Penyusunan Baseline Data Pengelolaan Ekosistem Mangrove di Pulau Bintan

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Promoting Local Community Initiative on the Rehabilitation of Mangrove Ecosystem with Demonstration Activities in Bintan Island to Reduce further Deforestation and Forest Degradation

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EXECUTIVE SUMMARY
Preparation of Baseline Data Mangrove Ecosystem Management in Bintan Island

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INTRODUCTION

Mangrove is one of the coast ecosystems which have important role for life on the earth. In addition serve to prevent abrasion, reduce the impact of tsunami, become ecosystem for plants and animals, mangrove ecosystem also have a role as carbon reservoirs. Mangrove stands are famous for its high wood density (wood density) is an indicator of the magnitude of potential high mangrove ecosystems as carbon reservoirs. Along with the efforts of the world in order to mitigate and adapt to the negative effects of global warming and global climate change, the role of mangrove ecosystems in maintaining the balance of life on earth is increasingly considered important. Therefore the existence of remaining mangrove ecosystems should be managed optimally based on the principles of sustainable forest management.

As an archipelago with 28 major islands and 92 smaller outer islands, Indonesia has the potential for considerable mangrove spread in 257 districts /cities and in 32 provinces. Based on the results of the inventory and identification conducted in 2006 by the Directorate General of Land Rehabilitation and Social Forestry (RLPS), Ministry of Forestry, Indonesia's mangrove forests cover an area of more than 7.7 million acres spread across the island of Sumatra: 4.174 0.041 ha; Java: 338.243 ha; Bali, West Nusa Tenggara, and East Nusa Tenggara: 61.214 ha; Sulawesi: 201.266 ha; Kalimantan: 1.3733 million ha; Maluku and Papua: 1,610,343 ha. However, due to lack of attention on the aspects of management and use, then the mangrove areas continue to decline. A total of 3.250 million ha or 41.9% of the 7.7 million ha of mangrove in Indonesia suffered serious damage, as many as 2.13 million ha or 27.4% damaged and only 2.38 million ha (30.7%) in the good condition. Approximately 70% of mangrove ecosystems damaged by conflicts of land ownership, land clearing mangroves into fishponds and other use, licensing conflicts, as well as the utilization of mangrove wood and its assosiates.

Bintan Island is one of the group of islands in the Riau Islands are potential mangrove ecosystem that has not managed optimally. In fact, along with the increase in saving the world's attention in the remaining forest as a carbon reservoir through REDD + scheme has provided an opportunity for the government to get revenue while preserving forest resources. Baseline data is a requirement that must be met for a government that wishes to obtain the sustainable management of mangrove ecosystems. Based on this, the preparation of baseline data on the activities of mangrove ecosystem on the island of Bintan - Bintan regency, Riau Islands became an important activity that needs to be succed by many parties. Vegetation and carbon dynamics in mangrove ecosystems in Bintan Island is one aspect of baseline data is still not available so that the data and information needs to be raised.

Purpose of this activity is to establish baseline data on the mangrove ecosystem through mangrove vegetation data inventory, and potential carbon emissions. While the objectives of the activity are: (1) In order for a data base that can be used to formulate structured policy of community-based Mangrove Management in Bintan regency, and (2) In order for the management of mangrove ecosystems in Bintan conducted in accordance with the policies established with the support of accurate data.

METHODOLOGY

Preparation of baseline data on the activities of mangrove ecosystems in Bintan Island in Riau Islands Province was selected locations specified in stages (stratification) and the initial determination made by purposive sampling plot. Location consists of 14 lines spread over 8 villages mangrove conditions can describe the condition of the mangrove ecosystem in Bintan Island. Inventory of mangrove vegetation conducted by the checkered line method in accordance with ISO standards mangrove mapping and survey. Parameters collected include broad and vegetation cover, density, frequency, dominance, completeness zoning, content and carbon emissions. Data analysis was performed to determine the condition of mangroves on the island of Bintan through density measurement, frequency, species dominance, species diversity, and the content of carbon emissions.

Carbon reservoir in mangrove ecosystems on the island of Bintan is measured by using a combination of volumetric methods and allometric. The volumetric method used to measure biomass above ground parts (above ground biomass) of mangrove stands, while the allometric method used to calculate the under ground biomass (below ground biomass) mangrove. Upper mangrove biomass was calculated by multiplying the volume of plants mangrove vegetation analysis of the results of the activities of the types of mangrove wood density measured. Allometric equations the results of research Komiyama et al (2008) as follows WR = 0.199 p0, 899D2, 22, is a form of the general equation used to calculate the lower biomass of mangrove tree (root), where p is the wood density (g/cm3) and D is diameter at breast height or diameter 20 cm above buttresses (cm) from the mangrove plant species measured. Calculating the amount of carbon savings was made by using a conversion factor of 0.55.

RESULT AND DISCUSSION

Structure and Composition of Mangrove Species at Bintan Island

Data processing result of vegetation analysis at 14 selected track, showed that 8 of 14 track have mangrove stands with average diameter more than 50 cm. Moreover, On 7th track at Bintan Bunyu, are found Nyirih Merah tree (Xylocarpus granatum) with the diameter of trunk reach 123,77 cm. The condition of those diameter structure indirectly point out the high potency of biomass carbon saving on mangrove ecosystem at Bintan Island.

As many as 42 mangrove species are identified, either the true mangrove species, associate, or ekoton or terrestrial species which were still adjacent with mangrove vegetation. 32 of 42 species found inside sample plot, and the other 10 species found outside sample plot. 5 Mangrove species found on 8 track to 12 track that is Rhizophora apiculata, Xylocarpus granatum, Scyphiphora hydrophillacea, Lumnitzera littorea, dan Xylocarpus moluccensis. Structure and composition details of analyzed mangrove species on 14 tracks are presented on Tabel 1. The 21 identified mangrove species identified and wood density calculation result are presented on Tabel 2.

Tabel 1. Structure and Composition of Mangrove Species at Bintan Island

No.	Jalur	Lokasi	Luas (m^2)	Diameter (cm)	Volume (m^3)	Kerapatan Kayu (g/cm^3)	Jenis mangrove	
							Jumlah	Species (individu/ha)
1.	Jalur 1	Busung	2100	10,18 - 44,55	0,02-2,77	0,571-0,884	10	*Scyphiphora hydrophillacea* (62), *Xylocarpus granatum* (62), *Bruguiera gymnorrhiza* (33), *Rhizophora apiculata* (29), *Rhizophora mucronata* (24), *Xylocarpus moluccensis* (19), *Exoecaria agallocha* (19), *Bruguiera cylindrica* (10), *Lumnitzera racemosa* (5), *Avicennia marina* (5).
2.	Jalur 2	Kuala Sempang	1400	10,18-71,59	0,05-7,26	0,571-0,884	8	*Xylocarpus granatum* (136), *Scyphiphora hydrophillacea* (114), *Rhizophora mucronata* (86), *Bruguiera gymnorrhiza* (21), *Lumnitzera littorea* (14), *Xylocarpus moluccensis* (7), *Exoecaria agallocha* (7), Mentada (7).
3.	Jalur 3	Kuala Sempang	800	10,18-66,18	0,06-8,19	0,571-0,884	5	*Xylocarpus moluccensis* (250), *Xylocarpus granatum* (175), *Scyphiphora hydrophillacea* (25), *Lumnitzera littorea* (25), *Rhizophora apiculata* (13).
4.	Jalur 4	Pengujan	600	10,82-58,23	0,08-4,30	0,571-0,855	4	*Xylocarpus moluccensis* (267), *Xylocarpus granatum* (100), *Rhizophora apiculata* (83), Babaru (33).
5.	Jalur 5	Penaga	3200	10,50-89,09	0,03-6,86	0,571-0,884	9	*Xylocarpus granatum* (188), *Xylocarpus moluccensis* (78), *Rhizophora apiculata* (34), *Scyphiphora hydrophillacea* (22), *Bruguiera gymnorrhiza* (22), *Lumnitzera littorea* (19), *Exoecaria agallocha* (13), *Bruguiera cylindrica* (3), *Heritiera littoralis (3).*
6.	Jalur 6	Penaga	2000	10,18-49,00	0,05-3,02	0,571-0,884	9	*Xylocarpus granatum* (395), *Rhizophora apiculata* (45), *Heritiera littoralis* (30), *Bruguiera gymnorrhiza* (25), *Scyphiphora hydrophillacea* (15), *Avicennia marina* (15), *Rhizophora mucronata* (10), *Xylocarpus moluccensis* (10), *Bruguiera parviflora* (3).
7.	Jalur 7	Bintan Bunyu	1800	10,18-123,77	0,05-24,07	0,650-0,884	8	*Xylocarpus granatum* (356), *Lumnitzera littorea* (78), *Scyphiphora hydrophillacea* (44), *Rhizophora apiculata* (39), *Exoecaria agallocha* (17), *Derris trifoliata* (17), *Bruguiera parviflora* (6), *Avicennia marina* (6).
8.	Jalur 8	Tembeling	1500	11,14-71,91	0,08-6,09	0,571-0,884	8	*Xylocarpus moluccensis* (100), *Xylocarpus granatum* (60), *Rhizophora apiculata* (47), *Lumnitzera littorea* (20), *Bruguiera gymnorrhiza* (7), *Rhizophora mucronata* (7), *Scyphiphora hydrophillacea* (7), *Ceriops tagal* (7)
9.	Jalur 9	Tembeling	2100	10,18-76,36	0,03-8,25	0,686-0,884	7	*Rhizophora apiculata* (105), *Xylocarpus granatum* (81), *Scyphiphora hydrophillacea* (48), *Lumnitzera littorea* (29), *Bruguiera cylindrica* (19), *Bruguiera sexangula* (10), *Ceriops tagal* (5)
10.	Jalur 10	Tembeling	2400	10,18-45,18	0,03-8,73	0,571-0,884	5	*Lumnitzera littorea* (117), *Rhizophora apiculata* (42), *Xylocarpus granatum* (17), *Scyphiphora hydrophillacea* (4), *Xylocarpus moluccensis* (4)
11.	Jalur 11	Mantang Baru	1000	10,50-16,55	0,078-0,258	0,913	1	*Rhizophora stylosa* (15)
12.	Jalur 12	Mantang Baru	2500	10,18-54,09	0,03-2,76	0,686-0,913	6	*Rhizophora apiculata* (132), *Xylocarpus granatum* (48), *Heritiera littoralis* (44), *Scyphiphora hydrophillacea* (40), *Rhizophora stylosa* (20), *Lumnitzera littorea* (29).
13.	Jalur 13	Simpang Lagoi	600	10,18-40,41	0,05-2,31	0,650-0,913	6	*Rhizophora apiculata* (167), *Xylocarpus granatum* (100), *Rhizophora stylosa* (67), *Avicennia marina* (17), *Bruguiera cylindrica* (17), *Sonneratia alba* (17).
14.	Jalur 14	Simpang Lagoi	1200	10,18-39,14	0,06-1,44	0,588-0,884	5	*Lumnitzera littorea* (117), *Rhizophora apiculata* (42), Sentade (17), *Scyphiphora hydrophillacea* (8), *Lumnitzera racemosa* (8)

Tabel 2. Mangrove species, wood density calculation result, and line distribution

No	Species	Wood Density (g/cm^3)	Founded Location	
			Number of Line	Amount
1.	*Avicennia marina*	0,650	1,6,7,13	4
2.	*Babaru*	0,726	4	1
3.	*Bruguiera cylindrica*	0,763	1,5,9,13	4
4.	*Bruguiera gymnorrhiza*	0,730	1,2,5,6,8	5
5.	*Bruguiera parviflora*	0,763	6,7	2
6.	*Bruguiera sexangula*	0,763	9	1
7.	*Ceriops tagal*	0,884	8,9	2
8.	*Derris trifoliata*	0,726	7	1
9.	*Exoecaria agallocha*	0,726	1,2,5,7	4
10.	*Heritiera littoralis*	0,696	5,6,12	3
11.	*Lumnitzera littorea*	0,737	2,3,5,7,8,9,10,12,14	9
12.	*Lumnitzera racemosa*	0,737	1,14	2
13.	*Mentada*	0,588	2	1
14.	*Rhizophora apiculata*	0,855	1,3,4,5,6,7,8,9,10,12,13,14	12
15.	*Rhizophora mucronata*	0,792	1,2,6,8	4
16.	*Rhizophora stylosa*	0,913	11,12,13	3
17.	*Scyphiphora hydrophillacea*	0,884	1,2,3,5,6,7,8,9,10,12,14	11
18.	*Sentade*	0,588	14	1
19.	*Sonneratia alba*	0,647	13	1
20.	*Xylocarpus granatum*	0,686	1,2,3,4,5,6,7,8,9,10,12,13	12
21.	*Xylocarpus moluccensis*	0,571	1,2,3,4,5,6,8,10	8

Mangrove vegetation density

At seedling, species *Bruguiera cylindrica* have the highest density that is 4.133 individuals per *hectare. The evenlu distributed seedling species are Rhizophora apiculata and Xylocarpus granatum which found on 11 tracks or 78,6 %. Overall, identified saplings species as many as 23 species, with the average vegetation density that is 2.912 individuals per hectare. Viewed by species, cingam species (Scyphiphora hydrophyllacea) have the highest density that is 879 individuals per hectare. From 14 identified tracks, found 21 tree species with total density of 332 individuals per tree. Hence, manrove density at study location has a medium density (SNI criteria 2012 about mangrove survey and mapping).*

Mangrove species domination

Dominant species at seedlings are *Scyphiphora hydrophyllacea* at 4 tracks (1th , 2th ,3th ,10^{th}), *Rhizophora apiculata* at 2 tracks (11^{th} ,13^{th}), *Xylocarpus granatum* (6^{th} ,7^{th}), *Bruguiera gymnorrhiza* (1 track), *Scyphiphora hydrophyllacea* (1 track). Similar with the seedling, dominant species at saplings is *Xylocarpus granatum* (7 tracks). Dominant species at growth of trees is *Xylocarpus granatum* (5 tracks). Domination of species *Scyphiphora hydrophyllacea* and *Xylocarpus granatum* presumably because people's preferention in the utilization of mangrove woods. Mangroves utilization for charcoal and firewood before years 2000, usually using comercial woods from rhizopora species, therefore species *Scyphiphora hydrophyllacea* and *Xylocarpus* are less preferred and abandoned.

Tabel 3. Mangrove vegetation species domination at Bintan Island

No	Line	Dominant Species According to INP		
		Seedling	Sapling	Tree
1	Line 1	*Scyphiphora hydrophyllacea (49,82)*	*Scyphiphora hydrophyllacea (146,56)*	*Xylocarpus granatum (75,54)*
2	Line 2	*Scyphiphora hydrophyllacea (46,05)*	*Scyphiphora hydrophyllacea (181.47)*	*Scyphiphora hydrophyllacea*

No	Line	Dominant Species According to INP		
		Seedling	Sapling	Tree
				(95,83)
3	Line 3	*Rhizophora apiculata (124.24)*	*Xylocarpus moluccensis (85.16)*	*Xylocarpus moluccensis (148.56)*
4	Line 4	*Bruguiera gymnorrhiza (100.00)*	*Scyphiphora hydrophyllacea (124.82)*	*Xylocarpus moluccensis (145.33)*
5	Line 5	*Scyphiphora hydrophyllacea (122.92)*	*Scyphiphora hydrophyllacea (154.53)*	*Xylocarpus granatum (150.71)*
6	Line 6	*Xylocarpus granatum (52.78)*	*Xylocarpus granatum (97.79)*	*Xylocarpus granatum (204.15)*
7	Line 7	*Xylocarpus granatum (82.09)*	*Scyphiphora hydrophyllacea (171.07)*	*Xylocarpus granatum (194.98)*
8	Line 8	*Xylocarpus mollucensis (83.33)*	*Scyphiphora hydrophyllacea (157.28)*	*Xylocarpus mollucensis (127.09)*
9	Line 9	*Bruguiera cylindrica (88.64)*	*Scyphiphora hydrophyllacea (139.64)*	*Xylocarpus granatum (121.87)*
10	Line 10	*Scyphiphora hydrophyllacea (63.29)*	*Rhizopora apiculata (127.74)*	*Lumnitzera littorea (184.46)*
11	Line 11	*Rhizophora stylosa (175.00)*	*Rhizophora stylosa (300.00)*	*Rhizophora stylosa (300.00)*
12	Line 12	*Rhizophora apiculata (158.93)*	*Rizhopora apiculata (90.42)*	*Rizhopora apiculata (129.14)*
13	Line 13	*Rhizophora stylosa (120.00)*	*Rhizophora stylosa (199.15)*	*Rhizophora apiculata (96.03)*
14	Line 14	*Lumnitzera littorea (70.77)*	*Lumnitzera littorea (139.22)*	*Lumnitzera littorea (146.81)*

Species Diversity

Calculation result of Species Diversity Index for vegetation showed that the diversity varies between low (0) to medium (2,09). Highest index can be found on 1st track at Busung Village with index value of tree 2,09. The lowest index can be found on 11th track at Mantang Baru Village, where saplings and tree found only 1 species.

Spatial Distribution of Mangrove Vegetation

Spatial distribution of vegetation required to find out the distribution of mangrove vegetation based on diameter and high class. From the analysis, 10 – 20 cm diameter class have the greatest number of 529 tree or 70,16%. It can be seen that species merah (*Xylocarpus granatum*) and Nyirih Putih (*Xylocarpus moluccensis*) have multiple diverse of diameter distribution compared to the other species. These presumably because people's preferention of using mangrove species for charcoal. The more common species like Bakau mostly have a small diameter.

Mangrove's Biomass dan saving on 14 selected track

The calculation result of biomass content on 14 selected track showed that the total biomass saving at mangrove ecosystem ranging from 40,48 ton/ha to 671,56 ton/ha and average 231,99 ton/ha. The lowest biomass saving potency found on 11th track at Mantang Baru and the highest saving biomass potency found on 7th Track at Bintan Bunyu. As much as 68,85% from total biomass distributed to upper part of tree (above ground biomass) and the rest saved at the

lower part of tree (below ground biomass). Tree of mangrove species give contribution as much as 78,95% from the total biomass. The rest (21,05%) is the total biomass from saplings of mangrove species. The total biomass distribution indirectly as an indicator that showing the climax growth of mangrove at Bintan Island. These condition is also a carbon saving potency of mangrove ecosystem at Bintan Island. Details of biomass content distribution on 14 selected track are presented on Tabel 4.

Table 4. Biomass content distribution on Mangrove ecosystem at Bintan Island based on 14 selected track

No.	Location	TREE			SAPLING			TOTAL		
		AGB *(ton/ha)*	BGB *(ton/ha)*	TB *(ton/ha)*	AGB *(ton/ha)*	BGB *(ton/ha)*	TB *(ton/ha)*	AGB *(ton/ha)*	BGB *(ton/ha)*	TB *(ton/ha)*
1.	Busung	87,19	31,28	118,47	25,90	13,74	39,64	113,10	45,02	158,11
2.	Kuala sempang 1	134,64	37,94	172,58	34,00	21,45	55,45	168,64	59,40	228,04
3.	Kuala sempang 2	192,25	84,07	276,32	18,00	10,47	28,47	210,25	94,53	304,78
4.	Pengujan	178,33	63,31	241,64	18,00	13,46	31,46	196,33	76,77	273,11
5.	Penaga 1	151,75	76,72	228,47	6,25	4,30	10,55	158,00	81,03	239,03
6.	Penaga 2	105,45	47,14	152,59	17,73	10,20	27,93	123,18	57,34	180,52
7.	Bintan Bunyu	455,11	184,46	639,57	18,67	13,32	31,99	473,78	197,78	671,56
8.	Tembeling 1	113,53	51,75	165,29	35,20	20,80	56,00	148,73	72,56	221,29
9.	Tembeling 2	141,86	61,39	203,25	130,48	83,84	214,31	272,33	145,23	417,56
10.	Tembeling 3	54,04	13,76	67,81	29,33	21,71	51,04	83,38	35,48	118,85
11.	Mantang Baru 1	9,20	4,02	13,22	16,92	10,33	27,26	26,12	14,36	40,48
12.	Mantang Baru 2	72,12	32,83	104,95	22,24	14,87	37,11	94,36	47,71	142,07
13.	Sebong Lagoi 1	87,83	34,92	122,75	20,67	14,17	34,83	108,50	49,09	157,59
14.	Sebong Lagoi 2	38,42	18,65	57,07	21,00	16,76	37,76	59,42	35,41	94,82
	Average	130,12	53,02	183,14	29,60	19,24	48,84	159,72	72,26	231,99

Biomass content, carbon saving, and carbondioxide absorption on mangrove ecosystem at Bintan Island.

The calculation result of biomass content, carbon saving, and carbondioxide absorption on mangrove ecosystem at Bintan Island are presenter on Tabel 5, 6, and 7.

