACSA, casuarina was the target species and acacia (*A. crassicarpa* and *A.* hybrid), eucalyptus and cashew were the supplementary species. Coastal protection forests were created as pure forests using these species. Although the efforts to create coastal protection forests under PACSA achieved generally favorable results, the expected growth of the planted trees was not necessarily achieved for all species or compartments. For the present Project, a strong request has been made by the Vietnamese side (not only by government organizations but also by local residents) to improve the planting method to reflect the newly acquired knowledge of the characteristics of each species and the planting method, the social circumstances and other relevant matters. It has been decided to adopt the following planting method with the aim of creating higher quality coastal protection forests under the Project based on such request, experience and knowledge acquired and problems encountered in PACSA and field survey results for the Project.

1) Species

The average survival rate of the species used under PACSA as of January, 2006 is 82% for casuarinas, 80% for acacia (88% for *A. crassicarpa* and 71% for *A.* hybrid), 59% for eucalyptus and 60% for cashew. Among these species, *A.* hybrid (the survival rate of which is high but the growth of which in sandy areas is poor) and eucalyptus (the survival rate of which is low and of which the fallen leaves containing a plant growth inhibitor damage the fertility of the soil around the stand) have been dropped from the range of the planting species for the Project. These two species were not included in the original application made by the Government of Vietnam. Meanwhile, cashew has been included in the target species for the Study despite its low survival rate under PACSA because (i) an improved planting method can expect an increase of the survival rate, (ii) it is popular among local residents as a cash crop and (iii) it is included in the original application made by the Government of Vietnam. The target species for the Study also include neem which has been newly added to the original application and acacia (*A. difficilis* and *A. torulosa*) which have been added to the list of species suitable for planting in coastal sandy areas based on the results of recent experiments in Vietnam. Casuarina and acacia (*A. crassicarpa*), both of which have a high survival rate, have been decided as the target species.

The field survey results indicate that all of above species requested by the Vietnamese side are suitable for the afforestation of coastal sandy areas. Accordingly, the planting species for the Project are those shown in Table 2-7 in accordance with Design Policy 06.

Table 2-7 Planting Species and Their Characteristics

Category	Species	Scientific Name	Characteristics	Design Policy under the Project
Target Species	Casuarina	*Casuarina equisetifolia*	Originally from Australia and now found in Africa, Asia and Oceania. This tree looks like a conifer but is a broad-leaved species. It is an evergreen tall tree with an average height and DBH of some 20 – 30 m and 30 cm respectively. It can withstand drought, flooding and tides and can grow on poor soil. Accordingly, it is planted as coastal erosion control forests, at roadsides, at domestic gardens, as perimeter trees around paddy fields and shrimp ponds.	This will be the main planting species under the Project and will be used for severe moving sand areas, moving sand areas, areas adjacent to the shorelines, ordinary sandy areas, poorly growing scattered tree areas and dying forest areas. Pure *C. equisetifolia* forests will be created in severe moving sand areas, moving sand areas and areas adjacent to the shoreline, all of which are characterized by such severe conditions as moving sand and tides, while mixed forests with other species will be created in other areas.
	Acacia	*Acacia crassicarpa*	Originally from Australia. This tree can withstand drought and seasonal flooding and can grow on poor soil. Accordingly, it is used for the afforestation of degraded areas and windbreak forests. In PACSA, this tree was used in Quang Nam Province.	The experience of PACSA suggests that this tree is best suited to frequently flooded areas (all belong to Quang Nam Province) and pure forests will be created along with the creation of ridges. In Quang Nam Province, mixed planting with other species will be conducted at less technically difficult sites.
		Acacia difficilis	Mainly distributed in northern Australia with a height of some 2 – 13 m. The main habitat is sand/sandy soil/sandstone areas. The results of MARD and FSIV experiments have found that this species is suitable for the afforestation of coastal sandy areas.	These species will be planted along with other species at less technically difficult sites (ordinary sandy areas, poorly growing scattered tree areas and dying forest areas) in Quang Ngai Province and Binh Dinh Province. *A. torulosa* will be planted at those sites where excellent tree growth cannot be anticipated because of the site conditions (adverse soil conditions and sites of which the topography assists the localized convergence of wind) while *A. difficilis* will be planted at sites with a good growth prospect.
		Acacia torulosa	Mainly distributed from northern Australia to north-eastern Australia with a height of some 1.3 – 15 m. It grows on such poor soil as sand and rocky soil. The results of MARD and FSIV experiments have found that this species is suitable for the afforestation of coastal sandy areas because of its strong resistance to drought.	
Supplementary Species	Cashew	*Anacardium occidentale*	Originally from north-western Brazil and now widely found in the tropical regions of Central and South America and Southeast Asia. This is an evergreen tall tree with a height of some 10 – 15 m. Large orchards are found in coastal sandy areas to produce edible cashew nuts.	As this species is unsuitable for difficult planting sites, it will be planted along with other species in less technically difficult areas (ordinary sandy areas, poorly growing scattered tree areas and dying forest areas) in the three provinces.
	Neem	*Melia azadirachta*	An evergreen tall tree originating in India and now distributed not only in India but also in South Asia and Central and South America and Africa. The height is some 15 – 20 m. Insecticide, medicines for external application to combat rheumatism and medicines for fever and inflammations to prevent the development of skin disease are widely extracted from the seeds, leaves, bark, etc. In recent years, the excellent effect and safety of its use as an insecticide for organic farming has been attracting much attention and is now popularly used in the America, Europe, Australia, India, Southeast Asia, China, etc.	As this species is unsuitable for difficult planting sites, it will be planted along with other species in less technically difficult areas (ordinary sandy areas, poorly growing scattered tree areas and dying forest areas) in the three provinces.

2) Planting Density and Standard of Mixing Ratio

The standard planting density in Vietnam when attempting to create a coastal forest is 5,000 trees/ha (planting distance of 1 m x 2 m) in areas with a high planting difficulty and 3,333 trees/ha (planting distance of 1.5 m x 2 m) in areas with a low planting difficulty. In PACSA, a planting density ranging from 2,500 trees/ha (planting distance of 2 m x 2 m or 1 m x 4 m) to 2,000 trees/ha (planting distance of 2 m x 2.5 m) was mainly employed based on the examination results of a suitable planting density which would reasonable perform the expected shifting sand control and windbreak functions without excess. However, analysis of PACSA results has led to the conclusion that the planting density can be further reduced for stands of excellent growth. Moreover, the feasibility of mixed forests was examined by the field survey in response to a request made by the Vietnamese side in view of the ease of changing the planting species at the time of the actual afforestation work, the prospect of securing biodiversity and the prevention of damage by disease and pests.

Based on the results of field survey, the planting density under the Project will be 2,500 trees/ha (planting distance of 2 m x 2 m) at the sites with high technical difficulty. At those sites with a low level of technical difficulty where a high successful growth rate can be anticipated, the planting density will be 1,600 trees/ha (planting distance of 2.5 m x 2.5 m). At difficult planting sites, pure forests of *C. equisetifolia* or *A. crassicarpa* will be created while mixed forests of *C. equisetifolia*, *A. difficilis*, *A. torulosa*, *A. occidentale* and/or *M. azadirachta* will be created at sites with less technical difficulty as shown in Table 2-8.

Table 2-8 Planting Density and Standard of Mixing Ratio by Degradation Type

Primary Category	Degradation Type	Planting Species	Planting Density	Standard of Mixing Ratio
High technical difficulty	Severe moving sand area Moving sand area Area adjacent to the shoreline	*Casuarina equisetifolia*	2,500 trees/ha	Pure forest of Casuarina
	Frequently flooded area	*Acacia crassicarpa*		Pure forest of Acacia
Low technical difficulty	Ordinary sandy area (Quang Nam Province)	*Casuarina equisetifolia* *Acacia crassicarpa* *Anacardium occidentale* *Melia azadirachta*	1,600 trees/ha	Mixed forest of Casuarina : 30 % Acacia : 50 % Cashew : 10 % Neem : 10 %
	Ordinary sandy area (Quang Ngai Province) (Binh Dinh Province) Poorly growing scattered tree area Dying forest area	*Casuarina equisetifolia* *Acacia difficilis* / *torulosa* *Anacardium occidentale* *Melia azadirachta*		Mixed forest of Casuarina : 50 % Acacia : 30 % Cashew : 10 % Neem : 10 %

3) Planting Method

The required fertilizer quantity by species at the time of planting is shown in Table 2-9 based on the interview survey results and the reference materials obtained in Vietnam as indicated by Design Policy 06.

Table 2-9 List of Required Fertilizer Quantity by Species in Vietnam

Species	Fertilizers for Planting			Reference Material	
	Manure	Chemical Fertilizer	Organic Fertilizer	No.	Source
Casuarina equisetifolia	1 kg	50 g	-	0207	Quang Nam
	-	50～100 g	-	0304	Quang Ngai
	1～2 kg	-	-	0307	Quang Ngai
	-	-	60～100 g	0401	Binh Dinh
Acasia	1～2 kg	20～50 g	-	0302	Quang Ngai
	2～3 kg	-	-	0306	Quang Ngai
	1～2 kg	30 g	200～500 g	0308	Quang Ngai
	0.5～1 kg	50～70 g	-	0402	Binh Dinh
Anacardium occidentale	5～10 kg	600 g	-	0303	Quang Ngai
Melia azadirachta	-	-	-	0145	Hanoi
	-	-	-	0206	Quang Nam

Note: The above figures for acasia apply to *Acacia* hybrid, *Acacia auriculiformic*, *Acacia mangium*, etc. and there are no existing figures for *Acacia crassicarpa*, *Acacia difficilis* and *Acacia torulosa* to be planted in the Project.

In PACSA, 375 g of manure and 50 g of granular chemical fertilizer were applied per seedling at the time of the planting of *C. equisetifolia*, Acacia, *A. occidentale*, etc. but the subsequent height growth was not as good as anticipated (see Fig. 2-1 and Table 2-10).

