6. COASTAL EROSION

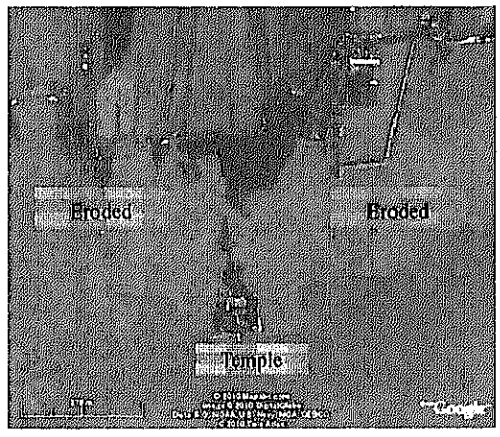
6.1 VULNERABILITY OF COASTAL AREA

6.1.1 EROSION AND CAUSES

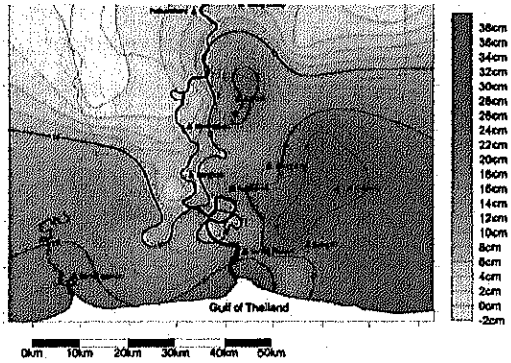
Thailand has a coastline approximately 2,730 km long, (excluding its islands). The majority of its coastline is located either adjacent to the Andaman Sea or the Gulf of Thailand. However, its coast has varied characteristics, with many sections of Thai coast rapidly being eroded. 570 km of coastline are being eroded at a rate of greater than 1 m/year, with 200 km of coastline at the rate of greater than 5 m/year. For an instance, the Southern Thai Gulf coast is in a typhoon zone which in recent years, has eroded nearly 100 m of land in just a few days. The coast of Chao Phraya delta is also being severely eroded. Topography of the hinterland is extremely low and flat which makes it vulnerable to future sea level rises. However, the cause of erosion is not rising sea level, but it is thought to be caused by other reasons. The followings are the major causes of erosion of Thai coast.

(1) Decrease of run off sand/silt supply from rivers

The Northern Thai coast used to receive sand/silt supply from the Chao Phraya River. But after Dams such as the Bhumibol Dam and the Sirikit Dam were built, sediment of the river is trapped in the reservoirs. In addition to that, excavation from river is a major cause for the decrease in the sediment supply. There is major dredging at downstream of Ayutthaya, and, presumably the most influential activity of coastal erosion is dredging for the navigation channel from river mouth to the Bangkok port, almost 40 km in length. Sand/silt, 5,000,000 m^3/year, which is supposed to arrive at the coast, are dredged from the river and dumped at offshore area. The photo shows a temple on the West bank of the Chao Phraya River mouth, the surrounding area is being eroded and now sea water surrounds it during high tide.



Source: Google earth



Source: UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific)

(2) Land subsidence

Another cause of the coastal erosion at the Northern Gulf of Thailand is land subsidence of the area caused by excessive groundwater extraction. The figure shows land subsidence occurred during a period of eight years (1992-2000). There are coastal areas subsiding more than 20 cm during that period.

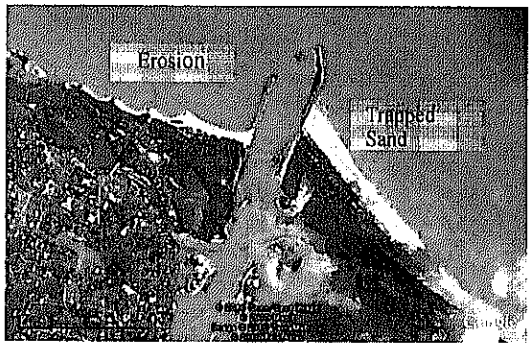
(3) Changes in land use

Once abundant mangrove forests along the Northern Gulf of Thailand were transformed to aquiculture ponds, the wave dissipating function of the shore was lost together with mangrove. As a result, the same grade of waves can now penetrate deeper inland, especially at high tide together with a low pressure climate. Development of unused coastal areas for industries and residential purposes increase the flood prone areas on its own without the need of other influences. The increasing in the number of vulnerable places along coastal areas is not due to change in natural conditions, but could be a man-made phenomenon for many areas.

Source: Google earth

(4) Cutting off of littoral drift by man- made structures

Jetty, breakwater, port, and land reclamation cut off littoral drift. Sand is accreted on the upstream side of the structure; and at the same time, the downstream side is eroded. Coastal erosion occurred after a large reclamation land project was undertaken in Rayong province on the Eastern Gulf of Thailand. The residents are now preparing court case, because they believe the erosion was totally manmade. The aerial photo shows the eroded beach of Narathiwat Province. The training wall of river mouth stopped the sand flow, and erosion occurred on the downstream side (left) due to a reduction of sand supply from upstream side.



Source: Google earth

(5) Development of tourism such as vertical seawall

Highly valuable beaches for tourism are often dwindled by the encroachment of commercial facilities or land use. A seawall is constructed in front of a road, park or commercial facilities for protection frequently; however, the seawall reflects the wave energy directly back towards the sea with sand, and can eventually excavate beach. Right photo shows encroachment of facilities into the beach, and a vertical seawall in Pattaya.

Source: Google earth Panoramio

Coastal erosion of Thailand is shown in Table 6.1.1 and Figure 6.1.1 Rapid erosion is obvious at the Northern and Southern Coast.

Table 6.1.1 Progress of Erosion

Province	Over 5m/yr		1-5m/yr		Total			Existing Coastal Protection Structure			Coast Length (km)
	Eroded Distance (km)	No. of eroded coast	Eroded Distance (km)	No. of Location	Distance (km)	Eroded Coast Ratio	No. of Location	Covered (km)	No. of Location	Structure Type	
1. Ranong	4.0	1	23.5	7	27.5	31%	8.	0.0	0	-	89
2. Phangnga	0.0	0	28.5	9	28.5	13%	9	2.0	1	Seawall	222
3. Phuket	3.0	1	1.5	1	4.5	3%	2	1.0	1	Seawall, sand nourishment	162
4. Krabi	6.0	4	11.0	5	17.0	7%	9	2.0	1	Seawall (rock, concrete)	234
5. Trang	4.0	1	18.5	6	22.5	20%	7	'-	'-	Seawall (rock, concrete)	114
6. Satun	6.0	4	9.0	5	15.0	10%	9	-	-	Seawall (rock, concrete)	148
7. Narathiwat	25.2	3	16.0	3	41.2	74%	6	22.5	2	Groin, detached breakwater	56
8. Pattani	11.0	5	12.5	3	23.5	24%	8	3.5	3	Groin, seawall	99
9. Songkhla	4.0	1	38.5	10	42.5	27%	11	2.5	1	Rock embankment, groin, detached breakwater	155
10. Nakhorn Si Thammarat	60.0	3	52.0	6	112.0	59%	9	6.0	4	Rock embankment, groin, detached breakwater	189
11. Surat Thani	8.0	1	14.8	6	22.8	17%	7	-	-	Seawall	138
12. Chumphon	0.0	0	16.8	10	16.8	8%	10	1.5	2	Seawall	215
13. Prachuap Khiri Khan	1.0	1	42.0	16	43.0	21%	17	7.7	6	Seawall, detached breakwater	208
14. Phetchaburi	6.5	2	30.0	6	36.5	43%	8.	11.5	7	Seawall, detached breakwater, groin	85
15. Samut Songkhram	0.0	0	6.5	1	6.5	28%	1	1.0	1	Seawall	23
16. Samut Sakhon	0.0	0	6.5	1	6.5	17%	1	1.0	1	Seawall , detached breakwater	39
17. Bangkok	5.5	1	0.0	0	5.5	100%	1	0.0	0	-	5.5
18. Samut Prakan	30.0	2	0.0	0	30.0	61%	2	-	'-	Seawall	49
19. Chachoengsao	9.0	1	0.0	0	9.0	69%	1	0.0	0	-	13
20. Chonburi	0.0	0	10.4	5	10.4	7%	5	4.5	2	Seawall, groin, detached breakwater	152
21. Rayong	4.7	1	21.1	9	25.8	25%	10	15.0	6	Seawall, detached breakwater, groin	103
22. Chantaburi	16.0	1	3.0	2	19.0	26%	3	3.0	2	Seawall	72
23. Trat	0.0	0	9.8	8	9.8	6%	8	1.4	3	Seawall	160

Andaman Coast
Southern Gulf
Middle Gulf
Upper Gulf
Eastern Gulf

Source: Action Plan for Integrated Coastal Erosion Prevention and Mitigation Management (DMCR)

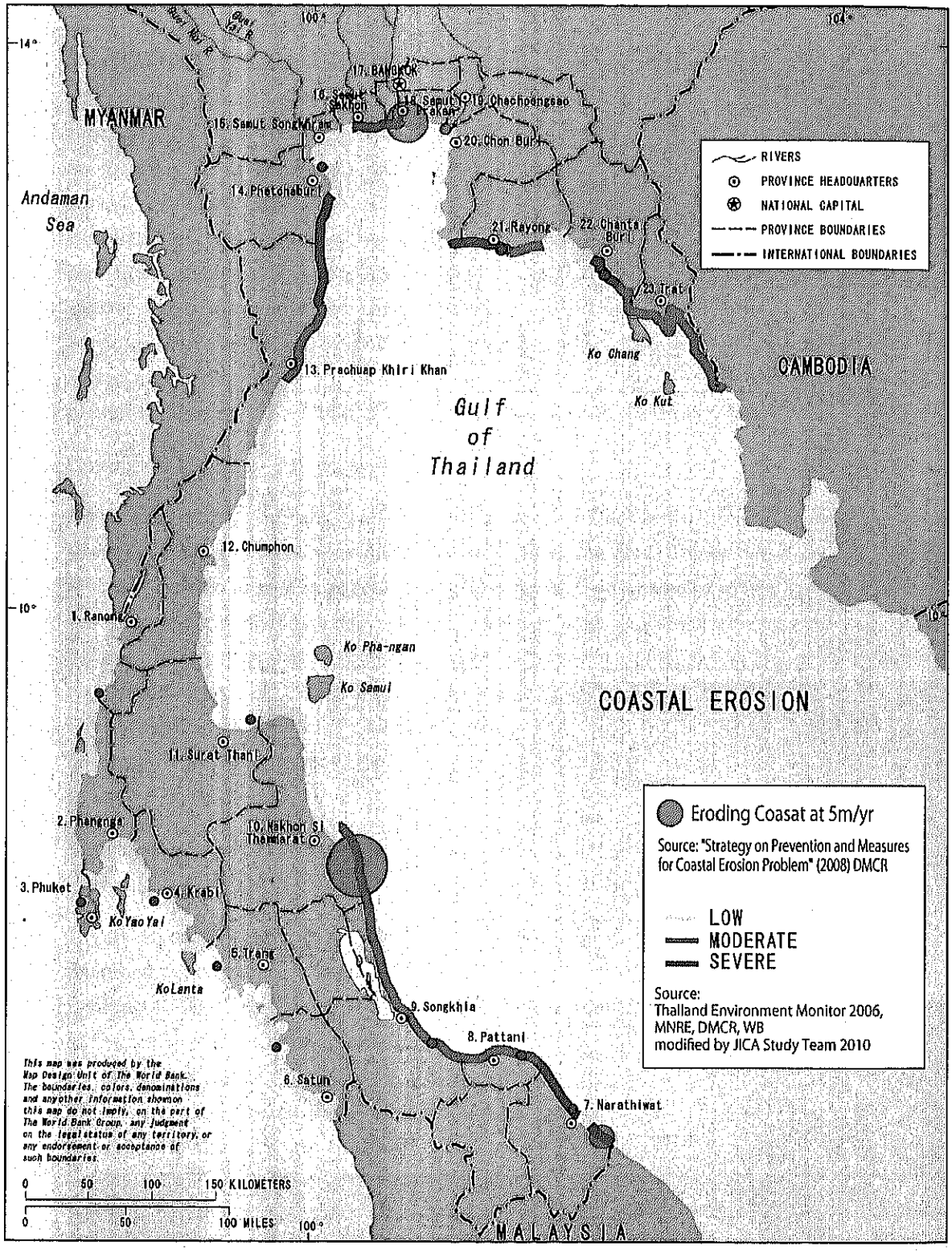


Figure 6.1.1 Location of Eroding Coast

Source : Thailand Environment Monitor 2006 (WB-DMCR); Action Plan for Integrated Coastal Erosion Prevention and Mitigation Management 2008 (DMCR), Modified by JICA Study Team 2010

6.1.2 IMPACTS OF COASTAL EROSION AND SEA LEVEL RISE

The expected impacts of climate change along the Thai coastal line are follows.

1) Coastal erosion caused by greater waves due to sea level rise and stronger typhoon (impacts on residential area, infrastructures such as road, industries, agriculture, fishery, tourism)
2) Flooding of hinterland by sea level rise (Figure 6.1.2, Table 6.1.2)
3) Salt intrusion into ground water by sea level rise.
4) Degradation of biodiversity, caused by the decreasing of natural shoreline by increasing coastal protection works.
5) Degradation of tourism resources, such as the breaching of coral reefs, and the ecosystem surrounding it.

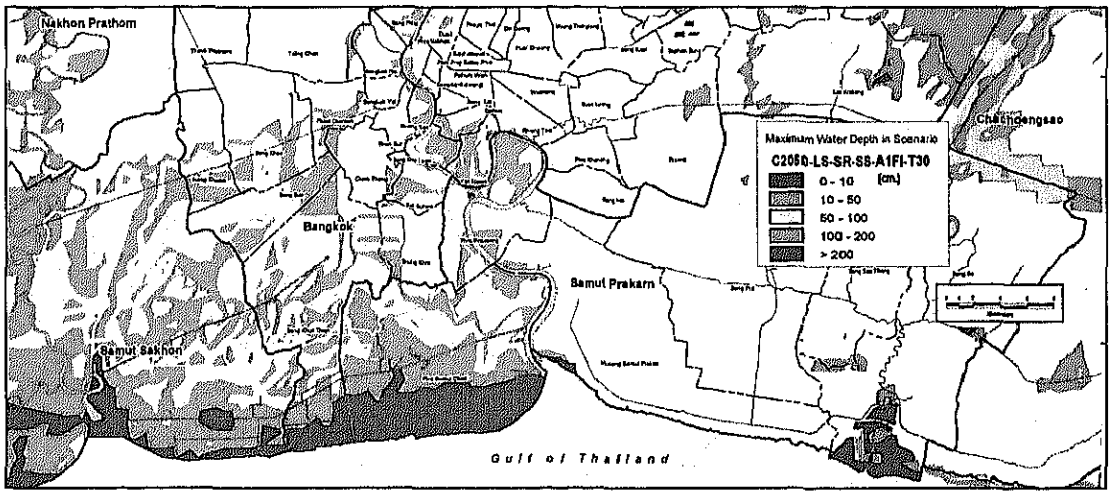


Figure 6.1.2 Prediction of Inundation at Hinterland of Northern Thai Gulf Coast

Source: Options and Strategies in Bangkok, S M Wahid, WB Bangkok CC study, AIT

Table 6.1.2 Applied Sea Level Rise to Prediction (Hatched Yellow)

Case	Flood protection structure	Land Subsidence	Sea Level Rise	SS	Flood scale from Precipitation at Return Period (Year)		
1.	C2008	-	-	-	10	30	100
2.	C2050	Applied	-	-	10	30	100
3.	C2050	Applied	+0.29m (A1FI)	-	10	30	100
4.	C2050	Applied	+0.19m (B1)	-	10	30	100
5.	C2050	Applied	+0.29m (A1FI)	+0.61m	10	30	100
6.	C2050	Applied	+0.19m (B1)	+0.61m	10	30	100

C2008 : Existing flood protection structure
C2050 : Planned flood protection structure by the year 2050
A1FI : Temperature up 1.9°C, precipitation increases 3%, and sea level rises 0.29 m. (from JBIC)
B1 : Temperature increases 1.2°C, precipitation increases 2%, and sea level rises 0.19 m. (from JBIC)
SS : Strom surge: + 0.61 m (Estimated by Watana, 2005) on the crown of the maximum sea level
Source: Options and Strategies in Bangkok, S M Wahid, WB Bangkok CC study, AIT

6.2 STRATEGIES, POLICIES AND WORK PLANS FOR CLIMATE CHANGE IN COASTAL EROSION

6.2.1 ACTION PLAN FOR COASTAL EROSION

Department of Marine and Coastal Resources (DMCR) proclaimed policy of coastal management in "Action Plan for Integrated Coastal Erosion Prevention and Mitigation Management 2008". The followings are the summary.