Table 5. Biomass conten on mangrove ecosystem at Bintan Island

No.	Village	TREE			SAPLING			TOTAL		
		AGB *(ton/ha)*	BGB *(ton/ha)*	TB *(ton/ha)*	AGB *(ton/ha)*	BGB *(ton/ha)*	TB *(ton/ha)*	AGB *(ton/ha)*	BGB *(ton/ha)*	TB *(ton/ha)*
1	Busung	87,19	31,28	118,47	25,90	13,74	39,64	113,10	45,02	158,11
2	Kuala Sempang	155,59	54,71	210,30	28,18	17,46	45,64	183,77	72,17	255,95
3	Pengujan	178,33	63,31	241,64	18,00	13,46	31,46	196,33	76,77	273,11
4	Penaga	133,94	65,35	199,29	10,67	6,57	17,24	144,61	71,92	216,52
5	Bintan Bunyu	455,11	184,46	639,57	18,67	13,32	31,99	473,78	197,78	671,56
6	Tembeling	99,65	39,93	139,58	41,20	27,44	68,64	140,85	67,37	208,22
7	Mantang Baru	54,14	24,60	78,74	20,42	13,32	33,74	74,56	37,92	112,49
8	Sebong Lagoi	54,89	24,07	78,96	20,89	15,89	36,78	75,78	39,97	115,74
	Average	152,36	60,96	213,32	22,99	15,15	38,14	175,35	76,11	251,46

Table 6. Carbon savings on mangrove ecosystem at Bintan Island

No.	Village	TREE			SAPLING			TOTAL		
		AGC *(ton C/ha)*	BGC *(ton C/ha)*	TC *(ton C/ha)*	AGC *(ton C/ha)*	BGC *(ton C/ha)*	TC *(ton C/ha)*	AGC *(ton C/ha)*	BGC *(ton C/ha)*	TC *(ton C/ha)*
1	Busung	47,95	17,20	65,16	14,25	7,56	21,80	62,20	24,76	86,96
2	Kuala Sempang	85,58	30,09	115,67	15,50	9,60	25,10	101,08	39,69	140,77
3	Pengujan	98,08	34,82	132,90	9,90	7,41	17,31	107,98	42,23	150,21
4	Penaga	73,67	35,94	109,61	5,87	3,61	9,48	79,53	39,55	119,09
5	Bintan Bunyu	250,31	101,45	351,76	10,27	7,33	17,59	260,58	108,78	369,36
6	Tembeling	54,81	21,96	76,77	22,66	15,09	37,75	77,47	37,05	114,52
7	Mantang Baru	29,78	13,53	43,31	11,23	7,33	18,56	41,01	20,86	61,87
8	Sebong Lagoi	30,19	13,24	43,43	11,49	8,74	20,23	41,68	21,98	63,66
	Average	83,80	33,53	117,33	12,65	8,33	20,98	96,44	41,86	138,30

Table 7. Carbondioxide absorption on Mangrove ecosystem at Bintan Island

No.	Village	TREE			SAPLING			TOTAL		
		AGCO	BGCO	TCO	AGCO	BGCO	TCO	AGCO	BGCO	TCO
		(ton CO/ha)	*(ton CO/ha)*	*(ton CO/ha)*	*(ton CO/ha)*	*(ton CO/ha)*	*(ton CO/ha)*	*(ton CO/ha)*	*(ton CO/ha)*	*(ton CO/ha)*
1	Busung	175,99	63,14	239,13	52,29	27,73	80,02	228,28	90,86	319,15
2	Kuala Sempang	314,06	110,44	424,50	56,89	35,24	92,12	370,95	145,68	516,63
3	Pengujan	359,97	127,79	487,76	36,33	27,18	63,51	396,30	154,97	551,27
4	Penaga	270,36	131,90	402,26	21,53	13,26	34,79	291,89	145,16	437,06
5	Bintan Bunyu	918,64	372,33	1290,97	37,68	26,89	64,57	956,32	399,22	1355,54
6	Tembeling	201,14	80,60	281,74	83,17	55,38	138,55	284,31	135,98	420,29
7	Mantang Baru	109,29	49,66	158,95	41,22	26,89	68,11	150,51	76,55	227,05
8	Sebong Lagoi	110,79	48,59	159,38	42,16	32,08	74,25	152,96	80,67	233,63
	Average	307,53	123,06	430,59	46,41	30,58	76,99	353,94	153,64	507,58

From the data above, average carbon savings on mangrove ecosystem at Bintan Island is relatively high that is 138,30 ton C/ha or equal to carbondioxide absorption as much as 507,58 ton CO2/Ha. Those average carbon saving is bigger than carbon saving on preserved mangrove ecosystem at Jaring Halus Village, Langkat, that is 116,2 ton C/Ha or equal to carbondioxide absorption as much as 426,5 ton CO2/Ha (Onrizal, 2013). Biomass content at Bintan Island's Mangrove forest evidently bigger than Merbok Mangrove Forest that reach 245 ton/Ha (Anwar et.al, 1984), Biomass content at Siberut Mangrove Forest that is 49,13 Ton/Ha, biomass content at secondary forest with average density that is 54,34 ton/ha and carbondioxide absorption102,31 ton CO2/ha (Heriyanto dan Siregar, 2007).

Carbon Dynamics on Mangrove Ecosystem at Bintan Island

Carbon dynamics showed equilibrium between carbon absorption and carbon emission at a forest ecosystem which occurs in the continuous time (time series). Based on satellite imagery analysis, average number of deforestation of mangrove ecosystem at Bintan Island as many as 0,46 ha/year from years 1995 to 2013. The highest mangrove ecosystem deforestation at Penaga Village that is 2,17 ha/year. Though the number is relatively small, in the framework of global warming mitigation and global climate change, those condition are need to be aware of. It is because the deforestation producing carbondioxide emission and contribute to global warming. Calculation result of this study showed carbon emission potency on mangrove ecosystem at Bintan island as many as 236,06 ton O2/year, details are presented on Tabel 8.

Table 8. Carbon dynamics on Mangrove ecosystmen at bintan Island

No.	Village	Forest Wide Year 2013	UPTAKE			Deforestation rate (95-13)	EMISSION
			TC	TCO_2	Total Stok Karbon	Emisi CO/tahun	
			(ton C/ha)	*(ton CO_2/ha)*	(ton C)	(ha/tahun)	*(ton CO_2/tahun)*
1	Busung	117,81	86,96	319,15	10.244,73	0,14	*44,68*
2	Kuala Sempang	434,36	140,77	516,63	61.144,15	0,23	*118,82*
3	Pengujan	117,45	150,21	551,27	17.642,46	0,00	*0,00*
4	Penaga	506,48	119,09	437,06	60.315,81	2,17	*948,41*
5	Bintan Bunyu	254,61	369,36	1355,54	94.040,54	0,33	*447,33*
6	Tembeling	604,87	114,52	420,29	69.270,12	0,70	*294,20*
7	Mantang Baru	182,42	61,87	227,05	11.286,02	0,00	*0,00*
8	Sebong Lagoi	187,96	63,66	233,63	11.965,31	0,15	*35,04*
	Rata-rata	300,74	138,30	507,58	41.988,64		236,06
	Jumlah	2.405,95			335.909,14		1888,49

Conclusion

Conclusion of this study are:

1. Mangrove ecosystem at Bintan Island is growing to climax with wide range of trunk diameter, diverse species composition, average tree density, and have a high potency to be high conservation value mangrove ecosystem.
2. Carbon saving ability of mangrove ecosystem at Bintan Island is relatively high with an average 138,30 ton C/Ha or equal to carbondioxide absorption 507,58 ton CO_2/Ha.
3. Carbon emission on mangrove ecosystem at Bintan Island is relatively low with an average 236,06 ton CO_2/Ha.

PREFACE

Mangrove forest is one of the coastal resources which play an important role not only in terms of economic, ecological and social but also to target the national development programs. See symptoms of destruction of mangrove forests for various purposes in various regions in Indonesia, it is necessary to sustainable management of mangrove forests by involving various stakeholders, government, public, and private. To be able to perform the sustainable management of mangrove forests requires knowledge of baseline data and the strategic value of mangrove forests that are beneficial to all parties, especially the local community. One of the mangrove forest area with huge potential and needs attention is the mangrove forest on the island of Bintan

In general, studies and surveys aimed to promote mangrove rehabilitation of mangrove ecosystems to mitigate the damage and repair of critical land along the shoreline by constructing plots of activity on the island of Bintan. While the specific objective is to control the exploitation of mangrove forests by the communities through community-based mangrove management model. Studies and surveys also generate a data base of mangrove forest stand conditions through data collection: the potential, the structure and composition of mangrove forests, mangrove destruction on the island of Bintan and data collection potential of carbon and carbon emissions at the mangrove site. The study produced some important information that has been found 42 species of mangrove with various combinations of structure and species composition and carbon content worth 507.58 ton C / ha. Some conclusions and recommendations have been chronicled in this report.

IDEAS Consultancy Services gained the confidence of the Directorate General Development of Watershed Management and Social Forestry, Ministry of Forestry (BPDASPS) to conduct a study and survey to establish a baseline potential of mangrove forest in Bintan Island, an area management Bintan and measuring the potential of the carbon content on the site on October 4 to 13, 2013. The results of studies and surveys have been conducted on 7 November

2013 at the Directorate General Development of Watershed Management and Social Forestry, Ministry of Forestry (BPDASPS), Manggala Wana Bakti, Jakarta. The success of the study and survey activities in the field could not be separated from the support and participation of various parties. Therefore we would like to thank Mrs. Niniek Irawati as Committing Officer (CO), Mrs. Rektarini as Project Manager, Mrs. and Mrs. Irebella Ditha Astriani Siswondo as project staff, Mr. Nicholas and Mr. Belgrad Sinurat Nugroho as the committee of LPSE, and inspection team. In particular we wish to thank Mr. Moch. Ali Wafa Pujiono who have reviewed this report so much better. In the course of our many field surveys to obtain help and input from various parties, therefore we say thank you to Mr. Heri Sholeh; Mr. Arisman; Mr. Yaser; students UMRAH: Rian Paradiska, Rais Prasetio, and Feonawir Winardi, as well as the Chief Villages and communities Edema, Kuala Sempang, Penaga, Pengujan, Sebong Bintan, Bintan Buyu, New Mature and Tembeling village that has many participating in the data collection in the field. Finally, we provide a very high appreciation to all members of the study team and the survey, Mr. Ahmad Faisal Siregar, Mr. Gunawan Alfan Ahmad, Mr. Arif Prasetyo, Mrs. Diah Nurmalasari, and Arif Budiarto for his hard work completing the fieldwork and reporting.

Bogor, November 2013

IDEAS CONSULTANCY SERVICES

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APPENDIXES

GLOSSARY

Aboveground Biomass	Biomass was found on the ground, such as stems, branches, twigs, leaves, and fruit.
Abundance	Qualitative parameters that reflect the relative distribution of species of organisms in a community.
Alometric Equation	Mathematical equation that connects one or more parameters between tree dimensions as independent variables X (trunk diameter at breast height, total height, and wood or density) with the weight of the tree biomass as dependent variable Y.
Alometric Method	Method of measuring the biomass of trees or parts of trees through allometric equation linking between the independent variables (growth parameters such as tree trunk diameter at breast height or tree height) with a weight of biomass as the independent variables do not.
Basal area	Trees broad calculated from DBH. Overall width of basal area per unit area shows the value of the dominance of these plants.
Baseline data	The data on which the measurement boundary.
BEF (Biomass Expansion Factor)	Factors which doubles the stem biomass to total tree biomass.
Belowground Biomass	Biomass was found below ground, such as root.
Biomass	The total dry mass of living organic material.
Bush	Small-sized woody plants generally have short trunks, branches are very numerous and not a seasonal plant.
Carbon	chemical element with symbol C and atomic number 6 and became a major component of constituent organic materials
Carbondioxide uptake	The large amount of carbon dioxide as a result of the conversion of a number of deposits of C in biomass.
Carbon Emission	Total content of carbon released into the atmosphere as a result of the decomposition of organic matter.
Carbon Pool	Place or be a part of that ecosystem C stocks
Carbon Savings	The amount of carbon that is stored in an organic material.
Carbon Stock	The amount of carbon stored in each pool at any given time.
Carbon Stock	The quantity of carbon contained in a "bin", which is a reservoir or a system that has the capacity to accumulate or release carbon. In the context of the forest carbon stocks refers to the amount of carbon stored in the forest ecosystem in the world, especially in live biomass and soil, but also at least in dead wood and litter.
Carbon Take	The process of removal of carbon from the atmosphere and store it in a reservoir. Carbon dioxide is naturally captured from the atmosphere through the process of biological, chemical or physical. Some carbon capture technique utilizes the natural process of carbon capture techniques while others use artificial process.
Checkered lines Method	Modification of the double plot method or methods pathway that is by skipping one or more plots in the lane, so that there is a path along the line plots the same at a certain distance.
Community Empowerment	Such effort in order to improve the capability and survivability of society through (a) the creation of an atmosphere or climate that allows the development potential of its owned or community, (b) to strengthen its potential or community owned, and (c) to protect the public through the alignment toward the community to strengthen competitiveness.
DBH (Diameter Breast	Diameter at breast height or less than 1.3 m from the ground. The

Height)	method of measuring tree in forest ecology research, study or data collection potential of forest biomass. To buttress tree diameter is usually measured 20 cm above the buttresses.
Decomposition	Decomposition. In this case the decomposition of organic matter into inorganic materials through physical, chemical or biological. Decay of organic matter was observed.
Density	Value that indicates the number of individuals per unit area or per unit volume.
Diversity Index	levels of biological organization based community.
Dominance Index	Parameters that express the degree of concentration of dominance (mastery) species in a community.
Expansion factor	A factor or an amount double the value of the nominal amount (volume or biomass), which includes one or several parts of the tree to the other nominal amount that covers the entire tree.
Farmer groups	Groups of farmers in a growing organization based platform of togetherness, harmony, equality, profession and interest in harnessing the natural resources they control and stakeholders to work together in order to increase farm productivity and well-being of its members.
Forest and Land Rehabilitation	Efforts to restore, maintain and improve the function of forests and land so that the carrying capacity, productivity and its role in supporting life system is maintained.
Forest Deforestation	As defined by the Marrakech Accords, is the conversion of forest land into areas caused by human land clearing. Forest area is defined as the extent of at least 0.001 to 1 hectare with tree crown cover (or equivalent stocking level) of more than 10-30 per cent with trees with the potential of reaching a minimum height of 2-5 meters (at maturity in situ). The actual definitions can vary from country to country as the Kyoto Protocol allows each country to make a precise definition in accordance with the parameters used for calculating national emissions. Conversely, deforestation as defined by FAO as "the conversion of forest to other uses or reduction of forest area for the long term under the minimum limit of 10%".
Forest Degradation	Forest degradation is forest clearing to tree crown cover at a rate above 10%, but in addition to this general definition, the IPCC has not given a specific definition.
Forest Reforestation	Conversion of forest land have been cut down by humans into forest land back through planting, and plant or seed dispersal by human activities for the promotion of plant seed dispersal by human nature above reforested land but was converted to non-forest land. For the initial commitment, reforestation will be restricted only in lands that are not forest on December 31, 1989.
Frequency	the proportion between the number of samples that contain a particular species to the total number of samples.
Herba	Plants with woody stems wet or not. Generally in the form of seasonal plants.
Humus	Layer of organic material on the forest floor has been largely decomposed. The difference with litter, litter is still fresh or very slightly decomposed. One indicator is already decayed material that is no longer having a shape like the original form.
Identification	Review effort and further study of the data that has been inventoried to understand the situation and existing problems and the predicted may occur in a specific region as an input to decision-making materials.

Important Value Index (IVI / INP = Indeks Nilai Penting)	quantitative parameters that can be used to express the degree of dominance (mastery level) species in a plant community.
Institutional or social institutions	System behavior and credible form of relationship-specific activities to meet the needs of the community life, which includes three components: (a) the organization or container of an institution, (b) the functions of the public institutions and (c) the regulations set forth by specific institutional system .
Inventory	data collection activities are carried out either directly or indirectly, to obtain data and information on the condition of forest resources and the conditions surrounding communities covering aspects of biophysical, social, economic and culture in a specific region.
Landsat	Remote detection technology based on earth observation satellites. Medium resolution Landsat imagery obtained from optical and multispectral sensors, which are capable of detecting forest and land cover change. Because of limitations to penetrate clouds and aerosol, cloud cover is the biggest problem that inhibits monitoring in tropical regions.
Liana	Plants twining or climbing.
Litter	Collection of organic material on the forest floor that has not or slightly decomposed. Original form still recognizable bias or bias still retain their original shape (not destroyed).
Mangrove	Forest vegetation that grows between the tidal line, but can grow on coral beach that is on the dead coral on which the deposited thin layer of sand or silt.
Non Destructive sampling	Sampling method without felling trees or tree harvesting in total.
Priority Watershed	Watershed as good condition in terms of forest and land degradation as well as the interests of the environment and society, should receive immediate treatment at RHL activities.
Reboisasi	manufacturing capacity of forest tree crops in forest areas damaged in the form of an empty / open beams or scrub and forest, marsh to restore forest functions.
Reboisasi Richment	Additional activities on forest tree seedling mire that has a tiller stands, saplings, poles and trees of at least 500-700 stems / ha, with a view to enhancing the value of forest stands, both the quality and quantity according to its function.
Sample	Snippets, examples. Part of the research object being measured or taken for analysis.
Sapling	Level after level of seedling growth trees.
Sequestrasi	The process of increasing the carbon content of a carbon pool other than the atmosphere.
Sink	Any process or mechanism which removes a greenhouse gas, an aerosol, or the forming of greenhouse gases from the atmosphere. Existing pool (reservoir) can be sunk because of atmospheric carbon if during the time interval that is, more carbon is absorbed than is out.
Source	His opponent sinks: carbon pool (absorber) can be a source of carbon to the atmosphere too little carbon is absorbed than is released.
Stand	Community plants (trees) in a particular area.
Stratification	Vertical distribution of plants.
Undergrowth Plant	Plant is not a tree that grows on the forest floor.
Vegetation Analysis	A way of studying the arrangement or composition or structure types and forms of vegetation

Volumetric Method	Method of measuring the biomass of trees or parts of trees by multiplying the volume of trees or parts of trees as measured by the value of the wood density.
Wood density	Weight or mass per unit volume of wood.

I. INTRODUCTION

1.1. Background

Bintan Island is one part of a group of islands in the Riau Province that has a strategic position for the development of Southeast Asia that lies in the path of world trade crossing that connects several countries. Currently the Government of Riau Province has set Bintan island along with the island of Batam and Karimun as free trade zone and free port. Riau Provincial Government's decision is based on Government Regulation No. 46, 47, and 48 of 2007 on the Free Trade Zone and Free Port in Batam, Bintan and Karimun.

So free trade zone and free port can function optimally and it is necessary to have the support of various parties that include various aspects in a comprehensive, integrated, and sustainable. In addition to the support of the technical aspects of the infrastructure, once designated as a free trade zone and free port so the island of Bintan also need health support of ecological functions of ecosystems that exist in it. One of them is the health of the mangrove ecosystem function.

At first glance it appears there is no relationship between free trade zone and free port with the health of mangrove ecosystems. However, when examined more deeply, healthy mangrove ecosystem will provide benefits to optimizing the role of Bintan Island as an area of free trade and free port. Mangrove forests as a major component of mangrove vegetation is typical of the type of tidal land that serves as a buffer zone of land and ocean ecosystem stability. In tropical and sub-tropical regions, mangrove forests play an important role in reducing coastal erosion, and treating malignancies hydrological function networks and trenches (Wiyono, 2009). In addition, mangrove forest also acts as a protector of terrestrial life from the sea wind blows. The ability of mangrove ecosystems in maintaining stability between terrestrial and marine ecosystems has an important role in supporting the optimization of Bintan Island as a free trade zone and free port. The stability of the terrestrial and marine ecosystems will directly impact on the disruption and destruction of natural resources on the island of Bintan which become a free trade zone and free port.

Beside that, mangrove ecosystem which is rich with flora and fauna will be the main attraction for the island of Bintan as a free trade zone and free port. The beauty of the

flora and fauna will make the landscape of Bintan more beautiful so in the midst of a free port and trade activities, the business person can still feel the atmosphere fresh and comfortable environment. Such conditions would promote the establishment of free trade zone and free port that is productively.

In accordance with its strategic global position, then Bintan Island must be managed in accordance with world issues currently being discussed many countries to the anticipation of global warming and global climate change. In addition to be directed as free trade zone and free port, it's time for Bintan Island is directed as a green island that the island with high levels of carbon savings and lower carbon emission levels which contribute significantly to the mitigation of global warming and global climate change. The existence of the mangrove ecosystem as a vehicle is to make Bintan to be a green island.

Based on the description above, the preparation of baseline data related to the structure and composition of mangrove species and the amount of savings and carbon emissions in the mangrove forest in Bintan Island become an important activity that needs to be prioritized all parties. This is important because the baseline data is successfully compiled and it will be an important consideration for strategic management of mangrove ecosystems in Bintan Island as a whole, integrated, and sustainable community-based.

1.2. Purpose and Objectives

Purpose of this activity is to arrange basic data and information on the mangrove ecosystem through an inventory of mangrove vegetation data, potential and carbon emissions. While the objectives of the activity are:

1. Basic data can be used to formulate structured management policy based mangrove community in Bintan, and
2. Management of mangrove ecosystems in Bintan is conducted in accordance with policies established with the support of accurate data.

1.3. Target

Target of this activity is the availability of data and information mangrove ecosystem, the potential for carbon, and carbon emissions in Bintan.

1.4. Location of Activity

Location for drafting baseline of mangrove ecosystems management is on the mangrove ecosystem in Riau Bintan Island.

1.5. Scope

Scope of activities are:

1. Collecting secondary data such as map location and satellite imagery.
2. Collecting vegetation data, especially the results of an inventory of mangrove stands of mangrove.
3. Collecting potential data and carbon emissions on mangrove forest in Bintan Island.
4. Meetings with the Committing Officer and insurer of activity funds.
5. Performing analysis of vegetation and analysis of savings and carbon emissions on the mangrove forest in the island of Bintan.
6. Preparation reports.
7. Conducting exposure assessment results.

II. GENERAL CONDITION

2.1. Location and Area

Bintan Island is part of the Riau Islands where are located to the east of the island of Batam with geographical coordinates of the position lies between 0°47′- 1°15′ North Latitude dan 104°15′ - 104°43′ East longitude. Based on the analysis of geographic information systems, Bintan Island's land area is ± 115,764 hectares of which there are two (2) administrative area namely Tanjungpinang as the capital of Riau Islands province of ± 12,863 hectares (entirely are of Tanjungpinang is ± 13,600 acres) and Bintan regency of ± 102,901 hectares.

Tanjungpinang city is determined for capital city based on based on Law No. 25 of year 2002, while determining Bandar Seri Bintan for capital city of Bintan based on based on Government Regulation No. 38 of year 2004.

2.2. Climate

As with other islands in Indonesia, Bintan Island is also the tropical areas. During the period year of 2005-2010, average lowest temperature 23.9° C and an average high of 31.8° C with a humidity of about 85%.

Bintan has 4 kinds of changes in wind direction are:

- December-February : North Wind
- March-May : East Wind
- June-August : South Wind
- September-November : West Wind

The highest wind speed was 9 knots and occurred in December-January, while the lowest wind speed in March-May.

Based on the data series of rainfall obtained from the Meteorological Station Tanjungpinang for 20 years (1987-2006) shows that the average rainfall occur annually in Bintan amounted to 3271.9 mm/year with an annual highest rainfall average is in 2003 amounting to 4,118 mm/year and an annual lowest rainfall average occurred in 1997 and amounted to 2416.5 mm/year.

Monthly highest rainfall average was 398.4 mm/month and occurred in December with the number of rainy days as much as 16 days, while the lowest was 104.5 mm/month and occurred in February the number of rainy days for 6 days.

