Study on Coastal Protection and Production Functions of Mangrove Vegetation in Thanh Phu Natural Reserve, Mekong Delta, Vietnam

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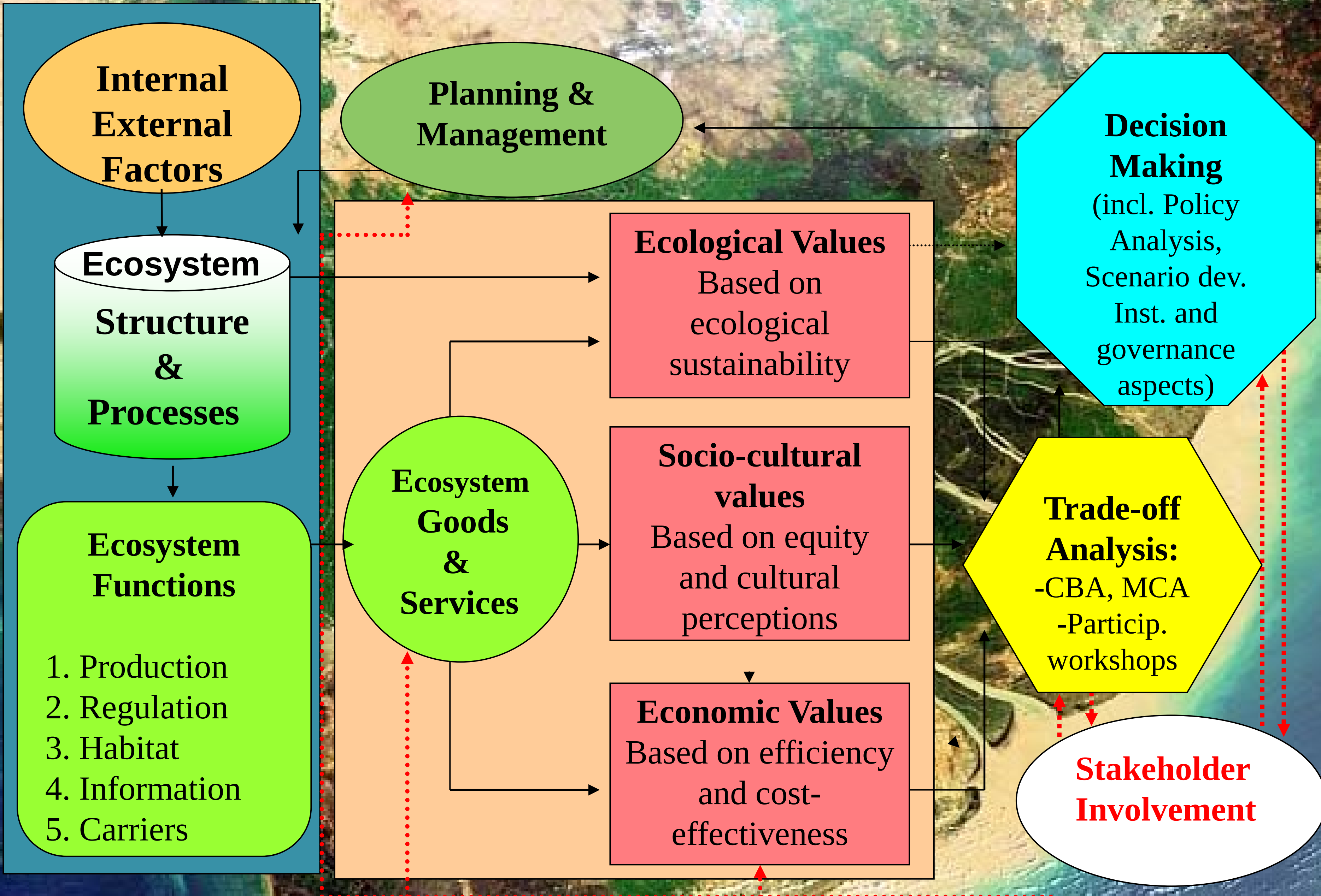
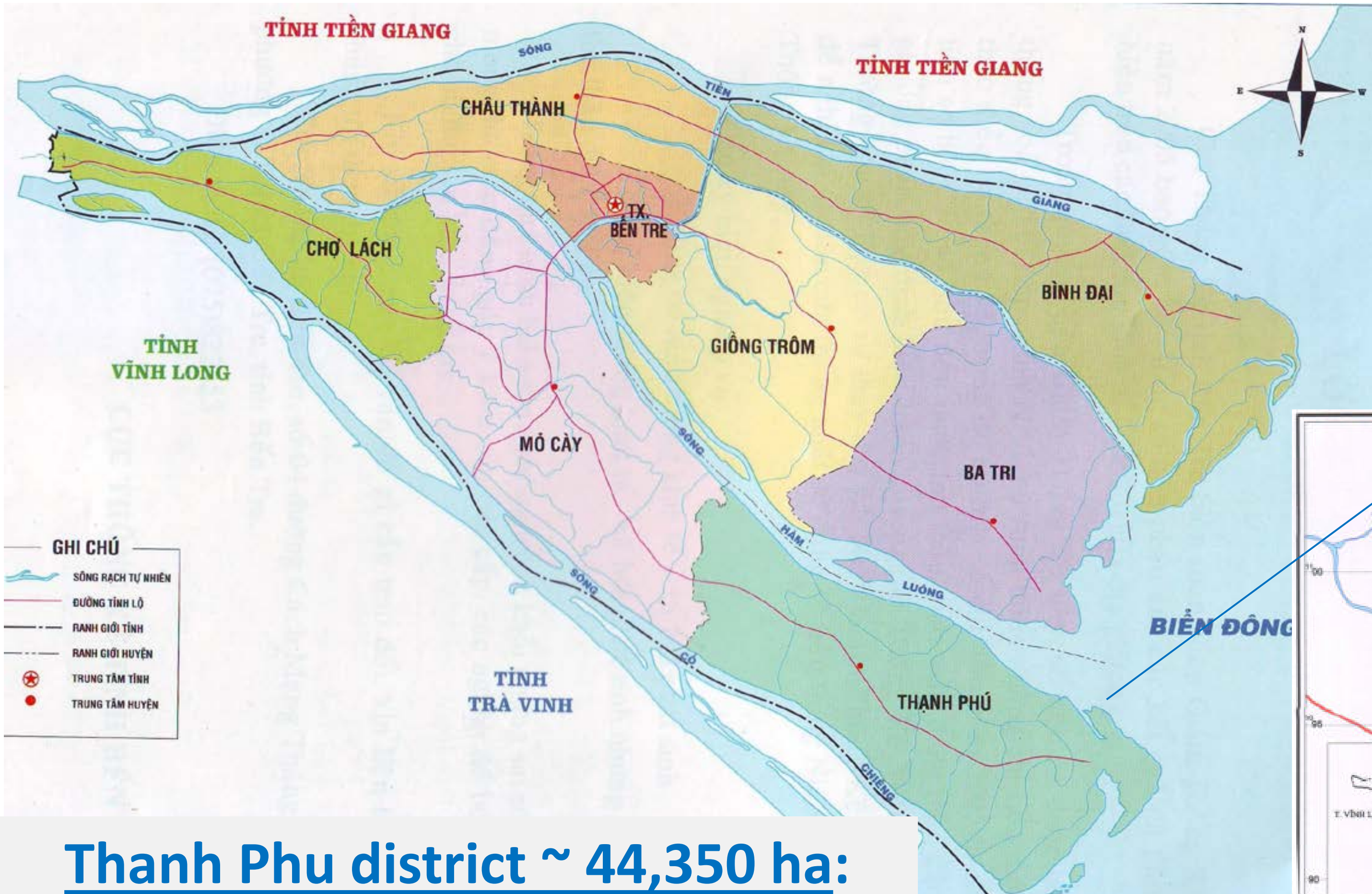
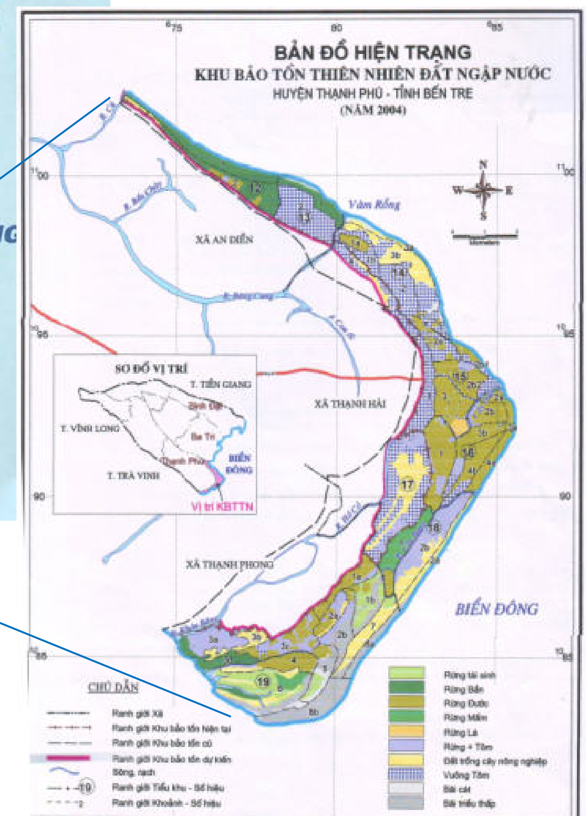