Principal 1 : To create database of coastal line for formulation of coastal management plan

1) Action

- Creation of land morphology database by collecting of present and past erosion data
- Creation of database for coastal disasters of the hinterland in field of economic, social, environment
- Revising the database

2) Subject area

- All the coast of Thailand

3) Related agencies

- DMCR, Department of Mineral Resources (DMR), Ministry of Defense (MD), Department of Public Works and Town & Country Planning (DPT), Local, Geo-Informatics and Space Technology Development Agency (GISTDA), Hydrographic Department, Royal Thai Survey Department (RTSD), Office of Natural Resources and Environmental Policy and Planning (ONEP), The Thailand Research Fund (TRF), National Research Council of Thailand (NRCT), Bureau of Budget (BB)

Principal 2: Promotion of public participation for formulation of coastal management plan for erosion control

1) Action

- Awareness of knowledge of coastal erosion and providing opportunities for public participation
- Capacity buildings of officials and development of organizations in the responsible agencies

2) Subject area

- All the coast of Thailand

3) Related agencies

- DMCR, DMR, MD, DPT, Local, Department of Environmental Quality Promotion

(DEQP), Ministry of Education (MOE), Ministry of Tourism and Sports (MOTS), DNP, NRCT, TRF, BB

Principal 3: Formulation of Integrated Coastal Zone Management and strategy of coastal conservation master plan in each area

1) Action

- Providing information to all stakeholders, and participation for decision making for the common goal
- Formulation of Integrated Coastal Zone Management and design for coastal protection works in areas that require emergency remedies

2) Subject area

- All the coast of Thailand
- Area which need emergency remedies

3) Related agencies

- DMCR, ONEP, DMR, MD, DPT, Local, PNEO, Regional Environment Office (REO), BB, Office of Nation Economic and Social Development Board (NESDB), Department of Water Resources (DWR), Department of Groundwater Resources (DGR), Ministry of Interior (MOI), Department of Fishery (DOF), Royal Forest Department (RFD), MOTS, Department of National Parks, Wildlife and Plant Conservation (DNP), NRCT, TRF

Principal 4: Securing hinterland, and implementation of measures against coastal erosion

1) Action

- To identify particular cause of erosion in an area, and selection of counter erosion measures in accord with the characteristics of the environment
- To formulate measures with participation of residents in the hinterland and related organizations, and the formulation of the implementation plan
- Implementation of recovery measures for the natural environment in eroded coast or utilization of the coast.
- Implementation of measures for decreasing coastal disaster's, risks and transforming the hinterland to a disaster resilient area.

2) Subject area

- All the coast of Thailand
- Areas which need emergency remedies
- Prone area for coastal disasters

3) Related agencies

- DMCR, DMR, MD, DPT, Local, ONEP, PNEO, REO, BB, NESDB, MOTS, DOF, RFD, MOI, TRF

Principal 5: To Establish a system to manage, supervise, evaluate coastal management projects

1) Action

- Implementation of emergency remedies under present law and also the amendment of operation guideline
- Implementation of strategic coastal management and formulation of evaluation method for the remedies for future erosion predicted by observation and verification.

2) Subject area

- All the coast of Thailand

3) Related agencies

- DMCR, Provincial Statistical Offices (PSO). of MNRE, ONEP, DMR, MD, DPT, BB, NESDB, MOTS

6.2.2 REMEDIES TAKEN FOR COASTAL EROSION

Coastal protection measures implemented in Thailand so far are as follows.

(1) Database formulation

DMCR has produced database of coral and sea grass for all the Thai coast in 2009. According to DMCR, it is planning to modify their database to include mangrove and to indicate the present status of coastal erosion together with the changes. In addition to that, land use planning of all the provinces along the coast are being formulated and will also be incorporated into their database. Land use planning of Prachuap Khiri Khan, Phetchaburi, Samut Songkhram, Samut Sakhon, Chachoengsao, Chonburi Provinces have been done already. DNP is also making database of mangrove and important biologic species in protected area.

(2) Mangrove plantation

DMCR and other organizations are planting mangroves enthusiastically. Mangrove forest is recognized as being an effective means for the prevention/reduction of coastal erosion at mudflat in the Northern Gulf of Thailand. The plantation is being conducted by participation of local residents and provincial government of Chachoensao, Samut Prakan, Samut Sakhorn, Samut Songkhram provinces.

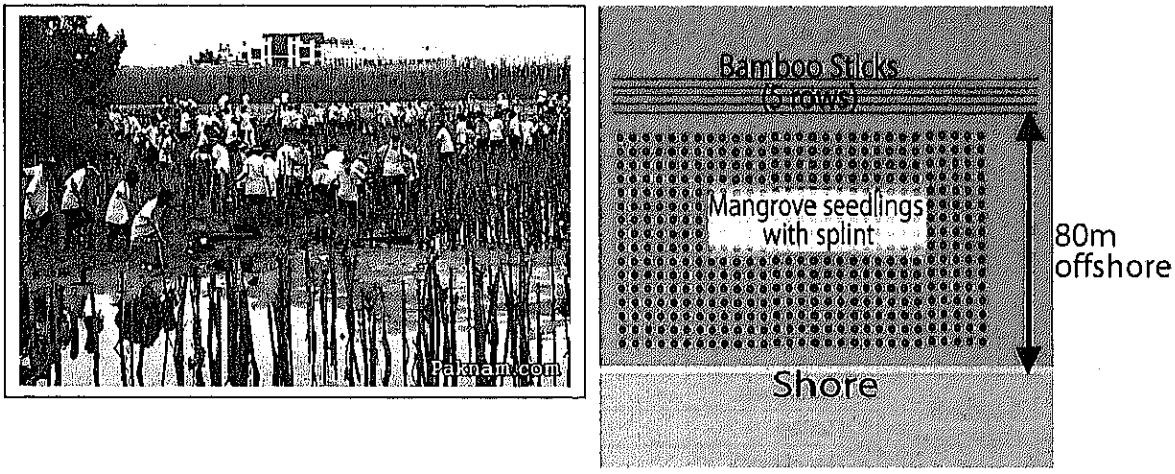


Figure 6.2.1 Mangrove Plantation Conducted by communities in Samut Prakan Province

Source: Paknam.com (Left photo), JICA Study Team 2010 (Right figure)

DMCR is operating mangrove seedling production center in each of the Northern Gulf provinces, and it supplies the seedlings and, at the same time, offering technical assistance for the mangrove plantations to the participants.

(3) Coastal protection

Master plans for coastal management are being formulated by consultants for each region (Table 6.2.1). For the areas which require emergency remedies, a detailed design is conducted (Table 6.2.2). Research, study, design, and construction of coastal structures of all Thailand (except Bangkok) are conducted by Marine Department (MD) of Ministry of Transportation.

Table 6.2.1 Coastal Conservation Projects of DMCR

Coastal Division	Province	Before FY2009	Year 1 (FY2009)	Year 2 (FY2010)	Year 3 (FY2011)
Andaman coast	1. Ranong			Master Plan	
	2. Phangnga				
	3. Phuket				
	4. Krabi		Mangrove Plantation		
	5. Trang				
	6. Satun				
Southern Gulf Coast	7. Narathiwat				
	8. Pattani				
	9. Songkhla	Master Plan			
Middle Gulf Coast	10. Nakhorn Si Thammarat	(2007-2009)			
	11. Surat Thani			Master Plan	
	12. Chumphon				
	13. Prachuap Khiri Khan				
Phechaburi Coast	14. Phetchaburi	Master Plan			
Northern Gulf Coast	15. Samut Songkhram	Master Plan	Mangrove Plantation		
	16. Samut Sakhon		Mangrove Plantation		
	17. Bangkok				
	18. Samut Prakan		Mangrove Plantation		
	19. Chachoengsao				
Eastern Gulf Coast	20. Chonburi	Master Plan			
	21. Rayong				
	22. Chantaburi				
	23. Trat				

Source : DMCR, BMA hearings

Construction of coastal protection structures are progressed at coastal areas being eroded severely in the Northern Gulf, Eastern Gulf, and Southern Gulf. These are being constructed mainly by the Marine department. Their location, magnitude of erosion and the protection method are summarized below.

Table 6.2.2 Coastal Erosion and Existing Coastal Protection Structures

Province	Location (Erosion in progress at speed over 1m/year)	District	Eroded Distance (km) * erosion more than 5m/year	Existing Coastal Protection Structure	Length covered by structure (km)
1. Ranong	Jangoy Sand Bar	A.Kohyaoyai	1.0	-	-
	Ban Hinkong	A.La-oon	7.0	-	-
	Ban Thapho	A.La-oon	1.0	-	-
	Ban Kaohinchang	A.La-oon	1.5	-	-
	Ban Hadsaidum	A.Muang	3.0	-	-
	Laemson Nat.Park	A.Kapur	2.0	-	-
	Papas Beach	A.Suksamran	8.0	-	-
	Ban Talaynok	A.Suksamran	4.0 *	-	-
2. Pang-nga	Koh Prathong	A.Kuraburi	8.0	-	-
	Koh Korkao	A.Kuraburi	1.0	-	-
	South Ban Namkhem – Ban Bangsaknuea Laemkrangyai	A.Takoapha	7.5	-	-
	Ban Lumoan-Ban Nang Neang	A.Takaopha	1.5	-	-
	Ban Tublamu	A.Taimeong	2.0	-	-
	Bortan Beach	A.Taimeong	3.5	-	-
	Ban Klang – Laem Namjeed	A.Kohyaonoi	2.0	Seawall	2.0
3. Phuket	Saepung Beach, Ban Bangtao	A. Talang	3.0 *		1.0
	Bor Bay, Banbangrae	A.Talang	1.5	-	-
4. Krabi	Ban Klongsai	A.Muang	1.0 *	-	-
	Ban Laempho	A.Muang	2.0 *	-	-
	Ban Klongprasong	A.Muang	2.0 *	-	-
	Laem Kham	A.Muang	1.0 *	-	-
	Ban Thalane – Thongtal Hill	A.Muang	4.0	-	-
	Laem Pong	A.Muang	1.0	-	-
	Ban Klongmuan	A.Muang	1.0	-	-
	Nopparattara Beach-Pranang Beach	A.Muang	3.0	Seawall + Armor rocks	2.0
	Ban Bormuan	A.Klongtom	2.0	-	-
5. Trang	Pakmeng Beach	A.Sikao	4.0 *	Seawall + Armor rocks	2.5
	Ban Huahin	A.Sikao	0.5	-	-
	Ban Changlhang	A.Sikao	1.0	-	-
	Yaichaomai Beach	A.Kantang	2.5	-	-
	Pakrhon-Ban Laembor	A.Parlien	4.0	-	-
	Ban Laembor-Ban Natalay	A.Palien	7.0	-	-
	Laem Thayongling	A.Palien	3.5	-	-
6. Satun	Paklangou	A.La-ngou	1.0 *	-	-
	Pakbara Beach	A.La-ngou	3.0	Seawall + Armor rocks	1.0
	Pakbang-Kokpayom	A.La-ngou	2.0	-	-
	Ban Rawaitai	A.Tungwar	1.0 *	-	-
	Ban Tungsapoe	A.Tungwar	2.0 *	Seawall + Armor rocks	2.0
	Ban Bhakunkei –Ban Klang	A.Muang	2.0 *	Seawall	2.0
	Ban Sakorn	A.Muang	2.0	-	-
	Ban Manungpula	A.Muang	1.0	-	-
	Ban Kanthotid	A.Muang	1.0	-	-

Province	Location (Erosion in progress at speed over 1m/year)	District	Eroded Distance (km) * erosion more than 5m/year	Existing Coastal Protection Structure	Length covered by structure (km)
7. Narathiwat	Ban Bakae	A.Muang	4.0 *	-	-
	Ban Sakowpala	A.Muang	0.2 *	-	-
	Ban Klongton , Ban Nambang Beach – Kolok Canal	A.Takbai	21.0 *	Groins + Detached breakwater (rocks)	21.0
	Naratas Beach	A.Muang		Seawall	1.5
	Ban Hudaetuwor	A.Muang	3.0	-	-
	Manao Bay	A.Muang	3.5	-	-
	Ban Jijar – Ban kogkradukmoo	A.Muang	9.5	-	-
8. Pattani	Ban Baing – Ban Bangtawa	A.Nongjik	4.5 *	Groins and seawall	2.0
	Ban Tanyongpao	A.Nongjik	1.0 *	-	-
	Ban Bangtawa east	A.Nongjik	1.5 *	-	-
	Ban Kohlaenang –Ban Bangrhapha – Bakamutu Canal	A.Nongjik	7.0	-	-
	Ban Talosamilae	A.Yaring	2.0 *	-	-
	Ban Thakun – Ban Thadan	A.Yaring	0.5 *	-	-
	Laem Tasee (Laem Pho)	A.Muang	3.0 *	Groins+ Seawall	0.5
	Ban Laemnok	A.Muang	4.0	-	-
	Khatoh School	A.Phanarae	-	Seawall	1.0
9. Songkhla	Ban Outapao – Ban Paktrae	A.Ranode	4.0 *	-	-
	Ban Pakrava	A.Ranode	1.0	-	-
	Ban Mapboa and Ban Thabon		4.0	-	-
	Ban Watjang – Ban Pangtri	A.Ranode	3.5	-	-
	Ban Tia		1.0	-	-
	Ban Pangshe	A.Satingpra	5.0	-	-
	Ban Muan-ngam	A.Singhanakorn	2.5	-	-
	Ban Hadkaew	A.Singhanakorn A.Muang	2.0	Groins + Armor rocks	0.5
	Ban Puek – Ban Pakbangnatub	A.Muang and A.Jana	6.0	-	-
	Ban Nairai – Ban Borzone	A.Jana – A.Taepha	9.0	Detached breakwater (rocks)	2.0
	Ban Kohjean – Taepha river-mouth	A.Taepha	4.5	-	-
10. Nakorn Si Thammarat	Ban Kiandam – Ban Bornon		8.0 *	-	-
	Ban Photaray – Ban Nhahuay	A. Huasai and A.Ranode	9.0	-	-
	Ban Bangkum	A.Kanom	1.5	-	-
	Ban Parej	A.Kanom	7.0	-	-
	Ban Paitorn – Ban Roa	A.Sichol and A.Thasala	26.5	-	-
	Ban Bangbaimai	A.Thasala	1.0	Seawall, groins,, armor rocks	1.0
	Ban Khamthed – Ban Huapar	A.Pakpanang	7.0	-	-
	Ban Laemtalumpuk – Ban Bangbor	A.Pakpanang	29.0 *	-	-
	Ban Kohtang – Ban Nhasan	A.Pakpanang - A.Huasai	26.0 *	Seawall + groins + Armor rocks	3.5