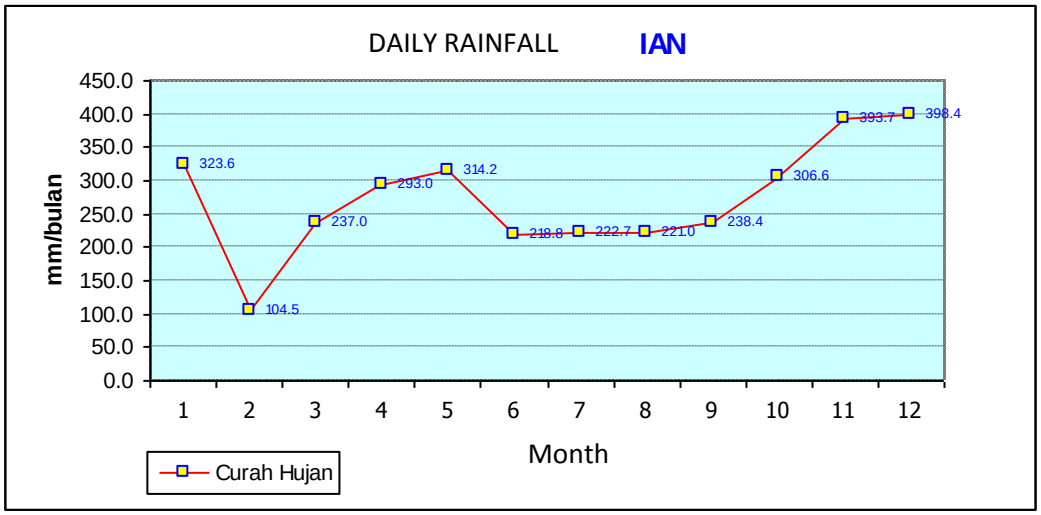

Figure 2.1.Graph of Average Rainfall in Bintan Island (1987-2006)

2.3. Topography and Geomorphology

Generally, steep area can only be found on area of Bintan Besar Mountain, Bintan Kecil Mountain, Kijang Mountain, and Lengkuas Mountain.

Review of aspects of geomorphology, in general Bintan Island is divided into 3 units of morphology, are:

1). Plain Morphology Unit

Plain Morphology Unit is scattered along the beach with a height ranging from 0-3 meters above sea level and ground slope <3%.

2). Hills Morphology Unit

Morphological Unit lightly undulating hills occupy the center that covers approximately 60% of the total area with field gradients of between 3-20%.

3). Mount Morphology Unit

Mount Morphology Unit can only be found in "spots" in the northern, central, and southern Bintan Island which are a mountain region with field gradients > 40%.

Picture of the topography of the island of Bintan is presented in the form of a contour map as Figure 2.2.

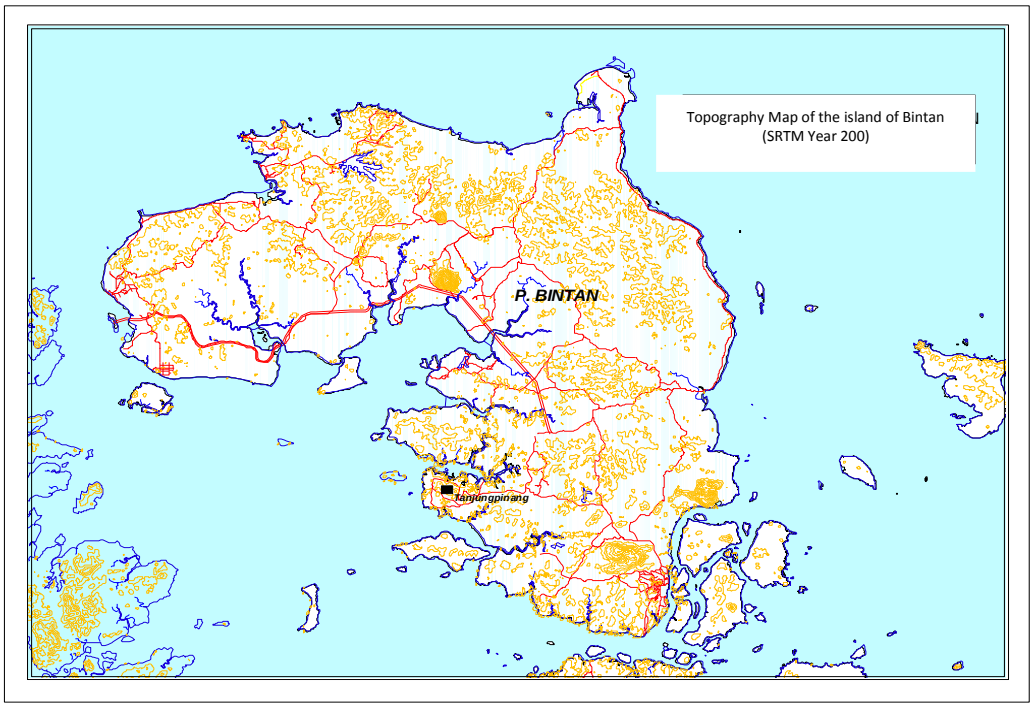

Figure 2.2. Topography of Bintan

2.4. Hydrogeology

Water sources on the island of Bintan is still be obtained from surface water (rivers, swamps / lakes) and groundwater both shallow ground water, ground water and springs. To meet the need of drinking water, the public in general use the river and wells (shallow groundwater).

The results of the hydrogeological investigation conducted by the District Mining Office Riau Islands (2002) suggests that the major rivers in the area of Tanjung Uban is used as a source of raw water bylocal water company, while other smaller rivers including the category of intermitent streams with small debit is utilized by the community and used for sale. Other water sources such as lakes water / former sand excavation is also used by the community to meet the water needs of the household.

From the results of field investigations in the Department of Mines, shows that the ground water-free and depressed can still be found in some parts of Bintan Island. In areas with plain morphology, generally dug wells have depths ranging from 3.5 to 5 meters with sand and clay lithology and water quality suitable for consumption. For mild

undulating hills region can still be found free soil water to a depth of ground water level is relatively more in.

Observations in the field for groundwater shows that water quality of wells drilled (15-30 meters) is not better than dug wells. The quality of many artesian well water contaminated by mud, while the springs are partly to be found in Bintan Island, generally have a relatively small debit (< 5 lt/det).

2.5. Soil

Soil is a physical factor watersheds that have an important role in the hydrological. The role is related to its ability to infiltrate rainwater that falls to the earth's surface. This ability is highly variable and depends on the difference in soil characteristics and soil surface conditions. Characteristics of the soil in question is the texture, structure, and depth of soil solum.

The type of soil found in Bintan is dominated by *Hapludox-Kandiudult-Dystropets* (USDA system) which is for PPT Bogor system is equivalent to the type Podsolic Bogor Red Yellow and in some coastal regions encountered types of *Sulfaquents-Hydraquens-Tropquepts* (*alluvial hidromorf* dan glei humus).

General characteristics of soil types Podsolic Red Yellow is characterized by light gray color to yellow, blocky structure, low permeability, low aggregate stability, low organic matter, and is composed of siliceous sediment source rock, marl, sandstone and clay. For alluvial soil and humus glei are characterized by poor drainage, dark colored surface horizon, and reacted sourly.

2.6. Mangrove ecosystems Condition

Extensive for mangrove forest in Bintan is about ± 7,956 ha Conditions of mangrove vegetation in Bintan Island has a fairly high species diversity, as many as 42 types. Some common types of mangrove are *Avicenia marina, Bruguera gymnarrhiza, B. parviflora, B. sexangula, Rhizophora apiculata, R. mucronata, Sonneratia alba, Excoecaria agalloca, Xylocarpus granatum, X. moluccensis, Nypa fruticans, etc.* Mangrove species are also very common follow as hibiscus, ketapang, coconut, butun, and various other types.

Mangrove forest in Bintan Island is used as a protective buffering zone. Nonetheless, there are still many mangrove forests used as wood and household purposes, farm land, ports, residential, and industrial so it is feared would happen exploitation. Therefore, the protection of the mangrove ecosystem needs to be improved so that the existence and continuity is maintained.

Wildlife that can be found during the review on the ground is very slight and rare. For Species of Aves, can be found a variety of birds including a pigeon (*Treron* sp) and marsh hawk (*Circus cyaneus*). In some areas such as in Lagoi wildlife like long-tailed macaque primates (*Macaca fascicularis*) can be found. Reptiles that are common to be foundare rice field snake (*Phyton* sp.) andlizard (*Varanus* sp.).

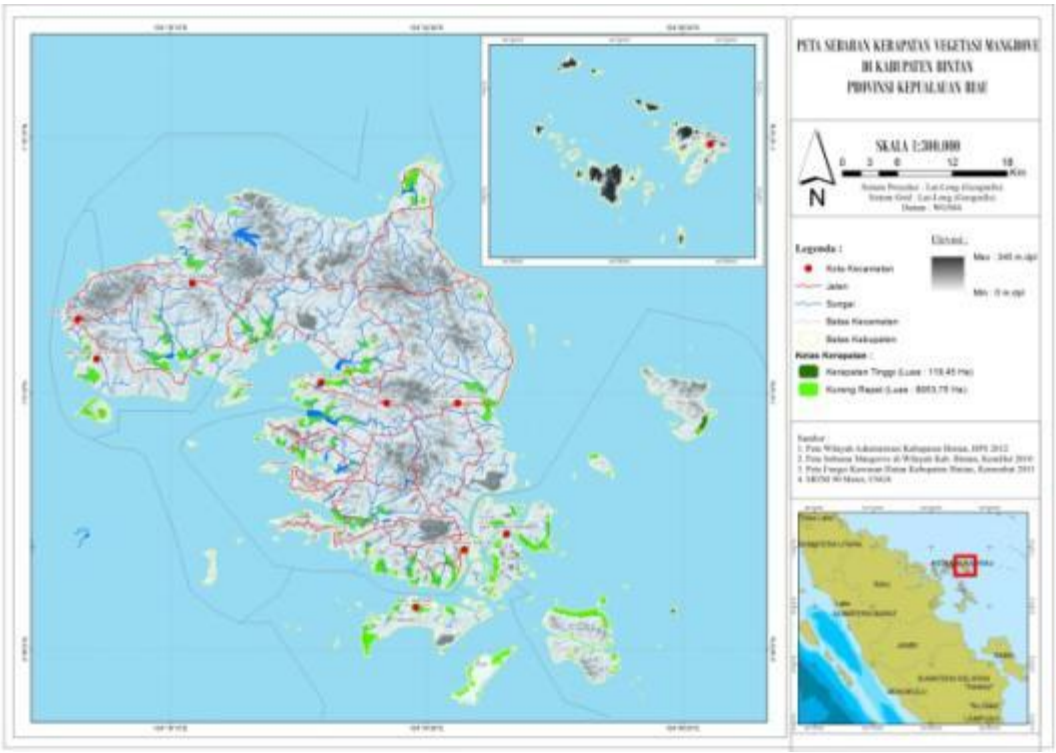

Figure 2.3. Mangrove deployment in Bintan Island

2.7. Socio-Economic Conditions

2.7.1. Population

Based on the 2010 Population Census, the total population of Bintan reached 142,281 people and consisted of 36 598 households. While the total population in year 2005 was 117 825 inhabitants, the Population Growth Rate of Bintan amounted to 2.98%.

With a land area of 1319.51 km^2,the average population density of Bintan in year 2010 (the ratio between the number of residents in the area) by 107 jiwa/km^2.

Table 2.1. Total Population by Age Group in Bintan, Year 2005-2010

No	Age Group	Year					
		2005	**2006**	**2007**	**2008**	**2009**	**2010**
1.	0-4	12,171	11,079	11,560	14,760	12,208	16,533
2.	5-9	10,858	11,687	11,048	12,465	12,457	14,783
3.	10-14	10,015	11,163	11,628	11,725	10,808	11,553
4.	15-19	8,441	9,764	9,677	10,968	10,755	10,258
5.	20-24	12,199	11,291	11,014	12,454	9,543	13,189
6.	25-29	14,054	14,150	14,344	13,586	13,504	16,889
7.	30-34	12,713	10,456	11,245	13,009	12,047	15,537
8.	35-39	9,753	10,392	10,258	10,409	10,946	12,065
9.	40-44	7,714	8,561	7,868	7,769	9,076	9,092
10.	45-49	6,231	7,942	6,183	5,859	7,839	6,858
11.	50-54	3,682	4,646	5,549	4,299	5,297	4,994
12.	55-59	4,073	3,074	3,690	2,937	4,175	3,614
13.	60-64	2,878	2,669	3,374	1,933	3,338	2,575
14.	65-69	1,704	1,472	2,341	1,279	2,311	1,963
15.	70+	1,339	1,482	1,533	1,606	3,073	1,252
Jumlah		117,825	121,303	122,677	125,058	127,404	142,281
Source : Central Statistics Agency (BPS)**of Bintan Year 2011**							

Meanwhile, until year 2010 *sex ratio* in Bintan reached 107 while *Dependency Ratio* reached 0,48, means a productive age population in Bintan must be able to bear less than 1 other residents (0,48).

At year 2010, Bintan population structure by age group in the category of productive age group (15-64 years) amounted 95071 inhabitants or 66.82%. As for the non-productive age group amounted 34531 inhabitants or 33.18%. Currently the proportion of the male population is likely to increase, it is expected because of the many job seekers who go to Bintan. If seen from the shape of the population pyramid, then Bintan has the potential of labor force is quite large with the dominant age group 24 to 39 years. For detailed information, it can be shown at following figure:

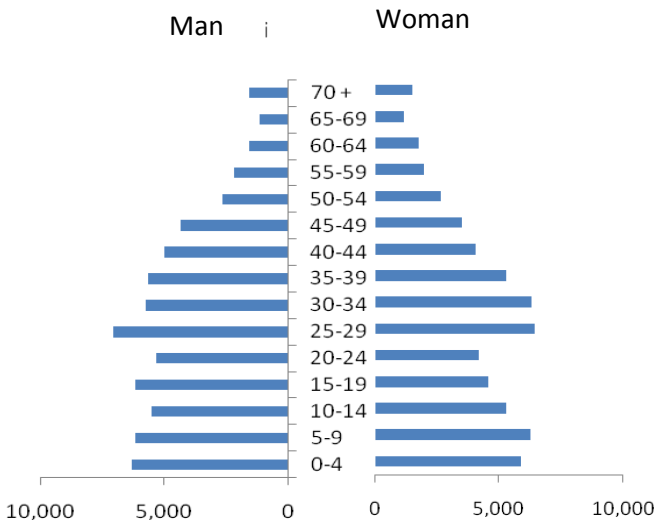

Figure 2.4. Population Structure by Age Group at Bintan Year 2010

Table 2.2. Amount of Bintan Population per Sub-District Year 2010

Sub-District	Population			Sex Ratio
	Man	Woman	Amount	
Teluk Bintan	4,755	4,179	8,934	114
Bintan Utara	10,644	10,550	21,194	101
Teluk Sebong	8,257	7,472	15,999	114
Seri Kuala Lobam	8,029	9,603	17,632	84
Bintan Timur	20,319	18,687	39,006	109
Gunung Kijang	6,573	5,434	12,007	121
Mantang	2,128	1,768	3,896	120
Bintan Pesisir	4,390	3,615	8,005	121
Toapaya	5,731	4,902	10,633	117
Tambelan	2,568	2,407	4,975	107
Bintan	**73,664**	**68,617**	**142,281**	**107**
Source : Central Statistics Agency (BPS)**of Bintan Year 2011**				

2.7.2. Human Development Index

The quality of human resources of an area can be seen from the value of Human Development Index (IPM). Values of IPM show the efforts made in establishing a regional human, the higher the value the better IPM efforts. In this regard, the Government of Bintan has tried to develop human through various development programs aimed at improving the standard of living in terms of purchasing power, health, and education. At year 2010, Value of IPM in Bintan reached 75,03. The achievement is a composite of the three main components of the IPM, namely: education index of 82.97; health index 74.50, and 79.61 purchasing power index.

1. Aspects of Health

Bintan health index in year 2005 was 73.88 points, in year 2010 to 74.50 points, it was up by 0.62 points. This indicated that the quality of life of residents in the district had improved, so Bintan government had succeded in improving the quality of life of the population. This is reflected in AHH Bintan population of the age of 69.33 years in year 2005 to 69.70 years in year 2010. This figure indicates that on average there will be an increase in human lifespan of 69 years and 3 months to be 69 years 7 months.

Table 2.3. The Development of Life Expectancy and Healthy Index in Bintan Year 2005-2010

No.	Year	Life Expectancy Value	Healthy Index
1.	2005	69.33	73.88
2.	2006	69.50	74.17
3.	2007	69.57	74.28
4.	2008	69.61	74.35
5.	2009	69.69	74.48
6.	2010	69.70	74.50
Source : Central Statistics Agency (BPS)**of Bintan and Bintan Health Institution, Year 2011**			

2. Aspects of Education

Education index is supported by indicators: literacy rate (AMH) and the average length of school (RLS). These indicators can describe the quality of human resources and the number of years spent in taking all kinds of formal education. At year 2010, percentage of the adult population (aged 15 years and above) was reached 98.09% for literate, with an average length of school reached 7.91 years.

Table 2.4. Average of Length of School Development and Bintan Education Index Year **2005-2010**

No	Year	Average Length of School	Education Index
1.	2005	6.67	80.16
2.	2006	7.03	80.52
3.	2007	7.15	80.92
4.	2008	7.76	82.41
5.	2009	7.82	82.76
6.	2010	7.91	82.97
Source: Bintan Education Institutional, Year 2011			

The level of education attained by people of Bintan population in 2009 was 102,997 people or reaching 72.39% of total population, whereas people who had not or did not complete primary school / MI are 17,828 people or 12.53% of the total population. The greatest level of education attained by level of education, is a graduate of seniorhigh scholl / MA or equivalent, reaching 35.869 people or 25.21% of the total population, whereas the least level of education attained is Diploma I / Diploma II is only 1,537 people, or 1.08% of total population.

Table 2.5. Percentage of BintanPopulation Aged 10 Years upwards According Highest Educational Attainment, Year 2005-2010

HighestCertificate	Amount					
	2005	**2006**	**2007**	**2008**	**2009**	**2010**
1. No / not done once school	5,37	7,36	5,28	7,50	7,88	15,08
2. No / not done graduation of elementary	19,09	21,18	21,70	26,25	31,21	12,53
3. Elementary/MI sederajat	25,89	25,98	25,62	22,26	26,36	20,82
4. Junior High School /MTs equivalent	18,64	14,98	19,48	18,65	13,33	17,79
5. High School/MA sederajat	20,48	22,80	18,36	16,33	13,64	25,21
6. Vocational School	7,48	4,70	5,80	3,45	3,33	3,37
7. Diploma I/II	1,83	1,03	0,73	1,47	0,91	1,08
8. D iploma III	0,33	1,07	1,11	1,05	0,61	1,85
9. Diploma IV/S1/S2/S3	0,88	0,90	1,92	3,04	2,73	2,27
Source : Central Statistics Agency (BPS)**of Bintan Year 2011**						

3. Aspects of Buying Power

Purchasing power of the population in Bintan in 2010 was influenced by policy changes in the sector due to the increase in fuel economy in the year 2008, so that the average real income per capita in 2010 was only able to ride for Rp 644.470.

Table 2.6. Buy Power Society in Bintan, Year 2005-2010

No.	Year	Buying Power (Rp)
1.	2005	623.000,-
2.	2006	626.220,-
3.	2007	637.000,-
4.	2008	641.600,-
5.	2009	643.000,-
6.	2010	644.470,-
Source : Central Statistics Agency (BPS)**of Bintan Year 2011**		

4. Security and Order

In general, security and order in Bintan relatively conducive to the ongoing activities of the community. Various crimes can be overcome thanks to the alertness of security personnel in detecting early symptoms of disorders and addressing security and public order. Despite various efforts to increase the security, public order and prevention of crime continues to be done. However, to achieve security and order can not be fully realized. This is reflected in the development of various social problems and social ills, such as drug abuse, gambling, theft cases, and acts of violence, although in a scale that can be controlled.

Performance improvement of safety, peace, order, and crime prevention can be drawn from the number and order of society according to the incident. In 2006, victims of crime index (base year 2005) in Bintan obtained by 54.84% and by type of crime index offenses dominant at 81.84%. This figure increased in year 2009 in which the index reached 112.10% of victims of crime and crime index by type of crime that became dominant 112.96%.

Although crime index in Bintan tend to increase, but due to rapid handling of the security forces and local governments and public awareness, the problem does not lead to greater social unrest. This is possible thanks to our efforts in building synergy between community leaders and government officials at all levels.

2.7.3. Local Economy

Important indicator to determine the condition of the economy in a region in a given period is shown by the data of Gross Domestic Product (GDP). GDP is defined as the value-added in all business units within a particular area, or a total value of final goods and services produced by all economic units. Value-added goods and services are calculated by reference to the prices prevailing in a given year is known as GDP at current prices that will be useful to see a shift and economic structure of a region, while the value-added goods and services are calculated based on the price of a given year is known as GDP at constant prices, where prices in 2000 and used as the basis of computation is useful to look at the magnitude of the rate of economic growth of a region.

The development of general economic conditions Bintan is a macro picture of the performance of governance and development in the last few years that shows a positive development, despite the fact that the development of national conditions while providing color in the accompanying dynamic for development of economic conditions in areas across Indonesia, including Bintan. General economic conditions in the region can be shown by figures Gross Domestic Product (GDP), which describes the gross value added / value of final output produced through the production of goods and services by production units in an area within a certain period. Economy of a region is said to grow when there is an increase in value added from the production of goods and services in a given period

Table 2.7. Gross Regional Domestic Product (GRDP) of Bintan at Constant Prices of Year 2000 by Industrial**, Tahun 2005-2010**

Lapangan Usaha	2005	2006	2007	2008	2009	2010
1. Farm	114.36	124.85	139.41	150.22	162.55	175.37
2. Mining and quarrying	254.22	266.89	277.44	292.80	307.06	325.84
3. Processing industry	1,336.40	1,392.96	1,441.85	1,502.41	1,562.13	1,634.16
4. Electricity. gas and water supply	6.52	6.87	7.40	7.72	8.05	8.38
5. Real Estate	66.44	72.00	78.92	84.96	90.69	96.90
6. Trade. hotels and restaurants	435.04	467.20	506.33	540.08	576.17	615.25
7. Transportation and communication	83.50	88.76	95.02	100.54	106.55	112.77
8. Finance. leasing and services	36.11	37.86	40.04	42.88	45.78	48.65
9. Services	67.97	71.83	77.11	82.30	88.07	93.47
GDB	**2,400.56**	**2,529.22**	**2,663.52**	**2,803.91**	**2,947.05**	**3,110.79**
Source : Central Statistics Agency (BPS)**of Bintan Year 2011**						

Table 2.8. GrowthRate Per Sector in BintanAccoringto Industrial, Year 2005-2010

Industrial	Growth Rate ofSector (%)					
	2005	2006	2007	2008	2009	2010
1. Farm	7.37	9.17	11.67	7.75	8.2	7.89
2. Mining and quarrying	4.52	4.99	3.95	5.54	4.87	6.11
3. Processing industry	4.77	4.23	3.51	4.2	3.98	4.61
4. Electricity, gas and water supply	4.05	5.47	7.68	4.3	4.27	4.1
5. Real Estate	5.61	8.37	9.61	7.65	6.75	6.85
6. Trade, hotels and restaurants	7.79	7.39	8.37	6.67	6.68	6.78
7. Transportation and communication	4.84	6.29	7.05	5.81	5.98	5.84
8. Finance, leasing and services	3.24	4.85	5.77	7.1	6.75	6.28
9. Services	0.94	5.68	7.35	6.74	7.01	6.12
Source : Central Statistics Agency (BPS)**of Bintan Year 2011**						

Based on data collected from the Central Statistics Agency (BPS), Bintan GDP on year 2005 and at current prices amounted to Rp 2.961 trillion increase to Rp 4.002 trillion in 2009 as measured from nine business sectors namely Agriculture field; Mining and Quarrying; Industry Manufacturing Electricity, Gas and Water; Building / Construction, Trade, Hotels and Restaurants; Transportation and Communications; Finance, Real Estate and Services Company and Services.