Fig. 2-1 Difference in *C. equisetifolia* Growth at a Stand of Poor Growth and Former Manure Yard (center of the photograph)

Table 2-10 Height Growth Data in PACSA

Species	Planting Area	Area and Proportion of Stands with Average Tree Height of Over 2m	
Casuarina	2,837.06 ha	1,114.31 ha	39.3%
Acacia	175.31 ha	164.91 ha	94.1%
Cashew	110.24 ha	12.33 ha	11.2%

To address these problems, the quantity of basal dressing has been decided as shown in Table 2-11. This decision is based on the following ideas.

- The quantity of manure and organic fertilizer is increased for *C. equisetifolia* and *A. occidentale* based on the knowledge obtained in PACSA and locally gathered data.
- The quantity of manure and (organic) fertilizer for Acacia is that in the table based on the knowledge obtained in PACSA as no relevant documents exist for the planting method and other relevant matters.
- The quantity of fertilizer etc. for *M. azadirachta* is based on the empirical values established at an experiment site in Quang Ngai Province as no knowledge was obtained in PACSA and no

documented data in Vietnam exists.

- As neither soil dressing nor straw burying are practiced in Vietnam, the respective input quantities are determined based on the Japanese standards and general examples. These methods are now considered to address the problem of poor height growth in PACSA due to conspicuous defoliation and yellowing in the dry season, in turn caused by the absence of these measures.

Table 2-11 List of Basal Dressing etc. by Species

Species	List of Fertilizers Used at the Time of Planting				
	Total	Manure	Organic Fertilizer	Soil Dressing	Buried Straw
Casuarina	4.50 kg	1.00 kg	100 g	3.00 kg	400 g
Acacia	3.83 kg	375 g	50 g	3.00 kg	400 g
Cashew	8.70 kg	5.00 kg	300 g	3.00 kg	400 g
Neem	4.00 kg	500 g	100 g	3.00 kg	400 g

The minimum size of the planting hole shown in Table 2-12 has been determined to reflect the characteristics of the species, the groundwater level in the rainy season and the degree of drought in the dry season.

Table 2-12 List of the Minimum Planting Hole Sizes by Species

Species	Geographical Area	Minimum Planting Hole Size
Casuarina equisetifolia	Quang Nam Province	Ø 30cm x 30cm deep
	Quang Ngai Province Binh Dinh Province	Ø 30cm x 60cm deep
Acacia		Ø 30cm x 30cm deep
Anacardium occidentale		
Melia azadirachta		

The planting method by species is given in "Standard Drawing of Planting D-301" through "D-304" in "2-2-3 – Basic Design Drawing".

4) Planting Time and Frequency

Planting will be conducted in two months (60 days) in the first half of the rainy season to ensure a sufficient period of growth after planting. As shown by the work flow, planting will be conducted over two years (Term 2 and Term 3). The planting area by term will be 1,044.42 ha in Term 2 and 1,419.33 ha in Term 3 as shown in Table 2-13.

Table 2-13 Planting Area by Planting Method and Term
(1/4)

Province	District	Commune	Compartment	Sub-Compartment	Degradation Type	Planting Species	Planting Density seedlings/ha	Planting Area (ha)		
								Total	Term-2	Term-3
Quang Nam	Thang Binh	Binh Minh	BM-1		Sub-Total	AC	2,500	151.97	151.97	
					Frequently Flooded Area	MP (1)	1,600	106.38	106.38	
					Ordinary Sandy Area			45.59	45.59	
			BM-2		Sub-Total	AC	2,500	35.29		35.29
					Frequently Flooded Area	MP (1)	1,600	14.12		14.12
					Ordinary Sandy Area			21.17		21.17
			BM-3		Sub-Total	AC	2,500	30.36		30.36
					Frequently Flooded Area	MP (1)	1,600	12.14		12.14
					Ordinary Sandy Area			18.22		18.22
			Sub-Total		Sub-Total	AC	2,500	217.62	151.97	65.65
					Frequently Flooded Area	MP (1)	1,600	132.64	106.38	26.26
					Ordinary Sandy Area			84.98	45.59	39.39
		Binh Dao	BD-1		Sub-Total	AC	2,500	167.18		167.18
					Frequently Flooded Area	MP (1)	1,600	117.03		117.03
					Ordinary Sandy Area			50.15		50.15
			BD-2		Sub-Total	AC	2,500	61.49	61.49	
					Frequently Flooded Area	MP (1)	1,600	24.60	24.60	
					Ordinary Sandy Area			36.89	36.89	
			BD-3		Sub-Total	AC	2,500	14.74	14.74	
					Frequently Flooded Area	MP (1)	1,600	5.90	5.90	
					Ordinary Sandy Area			8.84	8.84	
			Sub-Total		Sub-Total	AC	2,500	243.41	76.23	167.18
					Frequently Flooded Area	MP (1)	1,600	147.53	30.50	117.03
					Ordinary Sandy Area			95.88	45.73	50.15
		Binh Hai	BH-1		Sub-Total	AC	2,500	59.43	59.43	
					Frequently Flooded Area	MP (1)	1,600	23.77	23.77	
					Ordinary Sandy Area			35.66	35.66	
			BH-2		Sub-Total	AC	2,500	50.06		50.06
					Frequently Flooded Area	MP (1)	1,600	20.02		20.02
					Ordinary Sandy Area			30.04		30.04
			Sub-Total		Sub-Total	AC	2,500	109.49	59.43	50.06
					Frequently Flooded Area	MP (1)	1,600	43.79	23.77	20.02
					Ordinary Sandy Area			65.70	35.66	30.04
		Sub-Total			Sub-Total	AC	2,500	570.52	287.63	282.89
					Frequently Flooded Area	MP (1)	1,600	323.96	160.65	163.31
					Ordinary Sandy Area			246.56	126.98	119.58

Table 2-13 Planting Area by Planting Method and Term
(2/4)

Province	District	Commune	Compartment	Sub-Compartment	Degradation Type	Planting Species	Planting Density seedlings/ha	Planting Area (ha)		
								Total	Term-2	Term-3
Quang Ngai	Duc Pho	Pho An	PA-1	(1)	Dying Forest Area	MP (2)	1,600	69.82		69.82
				(2)	Area Adjacent to Shoreline	CE	2,500	13.63	13.63	
				(3)	Dying Forest Area	MP (2)	1,600	52.52		52.52
				(4)	Dying Forest Area	MP (2)	1,600	34.81		34.81
				(5)	Area Adjacent to Shoreline	CE	2,500	5.47	5.47	
				Sub-Total				176.25	19.10	157.15
					Area Adjacent to Shoreline	CE	2,500	19.10	19.10	
					Dying Forest Area	MP (2)	1,600	157.15		157.15
		Pho Quang	PQ-1	(1)	Area Adjacent to Shoreline	CE	2,500	2.11	2.11	
				(2)	Area Adjacent to Shoreline	CE	2,500	4.02	4.02	
				(3)	Area Adjacent to Shoreline	CE	2,500	2.08	2.08	
				Sub-Total	Area Adjacent to Shoreline	CE	2,500	8.21	8.21	
		Pho Vinh	PV-1	(1)	Area Adjacent to Shoreline	CE	2,500	17.49	17.49	
				(2)	Dying Forest Area	MP (2)	1,600	82.33		82.33
				Sub-Total				99.82	17.49	82.33
					Area Adjacent to Shoreline	CE	2,500	17.49	17.49	
					Dying Forest Area	MP (2)	1,600	82.33		82.33
		Pho Khanh	PK-1	(1)	Dying Forest Area	MP (2)	1,600	12.19		12.19
				(2)	Dying Forest Area	MP (2)	1,600	65.61	65.61	
				Sub-Total	Dying Forest Area	MP (2)	1,600	77.80	65.61	12.19
			PK-2	(1)	Area Adjacent to Shoreline	CE	2,500	14.62		14.62
				(2)	Area Adjacent to Shoreline	CE	2,500	10.38	10.38	
				Sub-Total	Area Adjacent to Shoreline	CE	2,500	25.00	10.38	14.62
								102.80	75.99	26.81
					Area Adjacent to Shoreline	CE	2,500	25.00	10.38	14.62
					Dying Forest Area	MP (2)	1,600	77.80	65.61	12.19
		Pho Chau	PC-1	(1)	Area Adjacent to Shoreline	CE	2,500	15.29	15.29	
				(2)	Area Adjacent to Shoreline	CE	2,500	7.24		7.24
				Sub-Total	Area Adjacent to Shoreline	CE	2,500	22.53	15.29	7.24
		Sub-Total						409.61	136.08	273.53
					Area Adjacent to Shoreline	CE	2,500	92.33	70.47	21.86
					Dying Forest Area	MP (2)	1,600	317.28	65.61	251.67

Table 2-13 Planting Area by Planting Method and Term
(3/4)

Province	District	Commune	Compartment	Sub-Compartment	Degradation Type	Planting Species	Planting Density seedlings/ha	Planting Area (ha)		
								Total	Term-2	Term-3
Binh Dinh	Phu My	My Duc	MD-1		Ordinary Sandy Area	MP (2)	1,600	29.59		29.59
		My Thang	MTg-1		Ordinary Sandy Area	MP (2)	1,600	54.65	54.65	
			MTg-2	(1)	Ordinary Sandy Area	MP (2)	1,600	6.54	6.54	
				(2)	Ordinary Sandy Area	MP (2)	1,600	2.88	2.88	
				(3)	Ordinary Sandy Area	MP (2)	1,600	61.77	61.77	
				Sub-Total	Ordinary Sandy Area	MP (2)	1,600	71.19	71.19	
			MTg-3	(1)	Ordinary Sandy Area	MP (2)	1,600	12.14		12.14
				(2)	Ordinary Sandy Area	MP (2)	1,600	20.38		20.38
				Sub-Total	Ordinary Sandy Area	MP (2)	1,600	32.52		32.52
			Sub-Total					158.36	125.84	32.52
		My An	MA-1		Ordinary Sandy Area	MP (2)	1,600	74.89		74.89
		My Thanh	MTh-1	(1)	Area Adjacent to Shoreline	CE	2,500	13.03	13.03	
				(2)	Severe Moving Sand Area_A	CE	2,500	33.41	33.41	
				(3)	Severe Moving Sand Area_A	CE	2,500	21.79	21.79	
				(4)	Severe Moving Sand Area_A	CE	2,500	40.20	40.20	
				(5)	Severe Moving Sand Area_B	CE	2,500	101.16		101.16
				(6)	Severe Moving Sand Area_B	CE	2,500	82.60	82.60	
				(7)	Severe Moving Sand Area_B	CE	2,500	156.45	156.45	
				(8)	Area Adjacent to Shoreline	CE	2,500	86.61		86.61
				(9)	Ordinary Sandy Area	MP (2)	1,600	174.64		174.64
				Sub-Total				709.89	347.48	362.41
					Severe Moving Sand Area_A	CE	2,500	95.40	95.40	
					Severe Moving Sand Area_B	CE	2,500	340.21	239.05	101.16
					Area Adjacent to Shoreline	CE	2,500	99.64	13.03	86.61
					Ordinary Sandy Area	MP (2)	1,600	174.64		174.64
		Sub-Total						972.73	473.32	499.41
					Severe Moving Sand Area_A	CE	2,500	95.40	95.40	
					Severe Moving Sand Area_B	CE	2,500	340.21	239.05	101.16
					Area Adjacent to Shoreline	CE	2,500	99.64	13.03	86.61
					Ordinary Sandy Area	MP (2)	1,600	437.48	125.84	311.64