Province	Location (Erosion in progress at speed over 1m/year)	District	Eroded Distance (km) * erosion more than 5m/year	Existing Coastal Protection Structure	Length covered by structure (km)
11. Surat Thani	Ban Pod – Ban Pakklongkram		8.0 *	-	-
	Ban Paknamthakrajai	A.Thachana	0.7	-	-
	Ban Thakrajai – Ban Tungnommaew	A.Thachana	4.0	-	-
	Ban Thamanao	A.Thachana	0.5	-	-
	Ban Kew	A.Thachana	1.5	-	-
	Ban Pakrad	A.Chaiya	1.0	-	-
	Jintarha Beach	A.Chaiya	0.8	-	-
	Ban Wanghin – LaemKula	A.Donsak	7.0	Seawall	2.0
12. Chumphorn	Ban Nampu	A.Patew	1.8	-	-
	Ban Klang-aou and Ban Nhatub	A.Patew	1.8	-	-
	Chumporn Bay	A.Muang	5.0	Seawall	1.0
	Ban Paknamtai	A.Muang	1.0	Seawall	0.5
	Ban Tungmakram	A.Muang	1.3	-	-
	Tongtanod Bay	A.Sawee	1.2	-	-
	Kram Bay	A.Sawee	2.0	-	-
	Ban Klang-aou	A.Langsuan	1.0	-	-
	Ban Bangmun	A.Langsuan	0.7	-	-
	Ban Bangrhu	A.Lamae	1.0	-	-
13. Prachurp Khiri Khan	Ban Borfai – Hua Hin	A.Hua-Hin	5.0	Seawall	2.5
	Ban Saothong – Ban Kaothakiab	A.Hua-Hin	3.5	-	-
	Ban KaoTao	A.Hua-Hin	1.0	-	-
	Ban Kungthatanod	A.Samroiyod	1.0	Seawall	1.0
	Front of Dang Hill or Dontonson Beach	A.Samroiyod	3.0	-	-
	Kwang Hill – Ban Pakklonggiew	A.Kuiburi	4.0	-	-
	Ban Tungmamaw	A.Muang	3.0	-	-
	Saded Beach – Ban Kanbandai	A.Muang	2.0	Seawall	0.2
	Prachurp Dontai Gulf	A.Muang	1.0	Seawall	2.5
	Makha Beach – Wanakorn Beach	A.Tubsakae	4.5	-	-
	Ban Koktahom and Ban Tangsal	A.Bangsapan	1.8	-	-
	Ban Chongchang – Ban Thamanao	A.Bangsapan	4.0	-	-
	Bangsapan gulf	A.Bangsapan	2.2	-	-
	Ban Fungdang	A.Bangsapan	2.5	-	-
	Ban Nongkao – Ban Nongsoer	A.Pranburi	1.0 *	Detached breakwaters (rock type)	1.0
	Ban Nongsoer – Ban Prueyai	A.Pranburi	1.5	-	-
	Paknampran – Ban Nongkao	A.Pranburi	2.0	-	-
14. Petchburi	Ban Donmakram – Ban Thatumniab	A.Banlaem	5.0 *	-	-
	Ban Bangkate	A.Banlaem	1.5 *	Detached breakwaters (rock type)	2.0
	Laem Lhang	A.Banlaem		Groins	1.5
	Laempakbia	A.Banlaem	3.5	Seawall	1.0
	Chaosamran Beach	A.Muang	1.0	-	-
	Ban Buatan – Ban Bangkao	A.Cha-am	12.0	Seawall	1.0
	Ban Klongtien	A.Cha-am	1.5	-	-
	Ban Nongjang – Ban Nongkaem	A.Cha-am	4.0	Seawall	4.0

Province	Location (Erosion in progress at speed over 1m/year)	District	Eroded Distance (km) * erosion more than 5m/year	Existing Coastal Protection Structure	Length covered by structure (km)
	Ban Bangsainoi – Ban Podsia	A.Cha-am	8.0	-	-
	Mrigadayavan Palace	A.Cha-am		Seawall	1.0
	Ban Tanodnoi	A.Cha-am		Seawall	1.0
15 Samut Songkhram	Ban Rongkung – Ban Praktalay	A.Muang	6.5	Seawall	1.0
16 Samut Sakhon	Saothong Canal – east Thajean River-mouth	A.Muang	11.0	-	-
	Ban Kumppraa	A.Muang	2.0	-	-
	Ban Kalonge	A.Muang	18.0	Seawall + Detached breakwater	2.0
17 Bangkok	Khunrachapinitjai Canal – Ban Thatrago	A.Bangkhuntien	5.6 *	-	-
18 Samut Prakarn	West Ban Klong silung – Ban Bangsumran	A.Bangbor-A.Muang	17.5 *	Seawall	4.0
	Ban Laemsingh - Khunrachapinitjai Canal	A. Muang	12.5 *	-	-
19 Chachengsao	Ban Klong chareonwai – Ban Klong silung	A.Bangprakong	9.0 *	-	-
20 Chon Buri	Talad Nhagea	A.Banglamung	0.5	Seawall	2.0
	Ban Nammao – Nhajomtien Beach	A.Pattaya	3.0	Seawall	1.0
	Pakklongban	A.Pattaya	1.0	-	-
	Bangpra	A.Sriracha to A.Muang	5.0	Groins	0.5
	Udom Bay	A.Sriracha	0.9	Groins + Detached breakwater (rock type)	1.0
21 Rayong	Ban Pungrad	A.Klaeng	4.0	Seawall	2.5
	Ban Samaepu – Ban Laem	A.Klaeng	3.0	Seawall	2.5
	Ban Sakmagrod	A.Klaeng	1.5	-	-
	Ban Nongsapan and Ban Nongsamed	A.Klaeng	1.4	-	-
	Maptaphut (Ban Nongfab and Takuan Beach)	A.Muang	4.7 *	Seawall	2.5
	Ban Pae	A.Muang	1.0	-	-
	Ban Gon-aou	A.Muang	1.0	-	-
	East Rayong River-mouth	A.Muang	2.0	Detached breakwater (rock type)	0.5
	Ban Paknam	A.Muang	1.0	-	-
	Saengjan Beach	A.Muang	4.2	Seawall, Groins	4.5
	Plar Temple – Ban Trakad	A.Banchang	2.0	-	-
22 Chantaburi	Koh Maew-Ban Laemyar	A.Laemsingh	16.0 *	Seawall	2.0
	Ban Kungkraben	A.Thamai	1.0	Breakwater	1.0
	Jaaolao Beach	A.Thayai	2.0	-	-
23 Trat	Ban Kaojik – Ban Pakklong	A.Laemngob	2.0	Seawall	1.0
	Laem Klad	A.Muang	0.5	-	-
	Ban Klongpang – Ban Klongson	A.Muang	2.5	-	-
	Ban Laemtayim	A.Muang	1.0	-	-
	Laem Tapan	A.Muang	0.3	-	-
	Kwang Canal – Nokkaew Beach	A.Muang	0.5	-	-
	Rajkharun Beach	A.Klongyai	1.0	Seawall	0.2
	Bancheon Beach	A.Klongyai	2.0	Seawall	0.2

Source : Action Plan for Integrated Coastal Erosion Prevention and Mitigation Management

6.2.3 BUDGET FOR COASTAL AREA PROTECTION

Rough amount of the budget for the fiscal years 2009, 2010, and 2011 for the Actions in the Policy Matrix, formulation of coastal database, reforestation of mangrove, and coastal protection, are shown in Table 6.2.3. mangrove plantation in Table 6.2.4, and request of coastal protection works from each province is shown in Table 6.2.5.

Table 6.2.3 Project Budget for Coastal Protection Works

Year	Type of Structure	Name of Coast/location	Province	Days	Budget (mil.TBH)	Responsible Agency
FY2009	1. Construction of seawall	Gulf of Kung Kraben	Chanta Buri	360	30.0	MD
	2. *Construction of groin*	Bang Bai village to Srabua village in Tha Sala District	*Nakhon Si Thammarat*	*540*	110.0	MD
	3. Construction seawall	Amphur village, Sattahip District	Chonburi	540	80.0	MD
	4. Design of coastal protection works	Moo 2, 3, 7 and 8, Hua Sai District	Nakhon Si Thammarat	360	3.5	MD
	5. Study of sand nourishment	Pattaya Beach	Chonburi	360	13.0	MD
	6. Excavation (to keep cross section of river)	Chaophraya River Mouth	Samut Prakan	-	300.0	MD, PA
	7. Formulation of Coastal Master Plan	Southern Gulf Coast	Narathiwat, Pattani, Songkhla	-	18.0	DMCR
	8. Bamboo barrier & mangrove plantation	Upper gulf of Thailand	Samut Prakarn, Chachoensao, Samut Sakhon, Samut Songkhram	-	29.4	Local Gov'ts
FY2010	1. Improvement of dike	Sangchan beach	Rayong	360	30.0	MD
		Koh Taeo village	Songkhla			MD
		Klong Varn	Prachual Kiri Khan			MD
	2. Sand bypass	Phra Put navigation channel	Songkhla	360	18.6	MD
	3. Sand bypass	Sakom navigation channel	Songkhla	360	18.6	MD
	4. Sand bypass	Na Thub navigation channel	Songkhla	360	16.9	MD
	5. Design of coastal protection works	Sakom, Thepa District	Songkhla	360	10.0	MD
	6. Design of coastal protection works	Moo 2, 3, 7 and 8 in Nasaton Sub-district, Hua Sai District	Nakhon Si Thammarat	240	3.5	MD
	7. EIA Study			360	3.0	MD
	8. Design of sand nourishment	Pattaya beach	Chonburi	360	13.0	MD
	9. Excavation (to keep cross section of river)	Chaophraya River Mouth	Samut Prakan	-	300.0	MD, PA

Year	Type of Structure	Name of Coast/location	Province	Days	Budget (mil.TBH)	Responsible Agency
	10. Construction of bamboo barrier	Tha Cam District (4.9km)	Bangkok	-	10.0	BMA
	11. Formulation of Coastal Master Plan	Andaman Coast	Ranong, Phangnga, Phuket, Krabi, Trang, Satun	2yrs	12.0	DMCR
FY2011	1. Construction of coastal protection works	Klang Canal, Klang District	Rayong	360	10.0	MD
	2. Construction of coastal protection works	Koh Phet village, Koh Phet Sub-district, Pak Panang District	Nakhon Si Thammarat	360	20.0	MD
	3. Improvement of coastal protection works	Klong Dan	Samut Prakarn	540	290.0	MD
	4. Improvement of coastal protection works	-	-	360	40.0	MD
	5. Improvement of navigation channel	Songkhla	Songkhla	360	33.0	MD
		Tamyongpao	Pattani			MD
	6. EIA Study	Khun Samut Chin village, Phra Samut Chedi District	Samut Prakarn	360	4.0	MD
	7. EIA Study	Ban Thung Yai Moo 3-7, Mueang District	Songkhla	360	7.0	MD
	8. EIA Study	Hua Laem Village Moo 12, Lang Suan District	Chumporn	360	7.0	MD
	9. EIA Study	Na Kote village, Pak Panang District,	Nakhon Si Thammarat	360	4.0	MD
	10. EIA Study	Pak Trae Sub-district, Ranode District	Songkhla	360	4.0	MD
	11. Design and EIA Study	Had Ban Kaeo beach, Singha Nakhon District	Songkhla	360	10.0	MD
	12. Design and EIA Study	Bor Tru Sub-district, Ranode District	Songkhla	360	10.0	MD
	13. Excavation (to keep cross section of river)	Chaophraya River Mouth	Samut Prakan	-	300.0	MD, PA
	14. Improvement of bamboo barrier	Tha Cam District (4.9km)	Bangkok	-	10.0	BMA
	15. Formulation of Coastal Master Plan	Middle Gulf Coast	Surat Thani, Chumphon, Prachuap Khiri Khan	-	not known yet	DMCR
				Total	1,768.4	mil. TBH

Source: DMCR: Dept. of Marine and Coastal Resources, MD: Marine Department, Ministry of Transportation PA: Port Authority, BMA: Department of Drainage and Sewerage, Bangkok Metropolitan Administration, Local Governments: MNRE Samut Prakan Office

Table 6.2.4 Yearly Budget for Mangrove Plantation

Work	Unit Price	Quantity	Total
Operation of seedling production centres	6.8 mil.THB	1	6.8mil THB
Plantation works(including splints)	20THB	3.5mil.	70mil. THB
Construction of bamboo pile breakwater	3 mil. THB /km	10km	30mil. THB
Total	-	-	106.8mil.THB

Source : MNRE Samut Prakan Office

Table 6.2.5 Amount of Budget Requested by Each Province for Coastal protection 2011-2016

Province	1. Study, Design, Environment Impact Assessment		2. Investment Plan		3. Restoration Plan of Land and Eco-System		4. Knowledge Enhancement and Participation Plan		Total (2011)	
	No. of Projects	Amount (Mil. THB)	No. of Projects	Amount (Mil. THB)	No. of Projects	Amount (Mil. THB)	No. of Projects	Amount (Mil. THB)	No. of Projects	Amount (Mil. THB)
1. Ranong	6	4.5	2	49.5	1	0.1	2	5.2	11	59.3
2. Pang-nga	1	10.0	1	5.0	3	100.0	2	7.5	7	122.5
3. Phuket	1	75.0	1	5.0	2	32.0	2	10.0	6	122.0
4. Krabi	1	0.5	0	0.0	1	3.0	1	6.0	3	9.5
5. Trang	2	11.5	2	10.0	0	0.0	3	7.7	7	29.2
6. Satun	5	25.0	2	17.0	0	0.0	3	10.8	10	52.8
7. Narathiwas	0	0.0	0	0.0	1	18.0	1	2.0	2	20.0
8. Pattani	5	165.0	0	0.0	3	23.0	0	0.0	8	188.0
9. Songkhla	6	230.0	1	40.0	7	195.5	0	0.0	14	465.5
10. Nakorn Si Thammarat	3	59.0	0	0.0	2	5.0	1	2.0	6	66.0
11. Surat Thani	4	65.0	0	0.0	0	0.0	1	2.0	5	67.0
12. Chumporn	6	53.0	0	0.0	0	0.0	0	0.0	6	53.0
13. Prachurp Khiri Khan	14	239.0	0	0.0	0	0.0	0	0.0	14	239.0
14. Petchburi	9	75.0	2	17.0	4	151.5	1	3.0	16	246.5
15. Samut Songkram	2	108.0	1	1.0	2	0.3	3	0.5	8	109.8
16. Samut Sakorn	2	90.0	2	7.0	0	0.0	4	1.9	8	98.9
17. Bangkok	1	5.0	1	600.0	0	0.0	0	0.0	2	605.0
18. Samut Prakarn	11	425.0	1	2.0	1	0.2	3	4.4	16	431.6
19. Chachengsao	2	106.0	4	15.0	0	0.0	2	0.4	8	121.4
20. Chonburi	6	458.5	1	10.0	2	7.5	4	40.0	13	516.0
21. Rayong	5	231.0	0	0.0	2	3.0	5	8.5	12	242.5
22. Chanthaburi	6	85.5	1	5.0	2	1.0	4	2.6	13	94.1
23. Trat	2	475.0	0	0.0	3	0.3	2	2.0	7	477.3
Total	100	2,996.5	22	783.5	36	540.4	44	116.5	202	4,436.9

Source : Clarification Meeting of Cabinet Resolutions on April 20th, 2010 on Integrated Budget Plan for Prevention and Solving Coastal Erosion - Problem in 23 Provinces Year 2011-2016 (DMCR)

6.2.4 RECOMMENDED POLICY FOR CCPL ASSISTANCE

The Thai government's effort for coastal management takes many forms, such as the formulation of coastal resources database, national Action Plan, inter-provincial coastal management plan, land use planning of provincial government, land reclamation, maintenance of navigation route, coastal protection measures. It can be said that these plans and projects are not well-integrated, and some projects see immediate problems at the specific site, and do not see the adjacent area which is actually undividable in terms of sand movement along the coast.

The Action Plan (Action Plan for Integrated Coastal Erosion Prevention and Mitigation Management) points out necessity of strategic and integrated counter erosion measures; however, it has no remark on climate change or sea level rise. Likewise, land use plan do not include strategic land use plan based on prediction of sea level rise. Coastal protection projects also are counter measures of present erosion problems.