Aligned with GDP performance indicators, macro performance indicators represents success or complete failure of government in Bintan regency in its mission to improve the welfare of Bintan society. PDRB Bintan regency which is calculated according to the present price (current price) indicates the contribution or share of each sector the structure of the local economy is based on the prices prevailing in the year in which the inflation rate has included macro elements of Bintan regency.

Given to the current price of GDP that contains elements of macro inflation appears more due to the low or high percentage of inflation in the period. Thus, the GDP at current prices in real terms have not depict the economic growth of Bintan. To show the growth of GDP County Government Bintan in real is to use constant price of GDP. This represents growth of Bintan regency without being affected by the problem of price changes or inflation on goods and services produced because of using a constant base price, ie the price of a year particular base chosen. Based on preliminary data obtained from BPS of Bintan regency in year 2009, the Gross Domestic Product (GDP) Constant of Bintan at year 2000 reached Rp 2,935 trillion. The development of macro-economic conditions of Bintan regency during the period 2005-2009 tendfluktuatif. Economic conditions of Bintan regency in year 2009 are still under heavy pressure from the previous year. In year 2009, economic growth of Bintan regency slowed 4.68% from the year 2005 amounted to 5.28%. The economic growth rate of Bintan regency during year 2009 relatively more driven by the tertiary sector with a growth rate of 5.72%. Furthermore, the growth of the primary sector with a growth rate of 4.93% and a growth in the secondary sector at 4.11%

When viewed from the economic growth rate for each sector is to be varied. There are some sectors that experienced significant growth sectors such as agriculture, poultry, forestry, and fisheries grew by 7.37% in year 2005 to 8.20% in year 2009. The electricity sector, in year 2005 grew by 4.05% rising to 4.27% in year 2009. Sectors including building

and construction sector are relatively high economic growth, that is, from 5.61% in year 2005 to 6.75% in year 2009. So also with the transport and telecommunications sector grew by 4.84% in year 2005 to 5.98% in year 2009. Finance, leasing and business services grew by 3.24% in 2005 increased to 6.75% in 2009. The service sector is a sector that can create jobs other than the third-largest agricultural sector and trade growth increased sharply from 0.94% in year 2005 to 7.01% in year 2009.

Trade, hotels and restaurants are sectors that have an important role for the regional economy because employers are becoming quite large. Nevertheless, at the end of the last period of growth of this sector slowed from 7.79% in yeayear r 2005 to 5.39% in 2009. In addition, the rate of growth of the industrial sector which is usually quite high also decreased from 4.77% in year 2005 to 3.96% in year 2009. Slowing growth in these two sectors was the growing issue of global diseases such as swine flu and bird flu as well as the global economic crisis that hit the developed countries that greatly affect the number of international tourist arrivals and foreign investment, especially investment to Bintan regency.

2.7.4. Per Capita Income

Other performance indicators related to the amount of Gross Domestic Product is GDP per capita. Amount of GDP per capita Bintan shows the average income received by each resident and can represent the level of welfare in the Bintan regency. GDP per capita is one of the benchmarks of progress the development of a area. GDP per capita is the GDP at current prices divided by the number of mid-year population. Over the past five years, GDP per capita of Bintan has increased from year to year. In year 2005, GDP per capita of Bintan was only Rp 20,63 million, but in 2010 the GDP per capita reached Rp 25,30 million or grew by 22.64%.

III. METHODOLOGY

3.1. Framework Approach

Mangrove forests are a major component in the mangrove ecosystem. Healthy or not the function of mangrove ecosystems in a region is determined by the existence and health of mangrove forests. Until now the basic data (baseline data) of mangrove forest in Bintan Island has not provided a complete and integrated. Though the availability of baseline data for mangrove forests are accurate and up to date is important information for the public in the preparation of mangrove management strategies in community-based on Bintan Island.

In This activity, there are two aspects measured in the mangrove forest on the island of Bintan, namely:

1). Aspect of Vegetation, covering the structure and mangrove species composition. The data collected was then analyzed to determine the dynamics of the growth occurred in stands of mangrove forest on the island of Bintan. Information about the growth dynamics in mangrove forests is useful as a material consideration for determining the action or treatment in the management of mangrove forests as a whole, integrated, and sustainable.

2). Aspects of carbon, including savings and carbon emissions in the mangrove forest on the island of Bintan. The data collected was then analyzed to determine the level of savings and carbon emissions that occur in the mangrove forest on the island of Bintan. Such information is important to measure the level of contribution of mangrove ecosystem management in order to mitigate global warming and global climate change.

Vegetation data is obtained through the inventory, while changes in the value of carbon stocks in mangrove ecosystems is derived from a combination of spatial analysis with measurement and analysis of carbon values in the plot scale. Changes in land cover will be analyzed using Landsat satellite image multi-temporal, the image acquisition period in year 1995, 2000, 2005, and 2013. Landsat imagery used is as follows:

1. Satellite Imagery Landsat TM5, acquisition June 27, 1995, Bintan Island - Riau Islands Province

2. Satellite Imagery Landsat TM5, acquisition June 9, 2000, Bintan Island - Riau Islands Province
3. Satellite Imagery Landsat TM5, acquisition March 5, 2005, Bintan Island - Riau Islands Province
4. Satellite Imagery Landsat TM5, acquisition July 27, 2013, Bintan Island - Riau Islands Province

This method will be linked with the visualization of multi-temporal satellite images. The results of the analysis of land cover change based on checking on the ground and satellite image interpretation will be applied to determine the baseline in the mangrove ecosystem on Bintan Island. The process of collecting field data, process, until the results of the spatial analysis presented in the diagram below:

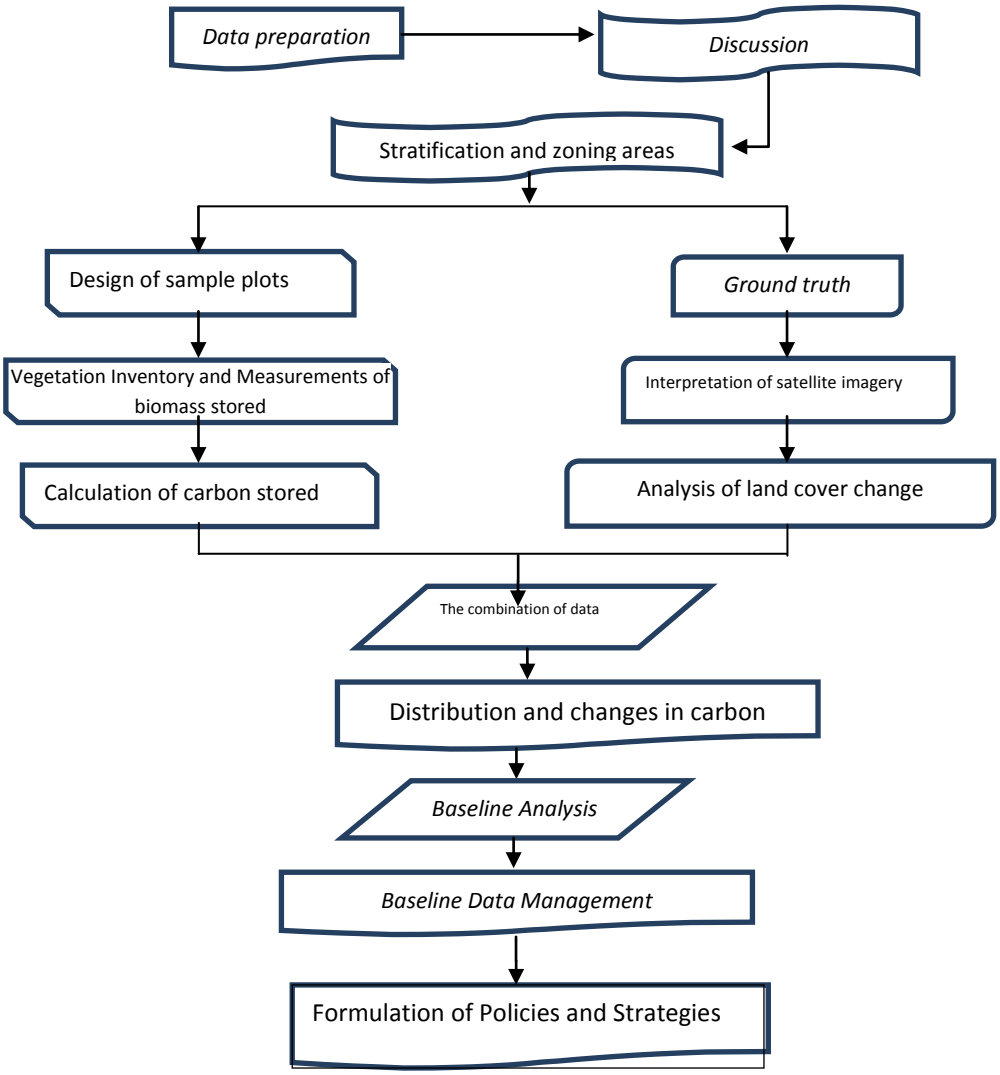

Figure 3.1. Baseline Data Management Framework Approach

in Bintan Mangrove Ecosystem

There are several steps taken in the preparation of baseline carbon in Bintan Island, ranging from preparation until further analysis as below:

a. *Preparation*

Preparation of this data contains the collection of secondary data related to the location of the study, among other types of mangroves, extensive mangrove ecosystem, mangrove history in Bintan Island, etc. Another data set is a multi-temporal satellite imagery covering the entire island of Bintan. The quality of satellite imagery is crucial in the analysis of changes in carbon stocks advanced in the study area. Therefore, it is necessary that the satellite imagery had a bit of cloud cover and cloud shadows that could minimize the loss of data in the study area. Selection of multi-temporal satellite images also have a tolerance, considering Bintan Island is one part of the islands that have the potential for very large cloud cover. The solution is to use a shorter span for a series of image acquisition between 1995 to 2013.

b. Discussion

This discussion is necessary to determine the methods used in the preparation of baseline studies in Bintan Island.

c. Stratification and zoning areas

Distribution of mangrove ecosystem has begun to be made in this stage. The goal is to support field survey measurements of carbon stocks stored in the scale of the plot in Bintan Island.

d. Ground truth

In addition to measuring carbon stocks in the scale of the plot, collected also point field that indicates the presence or distribution of mangrove vegetation on the island of bintan.

e. Interpretation of satellite imagery

Satellite images used in this study are Landsat satellite image multi-temporal. The method that will be used in the interpretation of this study is to manually-visual

classification. There are several parameters that will be used in the classification process, namely:

i. Color

Tone / Color Tone / Grey Tone is level of darkness or brightness of objects in the image. Color in thepanchromatic photo is an attribute for an object that interacts with the rest of the visible spectrum are often called white light, ie the wavelength spectrum (0,4 – 0,7) lm. Relating to remote sensing, so-called broad-spectrum spectrum, so the tone is a level of black to white or vice versa.

The color is a liberal visible to the eye by using a narrow spectrum, narrower than the visible spectrum. For example, objects appear blue, green, or red if only reflect the spectrum with wavelengths (0,4 to 0,5) lm, (0,5 to 0,6) lm, or (0,6 to 0,7) lm. Conversely, if the object absorbs the blue light then it will reflect the color green and red. As a result the object will appear in yellow.

ii. Size

Size is an attribute of objects such as distance, wide, high, slope, and volume. Due to the size of the object in the image is a function of scale, then in utilizing the element size image interpretation must always keep in mind the scale.

iii. Shape

The shape is a form of qualitative variables that describe the configuration of an object or frame. The shape is a clear attribute so many objects that can be recognized by its shape alone. Shape, size, and texture in Figure 1 are classified as the spatial arrangement of the secondary hue in terms of complexity. Starting from the hue which is the basic element and includes primary in terms of complexity. Observation of the hue can be done most easily. Therefore, the shape, size, and texture that instantly recognizable by hue, secondary grouped complexity.

iv. Texture

Texture is the frequency of changes in hue on hue images or repetition groups of objects that are too small to be distinguished individually. Texture is often expressed with rough, smooth, and mottled.

v. Design

Patterns, high, and shadows in Figure 1 are grouped into a tertiary level of complexity. At the higher level of complexity than the complexity of the shape, size, and texture as an element of image interpretation. Pattern or spatial arrangement is characteristic that marks the many objects of human formation and for some natural object.

vi. Shadow

Hide shadow detail or object is located in a dark area. Object or phenomenon that lies in the shadow areas are generally not visible at all or sometimes seems vague. Nonetheless, the shadow is often the key essential introduction to some object that was more evident from its shadow.

vii. Association dan the site

Associationscan be defined asthe relationship between one object with another object. This linkage makes sighting of an objectin the image so this is often acluetothe presenceof otherobjects. Together with the association, sitesare grouped into higher complexity. Siteis not afeature of the objectdirectly, but ratherin relation to the surrounding environment.

f. Analysis of land cover change

Analysis of changes in a mangrove area were analyzed using multi-temporal satellite images such as those mentioned above.

g. Rescaling land cover change to carbon stock change

Changes in land cover in the form of mangrove stands to be a non-mangrove or otherwise cause the dynamics of carbon stocks stored in these ecosystems. Measurement of carbon stocks in the plot scale will be correlated to land cover, so we get back the amount of carbon stored in the mangrove ecosystem of Bintan Island. Furthermore, land cover change data will be correlated, so that the data can be obtained changes in the value of carbon stored in the study area.

3.2. Materialand Tool

Preparation of Baseline Data in Mangrove Ecosystem Management in Bintan Island needs materials and suitable equipment inventory for mangrove vegetation, biomass and carbon emissions measurement. Description of materials and tools required as follows:

Table 3.1. Research Material and Tool

No	Tool/Material	Need			
		Vegetation	**Fauna**	**Carbon Measurement (biomass and carbon stock)**	**Carbon Emission**
1	Maps				
	a. Basic Map	√	√	√	√
	b. Landsat Satellite Imagery 2012	√	√	√	√
	c. Layout	√	√	√	√
	d. Mangrove Density	√	√	√	√
	e. Landsat Satellite Imagery <year 2000, year 2000-2010 and >year 2010				√
2	GPS (Global Position System)	√	√	√	√
3	Compass	√	√	√	
4	Tree diameter gauges (Phi Band, etc)	√		√	
5	Rope (500 meter)	√	√	√	√
6	Meteran (50 meter)	√	√	√	√
7	Digital camera and binokuler	√	√	√	√
8	Refractometer	√			
9	Plastic bagfor herbarium (size 50 kg)	√			
10	Stationery(pencil, eraser, board, paper, milimeter block paper).	√	√	√	√
11	Questionnaire survey	√	√	√	√
12	Newspaperand label	√		√	√
13	*Personal use* (boot shoes, backpack, raincoat, Roomy hats, t-shirts, life jackets, umbrellas, etc)	√	√	√	√
14	Alkohol 70 %, scissor (*Voucher Speciment*)	√			
15	Laboratorium Tool			√	
16	Office and its tool	√	√	√	√
17	Sofwere (MS Word, MS Ecxel, GIS sofwere, dll)	√	√	√	√
18	Axe, machete, Scales, etc			√	

3.3. Activity Location and Time

Location of activities located on Bintan mangrove forests mainly on the location of HKM / HD are already established or are being proposed. Location studies covering 8 villages with mangrove forests with a total area of 2.754,63 ha with the following details:

Table 3.2. Location of Mangroves Data Collection and Carbon in Bintan

No	Village Name	Sub-District	Wide (Ha)	%	Line Amount
1	Village Busung	Seri Kuala Lobam	174.79	6.35%	1
2	VillageKuala Sempang	Seri Kuala Lobam	489.66	17.78%	2
3	Village Bintan Biyu	Teluk Bintan	136.57	4.96%	1
4	Village Penaga	Teluk Bintan	432.59	15.70%	2
5	Village Pengujan	Teluk Bintan	109.76	3.98%	1
6	Village Tembeling	Teluk Bintan	785.12	28.50%	3
7	Village Matang Baru	Bintan Timur	385.66	14.00%	2
8	Village Sebong Lagoi	Teluk Sebong Lagoi	240.48	8.73%	2
	Amount		**2,754.63**	**100.00%**	**14**

Based on consideration of the existing mangrove area, accessibility, time, effort and available cost, then the data collection is done based on the proportional area of mangrove per village per lane range is 0-200 ha. Long lines adapted to field conditions (thick mangrove, accessibility, time andvarious other considerations).

Table 3.3. Location of Mangroves Data Collection and Carbon per Line

No	Line	Village	Wide (Ha)	Line Length (m)	Plot Amount
1	Line 1	Village Busung	174.79	210	21
2	Line 2	Village Kuala Sempang	489.66	140	14
3	Line 3	Village Kuala Sempang		80	8
4	Line 4	Village Pengujan	109.76	60	6
5	Line 5	Desa Penaga	432.59	320	32
6	Line 6	Village Penaga		200	20
7	Line 7	Village Bintan Biyu		180	18
8	Line 8	Village Tembeling	785.12	150	15
9	Line 9	Village Tembeling		210	21
10	Line 10	Village Tembeling		240	24
11	Line 11	Village Matang Baru	385.66	130	13
12	Line 12	Village Matang Baru		250	25
13	Line 13	Village Sebong Lagoi	240.48	60	6
14	Line 14	Village Matang Baru		120	12
	Amount		**2,754.63**	**2,350**	**235**

The research activities is carried out for 2 months starting from the preparatory studies, field visits, and preparation of reports. Field data collection is done on 4 - October 14, 2013.

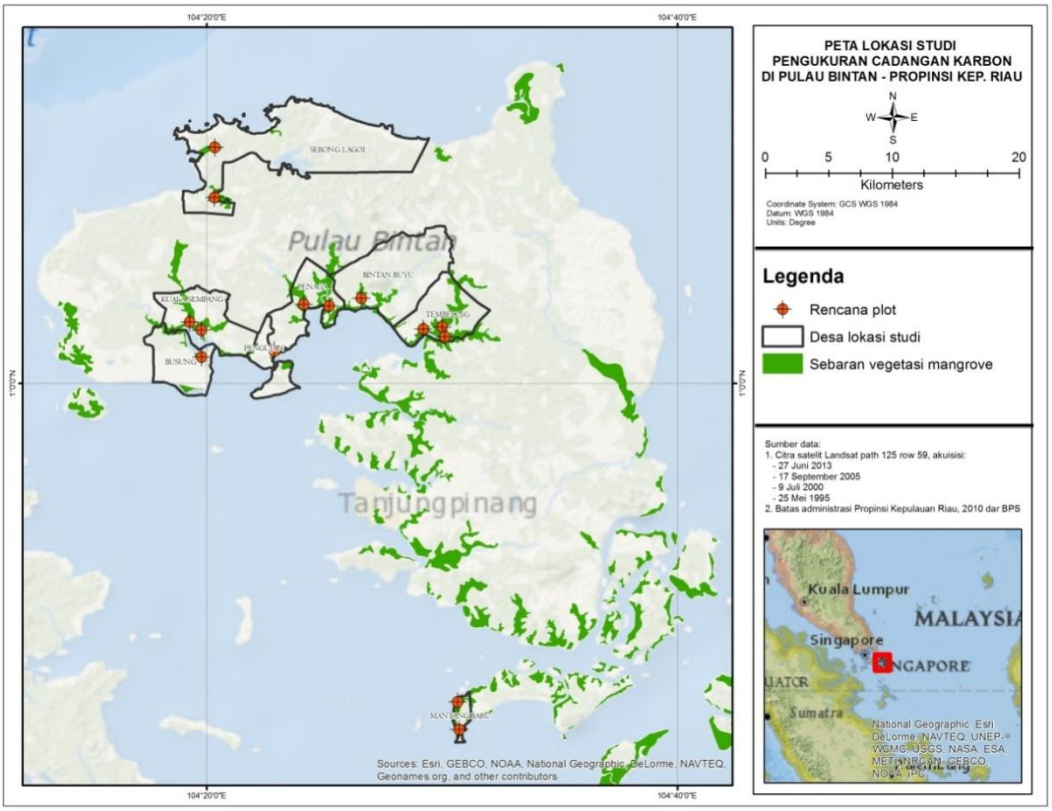

Figure 3.2. Point Location of Database Path Preparation Survey Mangrove Management in Bintan

Table 3.4. Preparation time of Mangrove Management Databasein Bintan

Activities		Time (weekly in 2 months)							
		1	2	3	4	5	6	7	8
Output 1	**Preparation Research**								
Activity 1.1	Preparation of working plan								
Activity 1.2	Secondary data collection (in Jakarta/Bogor)								
Activity 1.3	Verification of Secondary data								
Activity 1.4	Analysis (discussion with team)								
Output 2	**Field Visit**								
Activity 2.1	Secondary data collection								
Activity 2.2	Primary data collection								
Activity 2.3	Data Verification								
Output 3	**Report Preparation**								
Activity 3.1	Data Processing								
Activity 3.2	Making Report								

3.4. Stages of Implementation Activities

3.4.1. Preparation

To get a view of the mangrove ecosystem in Bintan, it would require the collection of a variety of data both secondary and primary materials to be further analysis.

3.4.2. Secondary data collection

Secondary data was collected through a literature study to look at the results of the study biophysical, socio-economic, that have been done in the area of mangrove in Bintan. Secondary data is taken from sources that are directly related, such as:

- Map of research location;
- Landsat Satellite Imagery;
- The results of studies related to the biophysical, socio-economic, institutional from various parties (government, NGOs, educational institutions, and research institutes);
- Data of mangrove management policies and regulations at both the central and regional levels.
- Data of Central Statistics Agency (Province, Regency and Distric determined in numeric)
- Village monography;
- Questionnaires and recorder.

3.4.3.Primary data collection

A. Mangrove Vegetation Inventory

Data collection mangrove vegetation adapted to RSNI-3 (Survey and mapping of mangrove) which is the result of the February 2011 Consensus Meeting on Geospatial Information Agency[1]. In vegetation surveys, parameters measured include:

a. Species Name
b. Individu Amount per species
c. Stem Diameter
d. Total Height
e. Individu Amount
f. Salinity, soil pH

[1]RSNI-3. 2011 Survey and mapping of mangrove. Result of Consensus MeetingFebruary 28,2011.

Stand density calculated using the method of vegetation analysis (Cox, 2001). Unit sample used in the analysis of activities in the mangrove forest vegetation is transect / path deliberately chosen (purpusive sampling). Line width used was 10 meters in the direction perpendicular to the direction of the mainland coastline. For mangrove forests growing on the riverbank path direction perpendicular to the line of the river. If both are used it is necessary to arrange in order to track the direction perpendicular to the coast not to intersect with the path direction perpendicular to the river.

