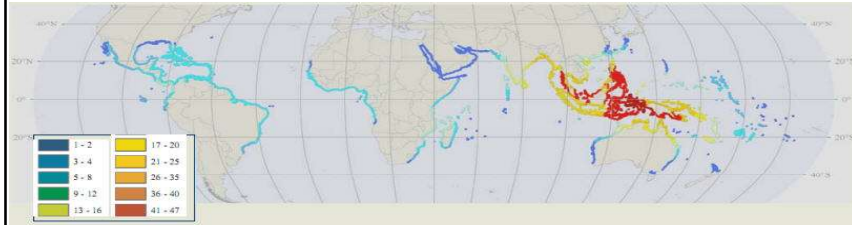


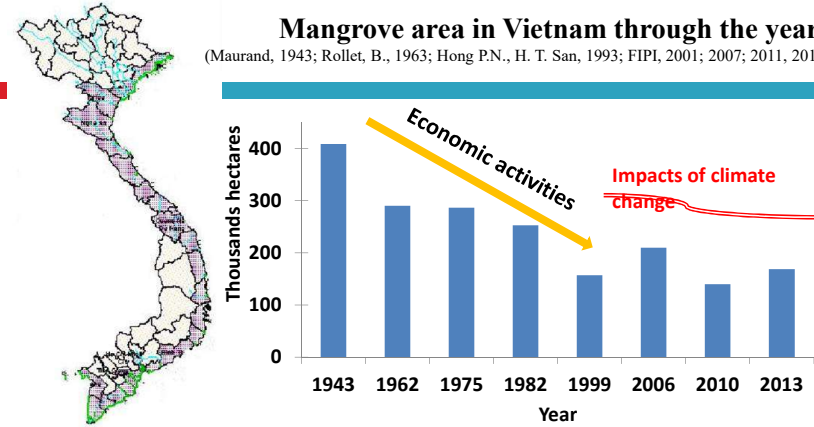
## Spatial distribution of mangroves



**South East Asia is the most diverse mangrove region**  
(World atlas of mangroves, 2010)

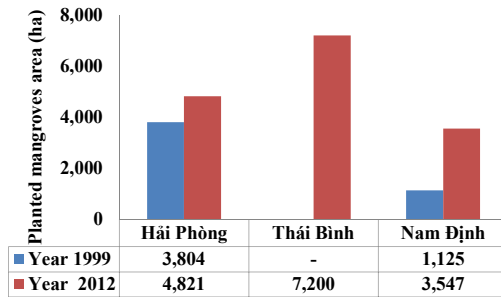
## Mangrove area in Vietnam through the years

(Maurand, 1943; Rollet, B., 1963; Hong P.N., H. T. San, 1993; FIPI, 2001; 2007; 2011, 2013)



## Mangrove forest landscape restoration

The change of mangrove areas in the region are mainly due to the mangrove rehabilitation programme







Mangrove forest landscape restoration



Planted  
*Bruguiera*  
*gymnorhiza*

Mangrove forest landscape restoration



13 year old  
planted *K.*  
*obovata*  
intermixed  
with  
*Sonneratia*  
*caseolaris*


Mangrove forest landscape restoration







Mangrove forest landscape restoration

## ECOLOGICAL FUNCTIONS

(Millennium Ecosystem Assessment, 2005)




-  Provisioning
-  Regulating
-  Cultural
-  Supporting



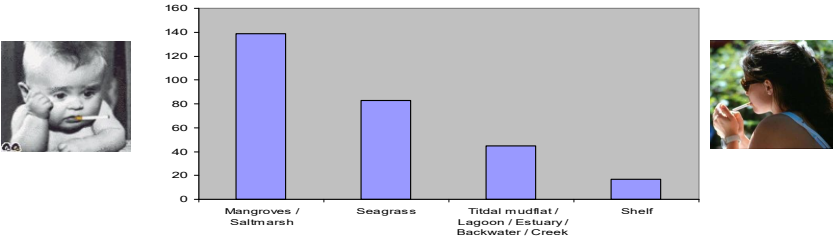
- Biomass of mangrove forest varies with age, dominant species, and locality;
- Net primary product of mangroves is significantly higher than in those of tropical upland forests => **high net ecosystem production**

## Carbon Sequestration Potential



- ▶ Mangroves have high levels of primary productivity than other tropical forests.
- ▶ 218 Tg C yr<sup>-1</sup> in biomass
- ▶ 17 Tg C yr<sup>-1</sup> in mangrove sediment

### Carbon burial rates (g C m<sup>-2</sup> y<sup>-1</sup>) in different coastal systems



Coastal System	Carbon Burial Rate (g C m <sup>-2</sup> y <sup>-1</sup> )
Mangroves / Saltmarsh	~140
Seagrass	~80
Tidal mudflat / Lagoon / Estuary / Backwater / Creek	~45
Shelf	~20

**Mangrove's carbon burial**  
 2 times greater than seagrass  
 50 times greater than tropical forest

### Restored mangroves and livelihoods of coastal communities



Mangrove reforestation has contributed to improving the Socio - economic life of some coastal communities.