(de Groot, 1992; de Groot et al., 2002, de Groot, 2006).

Ben Tre Province and study site Thanh Phu Natural Reserve

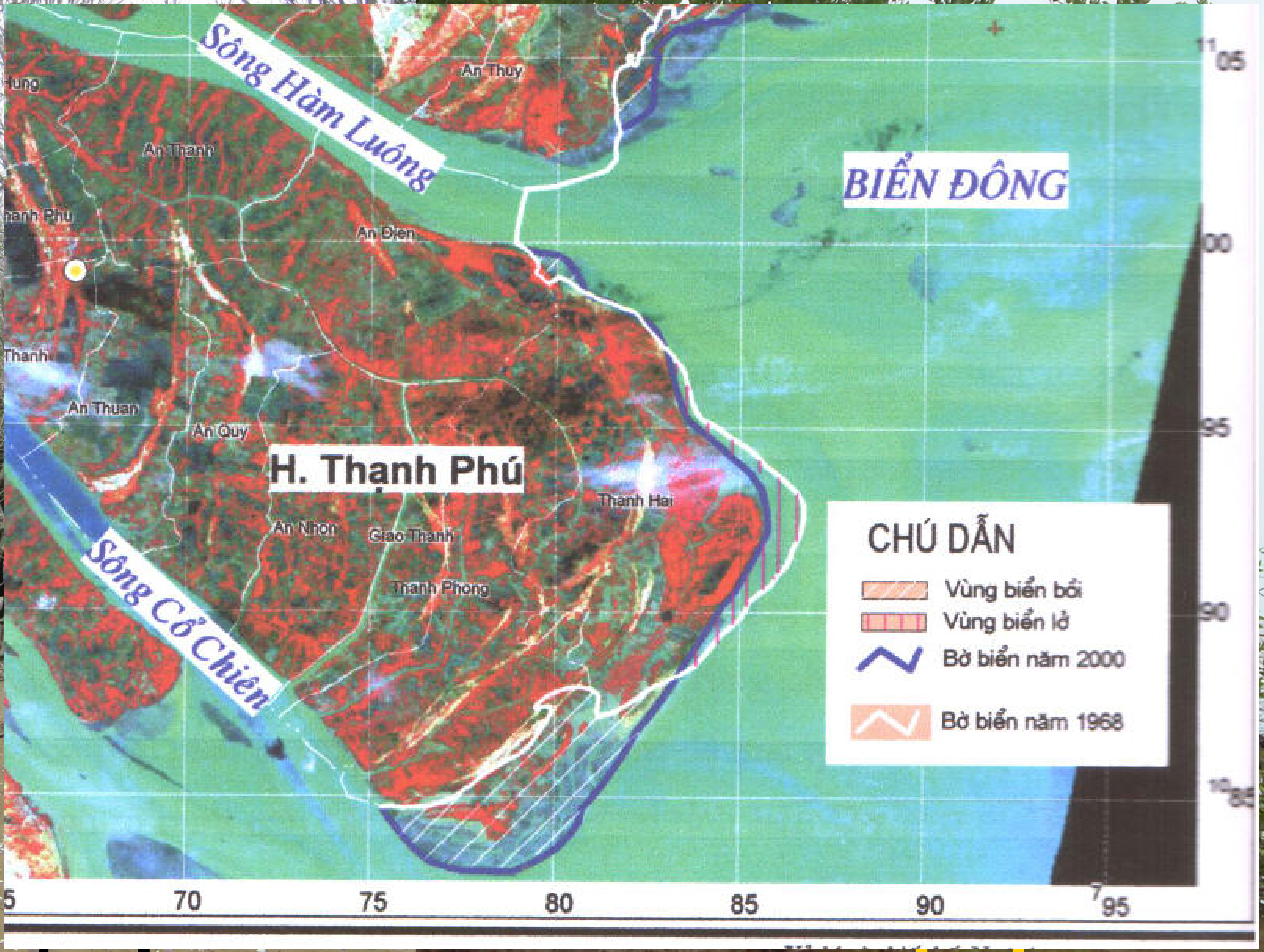




Thanh Phu district ~ 44,350 ha:

- 128,000 inhabitants
- aquaculture, paddy fields, fruit
- sandy belts, mudflats, swamps
- strip of 0.8-5 km mangroves