Furthermore transect was divided into plots measuring 10 mx 10 m (tree), 5 mx 5 m (saplings), and 1 mx 1 m (seedlings). Lay out transects and dimensional measurements of trees, saplings and seedlings can be seen in the picture below:

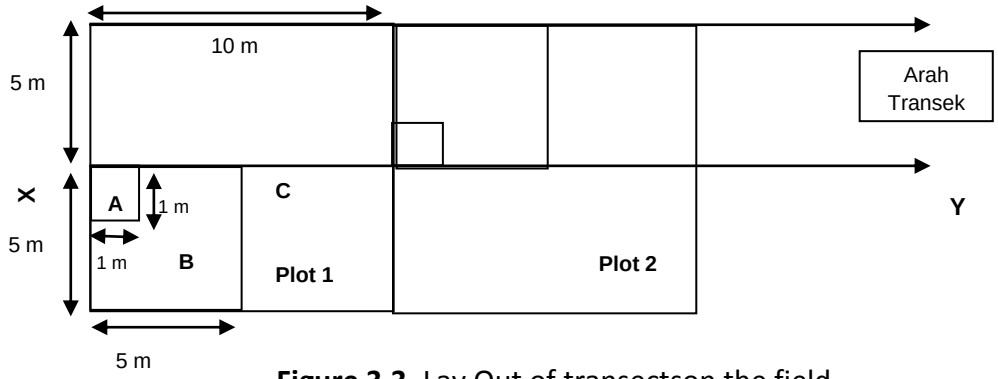

Figure 3.3. Lay Out of transectson the field

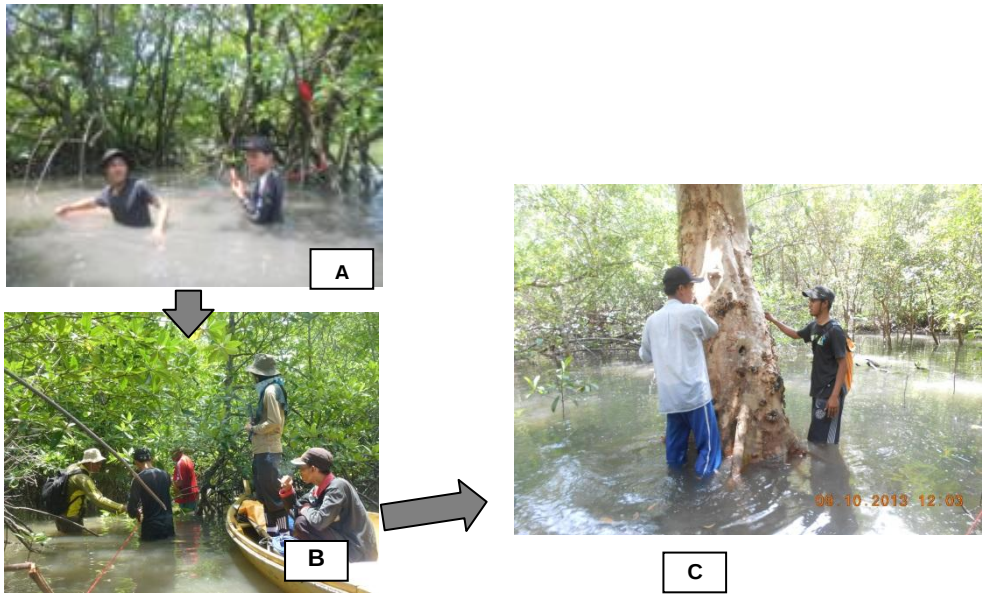

Figure 3.4. Mangrove Vegetation Inventory Process in Field: **A.**Preparation for Making Sample Plot Pembuatan Plot Contoh, **B**. Sample Plot, **C**. Dimension Measurement of Stem Diameter

Note : A = Seedling Measurement, plot size 2 m x 2 m
B = Sapling Measurement, plot size 5 m x 5 m
C = Tree Measuerement, plot size 10 m x 10 m

Vegetation data analysis was performed to determine the values of the parameters measured, such as the dominance of the vegetation on the other vegetation through Important Value Index (IVI / INP = Indeks Nilai Penting), Species Diversity Index, Similarity Index Type, and others. Important Value Index (IVI) Formula is:

$$\text{Density (stem/ha)} = \frac{\text{Amount of species individu}}{\text{Total Plot Area}}$$

$$\text{Relative Density} = \frac{\text{Density of current species}}{\text{Density of All Species}} \times 100\ \%$$

$$\text{Frequency} = \frac{\text{The number of a kind plots occupied}}{\text{Number of Whole Plots}}$$

$$\text{Relative Frequensy} = \frac{\text{Frequency of a kind of species}}{\text{Frequency of all species}} \times 100\ \%$$

$$\text{Dominance } (m^2/ha) = \frac{\text{An Area Wide of Field Basic of species}}{\text{Total Plot Area}}$$

$$\text{Relative Dominance} = \frac{\text{Dominance of current species}}{\text{Dominance of All Species}} \times 100\ \%$$

IVI = Relative Density (RD) + Relative Frequency (RF) + Relative Dominance (RD)

For seedling and sapling, Important Value Index (IVI) Formula is:

IVI = Relative Density (RD) + Relative Frequency (RF)

Furthermore, Species Diversity is calculated by using diversity index of Shannon-Wiener (Legendre dan Legendre, 1983) namely :

$$\mathbf{H' = \sum Pi \ln pi}$$

Note :

H' = Diversity Indexof Shannon-Wiener
Pi = ni/N
ni = Amount of species individu to-i
N = Amount of individu total

Values diversity begin greater with increasing number of genera found in sample. Legendre and Legendre (1983) argued that if H '= 0, then the community is composed of the genera or species (single type). H 'value will be close to the maximum when all species are equally distributed in the community. Range Shannon-Wiener index values are classified as follows :

H'<1 = Small population diversity and ecological pressures are very strong
1<H'<3 = Middle diversity
H'>3 = High diversityand occur ecosystems balance

B. Calculation of Savings and Carbon Emissions

Carbon deposits are calculated on a mangrove forest on the island of Bintan include carbon stored above ground (aboveground carbon) and carbon stored underground (belowground carbon). There are two types of mangrove growth rates measured from the content of carbon stocks and tree saplings. Non-destructive sampling method is used to calculate the carbon storage in mangrove forest on the island of Bintan to the stages of the following activities:

1. Inventory of extensive data sampling path, diameter, height, volume, and density of vegetation types mangrove carbon stocks will be calculated based on the analysis of vegetation.
2. Sampling of timber to determine the value of the density of wood (wood density) of each species of mangrove are inventoried. Referring to the Standard Operating Procedure for the Measurement of Carbon Stock in Conservation Areas prepared by the Forestry Research and Development Agency - Ministry of Forestry in collaboration with the International Tropical Timber Organization (2011), the calculation of the density of the wood (wood density) of each tree species is done by cutting the wood from one of the branches, and then measure the length, diameter and weigh wet weight. Enter it in the oven at 100°C for 48 hours and weigh the dry weight. Calculate the volume and density of the wood with the following formula:

   Volume (cm^3) = $\Pi R^2 T$

   Thus, calculate wood densitywith the following formula:

   $$\text{Wood density } (g\ cm^{-3}) = \frac{\text{Dried Weight (g)}}{\text{Volume } (cm^3)}$$
3. Calculating the value of the weight (grams) of upper mangrove biomass (aboveground biomass) with the volumetric method of multiplying the density of the wood (wood density) (g cm^3) a mangrove species with volume (cm^3). Furthermore, the results of the calculation are converted to weight in kilograms (kg)
4. Counting the number of severe upper mangrove biomass (aboveground biomass) of all types and levels of mangroves (trees and saplings) are measured in the same lane. The

result of this calculation is then converted into units of tonnes / ha by multiplying the total weight of biomass in a lane with a conversion factor to hectares (an area of 1 hectare divided by broad lines).

5. Recapitalize the results of calculations upper mangrove biomass (aboveground biomass) of mangrove saplings and trees in the same line.
6. Calculate the weight of the bottom of the mangrove biomass (belowground biomass) with allometric method approach generated by Komiyama et al (2005) as follows: BGB = $0{,}199^{p0{,}899}$ $D^{2{,}22}$ in which: BGB is Belowground biomass (biomass bottom) with units of kg , p is the density of the wood (wood density) with units of $g.cm^{-3}$ and D is the diameter of the trunk at breast height or 20 cm above buttresses (cm). The result of this calculation is then converted into units of ton / ha by multiplying the total weight of biomass in a lane with a conversion factor to hectares (an area of 1 hectare divided by broad lines).
7. Recapitalize the calculation results from bottom of biomass (belowground biomass) of mangrove saplings and trees in the same line.
8. Calculate the weight of the total biomass (total biomass) by summing the recapitulation upper biomass (Aboveground biomass) with the recapitulation lower biomass (Belowground biomass) on the same track. Based on the results of this recapitulation can know the content of the total biomass (tons/ha) in an area of mangrove ecosystems are represented by the line sampling
9. Calculating carbon savings in a mangrove forest (ton/ha) by multiplying the recapitulation of the calculation of total biomass with a conversion factor of 0,55 (Hilmi, 2003).
10. Calculate the CO_2 uptake in mangrove forest assessed by multiplying the carbon content (ton/ha) with a conversion factor of 3.67 which is the ratio between the relative molecular mass of CO_2 with relative atomic C.
11. Tabulate the results of the calculation of the content of the biomass, carbon storage, and the uptake of CO_2 by the villages which became the location of the measurement lines on the island of Bintan.

C. Calculation and Potential Analysis of Mangroves Carbon Emission

Calculation of potential carbon emissions mangrove on the island of Bintan is done by calculating the rate of deforestation in the area of mangrove forest in Bintan Island which started in 1990, 2000, 2010, and 2012. The magnitude of potential emissions is calculated by converting the deforestation rate (ha/year) in the mangrove forest with the magnitude of the potential value of carbon stock per hectare.

IV. BASELINE DATA OF MANGROVE ECOSYSTEM IN BINTAN ISLAND

4.1. Type Composition

Mangrove vegetation inventory in Bintan Island has identified 42 types of vegetation, both true mangrove species, also ecoton types or terrestrial those are still adjacent to mangrove vegetation. Of the 42 types, 32 types were found in the sample plots and other types beyond 10 sample plots.

Of all 42 types, 23 types are true mangrove types and other 19 types are adjacent mangrove types or the types those found in ecoton/terrestrial area. Those types are vegetations which naturally living in trees, palm, liana, shrubs, and ground cover species. The all details on the ecosystem of Mangrove species in Bintan Island are listed on **Table 4.1**. Documentation on all mangrove species of Bintan Island is available on **Picture 4.1**

Table 4.1. Composition of Mangrove Vegetation on Bintan Island

No	Types of Vegetation	Line														Details	Category
		1	2	3	4	5	6	7	8	9	10	11	12	13	14		
1	*Acanthus ilicifolius*	√				√	√										TM
2	*Avicennia alba*															Out of plot	TM
3	*Avicennia marina*	√					√	√			√		√	√			TM
4	*Avicennia officionalis*															Out of plot	TM
5	*Acrostichum aureum*	√			√												TM
6	*Acrostichum speciosum*	√			√												TM
7	*Barringtonia asiatica*															Out of plot	
8	*Calophyllum inophyllum*															Out of plot	
9	*Babaru*				√												
10	Bebetak				√	√											
11	*Bruguiera cylindrica*	√				√				√				√			TM
12	*Bruguiera gymnorrhiza*	√	√		√	√	√		√					√	√		TM
13	*Bruguiera parviflora*						√	√									TM
14	*Bruguiera sexangula*									√							TM
15	*Calamus* sp.															Out of plot	
16	*Ceriops tagal*								√						√		TM
17	*Derris trifoliate*							√									
18	*Exoecaria agallocha*	√	√		√	√	√	√									TM
19	*Finlaysonia*	√															

No	Types of Vegetation	Line														Details	Category
		1	2	3	4	5	6	7	8	9	10	11	12	13	14		
	maritima																
20	*Heritiera littoralis*				√	√	√		√	√			√				
21	*Hibiscus tiliaceus*				√	√											
22	*Ipommea pescaprae*														√		
23	*Citrus* sp (Jeruk limau)							√									
24	*Lumnitzera littorea*		√	√		√		√	√	√	√		√				TM
25	*Lumnitzera racemosa*	√						√									TM
26	Mata Keli					√											
27	Mentada		√														
28	*Morinda citrifolia*															Out of plot	
29	Nypa fruticans	√															TM
30	*Oncosperma tigillarium*															Out of plot	
31	*Pandanus tectorius*	√															
32	*Pongamia pinnata*															Out of plot	
33	*Rhizophora apiculata*	√	√	√	√	√	√		√	√	√		√	√	√		TM
34	*Rhizophora mucronata*	√	√				√		√	√			√	√			TM
35	*Rhizophora stylosa*											√	√	√	√		TM
36	*Scaevola taccada*													√			
37	*Sesuvium portulcastrum*													√			
38	*Sonneratia alba*													√			TM
39	*Sonneratia caseolaris*															Out of plot	TM
39	*Scyphiphora hydrophyllacea*	√	√	√	√	√		√	√	√	√		√				TM
40	*Termininalia catappa*															Out of plot	
41	*Xylocarpus granatum*	√	√	√	√	√	√	√	√	√	√		√	√	√		TM
42	*Xylocarpus mollucensis*	√	√	√	√	√	√		√	√	√	√					TM

Source : *Primary Data, Result of Invent, 2013*

Note /Information :

Line 1	Busung	Line 8	Tembeling
Line 2	Kuala Sempang	Line 9	Tembeling
Line 3	Kuala Sempang	Line 10	Tembeling
Line 4	Pengujan	Line 11	Mantang Baru
Line 5	Penaga	Line 12	Mantang Baru
Line 6	Penaga	Line 13	Sebong Lagoi
Line 7	Bintan Bunyu	Line 14	Sebong Lagoi

TM = True Mangrove

R. apiculata

Scyphiphora hydrophyllacea

R. stylosa

Ceriops tagal

Pandanus tectorius

Lumnitzera littorea

Brugiera cylindrica

Brugiera sexangula

Nypa fruticans

Bruguiera gymnorrhiza

Sonneratia alba

Stade

Picture 4.1. Some Species of Mangrove vegetation in Bintan Island

4.2. Density of Mangrove Vegetation

4.2.1. Density of Mangrove Vegetation on Seedlings Level

At the seedling level, the *Bruguiera cylindrica* species has the highest density if compare with other types with densities reaching 4,133 individuals per hectare. Other species with sufficiently high density is *Rhizophora apiculata* with density score is 3,477 individuals per hectare. Although *Bruguiera cylindrica* species is the highest density, but this species is not found to be spread evenly and only found in 3 lines. *Bruguiera cylindrica* was found clustered mainly in line 9 Tembeling village with densities reaching 55,000 individuals per hectare . In this line, *Bruguiera cylindrica* was found only in 3 plots of 21 existing plots .

The species at seedlings level that were found fairly evenly spread are *Rhizophora apiculata* and *Xylocarpus granatum* those were found on 11 lines or 78.6 % of the total 14 lines in the survey. While the types of seedlings are rarely found is *Babaru* species that only found in 1 line.

Overall the number of species at seedlings level that had identified are 15 species with a total density is 17,700 individual/ha. The highest density was found in line 9 of Tembeling village with 74,286 individual/ha and the lowest was found in line 7 of Bintan Bunyu village with seedling density level is only 561 individual/ha . This case can be seen in lines 2 and 1, respectively 35,750 stems/ha and 22,500 stems/ha . More vegetation seedling density data can be seen in Table 4.2.

Table 4.2. Recap data of Mangrove Vegetation Density at Seedling Level in Bintan Island

No	SPECIES	Seedling density in each lines (ind/ha)														*Each Species Density*	%
		1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***		
1	*Avicennia marina*		714					6								51	0.29
2	Babaru														833	60	0.34
3	*Bruguiera cylindrica*	1429	714							55714						4133	23.35
4	*Bruguiera gymnorrhiza*	1429	714		23333		500									1855	10.48
5	*Bruguiera parviflora*						500	6								36	0.20
6	*Derris trifoliata*							17								1	0.01
7	*Excoecaria agallocha*						500	17								37	0.21
8	*Lumnitzera littorea*							78			6667				3333	720	4.07
9	Mata keli					625										45	0.25
10	*Rhizophora apiculata*	2381	2143	12778		1875	2000	39	667	12857	5000		5600	3333		3477	19.64
11	*Rhizophora mucronata*	476	3571				1000			2381					5000	888	5.02
12	*Rhizophora stylosa*											8462	400	5000		990	5.59
13	*Scyphiphora hydrophyllacea*	1905	2857			10938	2000	44		2857	8333				1667	2186	12.35
14	*Xylocarpus granatum*	1905	2857	4444	11667	938	2500	356	667	476	833		400			1932	10.91
15	*Xylocarpus mollucensis*	476		1111	11667	625			1333		2083	769				1290	7.29
	Density each transek	10000	13571	18333	46667	15000	9000	561	2667	74286	22917	9231	6400	8333	10833	**17700**	100.00
	Amount of Species	***6***	***7***	***3***	***3***	***5***	***7***	***7***	***3***	***5***	***5***	***2***	***3***	***2***	***4***		

Sources *: Data Primer, 2013*

4.2.2. Mangrove Vegetation Density at Sapling Level

Overall, there were 23 types of Mangrove vegetations those have been identified with the density is 2,192 individual/ha. Based on the species, the cingam species (*Scyphiphora hydrophyllacea*) become species with the highest density, that is 879 species/ha. This type is pioneer mangrove type that commonly founded at disturbed mangrove location, log over area, or location with rare flooded duration. In normally, this tree has 3-4 meters height, even though there is tree that has height more than 7 m. Usually this plant has plenty of branches and growed in substrat mud, sand, coral on border of the land and embankment edge and close to the waterway.

Figure 4.2. Cingam type (*Scyphiphora hydrophyllacea*) that could be found on almost all Invent Line

Other sapling type that has high density is *Rhizophora apiculata* with the density is 668 plants per ha. Besides, this type is a species with the highest on founded frequency if to compare with other species. This species is a tree that could reach 30 meters for the height and 50 cm for the diameter. This species has unique on the root system. The root could be reachs 5 meters in height. The other side, the species with the lowest density is *Bruguiera parviflora* and *Bebetak* with the density is 1 individu / hectare.

Based on the location of the invent, so line 11 (Mantang Baru Village) has the highest mangrove vegetation density that is 4,954 plants per hektar of *Rhizophora apiculata* species, and to the sapling line the lowest density is at line 10 (Tembeling village).

Table 4.3. Recap of Mangrove Vegetation Density in Sapling level

No	Species	The density of saplings in each line (ind/ha)														*Density of spesies (ha)*	*Persentase (%)*
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*		
1	*Avicennia marina*						20	6					16			3	0.14
2	*Babaru*				67										33	7	0.32
3	*Bebetak*					13										1	0.05
4	*Bruguiera cylindrica*	171								286						33	1.51
5	*Bruguiera gymnorrhiza*	286	29		133	88	80							17		45	2.05
6	*Bruguiera paviflora*							6								1	0.05
7	*Ceriops tagal*								27							2	0.09
8	*Derris trifoliata*							17						17		2	0.09
9	*Excoecaria agallocha*	95	57					17								12	0.55
10	*Heritiera littoralis*		143			13	20		27	19			80			22	1.00
11	*Hibiscus tiliaceus*					25									200	16	0.73
12	*Lumnitzera littorea*		257	100		13		78		19	117				1067	118	5.38
13	*Mata keli*					113										8	0.36
14	*Mentada*		29													2	0.09
15	*Pandanus tectorius*	38														3	0.14
16	*Rhizophora apiculata*	171	57	650	133	500	420	39	853	552	42	4954	608	167	200	668	30.47
17	*Rhizophora mucronata*		29				1060			952			592			188	8.58
18	*Rhizophora stylosa*													167		12	0.55
19	*Scyphiphora hydrophyllacea*	1333	1800	350	933	1488	1640	44	2347	1238	4		528		600	879	40.10
20	*Sonneratia alba*	19												17		3	0.14
21	*Stade*														33	2	0.09
22	*Xylocarpus granatum*	76	114	350	467	163	1460	356	213	190	17		80	100		260	11.86
23	*Xylocarpus moluccensis*	19	29	600	467	25	20		187		4					97	4.43
	TOTAL	2210	2544	2050	2200	2438	4720	561	3653	3257	183	4954	1904	383	2133	2192	100.00
	Amount Jenis	10	10	5	6	10	8	8	6	7	4	1	6	6	6	23	

Sumber *: Data Primer, 2013*

4.2.3. Mangrove Vegetation Density in Tree Level

From all 14 invent lines, it was 21 tree species that has been identified and with the total density is 332 individual per ha. With that density, so mangrove density in Bintan Island area has medium density level. The tree density of this area has affected by mangrove tree usements like used as home materials, source on makin boat, etc. This medium density level also predicted that happened because the high utilization of mangrove tree to become mangrove charcoal that used mangrove wooden from the tree grow level.

If analyzed based on the species, so *Xylocarpus granatum* is a tree that become the highest density with 124 plants per ha. Then there is *Rhizophora apiculata* species with 51 plants per ha. Both species of the trees would be found at 10 lines from 12 surveyed lines.