(1) Type of projects recommended to be funded by CCPL

It is recommended that to utilize CCPL and to guide the Thai government to provide a more effective and sustainable way of coastal management, selecting favourable projects in following manner for CCPL by JICA would provide Thai government good incentive.

1) Emergency coastal protection works for endangered hinterland
2) Monitoring of coastal disaster such as coastal erosion and inundation
3) Hazard map making based on long term projection of sea level rise and abnormal weather condition
4) Formulation of long-term strategic coastal management plan, implementation of the plan, and effort for decreasing disaster prone areas
5) Measures utilizing natural wave dissipation function, especially reforestation of mangrove, where it is possible, land acquisition and zoning plan for mangrove plantation and buffer zone setting.
6) Sand/silt nourishment for eroded coast by excavated soil for maintenance of navigation route

(2) Type of projects should not be funded by CCPL

Projects listed below are not thought to be sustainable due to difficulties in their maintenance as a result of future environmental changes in coastal area; therefore, it is not recommended to support them by CCPL.

1) Structures whose design does not incorporate overall strategic plan, or movement of littoral drift
2) Project whose purpose is just to maintain existing shoreline, and there is no substantial damages in hinterland area
3) Coastal protection structures for new road along the cost, land reclamation, new development behind coast, new aquiculture pond, projects to decrease mangrove area

6.3 BACKGROUND OF POLICY MATRIX ON COASTAL EROSION

6.3.1 POLICY MATRIX FOR COASTAL EROSION AS OF JUNE 2010

Policy Matrix in Coastal Erosion is formulated based on projects being conducted by DMCR (Department of Marine and Coastal Resources). DMCR recognizes the following issues as being caused by recent and will be aggravated by future climate change.

- Coastal erosion
- Degradation of mangrove and sea grass
- Bleaching of coral
- Spread of disease amongst coral
- Disturbance of calcification by rising acidity of sea water
- Disturbance in reproductive behaviours
- Degradation of marine environment

DMCR has set its policy to tackle the above noted issues in 2009-2012 as follows.

- Formulation of database of biodiversity and land use planning*
- Identification of biological species in coastal areas
- Identification of endangered areas
- Protection of land from coastal erosion*
- Conservation of mangrove forest
- Recovering corals

(The * items apply to "Action" of the Policy Matrix, added by JICA Study Team)

Table 6.3.1 Policy Matrix for Coastal Erosion as of June 2010

Key Strategy	Outcome	Action	Year1 2009/2010	Year2 2010/2011	Year3 2011/2012	Agency
K3. Prevent coastal erosion	O4 Sustain coastal line and its bio-diversity/ eco-system	Establish marine/coastal Resource database (43)	Coral/ sea grass database completed	Other resources' database to complete	Other resources' database to complete	DMCR
		Prepare mangrove forest restoration pilot project: 300 rai (46)	Prepare mangrove forest restoration pilot project: 300 rai	Implement mangrove forest restoration pilot project: 300 rai	Implement mangrove forest restoration pilot project: 300 rai	DMCR
		Implement coastal line prevention project (44) (New :Added by JICA)	(Blank)	(Blank)	(Blank)	DMCR

* The number indicates reference No. of the original long list initially assessed by JICA.

Table 6.3.1 shows the original Policy Matrix for coastal erosion field. The original Policy Matrix is formulated according to issues and projects that DMCR plans. Although there are some blanks, the Policy Matrix is agreed as the first version by ONEP and DMCR. Among "Actions" in the Policy Matrix, "Formulation of coastal database (long list sequence number

43)" and "Coastal erosion (ditto 44)" are marked as high priority projects; and "Reforestation of mangrove (ditto 46)" was marked important by its scale, together with "Coastal erosion". Yearly actions of "Coastal erosion" were not decided at this point because this item was listed later than other two items.

6.3.2 POLICY MATRIX APPROVED BY RESPONSIBLE GOVERNMENTAL AGENCY

Final version of the Policy Matrix (Table 6.3.2) was admitted officially by DMCR on August 31, after modifications made through discussions with representatives of DMCR and JICA Study Team member, from coastal engineering point of view.

Table 6.3.2 Revised Policy Matrix for Coastal Erosion as of August, 2010

Key Strategy	Outcome	Action	Year1 2009/2010	Year2 2010/2011	Year3 2011/2012	Agency
K3. Sustainable coastal zone management	O4.1 Evaluate coastal hazard zone/ endangered species' habitat	Establish marine/coastal Resource database (43)	Coral/sea grass database completed	Other resources' database to complete	Other resources' database to complete	DMCR /DNP
	O4.2 Sustainable management of marine eco-system	Reforest mangrove (46)	Provide 3.5mil. seedlings for mangrove reforestation/ afforestation	Provide 3.5mil. seedlings for mangrove reforestation/ afforestation	Provide 3.5mil. seedlings for mangrove reforestation/ afforestation	DMCR
	O4.3 Sustainable protection of hinterland	Implement hinterland protection project (44)	- Formulate Master Plan on Southern Gulf of Thailand; - Implement community based mangrove barrier works	- Formulate Master Plan on Andaman and Middle Coast of Gulf of Thailand; - Detail design of coastal protection plan; - Implement community based mangrove barrier works	- Detail design of coastal protection plan; - Implement protection works and community based mangrove barrier works	DMCR

* The number indicates reference No. of the original long list initially assessed by JICA.

Reasons of modifications are summarized in the following Table 6.3.3.

Table 6.3.3 Comparison between Previous and Modified PMx

Items	Previous Terms	Modified Terms	Reason of modification/Remarks of DMCR
Key Strategy	K3. Prevent coastal erosion	K3. Sustainable coastal zone management	To halt erosion itself should not be the ultimate importance. The real purpose of the measure should be to secure hinterland with appropriate planning and engineering measures. The "key Strategy" is changed to "Sustainable coastal zone management"
Outcome	O4 Sustain coastal line and its bio-diversity/ eco-system	O4.1 Evaluate coastal hazard zone/ endangered species' habitat	The outcome was "Sustain coastal line and its bio-diversity/eco-system. In order to gain clearer understanding, it is divided in to two sections. The one of the two outcomes is "Evaluate coastal hazard zone/ endangered species' habitat". This outcome focuses on evaluation.
	-	O4.2 Sustainable management of marine eco-system	The other is "Sustainable management of marine eco-system," which focuses on management. This is also aimed to widen the applicable field for DDCL projects for CCPL.
	-	O4.3 Sustainable protection of hinterland	Based on new Key Strategy, "Sustain Coastal line " is changed to "Sustainable protection of hinterland"
Action	Establish marine/coastal Resource database (43)	Establish marine/coastal Resource database (43)	(No change) Database of coastal resources and the results gained from monitoring are essential information for formulation of appropriate plan and implementation.
Year 1	Coral/sea grass database completed	Coral/sea grass database completed	(No change) Coral and sea grass are important indices for evaluating wholesomeness of shallow water environment. Some of coral and sea grass are severely damaged along Thai coastal line. It is said that the damages are caused by rising temperature of sea water.
Year 2 & Year 3	Other resources' database to complete	Other resources' database to complete	(No change) DMCR is planning to add mangrove, coastal erosion, land use planning of each Province to database, and use the database for integrated coastal management plan.
Action	Prepare mangrove forest restoration pilot project: 300 rai (46)	Reforest mangrove (46)	In original Policy Matrix, it was written as "Prepare mangrove forest restoration pilot project: 300 rai". This is over-rapping with the yearly action, and was mis-printing. It is modified as simply "Reforest mangrove".
Year 1 Year 2 Year 3 (The same for each year)	Prepare mangrove forest restoration pilot project: 300 rai	Provide 3.5mil. seedlings for mangrove reforestation/ afforestation	From DMCR's point of view, it is almost impossible to keep track of areas of mangrove plantation, since seedlings are planted not only in government land but also in private land. However, seedlings are produced and distributed by DMCR solely in Thailand; hence, DMCR came to conclusion that the number of seedlings can be the good index of action plan.
Action	Implement coastal line prevention project	Implement hinterland protection project (44)	Initial projects to keep coastal line can be severely limited. Therefore, it is changed to "Implement hinterland protection project" in order to take variety of measures to protect hinterland into CCPL.
Year 1	(Blank)	- Formulate Master Plan on Southern Gulf of Thailand; - Implement community based mangrove barrier works	Projects that are implemented by DMCR, and local governments in fiscal year 2009 are listed.

Items	Previous Terms	Modified Terms	Reason of modification/Remarks of DMCR
Year 2	(Blank)	- Formulate Master Plan on Andaman and Middle Coast of Gulf of Thailand; - Detail design of coastal protection plan; - Implement community based mangrove barrier works	Projects that are being implemented by DMCR, local governments, and Marine Department in FY2010 are listed.
Year 3	(Blank)	- Detail design of coastal protection plan; - Implement protection works and community based mangrove barrier works	Projects to be implemented by DMCR, local governments, and Marine Department in FY2011, are listed.
Agency	DMCR	DMCR/DNP	DNP is added to CMCR for responsible agency. DNP is managing wildlife including mangrove in protected area, and making database of them. Since protected area is widely distributed along the coast, especially in the Southern Coastal area, it is agreed by DMCR and DNP to cooperate in making the database.

Source: the Study Team

Followings are explanation of three actions in Policy Matrix in field of Coastal Erosion.

(1) Establish marine/coastal resource database

This is an Action for achievement of the Outcome: Evaluate coastal hazard zone/ endangered species' habitat (Outcome O4.1). Formulation of a strategic and integrated coastal zone management and the implementation is necessary to cope with future sea level rises and rising temperature of sea water in order to lessen impacts on hinterland residents and eco-system of the coastal area. It is important to gather the information on present status of the coastal area, to allow analysis of the past and future prediction, and for the formulation and revising of the integrated coastal zone management plan.

DMCR has just begun establishing a database of the coastal area for coral and sea grass.

MNRE Management Plan 2008-2011 puts its emphasis on the establishment of the database, increasing of mangrove forest areas, and the strengthening resilience against coastal disaster. The followings are extracts from the MNRE Management Plan which requires a coastal database.

[Purpose] 2. Appropriate management of terrestrial and coastal biological resources and the environment for sustainable use.

[Target] 2.2 Bio-diversity of fore sea and sustainable use of the resources and management

[Outcome] 2.2.3 Sustainable management of coastal eco-system (mangrove, coral reef, sea grass) and appropriate programs for their restoration

[Achievement Index]

* Increasing of mangrove forest area

* Restoration of lost coral reef and mangrove
* Increasing resilience of the hinterland against natural disaster

Establishment of database is also in accord with Principle-1 of Action Plan for Integrated Coastal Erosion Prevention and Mitigation Management (Action Plan): To establish database of coastal area for coastal management plan.

(2) Reforest mangrove

This is an action for achievement of the Outcome: Sustainable management of marine eco-system (Outcome O4.2). Reforestation/Afforestation of mangrove is also stressed in MNRE Management Plan 2008-2011.

Reforestation/Afforestation of mangrove is being implemented widely by the MNRE, provincial government, and NGOs. Mangrove forest has many functions such as wave power dissipation, trapping silt, and creating a complex living environment for sustaining biological diversity. Since it provides good spawning grounds for fish, mangrove forests have a positive impact on the coastal fishing industry. Department of Fishery recognizes the importance of the mangrove forests and the benefits they bring to the fishing industry, so they take part in the coordinating of mangrove plantation projects.

(3) Implement hinterland protection project

This is an Action for achievement of the Outcome: Sustainable protection of hinterland (Outcome O4.3). This action is in accordance with following principals of Action Plan.

1) Promotion of public participation in the formulation of coastal management plan for coastal erosion (Principal-2)
2) Formulation of Strategic Coastal Management Plan in each region (Principal-3)
3) To secure hinterland and implementation of coastal protection measures (Principal-4)

Although protection from coastal erosion is one of the most important policies of MNRE; but, it was not written in original Policy Matrix, agreed by ONEP and DMCR, and is added in the revised Policy Matrix.

The causes of erosion may vary coast to coast, but erosion of Thai coast is in rapid progress in many areas. Coasts that erode more than 1 m/year account for 21% of the entire coasts of Thailand (Table 6.1.1). 35% of the total coast erosion erodes at the rate of 5 m/year. Coastal erosion is high profile issue in Thai society.

If the Government expects the coastal management measures to be sustainable, then it needs to accept that the coastline may change and effort to maintain the present coastline is not always the appropriate choice. Coastal protection structures frequently get damaged or sink into sand, the management cost will be even greater if sea levels rise.

Although it is an extreme case, there is a plan to construct gigantic seawall, the one like in Netherland, the cost may likely be greater than the benefit. In the area behind the seawall may experience higher flood levels than ever in shorter time. It requires many huge pumps

with diesel engines (that produces GHG). In addition to that, changing the natural coastal line into an artificial one will diminish environment of the coast line which is a precious environment to many biological species. The tidal area is used by fish, shellfish, birds and other animals' for spawning grounds, nesting and growing. It is also used for substantial fishery, navigation, and has a natural breakwater function. Replacing these with an artificial structure will require the residents to pay a tremendous social and environmental cost.

For sustainable counter erosion measures for the Northern Thai Gulf are, like the Thai Government advocates, that integrated coastal management is necessary. The contents of the integrated coastal management plan may include soft components such as setting-back the coastal line by land use planning, having a buffer zone with mangrove plantations. DMCR and Department of Public Works and Town & Country Planning (DPT) are trying to incorporate land use planning into the integrated coastal management plan.

Coastal erosion measures for beaches in tourist areas could adopt a different approach from other coasts, preserving these beaches are extremely important to the local governments who receive a large portion of income from tourism industry.

6.4 RECOMMENDATION FOR COASTAL EROSION

6.4.1 POLICIES AND STRATEGIES

(1) Issues

The coast along the Chao Phraya River delta (from Samut Sakorn Province to Chachoensao Province) and lowland of along the Southern Gulf of Thailand (Nakorn Si Thammarat and Songkla) are expected to be affected to an even greater extent by coastal erosion and loss of important biological environment, including wetland by future sea level rise. Millions of city dwellers in Bangkok metropolitan area may encounter hinterland inundation every year. The most vulnerable people at risk are the socially weak groups (The 11th National Economic and Social Development Plan 2012-2016, Executive Summary (NESDB)).

(2) Existing remedies

The Action Plan for Integrated Coastal Erosion Prevention and Mitigation Management stresses the importance for the projection of future erosion, and the formulation of strategic measures against them; however, unfortunately, it does not take into account future projection for the rise in sea level. Likewise, the present design for coastal protection structures have not been designed to accommodate future sea level rises, according to the Marine Department (MOT). It is the same for the provincial land use planning, which do not take into account future sea level rises and the level of inundation in extreme cases.

(3) The necessity for a new policy

NESDB also points out in the The 11th National Economic and Social Development plan that coastal management plan should be "in a more integrated manner, (omit) more increased

efforts to move from reactive to proactive responses". It also states that "Strengthening of integrated multidisciplinary and participatory approaches will also help improve the prospects for reducing vulnerability, as well as sustaining coastal resources and communities."

6.4.2 POSSIBLE FUTURE COOPERATION FROM JAPAN

(1) Assistance for integrated coastal conservation measures

[Database Formulation]

Although there are many stages required before the formulation of the strategic and integrated coastal management plan that NESDB intends, the DMCR and other organizations have begun section works, which are also incorporated in the Policy Matrix.

Many organizations are producing databases but due to the use of various fragmented time scales and independant nature of the information, it is not integrated. As a result, the databases are not fully utilized in the formulation of the strategic coastal management plan.

Creating new coastal database by gathering existing database, and adding some more categories if required, would be extremely useful for integrated strategic coastal zone management plan ("Item-1" of Figure 6.4.1).