Changed in coastal line between the year 1968 and 2000



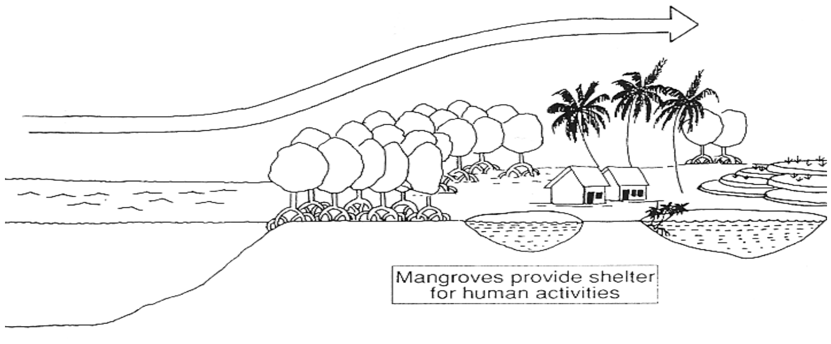
Accreted areas

eroded areas

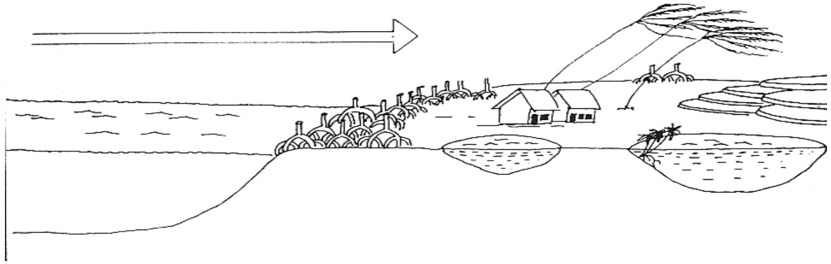
Mangroves – Green wall

“Engineers” building and maintaining physical structure of the habitat

Restorated forest protect coastal

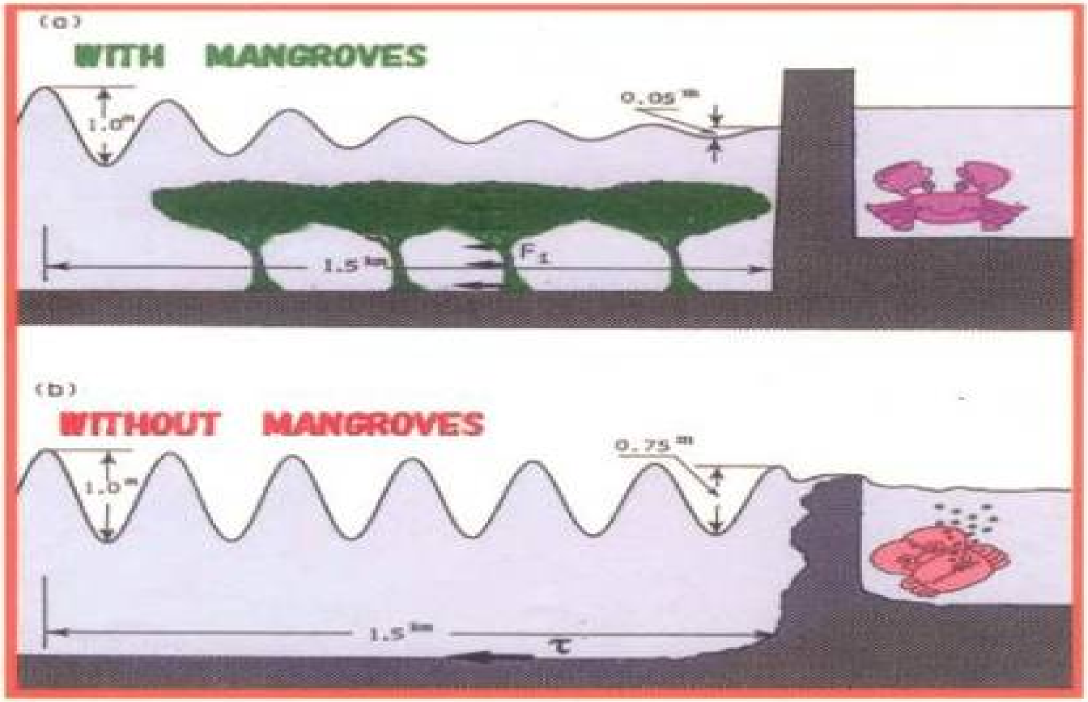


Mangroves have functions protection the coastline, coastal communities of wind, storm and stunami… (Davies & Claridge 1993)