If analyzed based on the line track location, line 6 (Penaga village) is the line with the highest tree density, that is 550 plants per ha, and the lowest tree density is on line 11 (Mantang Baru village) with 54 plants per ha. At Penaga village and other related villages it could be seen taht now the mangrove generation is well growing by the decreasing of the exploitation on mangrove trees. Eventhough, the growths of the mangrove is limited by lack supply of rich soil component from the mountain also that caused substrat become limited muddy and thin. This case also could be founded in Mantang Baru and Sebong Lagoi mangrove area that have substrat that dominantly with sand. At this two village for the first line of the survey track mostly be founded *Rhizophora stylosa* and *Ceriops tagal*, both on other village in Bintan Island, moslty the main species at the first linew that could be found is *Rhizophora apiculata.*

Mangrove Vegetation in Penaga Village

Xylocarpus granatum Species in Bintan Bunyu

Figure 4.3. Mangrove Vegetation Condition and *Xylocarpus granatum* type that has big diameter

Table 4.4. Recap of Mangrove Vegetation Density on Tree Level

No	Species	Tree density in each line (ind/ha)														*Density of species (ha)*	*%*
		1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***		
1	*Avicennia marina*	5					15	6								2	0.56
2	*Babaru*				17											1	0.37
3	*Bruguiera cylindrica*	10				3				19				17		4	1.05
4	*Bruguiera gymnorrhiza*	33	21			22	25		7							8	2.33
5	*Bruguiera paviflora*						5	6								1	0.24
6	*Bruguiera sexangula*									10						1	0.22
7	*Ceriops tagal*								7	5				17		2	0.62
8	*Derris trifoliata*							17								1	0.37
9	*Excoecaria agallocha*	19	7			13		17								4	1.21
10	*Heritiera littoralis*					3	30						44			6	1.66
11	*Lumnitzera littorea*	5	14	25		19		78	20	29	117		4		117	31	9.21
12	*Lumnitzera racemosa*	5													8	1	0.28
13	*Mentada*		7													1	0.15
14	*Rhizophora apiculata*	29		13	17	34	45	39	47	105	42		132	167	42	51	15.33
15	*Rhizophora mucronata*	24	86				10		7							9	2.73
16	*Rhizophora stylosa*											54	20	67		10	3.04
17	*Scyphiphora hydrophyllacea*	62	114	25		22	15	44	7	48	4		40		8	28	8.37
18	*Sonneratia alba*													17		1	0.37
19	*Stade*														17	1	0.37
20	*Xylocarpus granatum*	62	36	188	200	188	395	356	67	81	17		48	100		124	37.26
21	*Xylocarpus moluccensis*	19	7	263	183	78	10		100		4					47	14.28
	TOTAL	273	292	513	417	382	550	563	262	297	184	54	288	385	192	332	100.00
	Amount Jenis	11	8	5	4	9	9	8	8	7	5	1	6	6	5	10	
	Density Category (based on RSNI Survey and Mapping Mangrove)	rarely	rarely	average	average	average	average	average	rarely	rarely	rarely	rare	rarely	average	rarely	average	

Sumber *: Data Primer, 2013*

4.3. Species Dominance

Mangrove adaptability to field conditions caused the mangrove composition with typical limits were as a result of the selection of ground effects, long inundation and tidal currents (Samingan, 1972). Furthermore Sukardjo (1981) said that every mangrove vegetation generally will establish zoning different at every level of the community, is growing at a typical ecological niches and are dominated by one or several types of.

Sutisna (1981) stated that if the dominant tree species was said that type of tree had to be in the relevant area in large numbers. So that a determination of the dominant species on the basis of a value that is a combination of the three values, namely the values of density, frequency and dominance is very precise. This value indicates how large a role in the species habitat.

Overall, the composition and structure of the tree in each line (14 lines) is presented as follows:

4.3.1. Line 1 –Busung Village (21 Plots)

The location is not far from the path of settlement with the path length 210 meters. At the beginning of the path, types of tree are dominated by mangrove species, then dominated by nyirih merah and cingam. The results of the analysis of vegetation at a rate of seedlings, saplings and trees in the village Busung are presented in Table 4.5-4.7**.**

Table 4.5. Mangrove Vegetation Analysis Results at seedling level on Line 1

No.	Local Name	Latin Name	RD	RF	IVI
1	Bakau	*Rhizophora apiculata*	23.81	15.38	39.19
2	Blukap	*Rhizophora mucronata*	4.76	7.69	12.45
3	Boros	*Bruguiera cylindrica*	14.29	7.69	21.98
4	Cingam	*Scyphiphora hydrophyllacea*	19.05	30.77	49.82
5	Nyirih merah	*Xylocarpus granatum*	19.05	15.38	34.43
6	Nyirih putih	*Xylocarpus mollucensis*	4.76	7.69	12.45
7	Tumu	*Bruguiera gymnorrhiza*	14.29	15.38	29.67
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.6. Mangrove Vegetation Analysis Results at sapling level on Line 1

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	*Rizhopora apiculata*	7.76	8.82	15.28	31.87
2	Boros	*Bruguiera cylindrical*	7.76	8.82	7.95	24.53
3	Buta – buta	*Excoecaria agallocha*	4.31	8.82	6.86	19.99
4	Cingam	*Scyphiphora hydrophyllacea*	60.34	41.18	45.04	146.56
5	Nyirih merah	*Xylocarpus granatum*	3.45	8.82	5.79	18.06
6	Nyirih putih	*Xylocarpus mollucensis*	0.86	2.94	0.09	3.89
7	Pandan	*Pandanus tectorius*	1.72	2.94	2.88	7.54
8	Pedada	*Sonneratia alba*	0.86	2.94	0.67	4.47
10	Tumu	*Bruguiera gymnorrhiza*	12.93	14.71	15.45	43.09
	Amount		**100.00**	**100.00**	**100.00**	**300.00**

Table 4.7. Mangrove Vegetation Analysis Results at tree level on Line 1

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Api	*Avicennia marina*	1.75	2.78	0.82	5.35
2	Bakau	*Rhizophora apiculata*	10.53	5.56	9.62	25.70
3	Blukap	*Rhizophora mucronata*	8.77	2.78	2.39	13.94
4	Boros	*Bruguiera cylindrical*	3.51	8.33	3.98	15.82
5	Buta – buta	*Excoecaria agallocha*	7.02	11.11	6.05	24.18
6	Cingam	*Scyphiphora hydrophyllacea*	22.81	25.00	12.21	60.02
7	Nyirih merah	*Xylocarpus granatum*	22.81	19.44	33.28	75.54
8	Nyirih putih	*Xylocarpus mollucensis*	7.02	8.33	15.29	30.64
9	Sesap	*Lumnitzera littorea*	1.75	2.78	0.43	4.96
10	Teruntun	*Lumnitzera racemosa*	1.75	2.78	1.54	6.07
11	Tumu	*Bruguiera gymnorrhiza*	12.28	11.11	14.39	37.78
	Amount		**100.00**	**100.00**	**100.00**	**300.00**

Village Busung has an area of mangrove ecosystems 174.79 ha. From the analysis, the identified vegetation consists of 7 species types of seedlings, 10 species types of saplings and 11 species types of trees. At the seedlings and saplings, dominant species is cingam (Scyphiphora hydrophyllacea) with Importance Value Index (IVI) 49.82 and 146.56. While the level of tree, Xylocarpus granatum is the dominant species with IVI 75.54.

4.3.2. Line 2 –Kuala Sempang Village (14 Plots)

Mangrove ecosystem in Kuala Sempang village has an area of 489.66 ha. In line 2 of Kuala Sempang, seedlings are identified as 7 types and found no dominant species. Cingam (Scyphiphora hydrophillacea) has a higher IVI value when compared with other IVI with 46.05%.

Next is the type of bakau (*Rhizophora apiculata*) is a species with an IVI of 40.79%, while the lowest IVI which consists of three types, namely *Avicennia marina, Bruguiera cylindrica* and *Bruguiera gymnorrhiza* with IVI 12.60.

Likewise saplings, cingam is enough plot to dominate, especially after plot 2 to the plot 10 (IVI = 181,47). Overall saplings are found 10 types of species. At the beginning of the plot, bakau species is found, the next in the middle of the track is dominated by cingam, whereas at the end of the plots it is found mangrove species such as Dungun and Mentada. At the rate of tree growth, cingam also the more common types, although with a relatively small diameter compared to the other. At the end of the path is dominated by the type of pandan (*Pandanus tectorius*) and other mangrove species.

Table 4.8. Mangrove Vegetation Analysis Results at seedling level on Line 2

No.	Local Name	Latin Name	RD	RF	IVI
1	Api – api	*Avicennia marina*	5.26	8.33	13.60
2	Bakau	*Rhizhopra apiculata*	15.79	25.00	40.79
3	Blukap	*Rhizhopra mucronata*	26.32	8.33	34.65
4	Cingam	*Scyphiphora hydrophillacea*	21.05	25.00	46.05
5	Nyirih merah	*Xylocarpus granatum*	21.05	16.67	37.72
6	Turus	*Bruguiera cylindrica*	5.26	8.33	13.60
7	Tumu	*Bruguiera gymnorrhiza*	5.26	8.33	13.60
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.9. Mangrove Vegetation Analysis Results at Sapling level on Line 2

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Tumu	*Bruguiera gymnorrhiza*	1.12	4.35	0.92	6.39
2	Buta-buta	*Excoecaria agallocha*	2.25	4.35	0.52	7.12
3	Dungun	*Heritiera littoralis*	5.62	4.35	1.76	11.73
4	Sesap	*Lumnizera littorea*	10.11	8.70	20.41	39.22
5	Mentada		1.12	4.35	1.54	7.01
6	Bakau	*Rhizophora apiculata*	2.25	4.35	3.97	10.57
7	Blukap	*Rhizophora mucronata*	1.12	4.35	0.08	5.55
8	Cingam	*Scyphiphora hydrophillacea*	70.79	47.83	62.86	181.47
9	Nyirih merah	*Xylocarpus granatum*	4.49	13.04	5.96	23.50
10	Nyrih putih	*Xylocarpus mollucensis*	1.12	4.35	1.99	7.46
	Amount		**100.00**	**100.00**	**100.00**	**300.00**

Table 4.10. Mangrove Vegetation Analysis Results at Tree level on Line 2

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Tumu	*Bruguiera gymnorrhiza*	5.45	9.52	2.94	17.92
2	Sesap	*Lumnizera littorea*	3.64	9.52	11.51	24.67
3	Mentada		1.82	4.76	1.22	7.80
4	Nyirih putih	*Xylocarpus mollucensis*	1.82	4.76	8.11	14.69
5	buta – buta	*Excoecaria agallocha*	1.82	4.76	1.22	7.80
6	Blukap	*Rhizophora mucronata*	21.82	33.33	11.08	66.23
7	Cingam	*Scyphiphora hydrophillacea*	29.09	14.29	52.45	95.83
8	Nyirih Merah	*Xylocarpus granatum*	34.55	19.05	11.47	65.06
	Amount		**100.00**	**100.00**	**100.00**	**300.00**

4.3.3. Line 3 – Kuala Sempang Village (8 Plots)

In line 3 in the village of Kuala Sempang, bakau species (Rhizophora apiculata) is the dominant species on the growth rate of seedlings and saplings. This path was once of location for charcoal-making raw materials so that the types of commercial mangrove like bakau and crate and Tumu are very rarely encountered in the growth rate of trees. Tree species are dominant and are quite often found Nyirih putih and Nyirih merah types with stem diameter large enough. However, many trees are abandoned due to poor growth (wood is not straight). While a large tree with a good condition taken for various building needs.

Table 4.11. Mangrove Vegetation Analysis Results at Seedling level on Line 3

No.	Local Name	Latin Name	RD	RF	IVI
1	Bakau	*Rhizophora apiculata*	69.70	54.55	124.24
2	Nyirih merah	*Xylocarpus granatum*	24.24	27.27	51.52
3	Nyirih putih	*Xylocarpus moluccensis*	6.06	18.18	24.24
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.12. Mangrove Vegetation Analysis Results at Sapling level on Line 3

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	*Rhizophora apiculata*	31.71	30.00	18.66	80.37
2	Cingam	*Scyphiphora hydrophillacea*	17.07	20.00	12.03	49.10
3	Nyirih merah	*Xylocarpus granatum*	17.07	15.00	34.88	66.96
4	Nyirih putih	*Xylocarpus moluccensis*	29.27	25.00	30.89	85.16
5	Seresap	*Lumnizera littorea*	4.88	10.00	3.53	18.41
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

Table 4.13. Mangrove Vegetation Analysis Results at Tree level on Line 3

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	*Rhizophora apiculata*	2.44	6.25	0.88	9.57
2	Cingam	*Scyphiphora hydrophillacea*	4.88	12.50	1.31	18.69
3	Nyirih merah	*Xylocarpus granatum*	36.59	37.50	35.69	109.77
4	Nyirih putih	*Xylocarpus moluccensis*	51.22	37.50	59.84	148.56
5	Seresap	*Lumnizera littorea*	4.88	6.25	2.28	13.40
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

Figure 4.4. Figure of Mangrove at Jalur 3 of Kuala Sempang

4.3.4. Transect 4 – Pengujan Village 4 (6 Plots)

Pengujan village has an area of 109.76 ha of mangroves. At a growth rate of seedlings are found 3 types with dominant species is Tumu (*Bruguiera gymnorrhiza*) with IVI 100.00. At the saplings level are founded 6 types identified and cingam (Scyphiphora hydrophyllacea) is the dominant species with IVI 124.82. While at tree level of Nyirih Putih has IVI 145.33 .

Figure 4.5. Mangrove Condition in Pengujan Village

Table 4.14. Mangrove Vegetation Analysis Results at Seedling level on Line 4

No.	Local Name	Latin Name	RD	RF	IVI
1	Nyirih merah	*Xylocarpus granatum*	25.00	25.00	50.00
2	Nyirih putih	*Xylocarpus moluccensis*	25.00	25.00	50.00
3	Tumu	*Bruguiera gymnorrhiza*	50.00	50.00	100.00
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.15. Mangrove Vegetation Analysis Results at Sapling level on Line 4

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Babaru		3.03	8.33	1.43	12.79
2	Bakau	*Rhizophora apiculata*	6.06	8.33	7.36	21.76
3	Cingam	*Scyphiphora hydrophyllacea*	42.42	33.33	49.06	124.82
4	Nyirih merah	*Xylocarpus granatum*	21.21	16.67	18.47	56.35
5	Nyirih putih	*Xylocarpus moluccensis*	21.21	16.67	18.68	56.56
6	Tumu	*Bruguiera gymnorrhiza*	6.06	16.67	4.99	27.72
	AMOUNT		100.00	100.00	100.00	300.00

Table 4.16. Mangrove Vegetation Analysis Results at Tree level on Line 4

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Babaru		4.00	9.09	0.89	13.99
2	Bakau	*Rhizophora apiculata*	4.00	9.09	1.11	14.20
3	Nyirih merah	*Xylocarpus granatum*	48.00	45.45	33.03	126.48
4	Nyirih putih	*Xylocarpus moluccensis*	44.00	36.36	64.97	145.33
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

4.3.5. Line 5 – Penaga Village (32 plots)

Penaga village has an area of 432.59 ha of mangrove ecosystems. Location survey is about 5 km from the settlement, and it appears that quite well mangrove ecosystem mangrove with thickness reaches 320 meters. On seedlings and saplings, Cingam (*Scyphiphora hydrophyllacea*) is a species that has role and the highest niche role when compared with other types with IVI at seedling amount 122.92 and at aplings has IVI 154.53. While at tree level, Nyirih merah is the dominant species with an IVI amount 150.71. In addition to the original mangrove,in this line is found other mangrove species such as Dungun (*Heritiera littoralis*), Waru (*Hibiscus tiliaceus*), bebetak, and mata keli.


Figure 4.6. Mangrove Condition in Desa Penaga at line 5

Table 4.17. Mangrove Vegetation Analysis Results at seedling level on Line 5

No.	Local Name	Latin Name	RD	RF	IVI
1	Bakau	*Rhizophora apiculata*	12.50	25.00	37.50
2	Cingam	*Scyphiphora hydrophyllacea*	72.92	50.00	122.92
3	Mata keli		4.17	6.25	10.42
4	Nyirih merah	*Xylocarpus granatum*	6.25	6.25	12.50
5	Tumu	*Bruguiera gymnorhiza*	4.17	12.50	16.67
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.18. Mangrove Vegetation Analysis Results at Sapling level on Line 5

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	*Rhizophora apiculata*	20.51	21.43	22.25	64.19
2	Bebetak		0.51	1.79	0.06	2.36
3	Cingam	*Scyphiphora hydrophyllacea*	61.03	41.07	52.43	154.53
4	Dungun	*Heritiera littoralis*	0.51	1.79	0.99	3.28
5	Mata keli		4.62	7.14	3.64	15.39
6	Nyirih merah	*Xylocarpus granatum*	6.67	12.50	12.88	32.05
7	Nyirih Putih	*Xylocarpus mollucensis*	1.03	3.57	2.05	6.65
8	Seresah	*Lumnizera littorea*	0.51	1.79	0.25	2.54
9	Tumu	*Bruguiera gymnorrhiza*	3.59	5.36	5.32	14.27
10	Waru	*Hibiscus tiliaceus*	1.03	3.57	0.14	4.74
	AMOUNT		100.00	100.00	100.00	300.00

Table 4.19. Mangrove Vegetation Analysis Results at Tree level on Line 5

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	*Rhizophora apiculata*	9.02	14.04	2.45	25.50
2	Boros	*Bruguiera cylindrica*	0.82	1.75	0.90	3.47
3	Buta-buta	*Excoecaria agallocha*	3.28	3.51	1.02	7.81

No.	Local Name	Latin Name	RD	RF	RD	IVI
4	Cingam	*Scyphiphora hydrophillacea*	5.74	12.28	1.32	19.33
5	Dungun	*Heritiera littoralis*	0.82	1.75	0.41	2.99
6	Nyirih merah	*Xylocarpus granatum*	49.18	35.09	66.44	150.71
7	Nyirih putih	*Xylocarpus moluccensis*	20.49	15.79	17.50	53.78
8	Seresap	*Lumnizera littorea*	4.92	7.02	2.50	14.44
9	Tumu	*Bruguiera gymnorrhiza*	5.74	8.77	7.46	21.97
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

4.3.6. Transect 6 –Penaga Village

This line is still located in the Penagadengan Village with path length about 200 meters. At the level of seedling is found about 7 types with a fairly evenly dominance types. Nyirih merah has the highest dominance 52.78. Similarly, at the level of saplings and trees, red merah dominates with IVI respectively 97.78 and 204.15.


Figure 4.7. Mangrove Condition in Penaga Village at Line 6

Table 4.20. Mangrove Vegetation Analysis Results at seedling level on Line 6

No.	Local Name	Latin Name	RD	RF	IVI
1	Tumu	*Brugiera gymnorrhiza*	5.56	6.25	11.81
2	Burus	*Brugiera parviflora*	5.56	6.25	11.81
3	Buta-buta	*Excoecaria agallocha*	5.56	6.25	11.81
4	Bakau	*Rhizophora apiculata*	22.22	18.75	40.97
5	Blukap	*Rhizophoramucronta*	11.11	12.50	23.61
6	Cingam	*Scyphiphora hydrophillacea*	22.22	25.00	47.22
7	Nyirih merah	*Xylocarpus granatum*	27.78	25.00	52.78
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.21. Mangrove Vegetation Analysis Results at Sapling level on Line 6

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Api-api	*Avicennia marina*	0.42	2.00	0.39	2.81
2	Tumu	*Bruguiera gymnorrhiza*	1.69	8.00	3.66	13.34
3	Dungun	*Heritiera littoralis*	0.42	2.00	0.34	2.76
4	Bakau	*Rhizophora apiculata*	8.86	12.00	7.37	28.23
5	Blukap	*Rhizophora mucronata*	22.36	14.00	21.29	57.66
6	Cingam	*Scyphiphora hydrophillacea*	34.60	30.00	30.23	94.83
7	Nyirih Merah	*Xylocarpus granatum*	31.22	30.00	36.57	97.79
8	Nyirih putih	*Xylocarpus mollucensis*	0.42	2.00	0.15	2.57
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

Table 4.22. Mangrove Vegetation Analysis Results at Tree level on Line 6

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Api-api	*Avicennia marina*	2.73	5.00	1.66	9.38
2	Burus	*Bruguiera gymnoorhiza*	4.55	12.50	3.31	20.35
3	Burus	*Bruguiera parviflora*	0.91	2.50	0.32	3.73
4	Dungun	*Heritiera littoralis*	5.45	7.50	2.23	15.18
5	Bakau	*Rhizophora apiculata*	8.18	12.50	1.96	22.64
6	Blukap	*Rhizophora mucronata*	1.82	5.00	0.87	7.69
7	Cingam	*Scyphiphora hydrophillacea*	2.73	7.50	1.56	11.79
8	Nyirih merah	*Xylocarpus granatum*	71.82	45.00	87.33	204.15
9	Nyirih putih	*Xylocarpus mollucensis*	1.82	2.50	0.76	5.08
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

4.3.7. Transect 7 – Bintan Bunyu Village (18 Plots)

Bunyu Bintan village is administratively located in Bintan Bay District and has an area of 136.57 ha of mangroves. Mangrove ecosystem has encountered quite a lot of types, namely 6 types of seedlings, 10 types of saplings and 8 types of trees. At the level of seedling is dominated by Nyirih merah (*Xylocarpus granatum*) with IVI 82.09. While saplings, Cingam is the dominant species with IVI 171.07. While at the tree level, the type that dominates is a Nyirih merah with an IVI amount 194,98. Besides mangrove species, this pathway is also found some species which are in the type usually found in the yard like lime.

Table 4.23. Mangrove Vegetation Analysis Results at seedling level on Line 7

No.	Local Name	Latin Name	RD	RF	IVI
1	Api – api	*Avicennia marina*	13.64	11.76	25.40
2	Burus	*Bruguiera parviflora*	4.55	5.88	10.43

3	Sesap	*Lumnitzera littorea*	9.09	5.88	14.97
4	Bakau	*Rhizophora apiculata*	9.09	11.76	20.86
5	Cingam	*Scyphiphora hydrophillacea*	22.73	23.53	46.26
6	Nyirih merah	*Xylocarpus granatum*	40.91	41.18	82.09
	AMOUNT		**100.00**	**100.00**	**200.00**

Figure 4.8. Line 7 in Bintan Bunyu Village, dominated by Nyirih Merah (*Xylocarpus granatum*)

Table 4.24. Mangrove Vegetation Analysis Results at Sapling level on Line 7

No	Local Name	Latin Name	RD	RF	RD	IVI
1	Api-api	*Avicennia marina*	0.93	2.63	0.12	3.69
2	Tancang	*Bruguiera gymnorhiza*	1.87	2.63	0.66	5.16
3	Tuba laut	*Derris trifoliate*	1.87	5.26	2.83	9.97
4	Buta-buta	*Excoecaria agallocha*	1.87	2.63	0.88	5.38
5	Jeruk	*Citrus sp*	0.93	2.63	0.48	4.05
6	Sesap merah	*Lumnitzera littorea*	4.67	5.26	3.34	13.27
7	Sesap putih	*Lumnitzera racemosa*	3.74	10.53	2.18	16.44
8	Bakau	*Rhizophora apiculata*	4.67	7.89	5.80	18.37
9	Cingam	*Scyphiphora hydrophyllacea*	58.88	44.74	67.45	171.07
10	Nyirih merah	*Xylocarpus granatum*	20.56	15.79	16.26	52.61
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

Table 4.25. Mangrove Vegetation Analysis Results at Tree level on Line 7

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Api-api	*Avicennia marina*	0.99	2.78	1.93	5.69
2	Burus	*Bruguiera parviflora*	0.99	2.78	0.53	4.29
3	Tuba laut	*Derris trifoliata*	2.97	8.33	0.53	11.83
4	Buta-buta	*Excoecaria agallocha*	2.97	2.78	2.71	8.46
5	Sesap	*Lumnitzera littorea*	13.86	11.11	10.35	35.33

No.	Local Name	Latin Name	RD	RF	RD	IVI
6	Bakau	*Rhizhopora apiculata*	6.93	8.33	0.96	16.23
7	Cingam	*Scyphiphora hydrophyllacea*	7.92	13.89	1.38	23.19
8	Nyirih merah	*Xylocarpus granatum*	63.37	50.00	81.61	194.98
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

4.3.8. Transek 8 – Tembeling Village (15 plots)

Tembeling village is a village that has huge mangrove forest area with scale 785.12 ha. There are only founded 3 species of seedlings those are bakau, Nyirih Merah, and Nyirih Air and the dominant species is Nyirih Putih (*Xylocarpus moluccensis*) with the IVI level is 83.33. This species also dominant on the tree level with the IVI is 127.09. For the sapling level, the dominant species is Cingam (*Scyphiphora hyRDophyllacea*) with IVI level is 157.28.