- Generating jobs (planting, caring and protection of mangroves) for some poor people.
- Increasing income from rising marine resources.

### Restored mangroves and livelihoods of coastal communities



Mud crab seeds harvested in mangroves for aquaculture

Average income from mud crab seeds of 30 households in November 2000 at Nam Dinh Prov.

Commune	Income (USD)
Nam Dien – Nghia Hung Dist.	2,031
Nghia Hung – Nghia Hung	536
Giao Lam – Giao Thuy Dist.	596

### Restored mangroves and livelihoods of coastal communities

Comparison of the benefits of collecting aqua-products inside and nearby mangrove areas before 2005 (rare and young stand of planted mangroves) and in 2013 (mature restored forest)

	2005	2014
Area (ha)	210	300
Average income (VND/day)	123,573	266,860
Number of working days (day/month)	13	15
Number of working months (month/year)	6	6
Number of collectors (people/day)	89	115
Total income/commune (VND)	918,054,132	2,733,450,008
Income per ha (VND)	4,113,852	9,136,138
Income per ha (USD)	196	435

### Restored mangroves and livelihoods of coastal communities

socio-economic report of Bang La authority, the value of aqua-product collection in was 16.65 billion VND equivalent to \$ 2,643/ha

All value from agriculture (USD/ha/year) in Hai Phong, 2013  
(Statistic book, 2013)

Cultivation	3,042
Livestocks	2,907
Services	180
<b>Total</b>	<b>6,129</b>

### Restored mangroves and livelihoods of coastal communities

Bee keeping  
45 USD/ha/year



### Carbon stock



- the amount of carbon sequestration by mangroves in the study area up to 2013 was estimated to be 295,433 tons -
- equivalent to 1,083,291 tonnes of CO<sub>2</sub> (1,204 ton/ ha) and
- value of \$ 40,081,768 for the entire region and \$ 44,535/ha

(with the price of 37 USD/ton CO<sub>2</sub>)  
(World Bank, 2014).

### Regulating

#### Coastal protection Function

Coastal Protection against coastal erosion, waves, currents, storms, flood and natural calamities

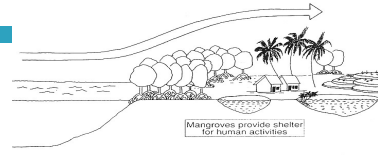


### Mangroves prevent soil erosion and trap sediment

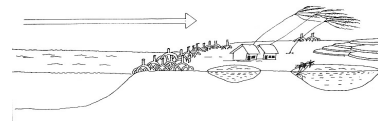
“Engineers” building and maintaining physical structure of the habitat



### Restorated forest protect coastal



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



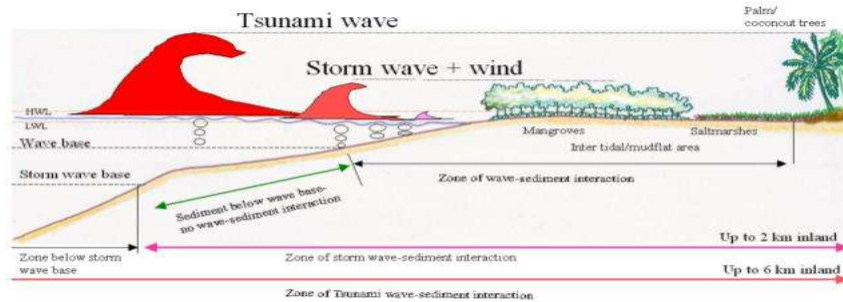
➔ Mangroves are a solid "green wall" protecting coastal areas

Mangroves prevent shoreline erosion by acting as buffer and binding soft sediments reducing the impacts of storms



Root system of *Rhizophora* sp. (Painting Ta Luu)

### Wave attenuation



### Tsunami of December 26, 2004, India

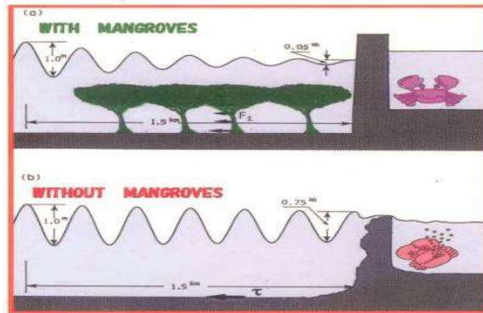




## Restorated forest protect coastal

Different effects of wave reduction in (a) mangrove (b) without mangrove areas

(Source: Y. Mazda, M. Michimasa, M. Kogo, P.N. Hong, 1997)