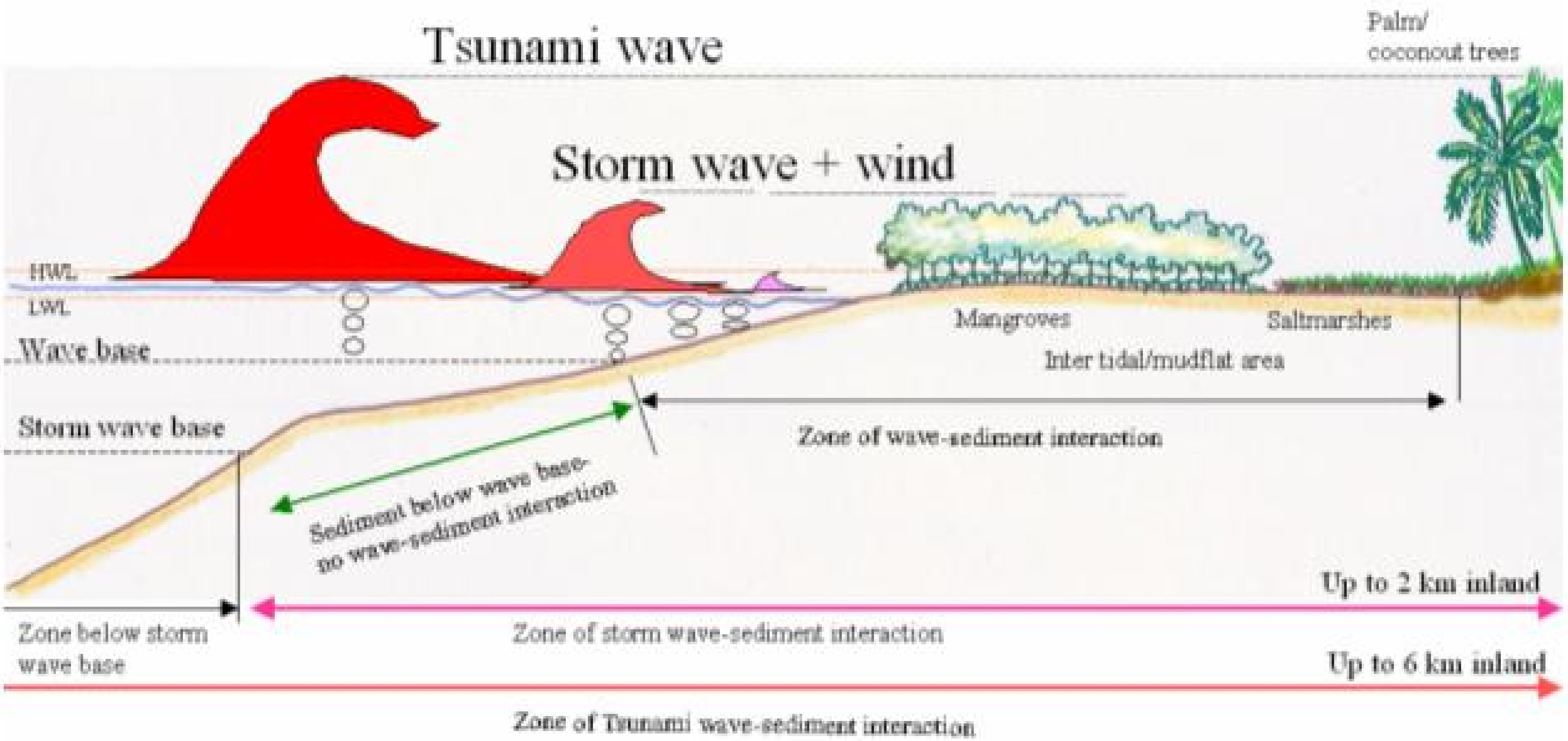


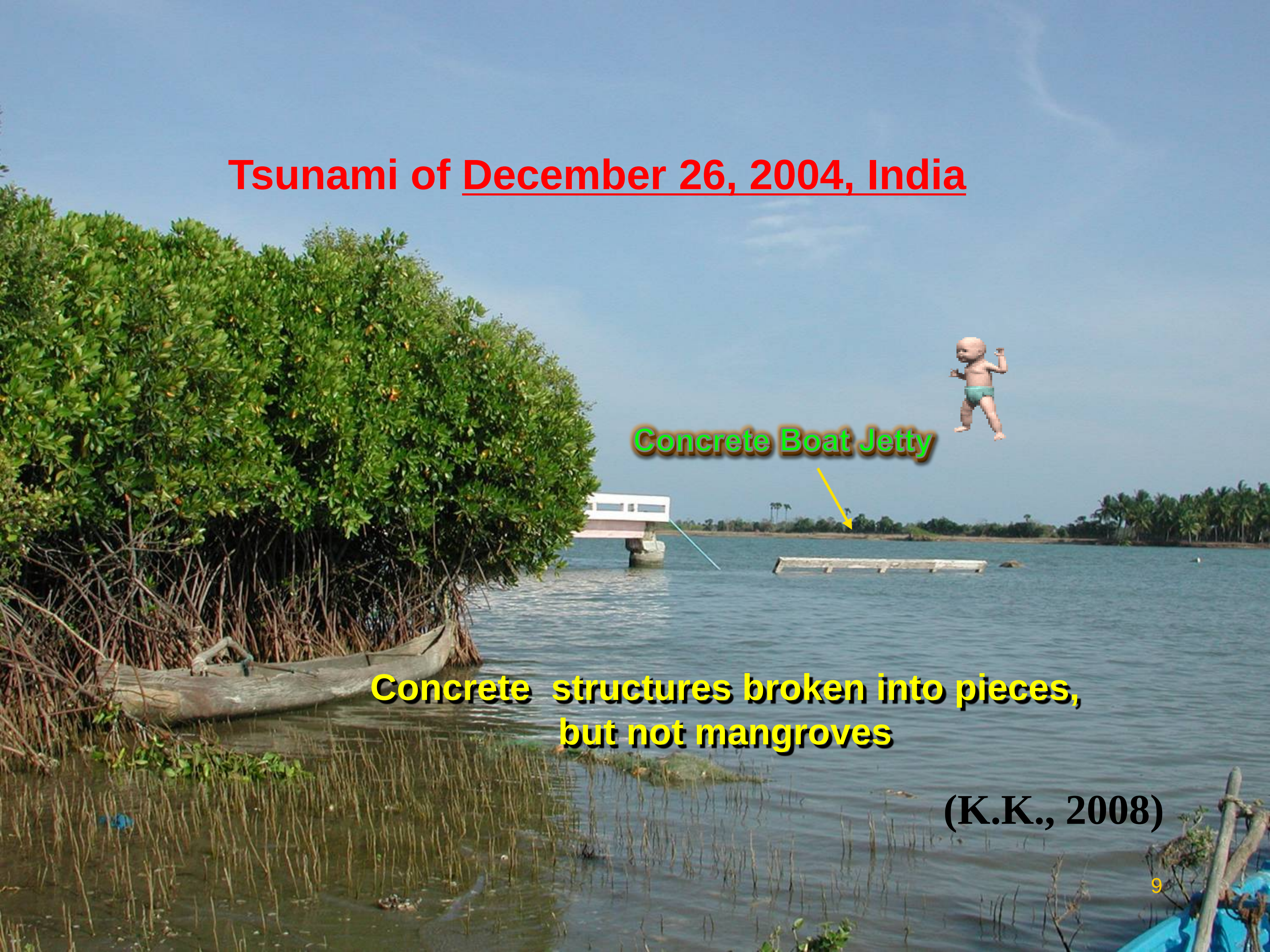
Restorated forest protect coastal

- Different effects of wave reduction in
  (a) with mangrove
  (b) without-mangrove areas
  (Source: Y. Mazda, M. Michimasa, M. Kogo, P.N.Hong, 1997)



Wave attenuation




Tsunami of December 26, 2004, India
Concrete Boat Jetty
Concrete structures broken into pieces,
but not mangroves
(K.K., 2008)

Mangrove forest protect coastal

Without mangroves

Concrete sea dyke in Do Son, Hai Phong

With mangroves

Unconcrete seadyke in Giao Thuy

Storm No 2 in 2007

Methodology: stand structure

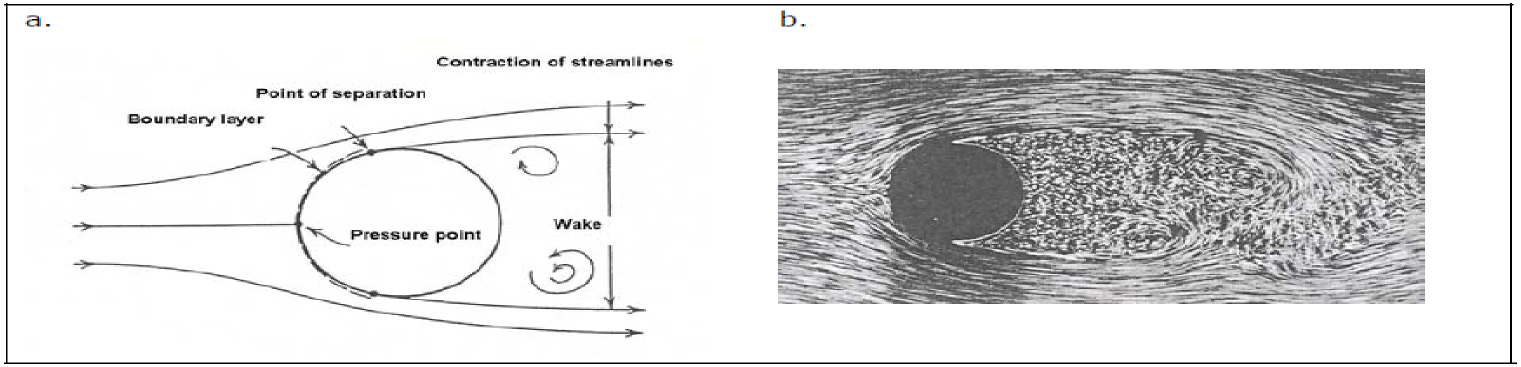
80-90% of mangroves: planted *Rhizophora apiculata*