Figure 4.9. Mangrove Vegetataion on Line 8 Tembeling Village

Table 4.26. Mangrove Vegetation Analysis Results at seedling level on Line 8

No.	Local Name		RD	RF	IVI
1	Bakau	*Rhizophora apiculata*	25.00	33.33	58.33
2	Nyirih merah	*Xylocarpus granatum*	25.00	33.33	58.33
3	Nyirih putih	*Xylocarpus mollucensis*	50.00	33.33	83.33
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.27. Mangrove Vegetation Analysis Results at Sapling level on Line 8

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Burus	*Ceriops tagal*	0.73	3.45	0.16	4.34
2	Dungun	*Heritiera littoralis*	0.73	3.45	0.21	4.38

No.	Local Name	Latin Name	RD	RF	RD	IVI
3	Bakau	*Rhizophora apiculata*	23.36	31.03	32.17	86.56
4	Cingam	*Scyphiphora hydrophyllacea*	64.23	37.93	55.11	157.28
5	Nyirih merah	*Xylocarpus granatum*	5.84	13.79	6.95	26.59
6	Nyirih putih	*Xylocarpus mollucensis*	5.11	10.34	5.41	20.86
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

Table 4.28. Mangrove Vegetation Analysis Results at Tree level on Line 8

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Tumu	*Bruguiera gymnorrhiza*	2.56	4.00	1.21	7.77
2	Burus	*Ceriops tagal*	2.56	4.00	1.58	8.14
3	Sesap merah	*Lumnitzera littorea*	7.69	12.00	3.26	22.95
4	Bakau	*Rhizophora apiculata*	17.95	20.00	5.06	43.00
5	Blukap	*Rhizophora mucronata*	2.56	4.00	0.56	7.12
6	Cingam	*Scyphiphora hydrophyllacea*	2.56	4.00	0.68	7.24
7	Nyirih merah	*Xylocarpus granatum*	25.64	20.00	31.02	76.66
8	Nyirih putih	*Xylocarpus mollucensis*	38.46	32.00	56.63	127.09
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

4.39. Jalur 9 - Tembeling (21 plot)

Line 9 located in Tembeling village has 210 meter length. The first point of the line that close to the end of waterline of Tembeling river, the species that was founded is Bakau types (*Rhizophora mucronata*) especially in poles grow level. The other plots Cingam species dominated with the IVI score 149.64. For tree level, Nyirih merah dominated the vegetation with the IVI score is 121.87.

On seedling level, Burus type (*Bruguiera cylindrica*) dominated and was founded in a group at plot 11 and 12. On this line also could be founded type *Brugueira sexangula* and C*eriops tagal*. This both species has limited spread capacity to the 8 villages as survey area.

Anakan *Bruguiera Cylindrica*

Rhizophora mucronata

Figure 4.10. Mangrove Vegetataion on Line 9 Tembeling Village

Table 4.29. Mangrove Vegetation Analysis Results at seedling level on Line 9

No.	Local Name	Latin Name	RD	RF	IVI
1	Burus	*Bruguiera cylindrical*	75.00	13.64	88.64
2	Bakau	*Rhizophora apiculata*	17.31	40.91	58.22
3	Blukap	*Rhizophora mucronata*	3.21	13.64	16.84
4	Cingam	*Scyphiphora hydrophillacea*	3.85	27.27	31.12
5	Nyirih merah	*Xylocarpus granatum*	0.64	4.55	5.19
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.30. Mangrove Vegetation Analysis Results at Sapling level on Line 9

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Burus	*Bruguiera cylindrica*	8.77	6.67	12.18	27.61
2	Dungun	*Heritiera littoralis*	0.58	3.33	0.07	3.99
3	Sesap merah	*Lumnitzear littorea*	0.58	3.33	1.39	5.31
4	Bakau	*Rizhopora apiculata*	16.96	20.00	15.61	52.56
5	Blukap	*Rizhopora mucronata*	29.24	10.00	19.38	58.62
6	Cingam	*Scyphiphora hydrophyllacea*	38.01	53.33	48.29	139.64
7	Nyirih merah	*Xylocarpus granatum*	5.85	3.33	3.09	12.27
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

Table 4.31. Mangrove Vegetation Analysis Results at Tree level on Line 9

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Burus	*Bruguiera cylindrical*	6.45	8.57	4.04	19.06
2	Burus	*Bruguiera sexangula*	3.23	2.86	1.05	7.13
3	Burus	*Ceriops tagal*	1.61	2.86	3.03	7.50
4	Sesap merah	*Luimnitzera littorea*	9.68	8.57	5.28	23.53
5	Bakau	*Rizhopora apiculata*	35.48	28.57	16.03	80.08

No.	Local Name	Latin Name	RD	RF	RD	IVI
6	Cingam	*Scyphiphora hydrophyllacea*	16.13	20.00	4.70	40.82
7	Nyirih merah	*Xylocarpus granatum*	27.42	28.57	65.88	121.87
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

4.3.10. Transek 10 –Tembeling (24 Plots)

Line 10 is located in Sungai Tembeling village with the height is 240 meter. At seedling level it was founded 5 species with the dominant species is Cingam ((*Scyphiphora hydrophyllacea)* with IVI level is 63.29. Also for sapling lebel, the Cingam also becomame the dominant species with IVI score 104.95. Generally, first zonation is dominated by mangrove, and followed by Cingam, and then the next is by Sesap species (*Lumnitzera littorea*). On the tree level, the dominant species is Sesap/Seresap (*Lumnitzera littorea*) with IVI 184.86. Sesap/seresap is *true mangrove spesies* that could be founded spread especially on middle or back zone (final line zone). The tree height could reached 25 meters, but usually lower than that. The root for breathing form look alike knee, has brown color, and has design on straight and vertical. Leaves are quiet thick and flowers are groups with bright-red colors and fully filled with nest. This species loves the substrat that is soft and muddy on the border area of island that rarely happened flood or watering.

Figure 4.11. Mangrove Vegetation Condtion on Line 10 Tembeling Village

Table 4.32. Mangrove Vegetation Analysis Results at seedling level on Line 10

No.	Local Name	Latin Name	RD	RF	IVI
1	Bakau	*Rhizophora apiculata*	21.82	23.08	44.90
2	Cingam	*Scyphiphora hydrophyllacea*	36.36	26.92	63.29
3	Nyirih merah	*Xylocarpus granatum*	3.64	7.69	11.33
4	Nyirih putih	*Xylocarpus mollucensis*	9.09	11.54	20.63
5	Sesap	*Lumnitzera littorea*	29.09	30.77	59.86
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.33. Mangrove Vegetation Analysis Results at Sapling level on Line 10

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	*Rhizopora apiculata*	42.48	35.48	49.77	127.74
2	Bongseng	*Avicennia marina*	0.38	1.61	0.32	2.31
3	Cingam	*Scyphiphora hydrophyllacea*	41.73	35.48	27.73	104.95
4	Nyirih merah	*Xylocarpus granatum*	1.13	4.84	0.97	6.93
5	Nyirih putih	*Xylocarpus mollucensis*	3.76	8.06	4.15	15.97
6	Seresap	*Lumnitzera littorea*	10.53	14.52	17.06	42.11
	AMOUNT		100.00	100.00	100.00	300.00

Table 4.34. Mangrove Vegetation Analysis Results at Tree level on Line 10

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	*Rhizophora apiculata*	22.73	32.00	14.78	69.50
2	Cingam	*Scyphiphora hydrophyllacea*	2.27	4.00	0.98	7.25
3	Nyirih merah	*Xylocarpus granatum*	9.09	8.00	13.91	31.00
4	Nyirih putih	*Xylocarpus mollucensis*	2.27	4.00	1.51	7.78
5	Seresap	*Lumnitzera littorea*	63.64	52.00	68.83	184.46
	AMOUNT		22.73	32.00	14.78	69.50

4.3.11. Line 11 – Mantang Baru Village (13 plots)

Mantang Baru village has mangrove forest area with scale 385,66 ha. On this track, it is only possible to reach upto 130 meters (13 plots) to the limit in the deep and huge river. The next line, line 12 could express more mangrove forest condition in Mantang Baru village. On the line 11 that was only founded 2 species of seedling level, and 1 species of sapling and tree, that is Bakau species (*Rhizophora stylosa*). The first invent line, substrat dominated by corally-sand, high frequncy on the water level of dominated and the salinity around 28 $^{o}/_{oo}$. Those all situation above made that the dominant mangrove is *Rhizophora stylosa.*

Table 4.35. Mangrove Vegetation Analysis Results at seedling level on Line 11

No.	Local Name	Latin Name	RD	RF	IVI
1	Bakau	*Rhizophora stylosa*	91.67	83.33	175.00
2	Nyirih putih	*Xylocarpus mollucensis*	8.33	16.67	25.00
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.36. Mangrove Vegetation Analysis Results at Sapling level on Line 11

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	*Rhizophora stylosa*	100.00	100.00	100.00	300.00
	AMOUNT		100.00	100.00	100.00	300.00

Table 4.37. Mangrove Vegetation Analysis Result at Tree Level on Line 11

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	*Rhizophora stylosa*	100.00	100.00	100.00	300.00
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

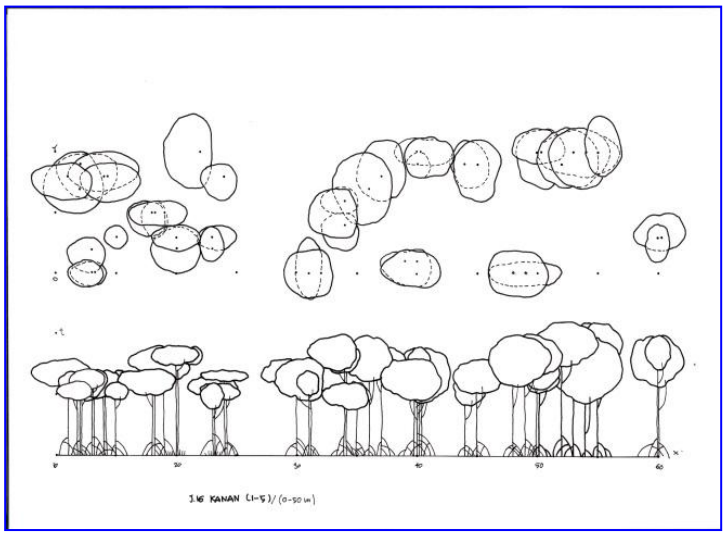

Figure 4.12. Strucutre of Mangrove Vegetation at Line 11 Mantang Baru Village

4.3.12. Transek 12 –Mantang Baru (35 plots)

Mantang Baru village is located at the island that separated from Bintan Island, that is at the southern side of Bintan Island. The survey location is at the western side of Mantang Baru Island that is close to suar location. At the beginning of the survey line, dominant substrat is coral sand and will be flooded when the water level up. The dominant species on this line is *Rhizophora stylosa.* At the next plot, species is dominated by *Rhizophora apiculata* for pole and

tree level with the IVI for each are 90.42 and 129.41. At the center side of the island that rarely flooded, shrubs of Piyai species are dominant.

Figure 4.13. Condition of Mangrove Vegetation in Line 12 Mantang Baru Village

Table 4.38. Mangrove Vegetation Analysis Results at seedling level on Line 12

No.	Local Name	Latin Name	RD	RF	IVI
1	Bakau	*Rhizophora apiculata*	87.50	71.43	158.93
2	Bakau	*Rhizophora stylosa*	6.25	14.29	20.54
3	Nyirih merah	*Xylocarpus granatum*	6.25	14.29	20.54
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.39. Mangrove Vegetation Analysis Results at Sapling level on Line 12

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Api-api	*Avicennia marina*	0.84	2.94	0.03	3.81
2	Dungun	*Heritiera littoralis*	4.20	5.88	5.87	15.95
3	Bakau	*Rizhopora apiculata*	31.93	35.29	23.20	90.42
4	Bakau	*Rizhopora mucronata*	31.09	14.71	37.97	83.77
5	Cingam	*Scyphiphora hydrophyllacea*	27.73	29.41	29.82	86.96
6	Nyirih merah	*Xylocarpus granatum*	4.20	11.76	3.12	19.09
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

Table 4.40. Mangrove Vegetation Analysis Results at Tree level on Line 12

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Dungun	*Heritiera littoralis*	15.28	15.63	8.56	39.46
2	Sesap	*Lumnitzera littorea*	1.39	3.13	0.51	5.03
3	Bakau	*Rizhopora apiculata*	45.83	43.75	39.56	129.14
4	Bakau	*Rizhopora stylosa*	6.94	9.38	2.34	18.66
5	Cingam	*Scyphiphora hydrophyllacea*	13.89	6.25	9.61	29.75
6	Nyirih merah	*Xylocarpus granatum*	16.67	21.88	39.42	77.96
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

4.3.13. Transek 13 – Sebong Lagoi (6 Plots)

Sebong Lagoi village is located in northern side of Bintan Island. Overall this vilage has 240,48 ha of mangrove vilage. At this moment the mangrove area of this village is one of area with the best mangrove tourism activity in Bintan district that managed by BRC and under cooperation with NGO and local community group.

Figure 4.14. Mangrove tourism Attraction at Sebong Lagoi Village

In general, mangrove species is the dominant species in this village. On this line 13 substrat area dominantly sand with little mud with the salinity level is around 30 %. For the seedling, it was found only 2 species, and the dominant type is bakau (*Rhizophora stylosa*) with IVI score is 120,00. Also at the pole level, this species is still dominant with the IVI core level is 199,15. This type is usualy become dominant at the first zone or around 30 meters from the first point of the line 13. For the next, middle plot and back side plot are dominated by bakau (*Rhizophora apiculata*) and Nyirih (*Xylocarpus granatum*).

Figure 4.15. Vegetasi Mangrove condition in Line 13 Sebong Lagoi Village

Table 4.41. Mangrove Vegetation Analysis Results at seedling level on Line 13

No.	Local Name	Latin Name	RD	RF	IVI
1	Bakau	*Rhizophora apiculata*	40.00	40.00	80.00
2	Bakau	*Rhizophora stylosa*	60.00	60.00	120.00
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.42. Mangrove Vegetation Analysis Results at Sapling level on Line 13

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Tumu	*Bruguiera gymnorrhiza*	3.45	11.11	0.32	14.88
2	Bakau	*Rhizophora apiculata*	17.24	22.22	12.91	52.37
3	Bakau	*Rhizophora stylosa*	62.07	55.56	81.52	199.15
4	Nyirih merah	*Xylocarpus granatum*	17.24	11.11	5.25	33.60
	AMOUNT		100.00	100.00	100.00	300.00

Table 4.43. Mangrove Vegetation Analysis Results at Tree level on Line 13

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bongseng	*Ceriops tagal*	4.35	8.33	2.93	15.61
2	Boros	*Bruguiera cylindrical*	4.35	8.33	3.00	15.68
3	Bakau	*Rhizophora apiculata*	43.48	25.00	27.55	96.03
4	Bakau	*Rhizophora stylosa*	17.39	25.00	10.16	52.55
5	Prepat	*Sonneratia alba*	4.35	8.33	12.26	24.94
6	Nyirih merah	*Xylocarpus granatum*	26.09	25.00	44.10	95.18
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

4.3.14. Transek 14 –Sebong Lagoi (12 plots)

Line 14 is part of Sebong Lagoi Village and this line is more thick compared with line 13. For the seedlings level, Seresap type (*Lumnitzera littorea*) is the dominant species with IVI score is 70,77%. Also on poles and tree, this species is dominant, with the IVI score 139,2 and 146,81. At the end of the line, species those founded are mangrove-followed species like Babaru, Waru laut, and Stade.

Subtrat is dominantly sand

Figure 4.16. Condition of Mangrove Forest at Line 14 in Sebong Lagoi Village

Table 4.44. Mangrove Vegetation Analysis Results at seedling level on Line 14

No.	Local Name	Latin Name	RD	RF	IVI
1	Babaru		7.69	20.00	27.69
2	Bakau	*Rhizophora apiculata*	46.15	20.00	66.15
3	Cingam	*Scyphiphora hydrophyllacea*	15.38	20.00	35.38
4	Seresap	*Lumnitzera littorea*	30.77	40.00	70.77
	AMOUNT		**100.00**	**100.00**	**200.00**

Table 4.45. Mangrove Vegetation Analysis Results at Sapling level on Line 14

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Babaru		1.56	7.69	0.58	9.83
2	Bakau	*Rhizophora apiculata*	9.38	15.38	6.28	31.04
3	Cingam	*Scyphiphora hydrophyllacea*	28.13	15.38	28.18	71.68
4	Seresap	*Lumnitzera littorea*	50.00	38.46	50.75	139.22
5	Setade		1.56	7.69	0.95	10.21
6	Waru	*Hibiscus tilliaceus*	9.38	15.38	13.27	38.03
	AMOUNT		100.00	100.00	100.00	300.00

Table 4.46. Mangrove Vegetation Analysis Results at Tree level on Line 14

No.	Local Name	Latin Name	RD	RF	RD	IVI
1	Bakau	Rhizophora apiculata	21.74	20.00	29.12	70.86
2	Cingam	*Scyphiphora hydrophyllacea*	4.35	10.00	3.08	17.43
3	Setade		8.70	20.00	9.78	38.48
4	Seresap	*Lumnitzera littorea*	60.87	40.00	45.94	146.81
5	Teruntun	*Lumnitzera racemosa*	4.35	10.00	12.07	26.41
	AMOUNT		**100.00**	**100.00**	**100.00**	**300.00**

4.4. Wood volume

Overall, the average volume of mangrove wood in the study area of saplings and trees was 224.18 190.89 m^3/ha with details m^3/ha volume and 33.21 m^3/ha tree saplings. Line 7 in the village of Bintan Bunyu a path with the highest timber volume reached 677.92 m^3/ha. In this type of Nyirih red lines (Xylocarpus granatum) is dominant with a trunk diameter reaching 123.77 cm. While the path with the lowest volume of wood can be seen in lane 11 in the village of New Mantang the total timber volume of 26.36 m^2. On this track the number and diameter of the tree-level timber is relatively small when compared to other locations. It also affects the volume of wood that is lower than the potential timber saplings.

Figure 4.17. One Tree Nyirih red (Xylocarpus granatum) with a great diameter

Table 4.47. Tree Stake and recapitulation Volume (m^3/ha) in Each Line Observations

No	Line	Potential Stake Level wood (m^3/ha)	The level of potential timber trees (m^3/ha)	Amount (m^3)
1	Line 1	31.74	124.05	155.79
2	Line 2	47.22	194.13	241.35
3	Line 3	25.52	311.83	337.35

No	Line	Potential Stake Level wood (m^3/ha)	The level of potential timber trees (m^3/ha)	Amount (m^3)
4	Line 4	45.64	293.8	339.44
5	Line 5	22.33	223.98	246.31
6	Line 6	67.83	151.55	219.38
7	Line 7	21.07	656.85	677.92
8	Line 8	41.66	179.3	220.96
9	Line 9	31.45	193.18	224.63
10	Line 10	35.29	73.83	109.12
11	Line 11	18.63	7.73	26.36
12	Line 12	25.39	92.43	117.82
13	Line 13	22.92	119.56	142.48
14	Line 14	28.26	50.26	78.52
	Average	**33.21**	**190.89**	**224.10**

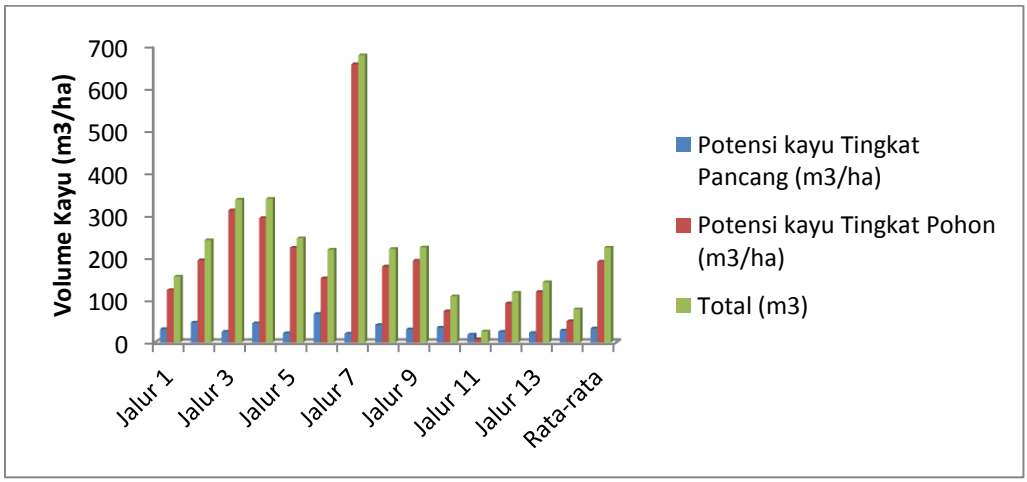

Figure 4.18. Potential Wood Pile Bird and Tree Based Path

4.5. Species Diversity Index

Results calculated Diversity Index (H') to indicate that vegetation diversity index varied between a low (0) to a high (2.09). Categories with the highest value can be seen in lane 1 at the Village Busung for strata tree with a value of 2.09. While the lowest can be seen in lane 11 in the village of New Mantang d IMANA of saplings and trees found only one type. More is presented in Table 4.48.