Table 2-13 Planting Area by Planting Method and Term
(4/4)

Province	District	Commune	Compartment	Sub-Compartment	Degradation Type	Planting Species	Planting Density seedlings/ha	Planting Area (ha)		
								Total	Term-2	Term-3
	Phu Cat	Cat Khanh	CK-1	(1)	Severe Moving Sand Area_C	CE	2,500	26.43	26.43	
				(2)	Moving Sand Area	CE	2,500	38.48	38.48	
				Sub-Total				64.91	64.91	
					Severe Moving Sand Area_C	CE	2,500	26.43	26.43	
					Moving Sand Area	CE	2,500	38.48	38.48	
		Cat Thanh	CT-1	(1)	Severe Moving Sand Area_C	CE	2,500	82.48	82.48	
				(2)	Moving Sand Area	CE	2,500	179.46		179.46
				(3)	Poorly Growing Scatterd Tree Area	MP (2)	1,600	181.82		181.82
				(4)	Area Adjacent to Shoreline	CE	2,500	2.22		2.22
				Sub-Total				445.98	82.48	363.50
					Severe Moving Sand Area_C	CE	2,500	82.48	82.48	
					Moving Sand Area	CE	2,500	179.46		179.46
					Area Adjacent to Shoreline	CE	2,500	2.22		2.22
					Poorly Growing Scatterd Tree Area	MP (2)	1,600	181.82		181.82
		Sub-Total						510.89	147.39	363.50
					Severe Moving Sand Area_C	CE	2,500	108.91	108.91	
					Moving Sand Area	CE	2,500	217.94	38.48	179.46
					Area Adjacent to Shoreline	CE	2,500	2.22		2.22
					Poorly Growing Scatterd Tree Area	MP (2)	1,600	181.82		181.82
								1,483.62	620.71	862.91
		Sub-Total			Severe Moving Sand Area_A	CE	2,500	95.40	95.40	
					Severe Moving Sand Area_B	CE	2,500	340.21	239.05	101.16
					Severe Moving Sand Area_C	CE	2,500	108.91	108.91	
					Moving Sand Area	CE	2,500	217.94	38.48	179.46
					Area Adjacent to Shoreline	CE	2,500	101.86	13.03	88.83
					Ordinary Sandy Area	MP (2)	1,600	437.48	125.84	311.64
					Poorly Growing Scatterd Tree Area	MP (2)	1,600	181.82		181.82
								2,463.75	1,044.42	1,419.33
Grand Total					Severe Moving Sand Area_A	CE	2,500	95.40	95.40	
					Severe Moving Sand Area_B	CE	2,500	340.21	239.05	101.16
					Severe Moving Sand Area_C	CE	2,500	108.91	108.91	
					Moving Sand Area	CE	2,500	217.94	38.48	179.46
					Area Adjacent to Shoreline	CE	2,500	194.19	83.50	110.69
					Frequently Flooded Area	AC	2,500	323.96	160.65	163.31
					Ordinary Sandy Area	MP (1)	1,600	246.56	126.98	119.58
					Ordinary Sandy Area	MP (2)	1,600	437.48	125.84	311.64
					Poorly Growing Scatterd Tree Area	MP (2)	1,600	181.82		181.82
					Dying Forest Area	MP (2)	1,600	317.28	65.61	251.67

Legend
- CE: *Casuarina equisetifolia*
- AC: *Acacia* spp.
- CA: Cashew
- NM: Neem
- MP (1): Mixed planting Type 1, CE:AC:CA:NM=3:5:1:1
- MP (2): Mixed planting Type 2, CE:AC:CA:NM=5:3:1:1

(3) Ancillary Planting Works

Compared to PACSA, the technical difficulty of planting under the Project is much higher and, therefore, the employment of ancillary planting works is planned to overcome such difficulty. As indicated in Design Policy 07, these ancillary planting works will use locally procurable materials. The structure will be simple enough to allow their easy assembly by local farmers and fishermen. As ancillary planting works to combat strong winds, sand deposition fencing, straw covering work, sand control hedging and/or shield stick work will be independently used or combined. As ancillary planting works to combat flooding, drainage ditch work and ridge work will be combined. The drawings for these ancillary planting works are given in "D-401" through "D-404" and "D-416" in "2-2-3 – Basic Design Drawing".

The structure and expected effects of each type of work are explained next.

i Sand Deposition Fencing

Fencing is erected on frontal sand dunes on the coast to directly block the strongest prevailing wind. As this fencing will directly face strong winds, supporting posts (strut) are placed at 10 m intervals to prevent the fencing from falling.

ii Sand Control Hedging

Sand control hedging further weakens the wind which is directly blocked and slightly weakened by the sand deposition fencing. As the wind direction is not necessarily the same, sand control hedging is created to form a rectangular shape inside of which planting is conducted.

iii Straw Covering Work

When it is anticipated that the effect of sand deposition fencing may be lost with the deposition of sand, straw is laid over the sand on the windward side of the fencing to prevent sand movement.

iv Shield Stick Work

Shield sticks are attached to the planted trees to prevent the damages to the planted trees from shifting sand and/or strong winds.

v Drainage Ditch Work

Drainage ditches are constructed to drain rainwater from areas which are flooded in the rainy season.

vi Ridge Work

If a planting site in a frequently flooded area is relatively large and the water depth is shallow, ridges are created to the extent that no hindrance occurs to the future development

of the root system. Planting is then conducted on these ridges.

Table 2-14 Types of Ancillary Planting Works by Degradation Type

Area Category	Main Ancillary Planting Work	Planning Concept
Severe Moving Sand Area A	Sand Deposition Fencing	A line of sand deposition fencing will be erected on the frontal sand dunes. In areas which are prone to the invasion of seawater (3,500 m equivalent), two lines are planned. The second line will be erected after the first line has been buried by deposited sand.
	Sand Control Hedging	Other areas will be enclosed by sand control hedging (forming a rectangular shape of 30 m wide and 25 m deep), inside of which planting will be conducted.
	Shield Stick Work	Shield sticks will be introduced to protect the planted trees from strong winds.
Severe Moving Sand Area B	Sand Deposition Fencing	Sand deposition fencing will be erected on the peak of the sand dunes along with the application of straw covering work with a width of 5 m on both sides of the fencing to prevent the movement of sand.
	Sand Control Hedging	Other areas will be enclosed by sand control hedging (forming a rectangular shape of 30 m wide and 25 m deep), inside of which planting will be conducted.
	Straw Covering Work	Straw will be laid for a width of 5 m on both sides of the sand deposition fencing to prevent sand movement.
	Shield Stick Work	Shield sticks will be introduced to protect the planted trees from strong winds.
Severe Moving Sand Area C	Sand Deposition Fencing	A line of sand deposition fencing will be erected on the frontal sand dunes.
	Sand Control Hedging	Other sandy areas will be enclosed by sand control hedging (forming a rectangular shape of 50 m wide and 30 m deep), inside of which planting will be conducted.
	Shield Stick Work	Shield sticks will be introduced to protect the planted trees from strong winds.
Moving Sand Area	Sand Control Hedging	Sandy areas will be enclosed by sand control hedging (forming a rectangular shape of 50 m wide and 30 m deep), inside of which planting will be conducted. In this case, the sand control hedging will be introduced as the front line coastal work instead of sand deposition fencing.
	Shield Stick Work	Shield sticks will be introduced to protect the planted trees from strong winds.
Area Adjacent to the Shoreline	Shield Stick Work	Shield sticks will be introduced to protect the planted trees from strong winds.
Frequently Flooded Area	Drainage Ditch Work	Drainage ditches will be introduced to drain water from a flooded area.
	Ridge Work	At a wide but shallow frequently flooded area, ridges with a relative height difference of 0.4 m will be created.

The deployment plans for the various ancillary planting works in severe moving sand areas A, B and C and moving sand areas are given in "D-405" through "D-408" in "2-2-3 – Basic Design Drawing". The

work quantities for the sand deposition fencing, sand control hedging and straw covering work and their deployment plan for each compartment are given in "D-409" through "D-415" in "2-2-3 – Basic Design Drawing".

Table 2-15 shows the location and quantity of each type of ancillary planting work by the natural conditions.