[Integrated Coastal Zone Management]

Although provincial land use plan and regional coastal protection management plans are being formulated, they are not taking future sea level rise and extreme weather into account: they are rather reactive and not proactive which NESDB advocates.

Hazard map making for the disaster prone areas are essential for the formulation of strategic coastal management plan, which can be created based on the coastal database ("Item-2" of Figure 6.4.1).

Next, by using the hazard map, the responsible government should identify the damage of future coastal disasters and analyze the root causes, and then, produce zoning maps with restrictions of land use with stakeholders. Strategic Integrated Coastal zone Management, with zoning, should also include the restriction for the development of vulnerable areas, setting asside buffer zones, resettlement plan, evacuation plan (during emergency), and measures to make disaster resilient hinterland ("Item-3" of Figure 6.4.1).

(2) Coastal protection measure for chao phraya delta coast

The coast along Chao Phraya delta is experiencing severe erosion. Since the hinterland is low, flat, and well developed, future inundation may well cause profound economic and social damage in this area. The causes of erosion are: 1) Land subsidence. The area is flood plain of the Chao Phraya River, and alluvium soil forms a huge estuary terrace. The delta had received sediments from the Chao Phraya River every year when it overflowed; however, sand/silt supply from the river has been discontinued; 2) Depletion of mangrove forest, by

converting it to aquiculture farms. Silt trapping function and wave dissipating function were lost; 3) Decreasing of sand/silt supply from the Chao Phraya River mouth. The main cause is excavation of the navigation channel by Bangkok Port Authority (BPA) and the Marine Department. The depth of navigation channel is 8.5m and the width is 150m, and the length from the estuary to the Bangkok Port is about 40km. BPA and the Marine Department are dredging 5 million m^3/year from the river channel (Marine Department). Since their budget are limited, they can not return the soil to coast but to dump it at offshore area (Figure 6.4.2).

By taking the causes into consideration, following measure are proposed for securing the hinter land. Mangrove plantation in combination with bamboo sticks, which are being implemented by provincial governments, conversion of existing shrimp ponds to organic shrimp farming[50] ponds by Department of Fishery, can use the soils dredged by BPA and the Marine Department; or, to seek alternatives such as limiting large vessels into Bangkok Port and channeling them to other existing ports or to a new port. If these measures are assisted and implemented, the erosion will likely be ceased.

The responsible person in the Marine Department remarked that the Thai Government is actually not willing to dump the dredged sand and silt at offshore area; and, if the Japanese government is to help establish a circulating system of the dredged silt/sand, it will help suppress the erosion of the coastal area.

(3) Technical cooperation for other coastal area

Characteristics of the Thai coast differ coast by coast, and the causes of erosion are not the same and complex; however, there are many cases that jetties, training dikes obstruct littoral drift and cause erosion on the downstream side. In other cases, commercial facilities are encroaching on to the beaches and shoreline of tourist areas. These types of land use are endangering themselves during extreme weather conditions (Figure 6.4.3). Technical assistance to solve these problems effectively, including soft component, sand nourishment, and sand-bypass technique are also requested from the Marine Department.

[50] Department of Fishery is promoting "organic shrimp farming", which is to add some more value on their product to compete against low-priced Vietnamese products

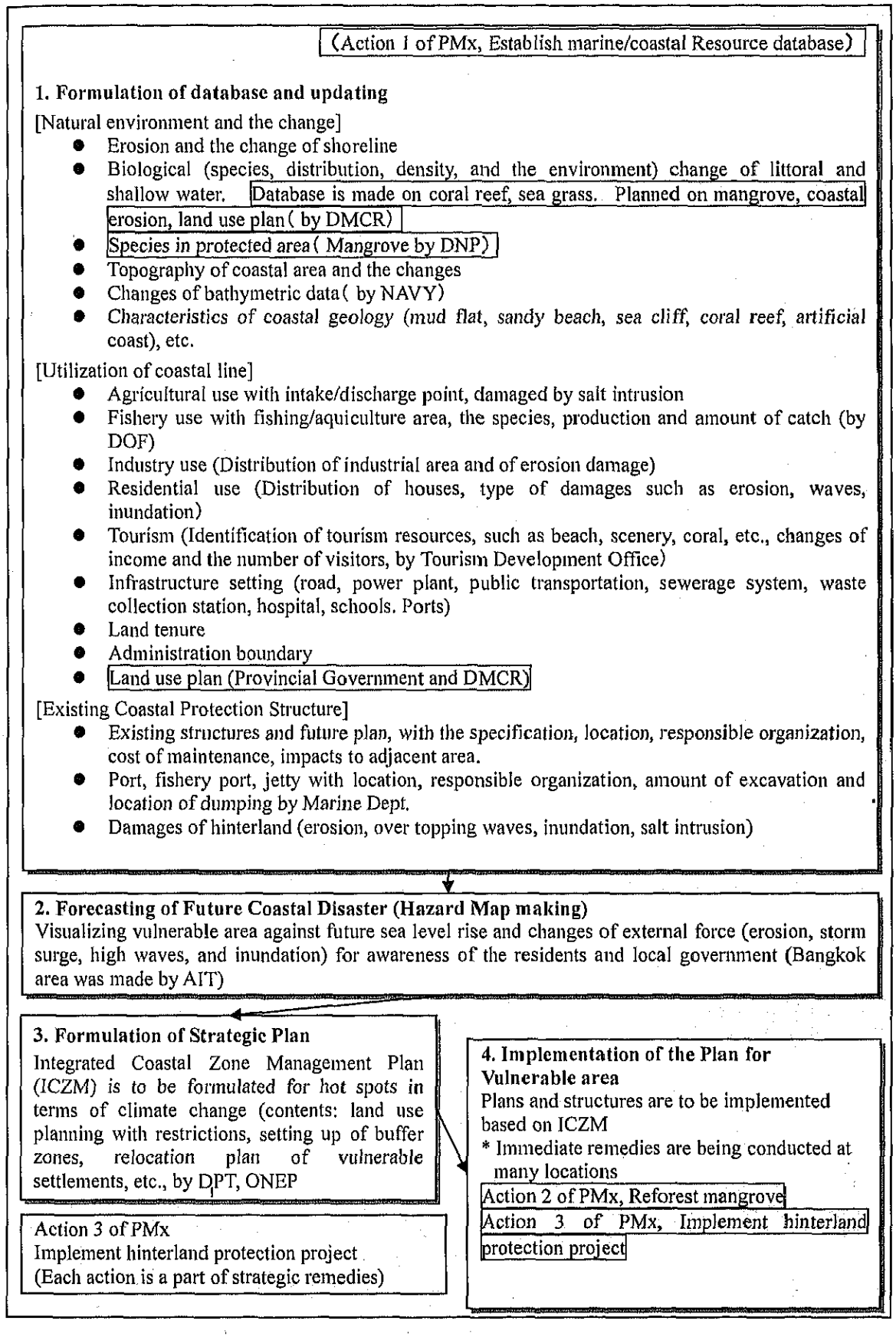


Figure 6.4.1 Work Flow of Integrated Coastal Zone Management

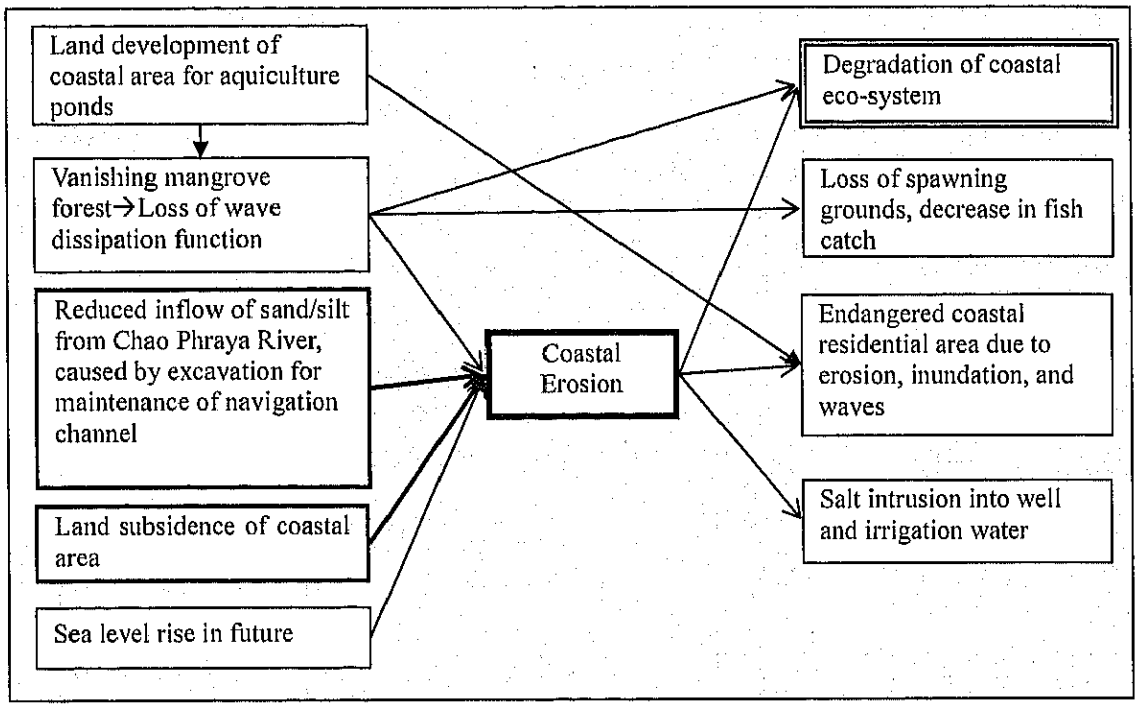


Figure 6.4.2 Cause-Effect Diagram of Chao Phraya Delta Coast

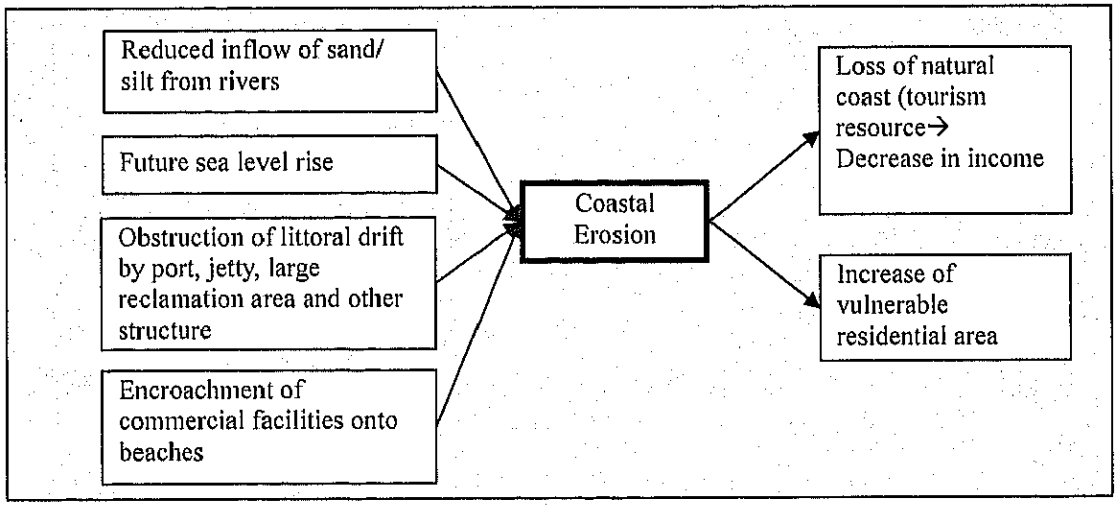


Figure 6.4.3 Typical Cause-Effect Diagram of Thailand Coast

7. CROSS-CUTTING ISSUES

Cross-cutting issues were selected initially by June 2010. Some actions were added based on the discussion the ONEP in July and August. The outcomes were divided as follows.

O11.1 Capacity building to cope with Climate Change

O11.2 Master plan preparation for Climate Change

Table7.1.1 Policy Matrix as of August 2010

K6. Knowledge management on Climate Change						
Outcome	Action	Year1 2009/2010	Year2 2010/2011	Year3 2011/2012	Agency	Ministry
O11.1 Capacity building to cope with Climate Change	Develop GHG inventory database system	Prepare GHG inventory database system	Finalize GHG inventory database system		ONEP	MNRE
	Capacity building of TGO (59)	Capacity building program prepared; training experts attached	Implement capacity building program	Implement capacity building program	TGO	MNRE
	CDM knowledge dissemination (61)	Monthly workshop	Monthly workshop	Monthly workshop	TGO	MNRE
	Capacity building for MNRE Regional Environment Office				ONEP	MNRE
	Capacity Building for DNP to Enhance Forest Conservation Action	Train the trainers for REDD-plus Monitor, Reportable and Verifiable Activities	Train the regional staff for REDD-plus Monitor, Reportable and Verifiable Activities	Train the regional staff for REDD-plus Monitor, Reportable and Verifiable Activities	DNP	MNRE
		Develop a network of warning system for the Monitoring and Surveillance Centre for Forest Encroachment and Forest Fire in Protected Areas	Train utilization and interpretation of GIS and satellite imagery for other 4 regional centres established in 2011	Train on utilization and interpretation of GIS and satellite imagery for another 4 regional centres established in 2012		
		Improve Forest Fire Management by Local community participation; train community personnel	Support & Establish Community Fire Suppression Units (CFSUs)	Supervise & Monitor the Implementation of the CFSUs		

K6. Knowledge management on Climate Change						
Outcome	Action	Year1 2009/2010	Year2 2010/2011	Year3 2011/2012	Agency	Ministry
O11.2 Master plan preparation for Climate Change	National Climate Change Master Plan (56)	Drafted in 2010	Implementing master plan	Implementing master plan	ONEP	MNRE
	NESDB Climate Change Master Plan (54)	Preparation works completed	To complete in Oct. 2010		NESDB	OPM
	Environmental Fund Supporting Program on Climate Change				ONEP	MNRE
	MOAC Climate Change Master Plan	Implement current master plan			OAE	MOAC
		Draft 2nd Master Plan	Complete final draft in June 2011	Implement 2nd Master Plan		

* The number indicates reference No. of the original long list initially assessed by JICA.

(1) Develop GHG inventory database system

This has been under process.

(2) Capacity building of TGO (59)

Capacity building of both TGO staff and stakeholders under the JICA Institutional Capacity Development Project on Thailand GHG Mitigation has been conducted. The progress can be confirmed through their periodical reports.

(3) CDM knowledge dissemination (61)

Workshops have been organized in the JICA TGO project mainly for relevant government officials. There are other efforts done by TGO such as The 1st NATIONAL CARBON NEUTRAL CONFERENCE, Climate Thailand Conference (CTC) August 2010.

(4) Capacity building for MNRE regional environment office

The project formation mission will be dispatched in December 2010 and the project itself will be launched the following year.

(5) Capacity building for DNP to enhance forest conservation action

Please refer section 4.3.4.

(6) National climate change master plan (56)

The draft National Climate Change Master Plan is in the process of the public hearing and will be formally publicized shortly.

(7) NESDB climate change master plan (54)

The team headed by Dr. Kitti, Associate Professor of the Chulalongkorn University conducted the survey in water, rice, crops and energy. The final outputs of the study, titled "Project for Preparation of the Master Plan on Global Climate Change, Price Fluctuation of the World Energy and Food Crisis" will be completed. While the National Climate Change Master Plan is prepared by the ONEP, this paper will oversee the Climate Change with regard to how it is incorporated in the National Economic Social Development Plan.

(8) Environmental fund supporting program on climate change

The detail has to be confirmed by ONEP.

(9) MOAC climate change master plan

Please refer section 4.3.2. Revised Policy Matrix of Agriculture as of August 2010.

ANNEX

Annex 4-1 MOAC Agriculture Global Warming Mitigation Plan (2008-2011)

The summary from ONEP National Master Plan on Climate Change Project is as follows.