Table 4.48. Diversity Index (H ') Based on Mangrove Forest Tree Growth Rate, saplings and seedlings in Bintan Island

No	Observation path	According to the Shannon Diversity Index Type		
		seedling	stake	Tree
1	Line 1	1.82	1.37	2.09
2	Line 2	1.76	1.15	1.56
3	Line 3	0.77	1.60	1.10
4	Line 4	1.04	1.47	1.00
5	Line 5	093	1.24	1.66
6	Line 6	1.75	1.42	1.13
7	Line 7	1.56	1.36	1.25
8	Line 8	1.04	1.01	1.60
9	Line 9	0.79	1.47	1.60
10	Line 10	1.40	1.16	1.01
11	Line 11	0.34	0	0
12	Line 12	0.46	1.39	1.46
13	Line 13	0.58	1.02	1.43
14	Line 14	1.21	1.28	1.12

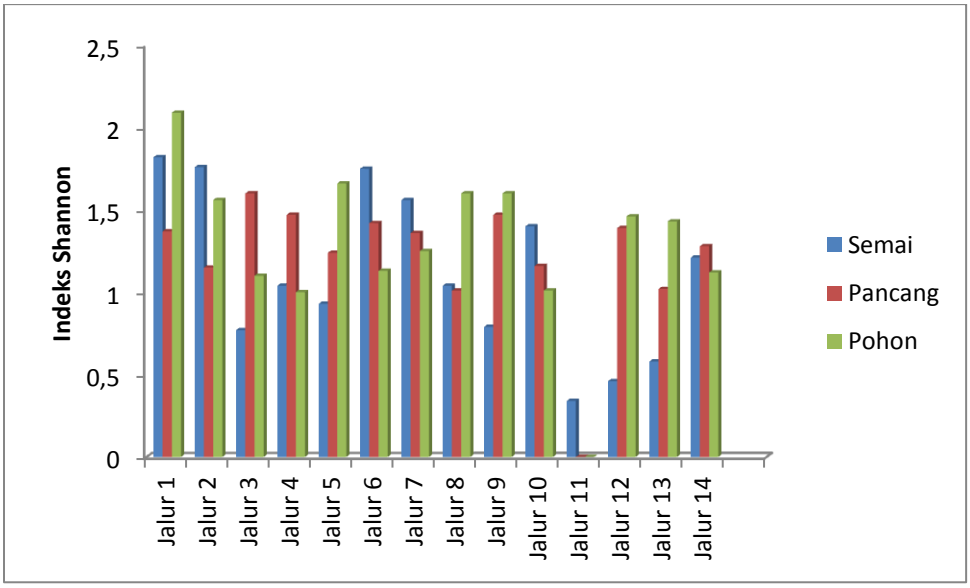

Figure 4.19. Diversity Index (H ') Strata Tree, Sapling, and seedling

4.6. Distribution of Mangrove Vegetation Scale Range

The spatial distribution of vegetation is needed to determine the distribution of mangrove vegetation by diameter class. From Table 4:49 shows that the diameter class 10-20 cm has the

highest number, ie 529 trees or 70.16%. Nyirih seen that kind of red (Xylocarpus granatum) and Nyirih White (Xylocarpus moluccensis) has a diameter distribution that is more diverse than the other types. This is thought to be influenced by the preferences of the public in decision-types who prefer the kinds of family Rhizophoacea for the raw materials of charcoal, poles and other materials are less preferred types.

Table 4.49. Distribution of Mangrove Vegetation Individuals Based Diameter Class

No	***Type***	The number of individual trees by diameter class (cm)						***Total***
		10 s/d 20	21 s/d 30	30 s/d 40	40 s/d 50	50 s/d 60	> 60	
1	*Avicennia marina*	6			1			7
2	*Babaru*	1						1
3	*Bruguiera cylindrica*	3	3					6
4	*Bruguiera gymnorrhiza*	17	3	1			1	22
5	*Bruguiera parviflora*	1	1					
6	*Bruguiera sexangula*	2						2
7	*Ceriops tagal*		1	1				2
8	*Derris trifiliata*	3						
9	*Excoecaria agallocha*	8	1	2				11
10	*Heritiera littoralis*	10						10
11	*Lumnitzera littorea*	59	10	5	2	1		77
12	*Lumnitzera racemosa*	1	1					2
13	*Mentada*	1						1
14	*Rhizophora apiculata*	108	13	3				124
15	*Rhizophora mucronata*	9						9
16	*Rhizophora stylosa*	16						16
17	*Scyphiphora hydrophyllacea*	66	2					68
18	Sonneratia alba		1					1
19	*Stade*	1	1					2
20	*Xylocarpus granatum*	168	78	33	17	5	12	313
21	*Xylocarpus molluccensis*	49	16	7	2	1	5	80
	Total	529	131	52	22	7	18	754
	Percentage	70.16	17.37	6.90	2.92	0.93	2.39	100.00

V. BASELINE OF DATA SAVINGS AND CARBON EMISSIONS

5.1. The structure and composition of mangrove type in Bintan Island

The results of vegetation analysis activity in 14 selected lines can be seen as many as 8 track have mangrove stands with a range of stem diameter exceeding 50 cm. Even in line 7 located in Bintan Bunyu has been found tree of red nyirih (Xylocarpus granatum) with a stem diameter reaching 123.77 cm. The structure of this diameter is not directly to indicate the magnitude of the potential savings of biomass carbon in mangrove ecosystem on the island of Bintan, Bintan regency, Riau Islands Province. A total of 21 species of mangrove can be identified.

Five mangrove tree species are found in 8 to d 12 lines like *Rhizophora apiculata*, *Xylocarpus granatum*, *Scyphiphora hydrophillacea*, *Lumnitzera littorea*, dan *Xylocarpus moluccensis*.Details of the structure and composition of mangrove species 14 lines analyzed are presented in **Table 5.1**. As for the 21 mangrove species identified and the results of the calculation of the Wood density are presented in **Table 5.2**

Table 5.1. Structure and Composition of Mangrove Tree Species in Bintan Island

No.	Jalur	Lokasi	Luas (m^2)	Diameter (cm)	Volume (m^3)	Kerapatan Kayu (g/cm^3)	Jenis mangrove	
							Jumlah	Species (individu/ha)
1.	Jalur 1	Busung	2100	10,18 - 44,55	0,02-2,77	0,571-0,884	10	*Scyphiphora hydrophillacea* (62), *Xylocarpus granatum* (62), *Bruguiera gymnorrhiza* (33), *Rhizophora apiculata* (29), *Rhizophora mucronata* (24), *Xylocarpus moluccensis* (19), *Exoecaria agallocha* (19), *Bruguiera cylindrica* (10), *Lumnitzera racemosa* (5), *Avicennia marina* (5).
2.	Jalur 2	Kuala Sempang	1400	10,18-71,59	0,05-7,26	0,571-0,884	8	*Xylocarpus granatum* (136), *Scyphiphora hydrophillacea* (114), *Rhizophora mucronata* (86), *Bruguiera gymnorrhiza* (21), *Lumnitzera littorea* (14), *Xylocarpus moluccensis* (7), *Exoecaria agallocha* (7), Mentada (7).
3.	Jalur 3	Kuala Sempang	800	10,18-66,18	0,06-8,19	0,571-0,884	5	*Xylocarpus moluccensis* (250), *Xylocarpus granatum* (175), *Scyphiphora hydrophillacea* (25), *Lumnitzera littorea* (25), *Rhizophora apiculata* (13).
4.	Jalur 4	Pengujan	600	10,82-58,23	0,08-4,30	0,571-0,855	4	*Xylocarpus moluccensis* (267), *Xylocarpus granatum* (100), *Rhizophora apiculata* (83), Babaru (33).
5.	Jalur 5	Penaga	3200	10,50-89,09	0,03-6,86	0,571-0,884	9	*Xylocarpus granatum* (188), *Xylocarpus moluccensis* (78), *Rhizophora apiculata* (34), *Scyphiphora hydrophillacea* (22), *Bruguiera gymnorrhiza* (22), *Lumnitzera littorea* (19), *Exoecaria agallocha* (13), *Bruguiera cylindrica* (3), *Heritiera littoralis (3).*
6.	Jalur 6	Penaga	2000	10,18-49,00	0,05-3,02	0,571-0,884	9	*Xylocarpus granatum* (395), *Rhizophora apiculata* (45), *Heritiera littoralis* (30), *Bruguiera gymnorrhiza* (25), *Scyphiphora hydrophillacea* (15), *Avicennia marina* (15), *Rhizophora mucronata* (10), *Xylocarpus moluccensis* (10), *Bruguiera parviflora* (3).

No.	Jalur	Lokasi	Luas	Diameter	Volume	Kerapatan Kayu	Jenis mangrove	
			(m2)	*(cm)*	*(m3)*	*(g/cm3)*	Jumlah	Species (individu/ha)
7.	Jalur 7	Bintan Bunyu	1800	10,18-123,77	0,05-24,07	0,650-0,884	8	*Xylocarpus granatum* (356), *Lumnitzera littorea* (78), *Scyphiphora hydrophillacea* (44), *Rhizophora apiculata* (39), *Exoecaria agallocha* (17), *Derris trifoliata* (17), *Bruguiera parviflora* (6), *Avicennia marina* (6).
8.	Jalur 8	Tembeling	1500	11,14-71,91	0,08-6,09	0,571-0,884	8	*Xylocarpus moluccensis* (100), *Xylocarpus granatum* (60), *Rhizophora apiculata* (47), *Lumnitzera littorea* (20), *Bruguiera gymnorrhiza* (7), *Rhizophora mucronata* (7), *Scyphiphora hydrophillacea* (7), *Ceriops tagal* (7)
9.	Jalur 9	Tembeling	2100	10,18-76,36	0,03-8,25	0,686-0,884	7	*Rhizophora apiculata* (105), *Xylocarpus granatum* (81), *Scyphiphora hydrophillacea* (48), *Lumnitzera littorea* (29), *Bruguiera cylindrica* (19), *Bruguiera sexangula* (10), *Ceriops tagal* (5)
10.	Jalur 10	Tembeling	2400	10,18-45,18	0,03-8,73	0,571-0,884	5	*Lumnitzera littorea* (117), *Rhizophora apiculata* (42), *Xylocarpus granatum* (17), *Scyphiphora hydrophillacea* (4), *Xylocarpus moluccensis* (4)
11.	Jalur 11	Mantang Baru	1000	10,50-16,55	0,078-0,258	0,913	1	*Rhizophora stylosa* (15)
12.	Jalur 12	Mantang Baru	2500	10,18-54,09	0,03-2,76	0,686-0,913	6	*Rhizophora apiculata* (132), *Xylocarpus granatum* (48), *Heritiera littoralis* (44), *Scyphiphora hydrophillacea* (40), *Rhizophora stylosa* (20), *Lumnitzera littorea* (29).
13.	Jalur 13	Simpang Lagoi	600	10,18-40,41	0,05-2,31	0,650-0,913	6	*Rhizophora apiculata* (167), *Xylocarpus granatum* (100), *Rhizophora stylosa* (67), *Avicennia marina* (17), *Bruguiera cylindrica* (17), *Sonneratia alba* (17).
14.	Jalur 14	Simpang Lagoi	1200	10,18-39,14	0,06-1,44	0,588-0,884	5	*Lumnitzera littorea* (117), *Rhizophora apiculata* (42), Sentade (17), *Scyphiphora hydrophillacea* (8), *Lumnitzera racemosa* (8)

Table5.2. List of Wood Density Calculation Results of 21 Mangrove type on Bintan Island which are Identified and Measured for Savings and Biomass carbon

No	Species	Wood Density (g/c^3)
1.	*Avicennia marina*	0,650
2.	*Babaru*	0,726
3.	*Bruguiera cylindrica*	0,763
4.	*Bruguiera gymnorrhiza*	0,730
5.	*Bruguiera parviflora*	0,763
6.	*Bruguiera sexangula*	0,763
7.	*Ceriops tagal*	0,884
8.	*Derris trifoliata*	0,726
9.	*Exoecaria*	0,726
10.	*Heritiera littoralis*	0,696

No	Species	Wood Density (g/cm^3)
11.	*Lumnitzera littorea*	0,737
12.	*Lumnitzera racemosa*	0,737
13.	*Mentada*	0,588
14.	*Rhizophora apiculata*	0,855
15.	*Rhizophora mucronata*	0,792
16.	*Rhizophora stylosa*	0,913
17.	*Scyphiphora hydrophillacea*	0,884
18.	*Sentade*	0,588
19.	*Sonneratia alba*	0,647
20.	*Xylocarpus granatum*	0,686
21.	*Xylocarpus moluccensis*	0,571

5.2. Savings and Distribution of Mangrove Biomass on Paths

The results of biomass content calculation on the fourteenth chosen path can be seen that the total savings of biomass in the mangrove ecosystem ranged from 40.48 to 671.56 tonnes / ha with an average of 231.99 tons / ha. Lowest potential of savings of mangrove biomass total found in line 11 which is located in New Mantang and highest biomass savings total is on line 7 and is located in Bintan Bunyu.A total of 68.85% from the biomass total is distributed to the top (Aboveground biomass) of mangrove trees, while the rest (31.15%) is stored at the bottom (Belowground biomass) or the roots of mangrove trees. Mangrove species at the tree level contribute 78.95% of the total biomass.As for the rest (21.05%) is the biomass total of mangrove species at saplings level. Distribution of the biomass total could indirectly be an indicator that the mangrove ecosystem in Bintan Island currently consists of mangrove stands that are experiencing growth towards the climax.This condition is also the potential for mangrove ecosystem on the island of Bintan as storage and effective carbon sink. Details of the distribution for the content of the biomass in the 14 selected lines are presented in **Table 5. 3**. below.

Table 5.3. Distribution of Content of Selected Biomass in Line 14 on Mangrove Ecosystem in Bintan Island

No.	Location	TREE			SAPLING			TOTAL		
		AGB	BGB	TB	AGB	BGB	TB	AGB	BGB	TB
		(ton/ha)	*(ton/ha)*	*(ton/ha)*	*(ton/ha)*	*(ton/ha)*	*(ton/ha)*	*(ton/ha)*	*(ton/ha)*	*(ton/ha)*
1.	Busung	87,19	31,28	118,47	25,90	13,74	39,64	113,10	45,02	158,11
2.	Kuala sempang 1	134,64	37,94	172,58	34,00	21,45	55,45	168,64	59,40	228,04
3.	Kuala sempang 2	192,25	84,07	276,32	18,00	10,47	28,47	210,25	94,53	304,78
4.	Pengujan	178,33	63,31	241,64	18,00	13,46	31,46	196,33	76,77	273,11
5.	Penaga 1	151,75	76,72	228,47	6,25	4,30	10,55	158,00	81,03	239,03
6.	Penaga 2	105,45	47,14	152,59	17,73	10,20	27,93	123,18	57,34	180,52
7.	Bintan Bunyu	455,11	184,46	639,57	18,67	13,32	31,99	473,78	197,78	671,56
8.	Tembeling 1	113,53	51,75	165,29	35,20	20,80	56,00	148,73	72,56	221,29
9.	Tembeling 2	141,86	61,39	203,25	130,48	83,84	214,31	272,33	145,23	417,56
10.	Tembeling 3	54,04	13,76	67,81	29,33	21,71	51,04	83,38	35,48	118,85
11.	Mantang Baru 1	9,20	4,02	13,22	16,92	10,33	27,26	26,12	14,36	40,48
12.	Mantang Baru 2	72,12	32,83	104,95	22,24	14,87	37,11	94,36	47,71	142,07
13.	Sebong Lagoi 1	87,83	34,92	122,75	20,67	14,17	34,83	108,50	49,09	157,59
14.	Sebong Lagoi 2	38,42	18,65	57,07	21,00	16,76	37,76	59,42	35,41	94,82
	Average	130,12	53,02	183,14	29,60	19,24	48,84	159,72	72,26	231,99

5.3. Content of Biomass, Carbon Savings, and uptake of carbon dioxide on the Mangrove Ecosystem in Bintan Island

Successive calculation results of biomass content, carbon storage and uptake of carbon dioxide in the mangrove ecosystem on the island of Bintan are presented in **Table 5.4.**,**Table 5.5.**,**and Table 5.6.**

Table 5.4. Biomass content of the Mangrove Ecosystem in Bintan Island in Eight Villages

No.	Village	TREE			SAPLING			TOTAL		
		AGB *(ton/ha)*	BGB *(ton/ha)*	TB *(ton/ha)*	AGB *(ton/ha)*	BGB *(ton/ha)*	TB *(ton/ha)*	AGB *(ton/ha)*	BGB *(ton/ha)*	TB *(ton/ha)*
1	Busung	87,19	31,28	118,47	25,90	13,74	39,64	113,10	45,02	158,11
2	Kuala Sempang	155,59	54,71	210,30	28,18	17,46	45,64	183,77	72,17	255,95
3	Pengujan	178,33	63,31	241,64	18,00	13,46	31,46	196,33	76,77	273,11
4	Penaga	133,94	65,35	199,29	10,67	6,57	17,24	144,61	71,92	216,52
5	Bintan Bunyu	455,11	184,46	639,57	18,67	13,32	31,99	473,78	197,78	671,56
6	Tembeling	99,65	39,93	139,58	41,20	27,44	68,64	140,85	67,37	208,22
7	Mantang Baru	54,14	24,60	78,74	20,42	13,32	33,74	74,56	37,92	112,49
8	Sebong Lagoi	54,89	24,07	78,96	20,89	15,89	36,78	75,78	39,97	115,74
	Average	152,36	60,96	213,32	22,99	15,15	38,14	175,35	76,11	251,46

Table 5.5. Carbon savings on the Mangrove Ecosystem in Bintan Island in Eight Villages

No.	Village	TREE			SAPLING			TOTAL		
		AGC *(ton C/ha)*	BGC *(ton C/ha)*	TC *(ton C/ha)*	AGC *(ton C/ha)*	BGC *(ton C/ha)*	TC *(ton C/ha)*	AGC *(ton C/ha)*	BGC *(ton C/ha)*	TC *(ton C/ha)*
1	Busung	47,95	17,20	65,16	14,25	7,56	21,80	62,20	24,76	86,96
2	Kuala Sempang	85,58	30,09	115,67	15,50	9,60	25,10	101,08	39,69	140,77
3	Pengujan	98,08	34,82	132,90	9,90	7,41	17,31	107,98	42,23	150,21
4	Penaga	73,67	35,94	109,61	5,87	3,61	9,48	79,53	39,55	119,09
5	Bintan Bunyu	250,31	101,45	351,76	10,27	7,33	17,59	260,58	108,78	369,36
6	Tembeling	54,81	21,96	76,77	22,66	15,09	37,75	77,47	37,05	114,52
7	Mantang Baru	29,78	13,53	43,31	11,23	7,33	18,56	41,01	20,86	61,87
8	Sebong Lagoi	30,19	13,24	43,43	11,49	8,74	20,23	41,68	21,98	63,66
	Average	83,80	33,53	117,33	12,65	8,33	20,98	96,44	41,86	138,30

Table 5.6. CO_2 uptake on the Mangrove Ecosystem in Bintan Island in Eight Villages

No.	Village	TREE			SAPLING			TOTAL		
		AGC (ton C/ha)	BGC (ton C/ha)	TC (ton C/ha)	AGC (ton C/ha)	BGC (ton C/ha)	TC (ton C/ha)	AGC (ton C/ha)	BGC (ton C/ha)	TC (ton C/ha)
1	Busung	175,99	63,14	239,13	52,29	27,73	80,02	228,28	90,86	319,15
2	Kuala Sempang	314,06	110,44	424,50	56,89	35,24	92,12	370,95	145,68	516,63
3	Pengujan	359,97	127,79	487,76	36,33	27,18	63,51	396,30	154,97	551,27
4	Penaga	270,36	131,90	402,26	21,53	13,26	34,79	291,89	145,16	437,06
5	Bintan Bunyu	918,64	372,33	1290,97	37,68	26,89	64,57	956,32	399,22	1355,54
6	Tembeling	201,14	80,60	281,74	83,17	55,38	138,55	284,31	135,98	420,29
7	Mantang Baru	109,29	49,66	158,95	41,22	26,89	68,11	150,51	76,55	227,05
8	Sebong Lagoi	110,79	48,59	159,38	42,16	32,08	74,25	152,96	80,67	233,63
	Average	307,53	123,06	430,59	46,41	30,58	76,99	353,94	153,64	507,58

Based on data above, it can be seen that the average carbon storage in mangrove ecosystem on the island of Bintan relatively high at 138.30 tons C/ha or equivalent to 507.58 tons CO2/ha of carbon dioxide uptake. Average carbon storage is apparently larger than the carbon stored in mangroves which are still well preserved in the village of Jaring Halus, Langkat Sumatra regency amounted 116.2 ton C/ha or equivalent to 426.5 tons CO2/ha uptake (Onrizal, 2013).The content of the biomass of mangrove forests in the Bintan Island was also greater than the Merbok mangrove forests which reached 245 tons / ha (Anwar et al., 1984), Siberut mangrove forests biomass reached 49.13 ton/ha (Bismark et al., 2008), biomass in a young secondary forest with medium density reached 54.34 ton/ha eith potential of carbon 27.18 ton C/ha or equivalent to 102.31 tons CO_2/ha (Heriyanto dan Siregar, 2007).

5.4. Mangrove Ecosystem Carbon Dynamics in Bintan Island

Carbon dynamics describes the balance between carbon uptake and carbon emissions in a forest ecosystem that occurs in continuous time (time series). Based on the analysis of satellite imagery can be seen the rate of mangrove deforestation on the island of Bintan at an average of 0.46 ha per year from 1995 to 2013.Highest deforestation occurs in mangrove ecosystem in the village Penaga ie 2.17 ha / year. Although relatively very small mangrove deforestation rate, then in order to mitigate global warming and global climate change must remain aware of these conditions.This is because of the deforestation of carbon dioxide emissions which further contributed to the increase in global warming. Calculation results in this study demonstrate the

potential of carbon emissions on the mangrove ecosystem in Bintan amounted to 236.06 tons CO_2/year with details of which are presented below in Table 5.7.

Table 5.7. Carbon dynamics on the Mangrove Ecosystem in Bintan Island in Eight Villages

No.	Village	Forest Area Year 2013	Uptake TC (ton C/ha)	Uptake TCO_2 (ton CO_2/ha)	Total Stock carbon (ton C)	Deforestation rate (95-13) (ha/tahun)	EMISSION Emission CO_2 /year (ton CO_2/tahun)
1	Busung	117,81	86,96	319,15	10.244,73	0,14	*44,68*
2	Kuala Sempang	434,36	140,77	516,63	61.144,15	0,23	*118,82*
3	Pengujan	117,45	150,21	551,27	17.642,46	0,00	*0,00*
4	Penaga	506,48	119,09	437,06	60.315,81	2,17	*948,41*
5	Bintan Bunyu	254,61	369,36	1355,54	94.040,54	0,33	*447,33*
6	Tembeling	604,87	114,52	420,29	69.270,12	0,70	*294,20*
7	Mantang Baru	182,42	61,87	227,05	11.286,02	0,00	*0,00*
8	Sebong Lagoi	187,96	63,66	233,63	11.965,31	0,15	*35,04*
	Rata-rata	300,74	138,30	507,58	41.988,64		236,06
	Jumlah	2.405,95			335.909,14		1888,49

VI. CONCLUSION

Conclusion of this study are:

1. Mangrove ecosystem at Bintan Island is growing to climax with wide range of trunk diameter, diverse species composition, average tree density, and have a high potency to be high conservation value mangrove ecosystem.
2. Carbon saving ability of mangrove ecosystem at Bintan Island is relatively high with an average 138,30 ton C/Ha or equal to carbondioxide absorption 507,58 ton CO_2/Ha.
3. Carbon emission on mangrove ecosystem at Bintan Island is relatively low with an average 236,06 ton CO_2/Ha.