30 plots (10 m × 10 m) were set in 7-26 year old planted *R. apiculata*:

- **density trees and stilt roots**
- **root diameter and height**
- **tree diameter at a height of 1.3 m**
- **height from stratum to height of the first branch, first leaf, the top of tree**

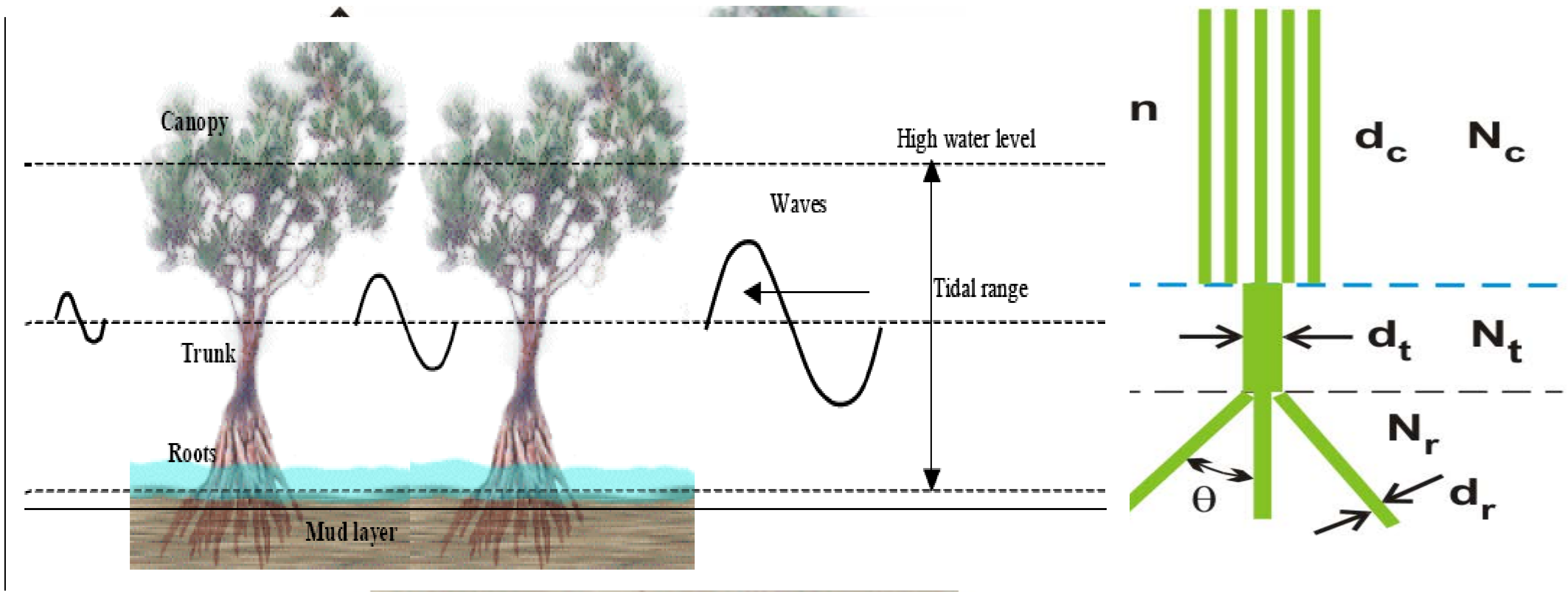
Methodology: SWAN (**S**imulation **WA**ve **N**earshore) model including SWAN-VEG module for wave dissipation by vegetation (Mendez & Losada 2004; Suzuki 2011; Suzuki *et al.* 2012)

- assuming a group of cylinders as representation of vegetation
- including vertical layer schematization which makes it possible to calculate multi layer structures such as mangroves
- model input: mean values of the measured parameters per transect



Wave attenuation

- **Mangrove trees are divided into 03 classes**
  - **Canopy**
  - **Trunk**
  - **Roots**