Table 2-15 Ancillary Planting Works by Natural Conditions

Degradation Type	Type of Ancillary Planting Work	Quantity			
		Total	Term-2	Term-3	Term-4
Severe Moving Sand Area A	Sand Deposition Fence（H=1.5m）	12,103.00 m	8,603.00	0.00	3,500.00
	Straw Covering Work	0.00 m^2	0.00	0.00	0.00
	Sand Control Hedge（H=1.7m, 25×30m）	67,447.80 m	67,447.80	0.00	0.00
	Sheild Stick Work	95.40 ha	95.40	0.00	0.00
Severe Moving Sand Area B	Sand Deposition Fence（H=1.5m）	11,152.00 m	7,051.00	4,101.00	0.00
	Straw Covering Work	84,982.00 m^2	47,836.00	37,146.00	0.00
	Sand Control Hedge（H=1.7m, 25×30m）	240,528.47 m	169,008.35	71,520.12	0.00
	Sheild Stick Work	340.21 ha	239.05	101.16	0.00
Severe Moving Sand Area C	Sand Deposition Fence（H=1.5m）	6,823.00 m	6,823.00	0.00	0.00
	Straw Covering Work	0.00 m^2	0.00	0.00	0.00
	Sand Control Hedge（H=1.7m, 30×50m）	56,633.20 m	56,633.20	0.00	0.00
	Sheild Stick Work	108.91 ha	108.91	0.00	0.00
Moving Sand Area	Sand Deposition Fence（H=1.5m）	0.00 m	0.00	0.00	0.00
	Straw Covering Work	0.00 m^2	0.00	0.00	0.00
	Sand Control Hedge（H=1.7m, 30×50m）	113,328.80 m	20,009.60	93,319.20	0.00
	Sheild Stick Work	217.94 ha	38.48	179.46	0.00
Area Adjacent to Shoreline	Sand Deposition Fence（H=1.5m）	0.00 m	0.00	0.00	0.00
	Straw Covering Work	0.00 m^2	0.00	0.00	0.00
	Sand Control Hedge（H=1.7m, 30×50m）	0.00 m	0.00	0.00	0.00
	Sheild Stick Work	194.19 ha	83.50	110.69	0.00
Frequnetly Flooded Area	Ridge Work (H=0.4m)	323.96 ha	160.65	163.31	0.00
	Drainage Ditch Work	10,000.00 m	4,960.00	5,040.00	0.00
Total	Sand Deposition Fence（H=1.5m）	30,078.00 m	22,477.00	4,101.00	3,500.00
	Straw Covering Work	84,982.00 m^2	47,836.00	37,146.00	0.00
	Sand Control Hedge（H=1.7m, 25×30m）	307,976.27 m	236,456.15	71,520.12	0.00
	Sand Control Hedge（H=1.7m, 30×50m）	169,962.00 m	76,642.80	93,319.20	0.00
	Sheild Stick Work	956.65 ha	565.34	391.31	0.00
	Ridge Work (H=0.4m)	323.96 ha	160.65	163.31	0.00
	Drainage Ditch Work	10,000.00 m	4,960.00	5,040.00	0.00

Similar ancillary planting works used for the creation of coastal forests in Japan are shown in Fig. 2-2.

Fig. 2-2 Ancillary Planting Works for the Creation of Coastal Forests in Japan

The configuration of these works is that 1) sand deposition fencing is set up in parallel with the coastline to create sand dunes, 2) a single line of sand control hedging is again set up in parallel with the coastline, 3) main sand control hedging is set up along the direction of as well as at a right angle to the prevailing wind to enclose the planting site and 4) screen work is set up on the windward side of the planting trees inside the enclosure.

There are several differences between the Project contents and the standard practice of creating coastal forests in Japan as described below.

- The principal objective to set up these ancillary planting works in Japan is to protect planted trees from strong cold wind in the winter, mainly in areas along the Sea of Japan. In contrast, as the southern central area of Vietnam where the project sites are located is rather warm throughout the year with a minimum temperature of seldom below 12°C, it is unnecessary to consider damage to planted trees due to cold wind.
- Most coasts in Japan are liable to erosion and, therefore, the construction of coast embankments made of concrete etc., first and the creation of artificial sand dunes behind these embankments prior to planting is necessary. In contrast, all of the project sites are sedimentary coasts and the further development of natural sand dunes is expected to take place.
- The speed of growth of *C. equisetifolia* to be planted under the Project is faster than that of

Pinus thunbergii used to create coastal forests in Japan.

Having taken these differences into consideration, the following ancillary planting works are planned under the Project.

i Sand deposition fencing will be set up along the coastline and will be used to fix sand landing from the sea to prevent the incursion of sand into the hinterland.

ii Sand control hedging will be used to decrease the force of the wind from the sea to prevent the movement of deposited sand.

iii Planting will be conducted in the enclosure created by the sand control hedging.

The hedge height above the ground will be 1.7 m as the maximum depth for the manual driving of 3 m long supports into the ground at the project sites is believed to be 1.3 m. The interval of the sand control hedges is determined as follows given the fact that the range of their effect is some 20 – 25 times the height.

Severe moving sand area A and B: The assumed effective range is set at 25 m, some 15 times the hedge height, along the direction of the prevailing wind and 30 m, 18 times the hedge height, along the direction at a right angle to the prevailing wind to provide a better safety margin in view of the especially conspicuous shifting sand and strong winds.
Severe moving sand area C and moving sand area: Because of the combined application of shield stick work, the effective range is set at 30 m, 18 times the hedge height, along the direction of the prevailing wind and 50 m, 29 times the hedge height, along the direction at a right angle to the prevailing wind.

(4) Tending

Tending will be conducted in tandem with planting for the purpose of reducing the death rate of the planted trees and improving the growth rate. The tending planned under APSA consists of supplementary planting and top dressing as referred to in Design Policy 08. Sand digging work which was conducted under PACSA will not be conducted because of the use of ancillary planting works.

Tending under the APSA will be conducted three times, i.e. once a year for three years, compared to once a year for two years under PACSA because of the following reasons.

i Planting is often conducted at difficult planting sites posing a high level of technical difficulty.

ii Tending once a year for three years is the general practice adopted by the technical standards in Vietnam.

iii There has been a strong request for tending once a year for three years by DARD in each province.

1) Supplementary Planting

Supplementary planting intends the replacement of those trees which have died after planting. This will be conducted in a two month period at the beginning of the rainy season one year after initial planting. The standards for the seedlings and quantity of fertilizer application for supplementary planting will follow the standard planting method for each species.

A supplementary planting rate of 15% was adopted by PACSA based on a death rate of some 15% of the planted trees for afforestation work in coastal sandy areas in southern central Vietnam. The same supplementary planting rate of PACSA of 15% is adopted for APSA despite afforestation being conducted at sites with a higher level of technical difficulty than PACSA sites because of the fact that the adverse conditions can be mitigated by ancillary planting works.

The supplementary planting area by province and term is shown in Table 2-16.

Table 2-16 Supplementary Planting Area by Province and Term

Province	Term-3	Term-4	Total
Quang Nam	287.63 ha	282.89 ha	570.52 ha
Quang Ngai	136.08 ha	273.53 ha	409.61 ha
Binh Dinh	620.71 ha	862.91 ha	1,483.62 ha
Total	1,044.42 ha	1,419.33 ha	2,463.75 ha

2) Top Dressing

Top dressing will be conducted one year after the initial fertilizer application at the time of planting or supplementary planting or the previous top dressing as the effect of fertilizer application and top dressing wears out for a period of three years. As the best timing for top dressing should coincide with the plant growth season, it will be conducted in the first half of the rainy season.

Because of the difficulty of procuring slow release chemical fertilizer in Vietnam, organic fertilizer will be used. While granular chemical fertilizer was used under PACSA, the results of fertilizing were not uniform because the nutrients were easily leached in sandy soil with a poor water bearing and retention capacity.

The top dressing area by province and term is shown in Table 2-17.

Table 2-17 Top Dressing Area by Province and Term

Province	Term-3	Term-4			Term-5				Total (ha)
	Term-2 Planting Area (ha)	total (ha)	Term-2 Planting Area (ha)	Term-3 Planting Area (ha)	total (ha)	Term-2 Planting Area (ha)	Term-3 Planting Area (ha)	Term-3 Planting Area (ha)	
Quang Nam	287.63	570.52	287.63	282.89	853.41	287.63	282.89	282.89	1,711.56
Quang Ngai	136.08	409.61	136.08	273.53	683.14	136.08	273.53	273.53	1,228.83
Binh Dinh	620.71	1,483.62	620.71	862.91	2,346.53	620.71	862.91	862.91	4,450.86
Total	1,044.42	2,463.75	1,044.42	1,419.33	3,883.08	1,044.42	1,419.33	1,419.33	7,391.25

The quantity of top dressing by species is shown in Table 2-18.

Table 2-18 List of Top Dressing Quantities by Species

Species	Type of Fertilizer	Quantity of Top Dressing		
		1st Year	2nd Year	3rd year
Casuarina	Organic Fertilizer	100 g	100 g	100 g
Acacia	Organic Fertilizer	50 g	50 g	50 g
Cashew	Manure	20 kg	20 kg	30 kg
Neem	Organic Fertilizer	100 g	100 g	100 g

(5) Procurement of Seedlings

1) Number of Required Seedlings

The total number of seedlings required for planting and supplementary planting is shown in Table 2-19.

Table 2-19 Number of Required Seedlings for Planting by Province, Species and Term

Province	Species	Term-2			Term-3			Term-4			Total		
		Total	Planting	Supplementary Planting	Total	Planting	Supplementary Planting	Total	Planting	Supplementary Planting	Total	Planting	Supplementary Planting
Quang Nam	Casuarina	57,904	57,904	0	63,211	54,528	8,683	8,177	0	8,177	129,292	112,432	16,860
	Acasia	478,053	478,053	0	550,451	478,746	71,705	71,808	0	71,808	1,100,312	956,799	143,513
	Cashew	19,296	19,296	0	21,069	18,176	2,893	2,725	0	2,725	43,090	37,472	5,618
	Neem	19,296	19,296	0	21,069	18,176	2,893	2,724	0	2,724	43,089	37,472	5,617
	Total	574,549	574,549	0	655,800	569,626	86,174	85,434	0	85,434	1,315,783	1,144,175	171,608
Quang Ngai	Casuarina	193,640	193,640	0	181,592	152,549	29,043	22,876	0	22,876	398,108	346,189	51,919
	Acasia	15,744	15,744	0	62,761	60,400	2,361	9,058	0	9,058	87,563	76,144	11,419
	Cashew	5,248	5,248	0	20,931	20,144	787	3,019	0	3,019	29,198	25,392	3,806
	Neem	5,248	5,248	0	20,931	20,144	787	3,019	0	3,019	29,198	25,392	3,806
	Total	219,880	219,880	0	286,215	253,237	32,978	37,972	0	37,972	544,067	473,117	70,950
Binh Dinh	Casuarina	1,182,717	1,182,717	0	1,340,392	1,162,991	177,401	174,403	0	174,403	2,697,512	2,345,708	351,804
	Acasia	54,576	54,576	0	194,649	186,464	8,185	27,967	0	27,967	277,192	241,040	36,152
	Cashew	18,192	18,192	0	64,886	62,160	2,726	9,321	0	9,321	92,399	80,352	12,047
	Neem	18,192	18,192	0	64,886	62,160	2,726	9,321	0	9,321	92,399	80,352	12,047
	Total	1,273,677	1,273,677	0	1,664,813	1,473,775	191,038	221,012	0	221,012	3,159,502	2,747,452	412,050
Total	Casuarina	1,434,261	1,434,261	0	1,585,195	1,370,068	215,127	205,456	0	205,456	3,224,912	2,804,329	420,583
	Acasia	548,373	548,373	0	807,861	725,610	82,251	108,833	0	108,833	1,465,067	1,273,983	191,084
	Cashew	42,736	42,736	0	106,886	100,480	6,406	15,065	0	15,065	164,687	143,216	21,471
	Neem	42,736	42,736	0	106,886	100,480	6,406	15,064	0	15,064	164,686	143,216	21,470
	Total	2,068,106	2,068,106	0	2,606,828	2,296,638	310,190	344,418	0	344,418	5,019,352	4,364,744	654,608

Table 2-20 shows the maximum required quantity of seedlings in one year. The seedling survival rate is set at 80% as in the case of PACSA.