The plan consists of three strategies as follows: (1) knowledge management; (2) prevention and solution of problems; and (3) information campaigns and dissemination, public relations, and personnel development. The total budget for 4-year operation is 1,013.68 million THB. Initially, the plan will target areas which grow economic crops and pilot areas in 9 sub-basins which are in risks of chronic droughts and degradation, totaling 18.6 million *rai*. Implementation of the plan is divided into 5 work plans the content of which can be summarizes as follows:

(1) *Plant work plan*: Studies on the impacts of cropping practices on global warming, adaptation of plant species to global warming, cultivation of perennial plants to provide natural water absorption and carbon storage in wood tissues and roots, rehabilitation of the environment and planting of fruit trees and economic perennial species in land reform areas, and mapping areas suitable for cultivating fuel crops.

(2) *Soil work plan*: Studies on the release of methane from paddy fields and carbon storage in tropical soils, mapping the carbon stock and organic matters contained in the various soil series, research on the appropriate measures, techniques, and practices for soil and water conservation, water storage in farmers' ponds, and reduction of soil evaporation.

(3) *Water work plan*: Studies to set up and install telemetry for forecast and warning in the basins, install devices to survey and monitor water level, water flow, and amount of precipitation.

(4) *Livestock and fisheries work plan*: Monitoring changes in water temperatures and fisheries resources, freshwater as well as marine, and migration of aquatic species, so as to learn about impacts from global warming; studies on ways to reduce GHG emissions from livestock, namely dairy cattle, swine, and poultry, such as management and use of farming waste, and adoption of livestock raising practices which are resilient and resistant to the warming climate.

(5) *Climate change and agriculture work plan*: Collection and setting up database on plants, soils, fisheries, livestock, and climate variability which would enable the utilization of information to solve the problems of and to promote adaptation to climate change; monitoring the impacts from droughts through satellites and geographic information system to prevent and solve the problems of desertification in northeast Thailand, to build preparedness in agricultural risk areas, and to map areas so as to determine how to assist farmers experiencing droughts; campaigning for tillage practices that reduce GHGs; extending good tillage practices and good soil, water and crop management to farmers; raising public consciousness and understanding about global warming; and educating and training personnel of the Ministry of Agriculture and Cooperatives to enable their true and correct understanding of the problems.

Projects in detail under the MOAC Master Plan (unofficial translation)
Strategy 1: Knowledge Management on World Climate Change Total Budget: 261.3 mil.THB

Plan Sector	Agency	Name of Project	Activity	Guideline of Activity	Budget (Million THB) 2008	2009	2010	2011	Expected Knowledge to be obtained	Output of Project
Sector of Plant	DOA	1. The Study on Impact of Plantations to Global warming	1.1 The Study on impact of Tree Plantation to Global warming	- Evaluate the Balance of Carbon and Water for tree plantation - Biomass production - Life Cycle Assessment	5	5	5	5	The result of study shows that Tree Plantation impact to Global warming in the aspect of protecting the global environment • Obtain the Carbon and Water balance evaluating technique which can apply to various types of tree Obtain LCA for Rubber • Obtain preliminary LCA for Mangosteen	Estimate environmental value of trees and use this data as indicator of status of Thai agriculture's to global environment
			1.2 The Study on impact of Farm/Crops Plantation to Global warming	- Evaluate the Balance of Carbon and Water for farm plantation - Biomass production - Nitrous Oxide emission	5	4	4	4	The study on direct impact shows both positive and negative result 1. Obtain the Carbon and Water balance evaluating data of Cassava and Sugarcane. 2. Obtain LCA of Cassava. 3. Obtain LCA of Sugarcane 4. Obtain the data on Nitrous oxide emission from corn plantation	
		2. The Study on Adaptation of plant type and plant breeding to	To Study on Adaptation of plant type and	- To study the effect of environmental change to	20	3	3	3	Obtain data on Adaptation of plant type and plant breeding to the environmental change for	Basic data as a guideline for adapting plantation system to face

		Climate Change	plant breeding to Climate Change	physical and growth of each plant type and plant breeding by controlling the internal environment (Phytotron)					Tree : Rubber , Longan and for Crops: Cassava, Corn, Soy Bean and Sugarcane. 1. Obtain temperature and optimum temperature of each type of plant. 2. Obtain the critical period of heat stress of each type of studied plant. 3. Obtain the adaptation mechanism of each type of studied plant in order to use as criteria in choosing the plant to grow under climate change.	global warming.
		3. Project to support production of plants which is used as raw material for Bio Degradable Plastic	3.1 Study on selection of quality plant breeding 3.2 Study on technology to increase plant production 3.3 Raw Material quality test 3.4 Machine Developmen t	- Selection of suitable plant and technology that give high quantity and suitable quality of starch for Bio Degradable Plastic Production and raw material testing - Define the suitable area for plantation - Study on supported machinery	5	5	5	5	Sufficient production of suitable starch and sugar as raw material for Bio Degradable Plastic Production 1. Obtain at least 1 suitable breed of Cassava 2. Obtain feasibility study data of starch to use as raw material 3. Obtain the prototype machine for each type of plant which is suitable for small industry	To provide suitable and sufficient raw material for Bio Degradable Plastic Production in Thailand. To support the production of Bio Degradable Plastic at the reasonable price in order to replace or reduce the use of more difficult degradable plastic to reduce Global Warming problems.

Sector of Soil	LDD	1. Study on Methane Gas Emission in rice field /rice field and storage of carbon in tropical soil		Prepare demonstration sites in 9 river basins to compare the results of Methane Gas emission and storage of carbon in rice field/rice field, field crops and orchard	15.039	8.276	8.276	5.20	Technologies to reduce Methane Gas Emission from rice filed, field crops and orchard. Educate farmers to understand this cause of Global Warming.	The study outcome will be utilized by farmers in the future.
	DOR				16.8					
	LDD	2. Project on Preparation of Map Showing Total Carbon storage in Soil and Land Use in Thailand		1. To collect samples of each type of plants at different ages all year round (by studying the amount of falling leaves/branches to plant production) and find relationship between plant waste and plant production. The organic litter to soil is calculated by considering ratio of biomass to yield. 2 Prepare Map of total Carbon storage in soil by applying GIS technology.	8	5	3	2	- Understand the source of Organic Waste from Biomass of various types of Thailand economic crops. - Prepare the Database and GIS Map showing sources and amount of Total Carbon storage in each type of soil, Organic Matter Map and Thailand Map C Sequestration	Guideline in management of National Economic Crop Plantation in order to reduce GHG emission.
Sector of	RRAA O	Study on impact of Global		1.Statistical analysis by using	1	1	-	-	Understand the change of pattern, amount and	Capacity to build models to forecast

Water	cooperate with TMD	Warming to amount and distribution of rainfall in Thailand		basic knowledge of meteorology. 2. Test on statistical assumption/ hypothesis 3. Summary and suggestion					distribution of rain fall in various regions both in the past and present which is facing Global Warming. Resulting in understanding the impact of Global warming to the rainfalls in Thailand.	rainfall by month, region in the future.
Sector of Livestock and Fishery	DOF	Monitoring the change of Temperature and Fishery Resources effected by Global Warming			19.830	10.175	10.175	10.175	- Data of environmental change - Data of the change of Natural Aquatic Resources - Effect of temperature on the change of Aquatic wildlife's and plants - Effect of changing temperature to the immigration of some aquatic wildlife's in Kong River Basins - Immigration Patterns of the studied species of aquatic wildlife's	Impacts of global warming to change of Environment and Fishery Resources in Gulf of Thailand, Andaman sea and Freshwater Fishery.
Climate Change to Agriculture	All agencies together with TMD	1.Project of creating database for prevention and solving problems from Climate Change		- installation of computer system & network and database program - Receive and input data - Data Analysis - Data service	21.35	20	5	5	Database and Network	Data service for solving and adapting to Climate Change problems.
TOTAL BUDGET for STRATEGY 1					**117.02**	**61.45**	**43.45**	**39.38**		

Strategy 2: Prevention and Solving Global Warming Problem Total Budget: 407mil THB

Plan Sector	Agency	Name of Project	Activity	Guideline of Activity	Budget (Million THB) 2008	2009	2010	2011	Expected Knowledge to be obtained	Output of Project
Sector of Plant	OAE / LDD / DLD /DOF	1. Project of Adaptation to deal with Global Warming on Agricultural Economy and farmers household		- Collection of Agricultural Economy data for analyzing economic impact. - Assess the economic impact of climate change to agricultural production and impact of drought and flood.	15.3	13.8	12.8	11.8	- Data on economic damage caused by drought, flood and disasters in agriculture sector. - Trend of production and growth development of major economic plants in the core farmlands of Thailand by forecast impact of climate change based on the scenarios.	- Data shows severity of damage to agriculture sector and build awareness to future damage. - Data to formulate Adaptation Plan to be accord with impact trend caused by predicted climate conditions (GCMs).
	LDD / all agencies	2. Project on Tree plantation		- Promotion of tree plantation in farm land and empty area of community area, especially in high risk critical area in 12 provinces and 9 river basins	21.58	10	10	10	- Areas for water absorption by nature and reduce damage by flood and convert more humidity to community area and store Carbon from forest to soil.	- Farmer and people reduce risk and property loss from disasters, esp. from flood and increase richness of farmlands

Plan Sector	Agency	Name of Project	Activity	Guideline of Activity	Budget (Million THB) 2008	2009	2010	2011	Expected Knowledge to be obtained	Output of Project
	ALRO	3. Project on environmental rehabilitation in Land Reforming Area		- Manage the fixed land utilization to prevent forest encroachment. - Define the Land Reforming Area and ensure that At least 20% of the area contains fruit orchard and economic trees (as per Cabinet Resolution on 30/06/98) - As per Land Reforming Committee, the condition of land utilization is defined.	1	1	1	-	- Create consciousness to maintain the area and environment in the Land Reforming Area - Create the food source for community - Reduce the expense and increase the income for community	10% of Land Reforming Area has been promoted to plant economic trees in order to store carbon.
	LDD	4. Project on finding the suitable areas to grow the plants for alternative energy.		1. Study on related factors for each type of plant and prepare map by using GIS technology.2. Planting various types of plant for alternative energy in the experimental plots in 12 areas of in order to analyze the growth, model, record the Organic Recycling Value from various parts of the plant and study the increment of OM value in term of Total Carbon Value in soil.	20.8	16.8	10.8	10.8	- Understand the necessary factors in planting the plant for alternative energy in Thailand - Map showing the suitable area for planting the plant for alternative energy in Thailand - Understand the amount of GHG that can be absorbed by plants for alternative energy - Increase the green	- Understand the Carbon absorbed area in agriculture and amount of Carbon which can be absorbed - Understand the suitable area for planting the plants for alternative energy in order to help in planning the production and ability to replace the utilization of fossil fuel

Plan Sector	Agency	Name of Project	Activity	Guideline of Activity	Budget (Million THB) 2008	2009	2010	2011	Expected Knowledge to be obtained	Output of Project
									area for GHG absorption by testing the area suitability in 9 sub river basins by planting Palm oil, Cassava and Sugarcane.	
Sector of Soil	LDD	Project of Water and Soil Conservation to maintain the water content in soil due to the impact of Climate Change		- Set up the System for Water and Soil Conservation - Use Application Software to find suitable area for small reservoirs by using the principle of Hydrology together with various measures to maintain small reservoirs, study the comparison of soil management - Field survey of pond(s) in the farmland by finding the relationship between evaporation rate vs various depth of pond which effect to increasing/ decreasing of water temperature, Oxygen content, living things	6	2	2	1	- Measures, techniques and suitable method for water and soil conservation; maintain water level in the pond and reduce the water evaporation from soil - Guideline for administrative soil resource management to maintain and maximize the use of water in soil	For water management and selection of suitable type of plants for existing amount of water supply, the data of evaporation rate and methods to prevent water evaporation is applied.

Plan Sector	Agency	Name of Project	Activity	Guideline of Activity	Budget (Million THB) 2008	2009	2010	2011	Expected Knowledge to be obtained	Output of Project
				both in the water and at the surface including what cover the water surface.						
Sector of Water	RID	Studying project to set-up and install Telemetering System for disaster forecasting and early warning in the river basin areas		Install irrigated equipments for monitoring water level and water flow of rainfall.	RID Annual Budget					
Sector of Livestock and Fishery	DLD	1. Set-up the suitable management system for Livestock Production in order to prevent the cause and to solve the problems of global warming. 2. Set-up the suitable Livestock Production System that is suitable to global warming situation.		- Study on GHG emission and impact from Livestock Production. - Study on Animal Waste Management and Livestock Management to prevent and solve the global warming problems.	20.3255	16.5755	16.5755	16.5755	- Reducing impact on global warming from livestock Production. - Utilize the waste from animal farm. - Maintain the environment and set the policies to prevent and solve the global warming problems.	
				- Select the breed that can tolerate the higher humidity and increasing of global temperature (for Beef Cattle, Dairy Cattle, Buffalo, Pig, Poultry)	18.0753	16.3253	16.3253	16.3253		
Sector of	LDD	Project on		- to produce digital	28.8	23	21	19	- To obtain the map and	- Map showing

Plan Sector	Agency	Name of Project	Activity	Guideline of Activity	Budget (Million THB) 2008	2009	2010	2011	Expected Knowledge to be obtained	Output of Project
Climate Change to Agriculture	together with Meteoro logical Dept. and Ministry of ITC	monitoring impact to draught in soil and economic crops in Thailand by using Satellite Technology and GIS and prevention of transforming to dessert in the north eastern area of Thailand		data, map of draught and type of impacted land by using whole data from past to present, to do field survey, to evaluate the impact of draught by using data interpreted from satellite technology and GIS and to set-up mathematical models - Study on type of land use and risk area to draught by using Satellite Technology together with Field Survey to monitor the frequency of draught and ratio of physical and economical impact. - Integrated activities to solve the problem of Saline Soil - Planting trees that can solve saline soil problem - Planting trees that can tolerate to saline soil to improve/ adjust the quality of					detail of impact from draught to use as reference in defining guideline for land development and helping farmer to mitigate and solve the problems from draught in the future and also use as basic information for monitoring/ forecasting the impact of draught in the future - To obtain the map showing area and type of land use, number of household and number of farmers living in the high risk situation and need help/support	repeatedly draught area in term of location, size, frequency, time, length of time and type of land use - Understand the area, type of land use and number of farmers who live in the high risk situation and need help/support

Plan Sector	Agency	Name of Project	Activity	Guideline of Activity	Budget (Million THB) 2008	2009	2010	2011	Expected Knowledge to be obtained	Output of Project
				soil - Conservation of water and soil by planting Vetiver Grass						
TOTAL BUDGET for STRATEGY 2					131.88	99.50	90.50	85.50		

Strategy 3: Public Campaign, Public Relations, Giving Knowledge and Personnel Development Total Budget: 345mil THB

Plan Sector	Agency	Name of Project	Activity	Guideline of Activity	Budget (Million THB) 2008	2009	2010	2011	Expected Knowledge to be obtained	Output of Project
All 5 Sectors - Plant - Soil - Water - Livestock & Fishery - Climate Change to Agriculture	LDD / DOR and all agencies under MOAC	1. Project to campaign ploughing rice stubble up and over to reduce GHG emission and expand the campaign to reduce open burning		1. Selection of sample areas in 6 sub-basins and study on comparison of GHG emission during plantation at various times, from burning and from ploughing rice stubble up and over. 2. Prepare demonstrated rice field to show how to plough rice stubble up and over after harvesting and	64	38	37	36	- Educate farmers the impact of burning rice stubble to Global Warming - Reduce rice stubble burning and promote awareness and understanding to farmers - Farmer to apply technology of soil quality improvement to decelerate the degradation of the soil in rice field - Promote the natural resources conservation and maximize the utilization of that	- Obtain technical data to support free burning campaign and to confirm GHG emission in Thailand - Farmers can integrate the soil improvement with soil & water conservation in planting economic crops

Plan Sector	Agency	Name of Project	Activity	Guideline of Activity	Budget (Million THB) 2008	2009	2010	2011	Expected Knowledge to be obtained	Output of Project
				to compare the rice production with the burning rice field and with the neglect rice field and also provide training to farmers.					resources	
	All agencies	2. Project to create awareness for the necessity of adaptation to climate change		Prepare & distribute the leaflets & media for public relations	20	20	20	10	Farmers understand the necessity of adaptation to climate change	Farmers change behavior on farm management
	All agencies	3. Project on capacity building of Officers and Farmers for adaptation to climate change		• Trainings and study tours on adaptation to climate change • Study tours both domestic and international	25	25	25	25	200 officers and 60,000 farmers gain knowledge and understanding on technology of adaptation to climate change	The knowledge and technology for adaptation to climate change can be applied by officers and farmers.
TOTAL					**109**	**83**	**82**	**71**		
GRAND TOTAL					**345**					

Annex 4-2 Master Plan for Climate Change of National Parks, Wildlife's and Plants Division (unofficial translation)

Vision: To be the leader in National administrative management of forest conservation to reduce Climate Change, to create awareness and to encourage the participation of all parties.