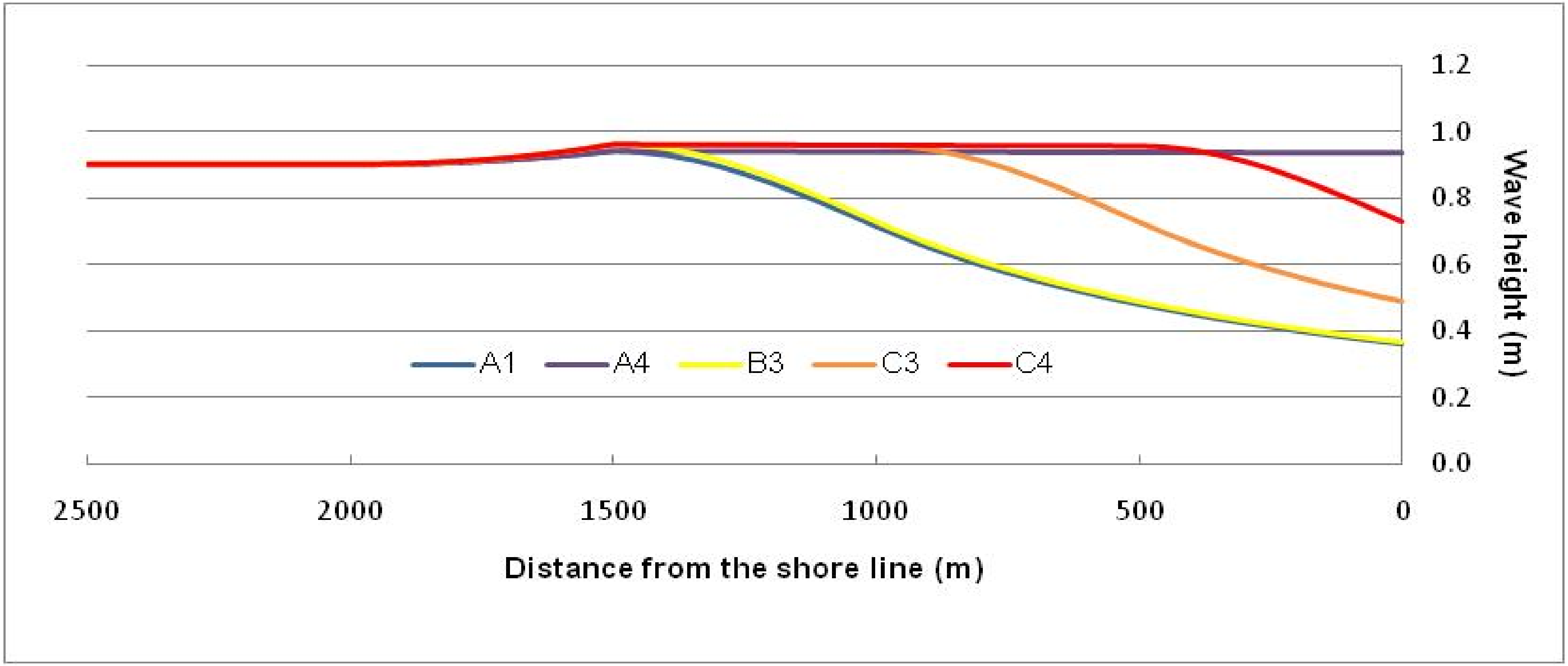
Wave attenuation

Spatial variation of significant wave height

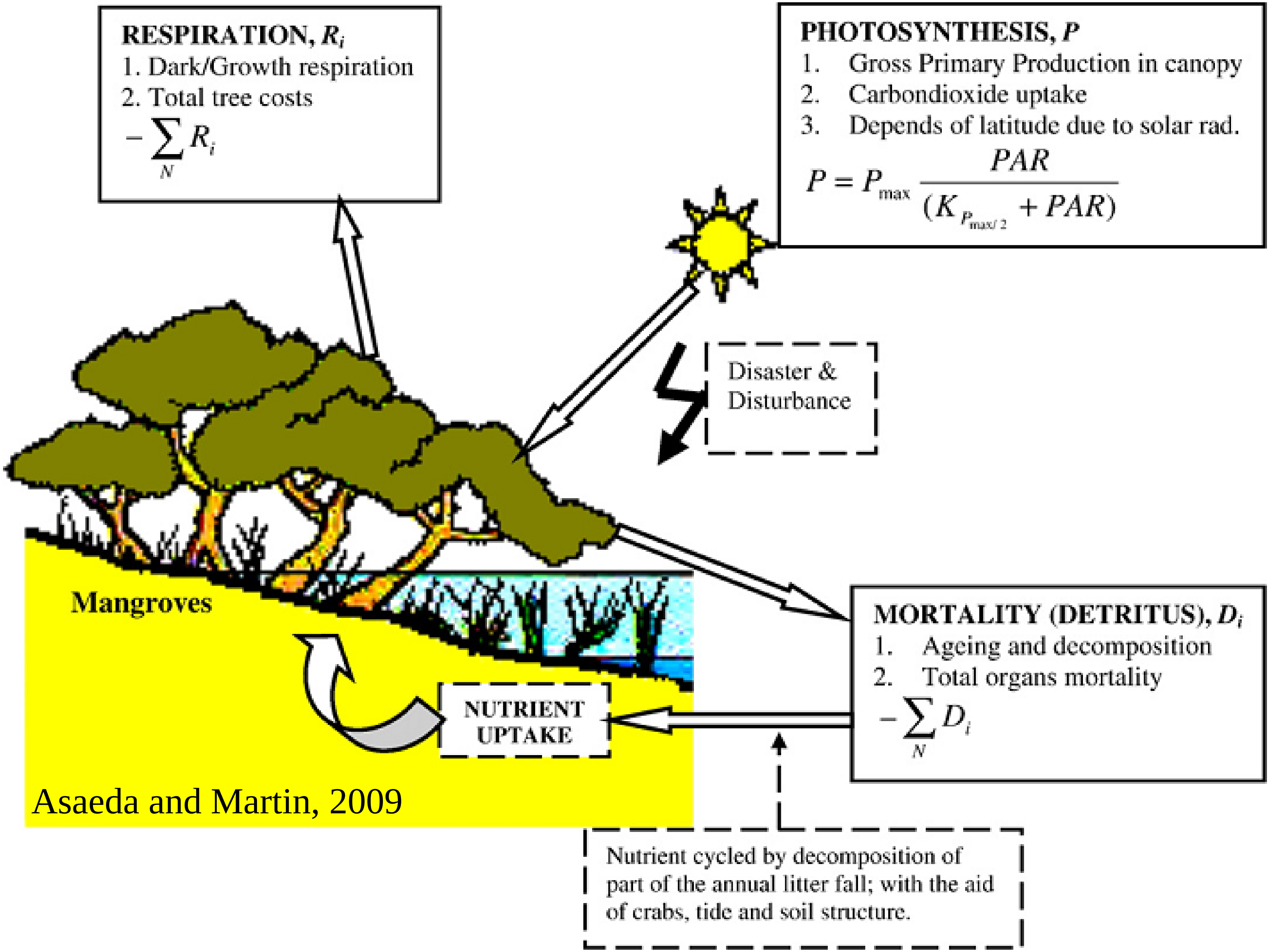
Cal. code	Vegetation condition (%)	Water level (m)	Width (km)	Wave attenuation (%)
A4	Non	4.1	1.5	0
A1	0.7	4.1	1.5	59.58
B3	0.7	5.06	1.5	59.04
C3	0.7	5.06	1.0	46.63
C4	0.7	5.06	0.5	19.41

A1: Planted *Rhizophora apiculata*; A4: No mangroves at current water level
B3, C3, C4: Planted *Rhizophora apiculata* at the scenario of sea level rise of 0.96 m high

Wave attenuation



Spatial variation of significant wave height

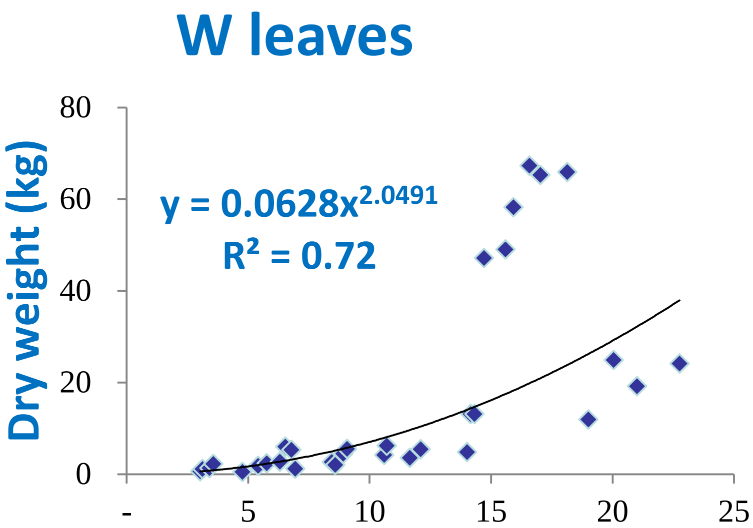

RESPIRATION, R_i
1. Dark/Growth respiration
2. Total tree costs
$-\sum_N R_i$
PHOTOSYNTHESIS, P
1. Gross Primary Production in canopy
2. Carbondioxide uptake
3. Depends of latitude due to solar rad.
$P = P_{max} \frac{PAR}{(K_{P_{max/2}} + PAR)}$
Disaster & Disturbance
Mangroves
MORTALITY (DETRITUS), D_i
1. Ageing and decomposition
2. Total organs mortality
$-\sum_N D_i$
NUTRIENT UPTAKE
Asaeda and Martin, 2009
Nutrient cycled by decomposition of part of the annual litter fall; with the aid of crabs, tide and soil structure.