Table 2-20 Required Quantity of Seedlings

Province	District	Region	Maximum Required Quantity of Seedlings (Number of Planting Holes)				Maximum Required Quantity of Seedlings (= Number of Planting Holes ÷ 0.8)			
			Casuarina	Acacia	Cashew	Neem	Casuarina	Acacia	Cashew	Neem
Quang Nam	Thang Binh		63,211	550,451	21,069	21,069	79,014	688,064	26,337	26,337
Quang Ngai	Duc Pho		193,640	62,761	20,931	20,931	242,050	78,452	26,164	26,164
Binh Dinh	Phu My	North	110,879	66,505	22,166	22,165	138,599	83,132	27,708	27,707
		South	741,650	67,056	22,352	22,352	927,063	83,820	27,940	27,940
	Phu Cat		585,819	61,088	20,368	20,368	732,274	76,360	25,460	25,460
	Subtotal		1,438,348	194,649	64,886	64,885	1,797,936	243,312	81,108	81,107
Grand Total			1,695,199	807,861	106,886	106,885	2,119,000	1,009,828	133,609	133,608

Meanwhile, Table 2-21 shows the estimated number of producible seedlings by the existing nurseries.

Table 2-21 Number of Producible Seedlings by Existing Nursery

Province	District	Name of Nursery	Size (ha)	Current Production Quantity of Seedlings				Produceable Quantity of Seedlings				Distance to Main Supply Source	
				Casuarina	Acacia	Cashew	Neem	Casuarina	Acacia	Cashew	Neem	Compartment	Distance (km)
Quang Nam	Thang Binh	Binh Tri Commune Agricultural Product and trading Co-operative	1.30	0	550,000	40,000	500	150,000	800,000	60,000	60,000	BM-1	6.00
	Thang Binh	PACSA N-6 Nursery	3.00	0	0	0	0	400,000	2,000,000	120,000	120,000	BM-1	15.00
	Tam Ky	Quang Nam Extention Center	10.00	1,500,000	500,000	500,000	1,000	800,000	4,000,000	250,000	250,000	BM-1	25.00
	Total							1,350,000	6,800,000	430,000	430,000		
Quang Ngai	Duc Pho	Plant Seed Enterprise	1.00	0	1,000,000	0	0	250,000	80,000	30,000	30,000	PK-1	10.00
	Quang Ngai	Plant and Animal Breeding Center of Quang Ngai	23.00	100,000	1,000,000	200,000	8,000	1,000,000	500,000	200,000	200,000	PA-1	50.00
	Total							1,250,000	580,000	230,000	230,000		
Binh Dinh	Phu My	MB of Forest Protection Phu My	1.00	160,000	55,000	15,000	0	150,000	170,000	60,000	60,000	MA-1	17.00
	Phu Cat	MB of Forest Protection Phu Cat	0.70	30,000	18,000	15,000	0	150,000	80,000	30,000	30,000	CK-1	25.00
	Quy Nhon	Binh Dinh Plant Seed Center (Cutting Center)	4.00	0	4,500,000	0	0	600,000				CT-1	40.00
	Total							900,000	250,000	90,000	90,000		

Comparison of the figures in Table 2-20 and Table 2-21 indicates that the required number of seedlings for every species can be supplied by the existing nurseries in Quang Nam Province (shaded in yellow in both tables) and Quang Ngai Province (shaded in green in both tables). In contrast, in the case of Phu My District in Binh Dinh province, while *C. equisetifolia* and other species (shaded in orange in both tables) can be sufficiently supplied in the northern part and the entire district respectively, there will be a supply shortage of some 930,000 *C. equisetifolia* seedlings in the southern part of the district. In the case of Phu Cat District in Binh Dinh Province (shaded in light blue in both tables), the required quantity of *C. equisetifolia* seedlings can be fully supplied by a nursery on the outskirts of Quy Nhon City even though the transportation distance to the project sites is not particularly short.

Based on the above analysis, some 930,000 *C. equisetifolia* seedlings to be used in Phu My District in Binh Dinh Province will be produced at a temporary nursery and all other seedlings will be purchased from existing nurseries.

2) Types and Standards of Seedlings

In accordance with Design Policy 09, the seedlings of *C. equisetifolia* will consist of 50% of seedlings nursed from seeds (collected from local elite trees) and 50% of rooted cuttings (Chinese 601 and 701). While the rooted cuttings can be nursed using those selected from excellent production sites, they can be simultaneously damaged by disease, insects or particular weather conditions due to their nature of being clones inheriting the same qualities. To avoid this risk, half of the seedlings will be produced from seeds. This 50 – 50 ratio will equally apply to both the purchased seedlings and produced seedlings and these two types of seedlings will be evenly distributed to each sub-compartment for mixed planting.

In regard to other species, no special rules apart from using locally procurable seedlings (sowed

seedlings, rooted cuttings and grafts) are set as the quantities to be used are not as large at that of *C. equisetifolia*.

The seedling standards by species are given in Table 2-22.

The seedling production method for each species will follow the technical procedure for seedling production set forth by MARD.

Table 2-22 Seedling Standards by Species

Species	Type	Height	Nursing Period	Minimum Pot Size
C. equisetifolia	Sowed seedlings Rooted cuttings	60 - 100 cm	6-8 months	Ø 10cm × 20cm (H)
Acacia	Sowed seedlings	25 - 45 cm	2.5-3 months	Ø 4cm × 10cm (H)
A. occidentale	Grafts	50 - 70 cm	3 months after grafting	Ø 10cm × 20cm (H)
M. azadirachta	Sowed seedlings	25 - 45 cm	4-5 months	Ø 10cm × 20cm (H)

(6) Production of Seedlings

A temporary nursery will be constructed inside the compartment MTh-1 in the southern part of Phu My District in Binh Dinh Province to produce the required quantity of *C. equisetifolia* as these seedlings cannot be supplied in this area by the existing nurseries. In accordance with Design Policy 10, half will be sowed seedlings and the other half will be rooted cuttings. The number of seedlings produced by the temporary nursery is as shown in Table 2-23, the breakdown of which is shown in Table 2-24.

Table 2-23 Number of Seedlings Nursed at Temporary Nursery

Province	Species	Term 2	Term 3	Total
Binh Dinh	*C. equisetifolia*	927,062	804,616	1,731,678

Table 2-24 Production Quantity of Seedlings by Types

Term	Species	Total			Planting			Supplementary Planting		
		Sub-Total	Seedlings from Seeds	Seedlings from Cutting	Sub-Total	Seedlings from Seeds	Seedlings from Cutting	Sub-Total	Seedlings from Seeds	Seedlings from Cutting
Term-2	Required Number of Seedlings	741,650	370,850	370,800	741,650	370,850	370,800	0	0	0
	Produced Number of Seedlings	927,062	463,562	463,500	927,062	463,562	463,500	0	0	0
Term-3	Required Number of Seedlings	643,694	321,863	321,831	532,451	266,238	266,213	111,243	55,625	55,618
	Produced Number of Seedlings	804,616	402,328	402,288	665,563	332,797	332,766	139,053	69,531	69,522
Total	Required Number of Seedlings	1,385,344	692,713	692,631	1,274,101	637,088	637,013	111,243	55,625	55,618
	Produced Number of Seedlings	1,731,678	865,890	865,788	1,592,625	796,359	796,266	139,053	69,531	69,522

The required quantity of seeds to produce *C. equisetifolia* seedlings is shown in Table 2-26 based on the relevant performance in PACSA (52,320 potted seedlings were produced from 1 kg of seeds; see Table 2-25).

Table 2-25 Quantity of Seeds and Potted Seedlings in PACSA

Nursery No.	N-6A	N-6B	N-13	N-16	P-1-2	P-3	P-6	Quang Nam Subtotal	Phu Yen Subtotal	Total
Number of Potted Seedlings (thou.pots)	375.00	493.50	705.00	805.00	993.60	345.00	415.91	2,378.50	1,754.51	4,133.01
Number of Potted Seedlings from Seeds (thou.pots)	225.00	481.00	505.00	535.00	553.33	255.00	234.17	1,746.00	1,042.50	2,788.50
Number of Potted Seedlings from Rooted Cuttings (thou.pots)	150.00	12.50	200.00	270.00	440.27	90.00	181.74	632.50	712.01	1,344.51
Quantity of Seeds to be Used (kg)	4.86	6.69	9.12	10.33	11.60	4.60	6.10	31.00	22.30	53.30
Number of Potted Seedlings per 1kg of Seeds（thou.pots/kg）	46.30	71.90	55.37	51.79	47.70	55.43	38.39	56.32	46.75	52.32

Table 2-26 Required Quantity of Seeds

	Term 2	Term 3	Total
Required Quantity of Seeds (kg)	8.9	7.7	16.6

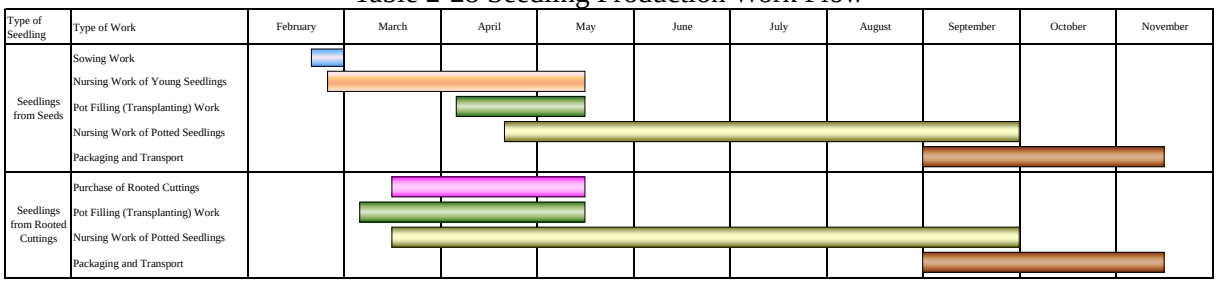
Similarly, the required quantity of rooted cuttings is shown in Table 2-27.