Implementation:

1) To administer the area of forest conservation with cooperation to reduce Climate Change
2) To develop human resource, database, knowledge and suitable technology in order to administer the forest conservation to reduce Climate Change
3) To create consciousness and awareness by all related parties to understand how influent the forestry has to the Climate Change

Objective:

1) For administering the area of forest conservation with cooperation to reduce Climate Change
2) For developing human resource, database, knowledge and suitable technology in order to administer the forest conservation to reduce Climate Change
3) For creating consciousness and awareness by all related parties to understand how influent the forestry has to the Climate Change

Point 1: To reduce the Climate Change	Point 2: To prevent the effect of Climate Change	Point 3: To adjust to the effect of Climate Change
Strategies; 1.1 To prevent the invasion and destroy the forest conservation area 1.2 To increase the potential source of Green House Gas Absorption in the forest conservation area 1.3 To reduce the Green House Gas Emission from tourism in the forest conservation area 1.4 To administrative manage the fire to reduce Climate Change	Strategies; 2.1 To improve the capability in estimating the effect of Climate Change to forestry ecology and variety of biology's. 2.2 To improve the capability in estimating the effect of Climate Change to tourism in the forest conservation area. 2.3 To prevent and reduce the effect of Climate Change to Ecology and variety of biology's. 2.4 To prevent and reduce the effect of Climate Change to the natural educational & tourism area.	Strategies; 3.1 To improve the capability in adjusting the Ecology and variety of Biology's in the forest conservation area. 3.2 To manage the recovery methods for National wildlife's resources and habitats which was effected by the Climate Change. 3.3 To improve the capability in estimating the effect of Climate Change to tourism in the forest conservation area. 3.4 To prevent and reduce the effect of Climate Change to Ecology and variety of biology's. 3.5 To prevent and reduce the effect of Climate Change to the Natural educational & tourism areas.
Projects; 1) To define and adjust the boundary of the forest conservation area. 2) To produce the map of land utilization in the forest conservation area. 3) To encourage the local communities to involve in protecting the forest conservation area.	Projects; 1) To develop database of climate condition by install the meteorological station in the forest conservation area. 2) To produce the map of critical area where it is affected by the Climate Change. 3) To develop the bio-indicator to indicate the effect	Projects; 1) To study and set up the priority of fragile Ecology and sensitive species. 2) To create options for the adjustment of forestry Ecology and species. 3) To study the response of forestry Ecology to the Climate Change.

4) To adjust Rules, Regulations and define Economic Procedures to attract public to look after the forest and to increase the area of forest. 5) To set priority of plants/trees which show potential to absorb the Green House Gas in the forest conservation area. 6) Recovering the destroyed forest conservation area in order to adjust the ecology and to be Carbon storage. 7) To study and analyze the positively attractive procedure in order to increase the efficiency of Green House Gas storage in the forest conservation area. 8) To reduce the Green House Gas emission from the energy aspect in the tourist area. 9) To reduce the Green House Gas production from the transportation in the tourist spots within the forest conservation area. 10) To support the use of replaceable energy in the tourist spots. 11) Efficiently manage the waste in the tourist spots within the forest conservation area. 12) To study the suitable procedure in Law/Economic to reduce the Green House Gas emission from the energy aspect in the tourist spots. 13) To develop the Mathematical Model to estimate fire-risk area and effect to Ecology. 14) To develop the Fire searching/detection system in order to estimate the fired area and the amount of the Green House Gas emission by using long distance detection technique. 15) To develop the fire protection and control system with the other departments. 16) To set up the fire protection plan for each type of fire in order to reduce the Climate Change on the basis of sustainable ecology. 17) To provide the Fire control equipment and to develop the patrol routes in the forest conservation area.	of Climate Change to Ecology and variety of biology's. 4) To develop the model to estimate the effect of Climate Change to Ecology and variety of biology's. 5) To develop the model to estimate the effect of Climate Change to water balance. 6) To estimate the value of damage in the aspect of Economic, Social and Environment from Climate Change to Ecology and variety of biology's. 7) To develop the index to indicate the high risk tourist spots from Climate Change. 8) To set up GIS to show the status of tourist spots with high possibility effect from Climate Change. 9) To estimate the value of damage in the aspect of Economic, Social and Environment from Climate Change to major tourist spots in the forest conservation area. 10) To study the effect of climate factors to life cycle and reproductively of plant's, wildlife's and Bacteria's in the high risk area from Climate Change. 11) To study the permanent change of forest Ecology. 12) To study the possibility to connect the forest conservation areas with forest. 13) To stop/control of the expansion of the plants or wildlife's from the other areas in the high risk Ecology. 14) To conserve the variety of biology's in situ and ex situ to create the suitable new habitat. 15) To study the short-term effect and long-term effect of fire to forestry ecology and variety of biology's. 16) To set up the warning system and plan to help tourists in the high risk area. 17) To define the suitable season(s) for tourist to visit	4) To improve the new species of plants/trees to be able to stand the changes of many factors due to Climate Change. 5) The sensitive species of plants/trees should be kept in the Genetic Bank. 6) To improve the habitat of wildlife's. 7) To look after the wildlife's who effected from the Climate Change. 8) To help looking after the wildlife's who effected from the Climate Change and release them back to the forest conservation area when they are strong enough. 9) To study the behavior of the wildlife's who effected from the Climate Change. 10) To manage the water resource in the tourist spots in the forest conservation area and to increase the efficiency in utilizing water. 11) To support and develop the eco-education & the conservative travelling in the forest conservation area. 12) To define the forest conservation area where there is high risk to the spreading of diseases, insects and disease-carriers. 13) To monitor the spreading of diseases by wildlife's both in situ & ex situ of forest conservation area.

18) To investigate the characteristic of economic, social and culture where there is related to the habit of fire utilization of people in the forest area. 19) To develop the prescribed burning in forestry ecology where there is related to reduce the Climate Change.	for the high risk area. 18) To specify the procedure and control the polluted air in the high risk area to Climate Change.	

Point 4: To develop the Knowledge and Technology	**Point 5: To create the consciousness & awareness**	**Point 6: To develop Human Resource & Cooperation**
Strategies; 4.1 To collect and create the knowledge & understanding of Climate Change. 4.2 To create Knowledge and Technology of monitoring & examining in collecting / releasing the Green House Gas of Ecology in forest conservation area	Strategies; 5.1 To develop the knowledge and create the awareness to the climate changing to the Government Offices. 5.2 To create the awareness and consciousness to public to realize the important & effect of climate changing in the forest conservation area. 5.3 To create potential cooperation in conservation of the forests.	Strategies; 6.1 To support the officers to continuously receive the development of knowledge and skills to work efficiently in the related field. 6.2 To produce the mechanism of knowledge transfer and exchange the experience among the related organizations or even in the same organization. 6.3 To support & develop the working procedure in the international cooperative framework.
Projects; 1) To create the database system which the central administrative office can link, set up the access & utilization and coordinate with the other parties for requesting the related information. 2) To investigate and produce database of resources of variety of Biology's in the forest conservation area. 3) To study the results of Climate Change to the type of fire. 4) To develop the factor for estimating the Green House Gas Emission in forestry aspect. 5) To study the efficiency of carbon collecting and storing in the forestry Ecology. 6) To develop the estimation of carbon collecting and storing in the forest conservation area by using the long distance detection technique.	Projects; 1) To collect and create the knowledge from researches of various departments to produce various materials to public. 2) Arrange training to provide knowledge & understanding to the government officers. 3) Promote local working network to deal with Climate Change. 4) Set up plan to provide knowledge of Climate Change in the aspect of both effect and the ways of self-adjustment of the forest conservation area. 5) Continuously creates promoting activities in various forms in order to create consciousness of the public to the important of the forest. 6) To produce the various types of advertising materials for both general and special occasions.	Projects; 1) To set up systematic plan for developing human resource to deal with the Climate Change. 2) To set up the training, site visit, meeting, seminar in order to exchange the knowledge about how to deal/manage with the Climate Change in the forest conservation area. 3) To set up the budget for related officers to develop and gain academic knowledge and skill about Climate Change. 4) To create working network among the related officers with the officers in the other sections. 5) To create the working system which is suitable for continuously & systematically knowledge transferring. 6) To produce handbook about all knowledge of

7) To develop the knowledge of Carbon Flux and Carbon Balance of various forestry Ecology. 8) To research to create the Ideal Climate for Thailand.	7) Set up and support activities in school to create the consciousness & awareness to the students & youths. 8) To produce the materials for the meanings of nature in both tourist spots and also the educational spots in the forest conservation area. 9) To create the mechanism to continuously monitor and estimate the results of advertising activities. 10) To give the knowledge, to create the local network and to do public relation in order to prevent fire in forest to reduce the problems from Climate Change._ 11) Set up the operational/research training to the community leaders. 12) Set up the competition among the villages in the theme of development of community forest to solve the Climate Change problems.	Climate Change in the forest conservation area in order to use as reference in the seminar. 7) To produce the Annual Summary Report and Future Plan to distribute to government offices and public. 8) To support the officers to join the International Conference and the meeting of Climate Change 9) To study the potential channels for business which are related to Climate Change i.e. Carbon Trading. 10) To study the possibility of discussing and co-working in Climate Change in the global negotiation..

Annex4-3 Action Plan for Solving Problem of Haze and Forest Fire Year 2008-2011 (unofficial translation)

- **Strategy 1 : control burning in both public and agricultural areas**

  1. **Measure to control open burning in residential area**
     - For resident in target area: no rubbish burning, no roadside grasses or weeds burning
     - The rubbish in the target area not less than 30% will be properly managed.
     - Develop and promote recycle centre in the target area
     - Investigation and law will be strictly apply to the pollution sources, types, manufacturers, vehicles and open burning
  2. **Measure to control open burning in agricultural area**
     - For target agricultural area in 25 provinces, at least 2000 Rai/year should be set up as pilot area to use the burn- free agricultural technology. Each province will have maintenance centre for burn- free agriculture. The Bio-extract substance used in burn- free agriculture should be demonstrated. Set up the pilot operation for burning management.

- **Strategy 2 : control forest fire**

  3. **Measure to control open burning in conservative forest**
     - For 103 million Rai of conservative forest; the measure to increase efficiency of controlling forest fire by encouraging the people in the area to cooperate, monitor & warn of the possibility of forest fire, to prevent & to help distinguish the forest fire should be promoted.
  4. **Measure to control open burning in protected forest**
     - For 56 million Rai of protected forest; to prevent and control forest fire, the transfer of responsibility to local administrative agencies should be done by setting the forest fire coordination centre in target area of 64 provinces. The measure of forest fire control should be promoted by having the people in the area to cooperate, monitor & warn of the possibility of forest fire, to prevent & to help distinguish the forest fire.
  5. **Royal Artificial Rain**
     - For the area that faces the Haze problem and forest fire, the Royal Artificial Rain should be done to reduce the problem.

- **Strategy 3 : campaign, advertise, publicise the knowledge, participation, monitoring, protecting and impact on public health**

  6. **Campaign, advertise, publicise the knowledge**
     - Continuously Campaign (especially during 6 months of dry season) for no roadside burning the rubbish & grasses and no forest fire, give knowledge of rubbish management (reduce, separate & recycle). The campaign can be done through radio, TV, leaflet, poster and/or advertisement board.
     - There are more than 300 schools/year join the competition of Recycle Bank Project.

- Advertise the news and information of Haze situation by Advertisement Centre of haze and forest fire situation.

7. Measure of public participation

- Set up the Database and IT Centre to manage resource and prevent the haze problem for public.
- Promote the general knowledge of Haze and Forest Fire problems to consumer/resident in the target area.
- Set up the action plan to integrate the water management at the source and in the town.
- 2000 communities have set up their action plan for forest fire management.
- Set up the boundary of forest fire prevention more than 8 million Rai.
- Volunteer for forest fire prevention more than 20,000 volunteers.
- Set up the prototype community forest with high potential in forest management more than 80 community forests.
- Restoration Action Plan for Ecology System in the Lowland.
- At least 10 Learning Centres in the sub-lowland areas.
- Set up more than 5000 of suitable weirs/dams to slow down the water current.
- Set up more than 80 areas to cooperate in land management in order to prevent and solve the haze and forest fire problem.
- Learning centre, advertise/broadcast the suitable production for high land.

8. The monitoring and warning of haze and forest fire situation Centre

- Advertise the news, information and update the situation of haze and forest fire situation by Provincial Coordination Centre for solving the haze and forest fire problem. In case of Haze Crisis, the press release on results of action to prevent and solve the problem should be done continuously.
- One set of accurate haze pollution forecasting system and warning system for various levels should be installed.
- Set up the semi permanent of 10 Ambient Quality Monitoring Stations in 10 provinces within year 2011.

9. Educate inside and outside school of the pollution from haze and forest fire

- Set up learning centre for Haze and Forest Fire Pollution Prevention and Control in 64 target areas.

10. Research

- Research on the reason of Forest Fire and Open Burning.
- Model of relationship between burning spot and haze movement and the concentration of dust size less than 10 microns.
- Research result between the vision and level of dust size less than 10 microns.

- Database of diseases and symptoms caused by Haze pollution, sick rate, dead rate, hospital admission rate, emergency hospital admission rate and expense in the hospital.
- Database of number of burning spots, size and position on the map by areas.
- Mathematical model for the relationship of air pollution, meteorological characteristic and cause of disease.

11. Monitoring and Prevention the impact to Public Health

- Sickness rate of breathing system less than 20% compare with the previous year.
- Set up the structure of commanding and information reporting for situation of Haze pollution affected persons.
- Produce handbook for emergency actions.
- Reporting system for health impact.
- Develop the capability of health officers in the high risk areas.
- Prepare the medicine and medical equipment.
- Personal protection device for people in the high risk areas.