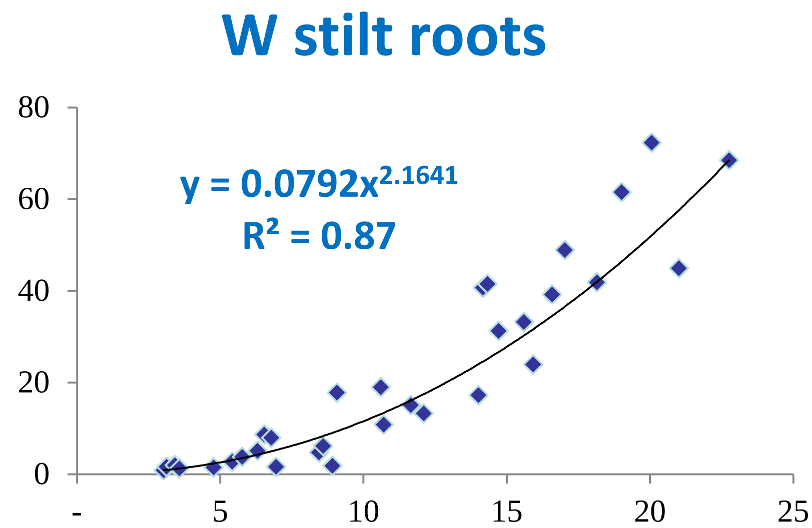
Methodology: above ground biomass

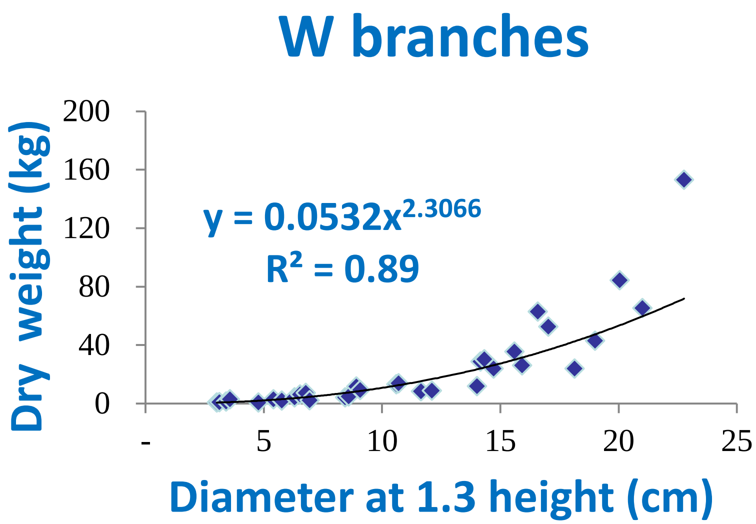
32 trees representing all ages harvested at ground level:

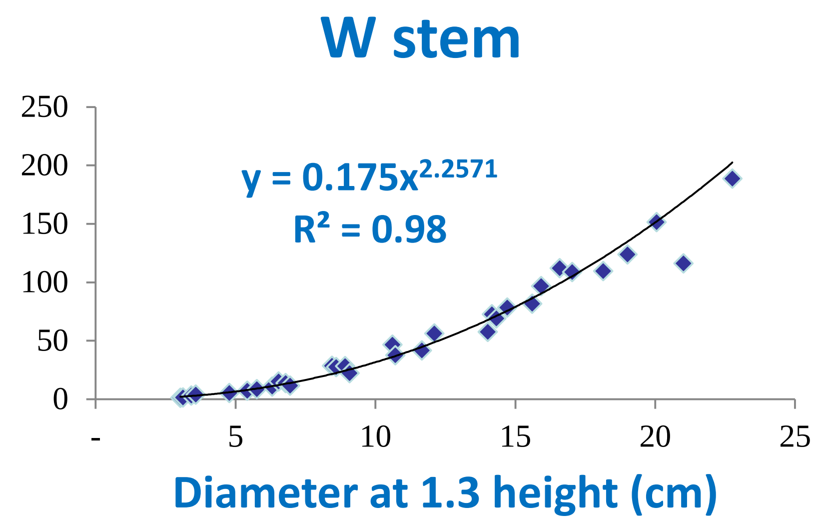
- **fresh weight of stems (Ws), branches (Wb), leaves (Wl), and above ground stilt roots (Wr) were measured *in situ***
- **sub-samples of each organ were taken for determination of fresh weight to dry weight ratio**
- **dry weights were obtained after 2 days' oven drying at 80° C**
- **dry/fresh-weight ratios of the samples were used to estimate the total dry weight of those plant parts (Ws + Wb + Wl + Wr = Wtop)**
- **allometric relations were established**