Table 2-27 Required Quantity of Rooted Cuttings

	Term-2	Term-3	Total
Required Quantity of Rooted Cuttings	463,500	402,288	865,788

The seedling production work flow is shown in Table 2-28.

Table 2-28 Seedling Production Work Flow



The individual seedling production works for each process are explained next.

1) Sowing Work

The sowing work will consist of sowing bed preparation, chemical spraying, sowing and straw laying. Approximately one week to 10 days prior to sowing, soil will be evenly placed on the sowing beds and fungicide and insecticide should be sprayed to sterilize the soil at least five days before sowing. Germination treatment will be applied to the seeds three to four days before sowing. Sowing will be conducted by evenly placing the seeds which have undergone germination treatment on the sowing beds and these seeds should then be covered with dry sand with a thickness of approximately 1 mm.

The sowing beds will then be covered with straw.

2) Nursing work of young seedlings

The nursing work of young seedlings will consist of watering, weeding, soil scarification, liquid fertilizer application, chemical spraying, shading and removal of shading of the sowing beds. For shading, a shading net with a shading rate of some 50 % will be used to cover the sowing beds prior to sowing. After sowing, watering will be conducted twice a day (morning and evening) and weeding, soil scarification, liquid fertilizer application and chemical spraying will be conducted when judged to be necessary (basically once every 15 – 20 days). The liquid fertilizer will consist of 100 liters of water and 1 – 2 kg of chemical fertilizer, i.e. a concentration of 1 – 2 %, and will be sprayed over the sowing beds at a rate of 100 liters per 400 – 500 m^2. Fungicide and insecticide will be used as in the case of the sowing work. After a downpour or long lasting rain, spraying should be urgently conducted regardless of the average chemical spraying interval.

3) Pot filling (Transplanting) Work

The pot filling work will consist of a series of work, such as potting of the soil, watering, chemical spraying and transplanting to transplant seedlings of some 5 – 7 cm in height (some 40 – 50 days after sowing) and the purchased rooted cuttings (some 30 – 35 days after collection). The composition of the potting soil will be 62 % soil (red soil), 25 % sand, 4 % organic material (husks), 8 % manure and 1 % phosphatic fertilizer as in the case of PACSA. The soil potting work should commence at least 10 – 15 days prior to the transplanting work. Prior to this, fungicide and insecticide should be sprayed into the pots at least one day before the soil is potted. Watering will commence on the day before the transplanting work to ensure a suitable moisture level inside the pots. Only the quantity of seedlings which can be transplanted in a single day should be procured or removed from the sowing beds so that the roots are not exposed for two or more days. If such length of exposure is unavoidable, the roots should be covered with slime for their protection.

As survival can be confirmed approximately one week after transplanting into pots, further transplanting should then be conducted using the same type of seedlings.

4) Nursing Work of Potted Seedlings

The nursing work of potted seedlings will consist of watering, weeding, soil scarification, liquid fertilizer application, chemical spraying, shading and removal of the shading of the nursery beds. A shading net with a shading rate of some 50 % will be used to cover the nursery bed prior to the pot filling (transplanting) work. After transplanting, the potted seedlings will be watered twice a day (morning and evening). Weeding, soil scarification, liquid fertilizer application and chemical spraying will be conducted when judged to be necessary (once every 15 – 20 days). The liquid fertilizer will consist of 100 liters of water and 30 – 50 g of chemical fertilizer, i.e. a concentration of 0.03 – 0.05 %, and will be sprayed over the nursery bed at a rate of 100 liters per 30 – 50 m^2. As in the case of other

types of work, fungicide and insecticide will be used. These should be urgently sprayed if damage due to insects and/or disease occurs regardless of the average chemical spraying interval.

The shading will be gradually removed from the nursing beds as careful observation of the growing state of the potted seedlings confirms the sufficient strength of these seedlings (maximum period of use of shading net: approximately 2.5 months).

Hardening (which is explained later) will start when the potted seedlings grow to a certain size as a measure to produce strong seedlings for planting which can reasonably withstand such environmental stress as drought and strong winds at the planned planting sites.

(7) Operation Roads

Operation roads will be constructed at the project target areas as in the case of PACSA to efficiently conduct planting, tending and maintenance (as well as post-planting protection). Under APSA, either vehicle roads or footpaths will be introduced depending on the shape and topographical conditions of each project site as stated in Design Policy 11. All operation roads should be opened prior to such work as planting, tending, construction of the temporary nursery, etc. No work will be conducted at the end of APSA to withdraw the operation roads and to restore the original state of the land.

1) Operation Vehicle Roads

The following conclusions have been reached as a result of a simulation exercise regarding the relationship between the planting, tending and operation vehicle road construction costs and the density of the operation road network as indicated by Design Policy 11. One precondition is that no operation vehicle road will be constructed in long and narrow compartment(s), typically represented by the project sites in Quang Ngai Province as such a road would reduce the planting area. Accordingly, these sites were excluded from the scope of the simulation.

- In the case of large compartment(s) with an area of some 600 ha, the construction of operation vehicle roads will keep the overall cost at a low level and the optimal density of these roads is 10.38 m/ha.
- In the case of small compartment(s) with an area of 150 ha or less, the construction of operation roads will increase the overall cost. Accordingly, no operation roads will be constructed in these compartments.

Based on the above conclusions, operation vehicle roads will be constructed in all compartments in Quang Nam Province (BM-1 – 3, BD-1 – 3 and BH 1 – 2 with a total area of 594.82 ha), Compartment MTh-1 (765.87 ha) in Binh Dinh Province and all compartments in Phu Cat District (CK-1 and CT-1 with a total area of 558.14 ha).

The alignment determined by the local topography, distribution of existing roads, etc. is shown in "Compartment Maps D-201", "D-209" and "D-211" in "2-2-3 – Basic Design Drawing". The total length of new operation vehicle roads in these three areas is 7,000 m, 9,400 m and 3,400 m respectively. As operation vehicle roads with a total length of 19,800 m will be constructed in a total area of 1,918.83 ha, the average density of operation vehicle roads will be 10.32 m/ha (see Table 2-29).

The standards and structure of operation vehicle roads will correspond to "Public Road Class IV of Vietnam" or "Forest Road Class 2 of Japan" in accordance with Design Policy 11. The details of the design standards are given below. For the structure, refer to the "Standard Drawing of Operation Road D-501" in "2-2-3 – Basic Design Drawing".

- The design vehicles are ordinary trucks (loading capacity of 6 tons).
- The standard design speed is 30 km/hr.
- The total width of an operation road is 4.0 m, consisting of a roadway of 3.0 m and a shoulder of 0.5 m on each side of the roadway.
- The slope gradient for cutting and banking is 1:1.8.
- The surface of the operation vehicle roads is paved with gravel and the subbase thickness is 40 cm, consisting of an upper subbase of 10 cm and a lower subbase of 30 cm.
- The road surface has a cross-sectional grade of 4%.
- The minimum curve radius of the operational vehicle roads is 20 m.
- The maximum longitudinal gradient is 10%.
- In principle, a turnout is introduced every 500 m or less of an operation vehicle road which also functions as a turning point for vehicles.

The subbase will be fully compacted. The material for the upper subbase will be equivalent to crusher run for a road (C-40: crushed stone size of 0 – 40 mm). The material for the lower subbase will be good quality soil with gravel which can achieve sufficient compaction and the gravel size will be 0 - 150 mm.

For the maintenance and repair of the operation vehicle roads, leveling work (leveling only) and repair work (supplementation of gravel and leveling) will be conducted. Leveling work will be conducted during each rainy season when these roads are most frequently used (four times for the operation vehicle roads constructed in Term 1 and Term 2 and three times for the operation vehicle roads constructed in Term 3). The repair work will be conducted in the dry season at a same frequency as that for leveling work. The quantity of supplementary gravel will be 15% of the quantity of the gravel

originally used.

Table 2-29 Total Length of Operation Vehicle Roads to be Created

Province	District	Compartment(s)	Construction Length (km)			
			Total	Term-1	Term-2	Term-3
Quang Nam	Thang Binh	BM-1～3、 BD-1～3、 BH-1～2	7.00	1.50	4.70	0.80
Binh Dinh	Phu My	MTh-1	9.40	1.60	6.60	1.20
	Phu Cat	CT-1	3.40	0.00	2.00	1.40
	Subtotal		12.80	1.60	8.60	2.60
Total			19.80	3.10	13.30	3.40

2) Operation Footpaths

As each project site in Quang Ngai Province forms a long and narrow stretch with a width of some 100 – 300 m, the construction of operation vehicle roads would reduce the width of the coastal protection forests to be created, resulting in possible failure to achieve the expected windbreak and sand control effects. In addition, these long and narrow sites are some distance from existing roads and the access points are limited. At such sites, there is concern in regard to poor work efficiency due to access on foot and, therefore, operation footpaths will be introduced to improve the access and work performance.

The standards and structure of these operation footpaths are based on local standards as indicated in Design Policy 11. The width and subbase thickness will be 0.8 m and 20 cm respectively and only subbase work using the material for the lower subbase (good quality soil with gravel) used for the operation vehicle roads will be conducted.