Annex 4-4 The Action Proposals for CCPL by Royal Forestry Department

Summary of three Action Plans against Climate Change Program Loan under the Cool Earth Partnership (Unofficial Translation)

Project/Division	Budget (THB)			Total
	Year 1	Year 2	Year 3	
1. Afforestation and Reforestation to Increase Forest Cover and Carbon Stocks,/State Reforestation Division	826,300,000	775,700,000	933,300,000	**2,535,300,000**
2. Forest-tree seedlings production to encourage the participatory of the public / Forest Nursery Division	218,000,000	220,000,000	220,000,000	**658,000,000**
3. Promotion of the economic-tree plantation for socio-economic and environment improvement / Private Reforestation Division	554,700,000	757,200,000	232,500,000	**1,544,400,000**
Total	**1,599,000,000**	**1,752,900,000**	**1,385,800,000**	**4,737,700,000**

4-4-1. Afforestation and Reforestation to Increase Forest Cover and Carbon Stocks,/State Reforestation Division

Activity	Year 1 (quater)				Year 2 (quater)				Year 3 (quater)			
	1	2	3	4	1	2	3	4	1	2	3	4
1. Afforestation and reforestation												
1.1 Site survey and boundary demarcation												
1.2 Site preparation												
1.3 Species selection and seedlings preparation												
1.4 Planting												
2. Maitenance												
2.1 Fertilizer application												
2.2 Weeding												
2.3 Survival rate and growth measure and re-planting												
2.4 Forest fire protection												
3. Capacity building												
3.1 Workshop												
3.2 Reserch publication and dissimination												
4. Monitoring and evaluation												
4.1 Internal controling and monitoring												
4.2 Project evaluation by the educational institute or third party												
5. Reporting												
5.1 Progress report												
5.2 Fiscal year report and Final report												
5.3 Seminar on the result of the project												
6. Administration												
6.1 Adminitration												

Budget

Activity	Year 1				Year 2		Year 3	
	Amount	Unit	Unit cost (Bath)	Total (Bath)	Amount	Total (Bath)	Amount	Total (Bath)
1. Afforestation and reforestation	300,000	Rai	2,500	750,000,000	200,000	500,000,000	200,000	500,000,000
2. Maintenance					300,000	204,000,000	500,000	340,000,000
3. Capacity building								
3.1 Workshop	1	Time	1,000,000	1,000,000	1	1,000,000	1	1,000,000
3.2 Research publication and dissemination	5	Topic	50,000	250,000	5	250,000	5	250,000
4. Monitoring and Evaluation								
4.1 Project evaluation							1	7,000,000
5. Reporting								
5.1 Progress and Final report	100	Copy	500	50,000	100	50,000	100	50,000
5.2 Seminar on the result of the project							1	1,000,000
6. Administration	1	Project	75,000,000	75,000,000	1	70,400,000	1	84,000,000
Sub-total				**826,300,000**		**775,700,000**		**933,300,000**
Total	**2,535,300,000**							

4-4-2. Forest-tree seedlings production to encourage the participatory of the public / Forest Nursery Division

Activity	1 st Year (quarter)				2 st Year (quarter)				3 st Year (quarter)			
	1	2	3	4	1	2	3	4	1	2	3	4
Preparation of Work Plan and Budget Plan of Project	■				■				■			
Preparation of public relations document and knowledge dissemination on forest nursery and tree plantation to reduce global warming	■	■	■	■	■	■	■	■	■	■	■	■
Public relation and invite people to join project	■	■	■	■	■	■	■	■	■	■	■	■
Prepare network and database system for whole country	■	■	■	■								
Preparation of general nursery and teak nursery	■	■	■	■	■	■	■	■	■	■	■	■
Distribute nursery to government office, private sector, organization and public			■	■			■	■			■	■
Follow-up and monitor project				■				■				■

1. Operation Units are: 14 Nursery Center, 77 Nursery Stations, Forest Development of Thung Kula Ronghai Project 1-2 Total units are 93 units.
2. Type of nursery will be provincial's tree, economy tree, food tree, local tree and other trees that people need to plant.

Budget

Activity	1st Year				2nd Year		3rd Year	
	Quantity	Unit	@ (THB)	Budget (THB)	Quantity	Budget (THB)	Quantity	Budget (THB)
General Nursery	100,000,000	Seedling	1.93	193,000,000	100,000,000	193,000,000	100,000,000	193,000,000
Teak Nursery	500,000	Seedling	7	3,500,000	1,000,000	7,000,000	1,000,000	7,000,000
Implementation and Monitoring	12	Times		20,000,000	12	20,000,000	12	20,000,000
Prepare Network and Database System	1	Times		1,500,000				
Sub-total				**218,000,000**		**220,000,000**		**220,000,000**
Total	**658,000,000**							

Type of nursery will be provincial's tree, economy tree, food tree, local tree and other trees that people need to plant.

4-4-3. Promotion of the economic-tree plantation for socio-economic and environment improvement / Private Reforestation Division

Activity	1st Year				2nd Year				3rd Year			
	1	2	3	4	1	2	3	4	1	2	3	4
1. Public Relations and Registration farmers who participate in the project												
2. Training staff and farmers who participate in project												
3. Seedling Procurement												
4. Giving Technical Instruction												
5. Fund support to farmers												
1st year 1,500 THB/Rai												
2nd year 1,000 THB/Rai												
6. Project Follow-up and Monitor												

Budget

Activities	1st Year				2nd Year		3rd Year	
	Quantity	Unit	@ THB	Budget THB	Quantity	Budget THB	Quantity	Budget THB
1. Public Relations and Registration farmers who participate in the project	150,000	Rai	300	45,000,000	150,000	45,000,000	-	-
2. Training				4,200,000		4,200,000	-	-
2.1 RFD's Officers 6 groups, each group 100,000 THB	6	Group	100,000	600,000	6	600,000		
2.2 Farmer 60 groups, each group 60,000 THB	60	Group	60,000	3,600,000	60	3,600,000		

Activities	1st Year				2nd Year		3rd Year	
	Quantity	Unit	@	Budget	Quantity	Budget	Quantity	Budget
			THB	THB		THB		THB
3. Seedling Procurement	150,000	Rai	1,320	198,000,000	150,000	198,000,000	-	-
4. Giving Technical Instruction	150,000	Rai	300	45,000,000	150,000	67,500,000	150,000	45,000,000
5. Fund support to farmers				225,000,000		375,000,000		150,000,000
1st year 1,500 THB/Rai	150,000	Rai	1,500	225,000,000	150,000	225,000,000		
2nd year 1,000 THB/Rai					150,000	150,000,000	150,000	150,000,000
6. Project Follow-up and Monitoring System	150,000	Rai	250	37,500,000	150,000	67,500,000	150,000	37,500,000
Total				554,700,000		757,200,000		187,500,000
Grand Total								1,544,400,000

4-4-4. Proposal against CCPL by RFD

I: Project on Promotion of Economy Trees Plantation for Economy, Social and EnvironmentUnder Climate Change Program Loan

1. Name of Project: Promotion of Economy Trees Plantation for Economy, Social and Environment

2. Justification

Forest is one of the most important resources of country in term of economy, social and environment. However, due to economic development, industry and technology, the requirement to use land for agriculture is increasing rapidly. Hence, people encroachment to forest is expanding seriously. Therefore, it is quite necessary for reforestation in Thailand.

Economy Sector

In the past, wood was one of the main products in the top five of export products of Thailand. After serious deterioration of forest, the Thai government banned logging from natural forest since 1989. While the domestic need for using wood is increasing yearly. Thailand has to import wood products from foreign countries at least 50,000 mil. THB/year. Thailand has a big balance of trade deficit while in other countries has started awareness on deterioration of forest and run campaign to protect their natural forests. Also, there is conservation trend that the product should use raw material from forest plantation, not natural forest.

Social Sector

Nowadays, there are some materials can be used as wood, but Thai society is still prefer wood, especially people in rural areas are need woods for household use such as construction of house, making tools and use as energy source like charcoal. The price of wood is still very high and illegal logging is existed, it is one of social problem. Moreover,

After forest was destroyed, environment condition getting worse, brings agricultural production down. Rural people have to go in urban area in order to find job for their living. This also brings problems to urban area including traffic problem and crime. Therefore, promotion of trees plantation will not only creating jobs in rural area but also people will have wood for their domestic use, reduce expenses and reduce other social problems.

Environmental Sector

Due to serious forest deterioration, carbon dioxide in atmosphere will be increased and brought Green House Effects, increasing of temperature and global warming Natural disaster such as draught and flood comes yearly. Every country must cooperate and solve problems together by forest plantation to mitigate environmental problem. In Thailand, this promotion can be promoted in all parts that facing draught and deterioration situation. Result of studies shows that fast growing trees plantation in deteriorated are will assist to maintain ecology balance and improve Microclimate stabilization) in local area. People are able to use their own agricultural land to plant forest which is another source of income.

3. Objective

1. To create income from fast growing trees and economy trees
2. To increase forest cover and solve problem of global warming
3. To create job for local people and solve problem of labor immigration to urban area
4. To stimulate economy in accordance with cabinet's policy

4. Target

Area of 600,000 Rai will be promoted for economy trees plantation. During the project, maintenance of forest plantation will be done for 2 years continuously.

Total time of project will be 3 years.

4.1 Target Area

4.1.1 Type of area will be promoted

- Area with land titling
- Area with legal occupation rights

4.1.2 Amount of Area

- 1st year: plantation 300,000 Rai
- 2nd year: plantation 300,000 Rai

Maintenance of 1st year plantation 300,000 Rai

- 3rd year: Maintenance of 2nd year plantation 300,000 Rai

4.2 Household Target

Beneficiary households from this project are 40,000 households or about 100,000 persons (1 Household will have forest plantation for 15 Rai)

5. Implementation Plan

5.1 Promote economy trees plantation in accordance with suitable type and species for local area conditions, including instruction and maintenance

5.2 Provide seedlings for people who participated in the project

5.3 Give technical instruction for planting and maintenance of trees

5.4 Fund support for 2,500 THB/Rai. Term of payment will be divided into 2 years, 1st year: 1,500 THB/Rai for planting and 2nd year: 1,000 THB/Rai for maintenance

5.6 Monitor the project

6. Activity

6.1 Public relation to farmer for joining the project, farmer's registration for 600,000 Rai (1st year: 300,00 Rai, 2nd year: 300,000 Rai)

6.2 Provide seedling for participants of project

6.3 Giving technical instruction for planting and maintenance of fast growing trees and economy tree

6.4 Fund support at rate of 2,500 THB/Rai to participants

6.5 Monitoring the project

7. Working Plan

Activity	Work Plan in 1st Year											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
1. Public Relations and Farmer's Registration for participation												
2. Providing seedlings												
3. Giving Technical Instruction												
4. Supporting fund to farmers 1st Year: 1,500 THB/Rai												
5. Monitoring												
Total												

8. Budget

Total Budget is 2,814,000,000 THB. The breakdown is as follows;

(unit: million THB)

Activity	Investment Cost							
	Year 1-3		1st Year		2nd Year		3rd Year	
	Budget	Loan	Budget	Loan	Budget	Loan	Budget	Loan
1. Public relations and Farmer's Registration for participation to project	-	180	-	90	-	90	-	-
2. Provide seedlings	-	792	-	396	-	396	-	-
3. Giving Technical Instruction	-	270	-	90	-	135	-	45
4. Supporting fund 2,500 THB/Rai	-	1,500	-	450	-	750	-	300
5. Monitoring	-	72	-	24	-	36	-	12
Total	**-**	**2,814**	**-**	**1,050**	**-**	**1,407**	**-**	**357**

9. Implementation Area

9.1 Area with land titling

9.2 Area with legal occupation rights

10. Expected Output

Increase raw material for wood industry and supply to factory such as power plant, pulp factory, lumber, piling and wood for furniture industry

11. Indicator

- Number of plantation area 600,000 Rai
- Participants to the project will be satisfied not less than 80%

12. Responsible Agency

- Main responsible agency is Community Forest Section, State Reforestation Division, Royal Forest Department
- Supporting agencies such as
  (1) Provincial Forest Office
  (2) Regional Forest Management Office

II. Project on Promotion of Fast Growing Trees Plantation as Raw Material for Wood Industry and Alternative Energy

Under Climate Change Program Loan

1. Name of Project: Promotion of Fast Growing Trees Plantation as Raw Material for Wood Industry and Alternative Energy

2. Justification

Forest is one of the most important resources of country in term of economy, social and environment. However, due to economic development, industry and technology, the requirement to use land for agriculture is increasing rapidly. Hence, people encroachment to forest is expanding seriously. Therefore, it is quite necessary for reforestation in Thailand.

Economy Sector

In the past, wood was one of the main products in the top five of export products of Thailand. After serious deterioration of forest, the Thai government banned logging from natural forest since 1989. While the domestic need for using wood is increasing yearly. Thailand has to import wood products from foreign countries at least 50,000 mil. THB/year. Thailand has a big balance of trade deficit while in other countries has started awareness on deterioration of forest and run campaign to protect their natural forests. Also, there is conservation trend that the product should use raw material from forest plantation, not natural forest.

Alternative Energy

At present, situation on fuel prices such as petroleum, coal and natural gas are increasing due to higher demand. These fuels are non-reuseable fuel and cause of green house effect and global warming. It is necessary for Thailand to pay interest on alternative energy. This project will reduce emission of carbon dioxide to atmosphere by tree plantation (especially fast growing tree). The carbon will be stocked in wood and the tree can be used for energy sector in short period (about 2 years)

Social Sector

Nowadays, there are some materials can be used as wood, but Thai society is still prefer wood, especially people in rural areas are need woods for household use such as construction of house, making tools and use as energy source like charcoal. The price of wood is still very high and illegal logging is existed, it is one of social problem. Moreover,

After forest was destroyed, environment condition getting worse, brings agricultural production down. Rural people have to go in urban area in order to find job for their living. This also brings problems to urban area including traffic problem and crime. Therefore, promotion of trees

plantation will not only creating jobs in rural area but also people will have wood for their domestic use, reduce expenses and reduce other social problems.

Environmental Sector

Due to serious forest deterioration, carbon dioxide in atmosphere will be increased and brought Green House Effects, increasing of temperature and global warming Natural disaster such as draught and flood comes yearly. Every country must cooperate and solve problems together by forest plantation to mitigate environmental problem. In Thailand, this promotion can be promoted in all parts that facing draught and deterioration situation. Result of studies shows that fast growing trees plantation in deteriorated are will assist to maintain ecology balance and improve Microclimate stabilization) in local area. People are able to use their own agricultural land to plant forest which is another source of income.

3. Objective

1. To create income from fast growing trees and economy trees for farmers and solve problem of labor immigration to urban area
2. To produce wood as raw material for wood industry and use as alternative energy
3. To increase forest cover and solve problem of global warming

4. Target

Area of 200,000 Rai will be promoted for fast growing trees During that period, maintenance of forest plantation will be done for 2 years continuously. Total time of project will be 3 years.
Beneficiary households from this project are 20,000 households (1 Household will have forest plantation for 10 Rai)

5. Implementation Plan

1. Public relation to farmers, organize group and registration for participation to the project.
2. Provide fast growing seedlings for people who participated in the project about 440 seedlings/Rai.
3. Give technical instruction for planting and maintenance of trees
4. Fund support for 1.300 THB/Rai. Term of payment will be divided into 2 years, 1st year: 800 THB/Rai for planting and 2nd year: 500 THB/Rai for maintenance
5. Monitor the project

6. Working Plan

Activity	Work Plan in 1st Year											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.
1. Public Relations and Farmer's Registration for participation to the project												
2. Providing seedlings												
3. Giving Technical Instruction												
4. Supporting fund to farmers (1,300 THB/Rai)												
5. Monitoring												

7. Budget

Total Budget is 650,000,000 THB. The breakdown is as follows;

(unit: million THB)

Activity	Investment Cost							
	Year 1-3		1st Year		2nd Year		3rd Year	
	Budget	Loan	Budget	Loan	Budget	Loan	Budget	Loan
1. Public relations and Farmer's Registration for participation to project	-	36	-	18	-	18	-	-
2. Provide seedlings	-	264	-	132	-	1326	-	-
3. Giving Technical Instruction	-	60	-	20	-	30	-	10
4. Supporting fund 1,300 THB/Rai	-	260	-	80	-	130	-	50
5. Monitoring	-	302	-	10	-	15	-	5
Total	**-**	**650**	**-**	**260**	**-**	**325**	**-**	**65**

8. Implementation Area

Area with land titling or area with legal occupation rights

9. Expected Output

Social Sector

Farmers have more income from selling trees that create awareness to maintain forest and reduce labor immigration to urban area.

Environmental Sector

Fast growing tree can stocks carbon in wood about 50% of total weight of dried wood.

10. Indicator

- Number of plantation area 200,000 Rai

11. Responsible Agency

- Main responsible agency is Community Forest Section, State Reforestation Division, Royal Forest Department
- Supporting agencies such as
  (1) Provincial Forest Office
  (2) Regional Forest Management Office