Results: allometric relations various plant parts

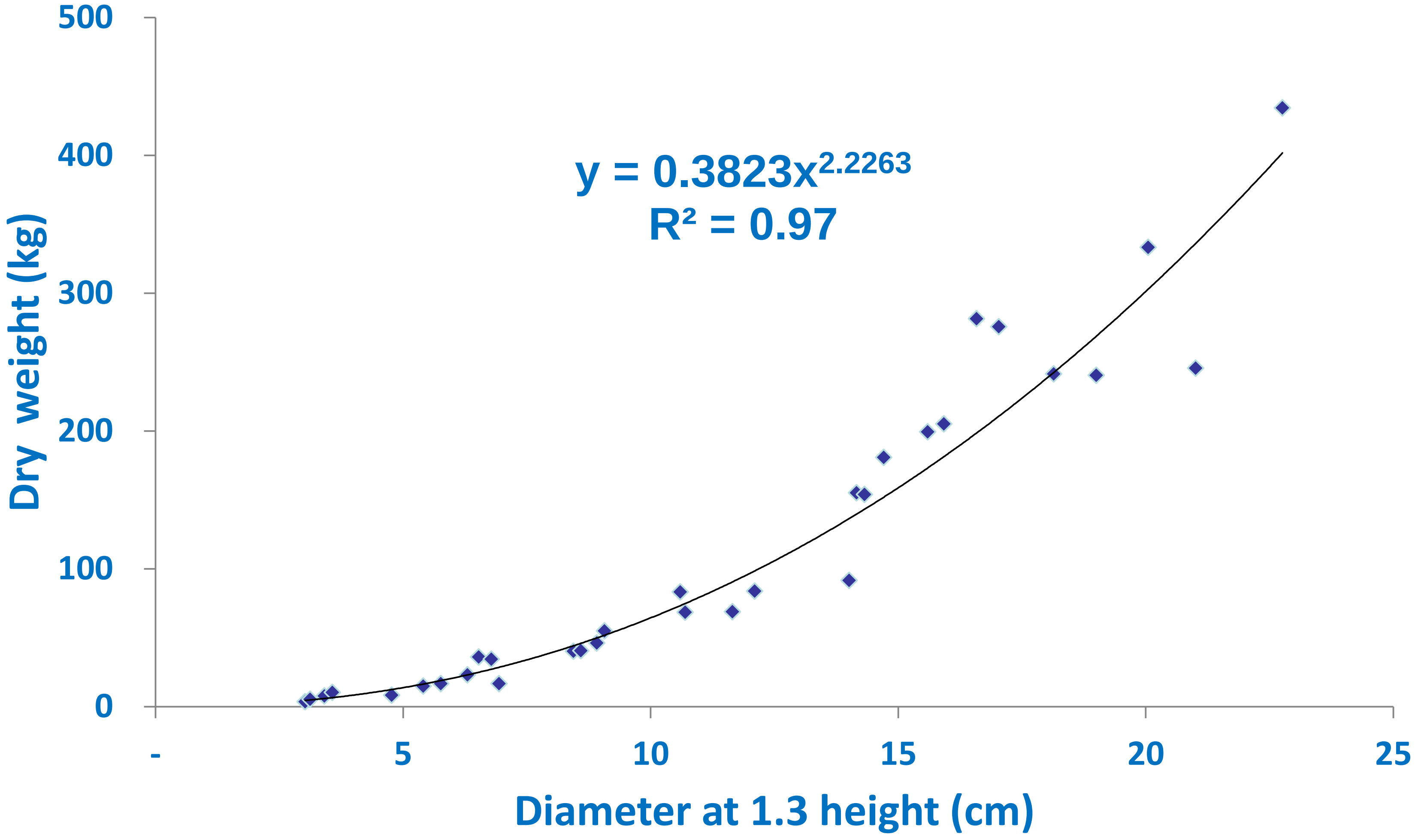




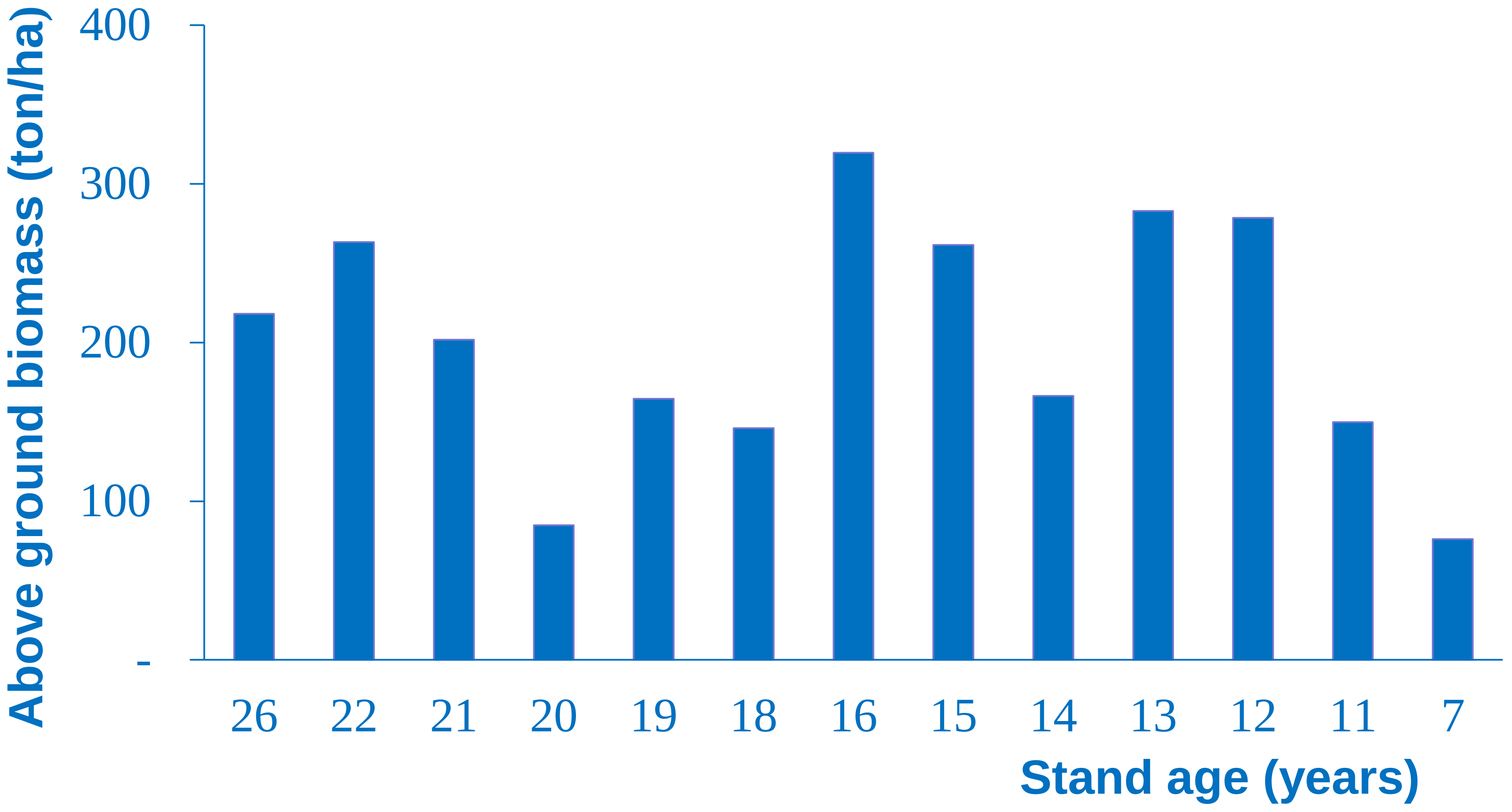




Results: allometric relations above ground biomass



Results: above ground biomass for different age plots



Global comparison above ground biomass mangroves

(after Komiyama 2008)

Region	Condition /age	Species	ABG biomass (ton/ha)	Reference
Malaysia (Matang)	>80	*R. apiculata*	460	Putz and Chan (1986)
Indonesia	Primary forest	*R. apiculata*	357	Komiyama et al. (1988)
Thailand	Primary forest	*Rizhophora spp*	299	Komiyama et al. (1987)
Sri Lanka	Fringe	*Rhizophora spp.*	240	Amarasinghe et al. (1992)
Malaysia (Matang)	28 years	*R. apiculata*	212	Ong et al. (1982)
Thailand (Phuket)	15 years	*R. apiculata*	159	Christensen (1978)
French Guiana	Mature	*Rhizophora, Avicennia*	122	Fromard et al. (1998)
Vietnam (Thanh Phu)	7-26 years	*R. apiculata*	76-320	This study

Results: carbon storage Thanh Phu Natural Reserve

Forest ages	Above ground Carbon storage (ton/ha)	Area (ha)	Carbon storage (ton)
20-26	77.60	278.70	21,626.80
14-19	103.09	432.59	44,594.58
11 - 13	114.54	92.58	10,603.80
Total Above ground Carbon storage in Thanh Phu		803.87	76,825.17

Conclusions

- **Mangroves: important for climate change adaptation and mitigation**
- **Protective potential under threat: erosion, accretion, (illegal) cutting**
- **Mitigation of climate change by storing carbon**
- **Use carbon compensation funds to develop local capacity and to support community-based management**

➔Mangroves could act as both climate change adaptation and mitigation measures


Thanks you!