The alignment determined by the local topography, distribution of the existing roads, etc. is shown in "Compartment Maps D-202" through "D-204" in "2-2-3 – Basic Design Drawing" and the total length is 15,100 m (see Table 2-30). For the structure, refer to the "Standard Drawing of Operation Road D-501" in "2-2-3 – Basic Design Drawing".

Table 2-30 Total Length of Operation Footpaths to be Created

Province	District	Compartment	Construction Length (km)			
			Total	Term-1	Term-2	Term-3
Quang Ngai	Duc Pho	PA-1	4.70	0.00	1.50	3.20
		PV-1	2.80	0.60	2.20	0.00
		PK-1	4.70	1.70	3.00	0.00
		PK-2	2.90	0.00	1.30	1.60
Total			15.10	2.30	8.00	4.80

(8) Setting-Up of Temporary Nursery

Based on the examination results of the prospect of seedling procurement, it has been decided to set up a temporary nursery capable of producing some 930,000 *C. equisetifolia* seedlings in Phu My District in Binh Dinh Province. Based on Design Policy 12, only one temporary nursery will be set up and will be located in Sub-Compartment MTh-1 (9) along the existing road within Compartment MTh-1 for which the produced seedlings will be supplied in view of the convenience for transport and degradation characteristics of the project target areas (see "Compartment Map D-209" in "2-2-3 – Basic Design Drawing").

The contents of the basic plan for the various facilities at this planned temporary nursery are described next.

1) Nursery Beds

As the diameter of the pots for *C. equisetifolia* seedlings to be produced is 10 cm, each pot will occupy an area of 100 cm^2 (10 cm x 10 cm) in the nursery bed. The standard dimensions of each nursery bed are set at 1 m x 30 m for the internal dimensions (capable of holding 3,000 potted seedlings) and 1.2 m x 30.2 m for the external dimensions in accordance with those adopted in PACSA as well as the common local standards. 310 beds will be required to produce a maximum number of 927,062 *C. equisetifolia* seedlings per year and the required area will be 11,234 m^2 (actual usage area of 9,300 m^2).

These nursery beds will have a simple structure. Ground sheets will be spread at the bottom of the beds and the potted seedlings will be placed in 10 lines of 300 pots each. The perimeter of the bed will be fixed by bricks and/or wooden planks. Some 80 cm tall wooden or bamboo supports will be placed at intervals of 1.5 m to allow shading cover (shading net).

2) Sowing beds

Given the fact that the average sowing quantity per m^2 in PACSA was 0.060 kg/m^2, the sowing of the

maximum quantity of the required seeds of 8.9 kg per year will require a sowing bed area of 148.33 m^2. However, as the internal dimensions of each sowing bed are 1 m x 10 m, 15 sowing beds totaling 150 m^2 will be required. Given the external dimensions of each sowing bed of 1.2 m x 10.2 m, the actual total area to accommodate 15 beds will be 184 m^2.

As in the case of the nursery beds, the sowing beds will have a simple structure of ground sheets spread at the bottom of the beds with the perimeter being fixed by bricks and/or wooden planks. Soil (sieved soil with a uniform grain size) will be evenly placed in these beds. The structure of these beds will be that of a vinyl mist house which is entirely covered by transparent vinyl sheeting to ensure a stable growth environment.

3) Soil Yard

Each pot will require 0.00157 m^3 of soil (Ø 10 cm x 20 cm high). Phosphatic fertilizer accounting for 1% of the potting soil mix will be stored in a warehouse and is, therefore, excluded from the calculation of the required quantity of potting soil. Accordingly, the required quantity of soil to fill 927,062 pots is 1,695.2 m^3, assuming a loss of 15% during temporary storage etc. As the potting soil will be stored at a height of 1 m, an area of 1,695.2 m^2 will be required to store the entire soil. The soil will be used through a series of work from delivery, mixing and potting and the storage of the entire quantity of the potting soil at once will be unnecessary. As such, half of the area calculated above will be secured as a soil yard while a quarter of the calculated area will be used as a mixing yard. The actual area will be 850 m^2 for the soil yard and 425 m^2 for the mixing yard.

4) Wells

0.69 m^3 and 63.24 m^3 of water will be required per day for the watering of the sowing beds and nursery beds respectively based on the daily watering volume per unit area of 4.6 mm/m^2/day for the sowing beds and 6.8 mm/m^2/day for the nursery beds in PACSA (see Table 2-31 and Table 2-32). The interview survey results for areas near the planned temporary nursery suggest that the average groundwater volume filling wells is 0.75 m^3/hr. This means that 85.24 hours will be required to secure the required water volume per day. Based on the assumption that the water pump at a well can be controlled for 19 hours per day by a full-time nursery worker as in the case of PACSA, the required number of pumps, i.e. wells, will be five (see Table 2-32).

Table 2-31 Watering in PACSA

Nursery No.	N-6A	N-6B	N-13	N-16	P-1-2	P-3	P-6	Total	Per Day	Watering Volume ($mm/m^2/day$)
Watering Days at Sowing Beds (days)	76	86	80	85	72	70	71	540		
Watering Work Volume with Sowing Beds (m^2)	11,768.0	18,150.0	23,238.0	27,414.0	30,240.0	11,648.0	13,007.2	135,465.2	250.86	
Watering Volume at Sowing Beds (m^3)	58.84	90.75	116.22	137.07	120.96	46.20	51.83	621.87	1.15	4.6
Watering Days in Pot Filling Work (days)	14	15	18	17	15	7	12			
Watering Work Volume in Pot Filling Work (m^2)	3,750.0	4,935.0	7,050.0	7,650.0	29,808.0	10,350.0	12,477.3			
Watering Volume in Pot Filling Work (m^3)	37.50	49.35	70.50	80.50	298.07	103.50	124.77			
Watering Days in Nursing Work of Potted Seedlings (days)	159	118	137	156	145	120	128			
Watering Work Volume in Nursing Work of Potted Seedlings (m^2)	802,691.4	874,798.0	1,222,569.4	1,430,077.4	2,139,272.2	696,840.0	829,202.4			
Watering Volume in Nursing Work of Potted Seedlings (m^3)	8,026.91	8,747.98	12,225.69	14,300.77	6,251.40	2,000.76	2,534.33			
Watering Days at Nursery Beds (days)	173	133	155	173	160	127	140	1,061		
Watering Work Volume with Nursery Beds (m^2)	806,441.4	879,733.0	1,229,619.4	1,437,727.4	2,169,080.2	707,190.0	841,679.7	8,071,471.1	7,607.42	
Watering Volume at Nursery Beds (m^3)	8,064.41	8,797.33	12,296.19	14,381.27	6,549.47	2,104.26	2,659.10	54,852.04	51.70	6.8

Table 2-32 Required Volume of Watering and Required Number of Wells

	Area	Watering Volume per Unit Area	Required Watering Volume	
Sowing Beds	150 m^2	4.6 $mm/m^2/day$	0.69 m^3/day	
Nursery Beds	9,300 m^2	6.8 $mm/m^2/day$	63.24 m^3/day	
Total	150 m^2		63.93 m^3/day	… (a)
Groundwater Volume Sprung to Well			0.75 m^3/hr	… (b)
Required Hours to Secure Daily Required Water Volume		((a)÷(b))	85.24 hr/day	… (c)
Operating Hours of Pump Installed at Well			19 hr/pump	… (d)
Required Number of Pumps (Wells)		((c)÷(d))	4.49 pump/day	
		≒	5 pump/day	

5) Reservoirs

Five reservoirs, i.e. the same number of wells, will be created to constantly store 191.79 m^3 of water which is equivalent to three days' watering operation (63.93 m^3/day x 3 days). Each reservoir will be required to store 38.36 m^3 of water (191.79 m^3 / 5 reservoirs). When the structure of these reservoirs is determined as shown in Fig. 2-3, 38.39 m^3 of water which is equivalent to 90% of the maximum water storage volume of 42.66 m^3 can be constantly stored. Based on this calculation, the ground area of each reservoir will be 50.4 m^2 or 252 m^2 for five reservoirs. These reservoirs will have a simple structure with the ground surface being covered by impervious sheeting.

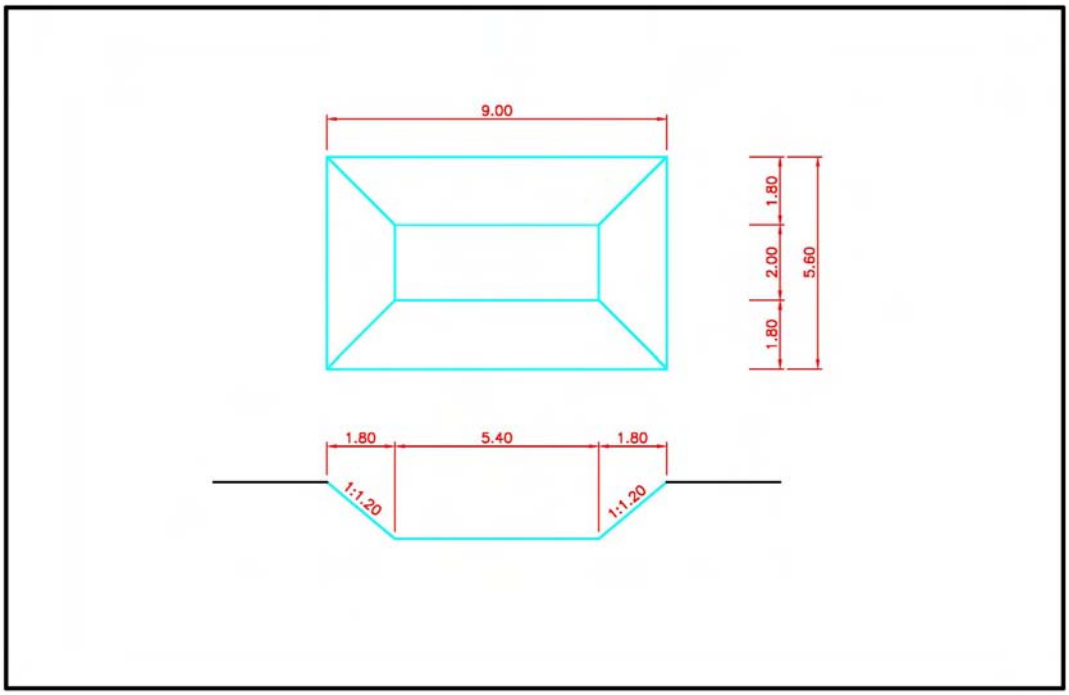


Fig. 2-3 Structure of Reservoir

6) Buildings on Nursery Premises (Office-cum-Sleeping Quarter and Warehouse)

The buildings on the nursery premises will be an office-cum-sleeping quarter and a warehouse as in the case of PACSA. The former will provide an office and meeting room for Japanese engineers (contractor's engineers and work supervisor) as well as Vietnamese engineers and a sleeping quarter for the full-time nursery workers. The latter will be used for the storage of fertilizer, chemicals, hand tools and dangerous substances, including oil. The office function will provide a base (on-site) office for all types of work ranging from planting to tending and the construction of operation roads.

As the scale of the nursery to be created under APSA will be similar to that in PACSA, the standards and structure of the buildings on the nursery premises will follow those adopted by PACSA. The total floor area of each building will be 116 m^2 for the office-cum-sleeping quarter building and toilets (15 m x 8 m equivalent) and 60 m^2 for the warehouse (7.5 m x 8 m equivalent).

7) Operation Roads inside Nursery

Operation roads will be introduced inside the nursery to allow the functional distribution of above facilities and the easy packaging and transport of the seedlings. The resulting configuration of the nursery is shown in the "Standard Drawing of Temporary Nursery D-601" in "2-2-3 – Basic Design Drawing".

The standards for operation vehicle roads also apply to operation roads inside the nursery. The total length and area of these operation roads inside the nursery will be 621 m and 2,466 m^2 respectively.

8) Securing Fencing

The temporary nursery will be fenced off using bamboo (logs or concrete posts may also be used) and barbed wire to prevent the theft of the seedlings, equipment, etc. The total length of this fencing will be 720 m.

9) Reserve Land etc.

Space other than that used for the above facilities will be considered reserve land. This space will be used for passageways (footpaths), a temporary stock yard, etc.

10) Total Area

The total ground coverage (area) of the planned temporary nursery will be 32,705 m^2 or 3.27 ha based on the measurements in the "Standard Drawing of Temporary Nursery D-601". The size and other relevant data of each facility is given in Table 2-33.

Table 2-33 List of Nursery-Related Facility Sizes

Facility		Quantity	
Nursery Beds	Actual Area	m^2	9,300
	External Area	m^2	11,234
	Total Area Inclusive of Passageways	m^2	17,951
	Number of Beds	beds	310
Sowing Beds	Actual Area	m^2	150
	External Area	m^2	184
	Total Area Inclusive of Passageways	m^2	282
	Number of Beds	beds	15
Soil Yard		m^2	850
Mixing Yard		m^2	425
Wells		wells	5
Reservoirs	Area	m^2	252
	Number	reservoirs	5
Office-cum-Sleeping Quarter and Toilets		m^2	116
Warehouse		m^2	60
Operation Roads	Area	m^2	2,466
inside Nursery	Total Length	m	621
Securing Fencing		m	720
Reserve Land etc.		m^2	10,303
Total Area		m^2	32,705
		ha	3.27

(9) Lookout Towers

Lookout towers are planned as monitoring facilities for the prevention and early detection of forest fire and the prevention of invasion by farm animals, illegal cutting and the spread of disease and insect damage during the implementation period of the Project. They will also function as fixed point observation facilities for the monitoring of tree growth and also as viewing platforms to increase the demonstration effect of the model forests. As indicated in Design Policy 13, these lookout towers will be constructed as permanent facilities which will be handed over to the Vietnamese side for the purpose of properly maintaining the protection forests.

No lookout towers were constructed under PACSA and the planting sites and planted trees have subsequently suffered from the various types of damage listed in Table 2-34 together with various minor damage. With the construction of the lookout towers under the Project, it is hoped that any potential damage will be detected at an early stage to minimize the damage.

Table 2-34 Damage to Main Planting Sites and Planted Trees in PACSA

Time	Province	Situation
December, 2002	Phu Yen	Feeding damage of the planted trees by invading cattle
July, 2003	Phu Yen	Loss of existing trees due to forest fire (over an area of some 1.3 ha; no planted tree were damaged)
November, 2004	Quang Nam	Feeding damage of the supplementary planted trees by invading cattle
January, 2004	Quang Nam	Mowing down of the planted trees by invading heavy construction machinery
Post-PACSA	Phu Yen	Illegal cutting by local residents to obtain wood

The design height of the lookout towers has been determined to oversee the planted trees in 10 – 15 years time when they have grown some 6 m above the ground while taking the following points into consideration.

i In regard to forest fires, patrolling by local residents and monitoring from the lookout towers are expected to raise the fire prevention awareness of the local residents.

ii In regard to feeding damage, the height growth is only affected when the terminal buds of the planted trees are damaged.

iii In regard to illegal cutting, the improved awareness of local residents is hoped for as in the case of forest fires.

iv Mowing down by heavy construction machinery and vehicles can be prevented when the planting trees have grown sufficiently large enough to prevent such accidents.

A total of four lookout towers will be constructed, i.e. one in Quang Nam Province, one in Quang Ngai Province and two in Binh Dinh Province. These will be located at a site with a relatively high

elevation so that a wide area can be observed. The lookout towers will be made of preserved wood treated with creosote. The structure of the lookout towers is shown in "Standard Drawing of Lookout tower D-701" in "2-2-3 – Basic Design Drawing".

In regard to the cases of damage listed in Table 2-34, the measures listed in Table 2-35 have been adequately implemented and the planted trees are favorably growing at present.

Table 2-35 Measures to Prevent Recurrence of Damage Experienced by PACSA and Their Present Situation

Type of Damage	Preventive Measure	Present Situation
Feeding damage to the planted trees by cattle	Local residents were approached via DARD and district/commune P'C to understand the need for and to cooperate with intensified patrols and cattle raising in an appropriate manner. As the damage occurred during the planting period, the contractor replaced the damaged trees.	The planted trees are growing steadily.
Forest fire	The Song Cau FE intensified the patrols as instructed by MARD and Phu Yen DARD. As hardly any damage was caused to the planted trees, supplementary planting was not conducted.	The planted trees are growing steadily.
Feeding damage to the supplementary planted trees by cattle	Local residents were approached via DARD and district/commune P'C to understand the need for and to cooperate with intensified patrols and cattle raising in an appropriate manner. As the damage occurred during the planting period, the contractor replaced the damaged trees.	The planted trees are growing steadily.
Mowing down	After on-site investigation by the Quang Nam DARD and district/commune P'C, a demand for compensation was made to the construction company possessing the said heavy machine. Supplementary planting was later conducted as compensation.	The planted trees are growing steadily.
Illegal cutting	A report on illegal cutting was sent to the commune P'C via the Phu Yen DARD and measures, including intensified patrols, were implemented.	Because the illegal cutting was not extensive and because of the vigorous growth of the lateral buds, the damage did not affect the function of the coastal forest in question. The remaining planted trees are growing steadily.

(10) Project Information Signboards

In accordance with Design Policy 14, project information signboards will be erected as permanent facilities.

Two large signboards (5 m x 10 m) will be erected along National Road No.1 in each province and 2 – 9 smaller signboards (3 m x 6 m) will be erected in each province along the access roads to the project sites. For details of the number of signboards, refer to Table 2-36.

In view of the natural conditions of the installation locations, these signboards will be given an anti-rust treatment to prevent rust caused by the salty sea breeze. The structure of these signboards is shown in the "Standard Drawing of Project Information Signboards D-801" in "2-2-3 – Basic Design Drawing".

Table 2-36 Number of Project Information Signboards

Province	Type	Number	Installation Location
Quang Nam	Large	1	Along National Road No.1 in the Thang Binh District
		1	Along National Road No.1 in Tam Ky Town (provincial capital)
	Sub-Total	2	
	Small	1	Near the entry point to Compartment BM-1 along the access road (in either Binh Minh Commune or Binh Dao Commune)
		1	Near the entry point to Compartment BH-2 along the access road (in Binh Hai Commune)
	Sub-Total	2	
Quang Ngai	Large	1	Along National Road No.1 in the Duc Pho District
		1	Along National Road No.1 in Quang Ngai Town (provincial capital)
	Sub-Total	2	
	Small	1	Near the entry point to Compartment PA-1 along the access road (in Pho An Commune)
		1	Near the entry point to Compartment PQ-1 along the access road (in Pho Quang Commune)
		1	Near the entry point to Compartment PV-1 along the access road (in Pho Vinh Commune)
		1	Near the entry point to Compartment PK-1 along the access road (in Pho Khanh Commune)
		1	Near the entry point to Compartment PK-2 along the access road (in Pho Khanh Commune)
		1	Near the entry point to Compartment PC-1 along the access road (in Pho Chau Commune)
	Sub-Total	6	
Binh Dinh	Large	1	Along National Road No.1 in Phu My District
		1	Along National Road No.1 in Phu Cat District
	Sub-Total	2	
	Small	1	Along the access road linking National Road No.1 with Compartment MD-1 (in My Duc Commune)
		1	Along the access road linking Compartment MD-1 with Compartments MA-1 (in My Thang Commune)
		1	Along the access road linking National Road No.1 with Compartment MA-1 (in My Loi Commune)
		1	Along the access road linking Compartment MA-1 with Compartment MTh-1 (in My Tho Commune)
		1	Along the access road linking National Road No.1 with Compartment MTh-1 (in My Chanh Commune or My Chanh Tay Commune)
		1	Along the access road linking Compartment MTh-1 with Compartment CK-1 (in My Chanh Commune or My Cat Commune)
		1	Along the access road linking National Road No.1 with Compartment CK-1 (in Cat Minh Commune)
		1	Near the entry point to Compartment CK-1 along the access road (in Cat Khanh Commune)
		1	Near the entry point to Compartment CT-1 along the access road (in Cat Thanh Commune)
	Sub-Total	9	
Total	Large	6	
	Small	17	