## Restorated forest protect coastal

Typhoon in 2005 broked seadyke



Typhoon No 2 hit Hai Phong on July 31, 2005. The seadyke in Cat Hai District where covered no mangroves was broken

## Restorated forest protect coastal

Without mangroves



650m sea dyke without mangroves at Thái Đô was partly destroyed in the Storm No. 2 in 2005

With mangroves



5km seadyke at Thai Do with mangroves protection was totally safe after the same storm

## Restorated 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

## Restorated forest protect coastal

### Without mangroves



Without mangroves protection seadyke in Cat Hai was destroyed Storm No 2 in 2007

### With mangroves

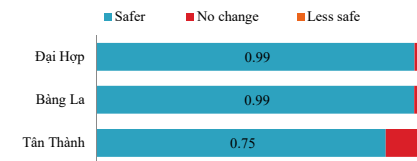


The sea dyke in Bang La was protected with mangroves

## Restorated forest protect coastal

331/430 (77%) of respondents said they felt safer from disasters (typhoon) compared to the period before 2005

Local community felt safer from disasters (typhoon) compared to the period before 2005

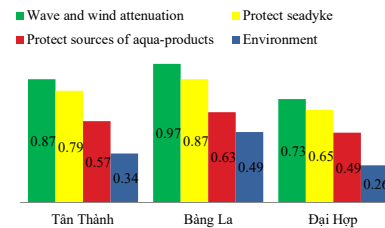


## Restorated forest protect coastal

from 73% to 97% of the households confirmed the role of mangroves in buffering seawater/waves,

65-87% mentioned the protective role of sea dykes

Awareness of local community of the role of mangroves through natural disaster in the region recently



## Restorated forest protect coastal

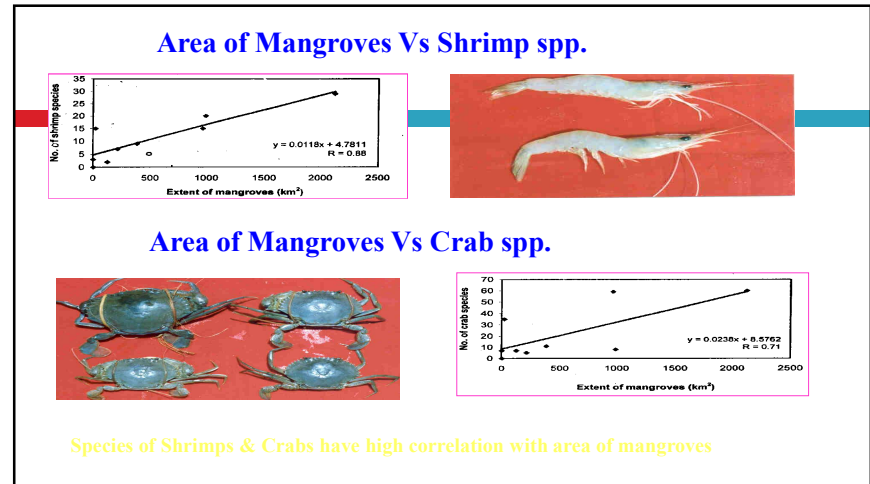
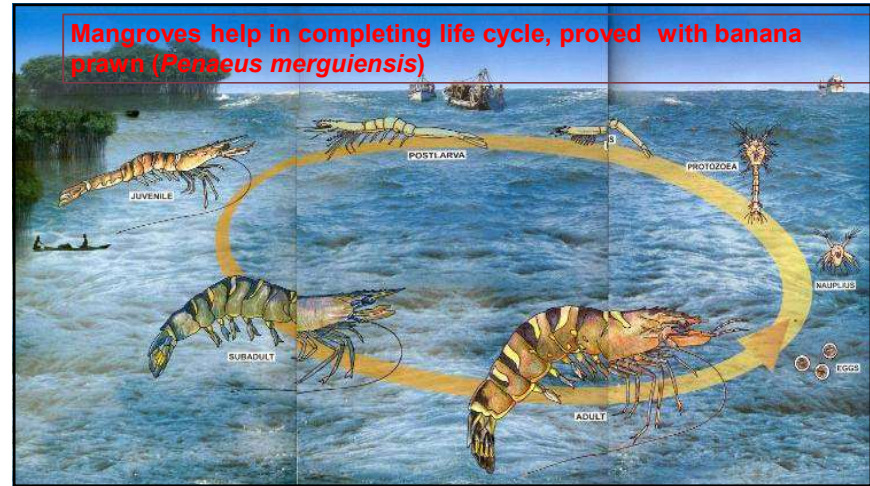
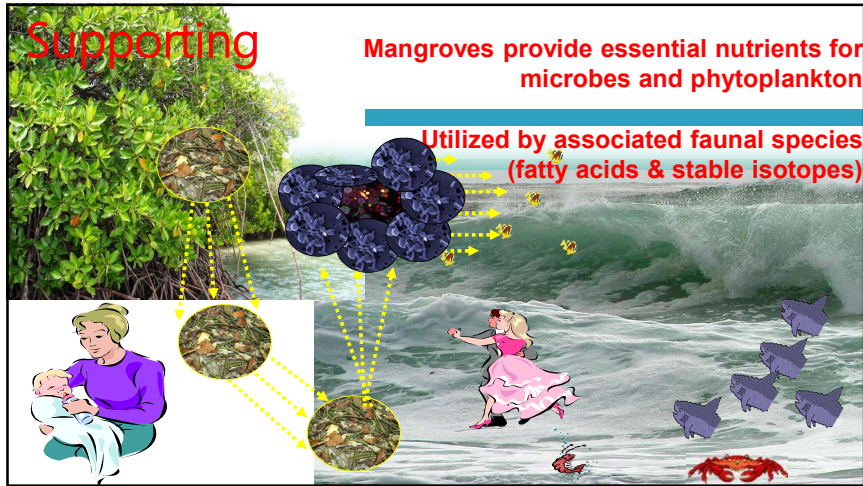
the two **level 9** typhoons that hit Dai Hop in 1987 and 2005 under similar conditions of direction, tides, waves etc.:

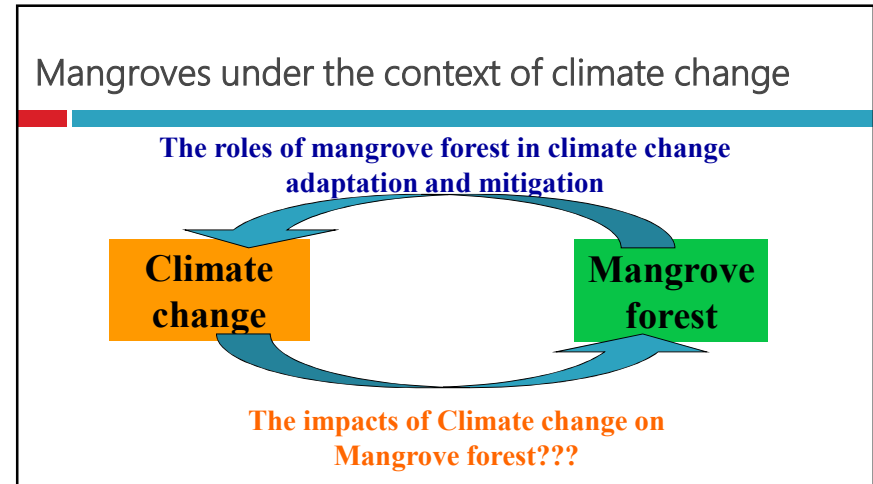
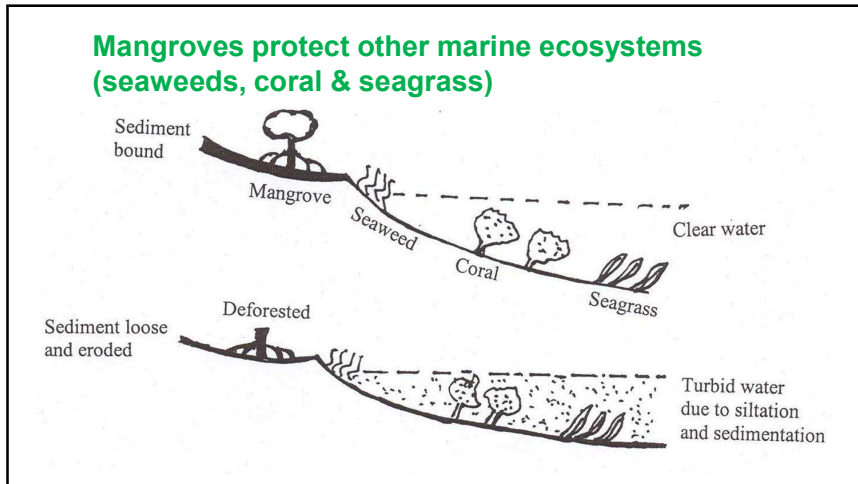
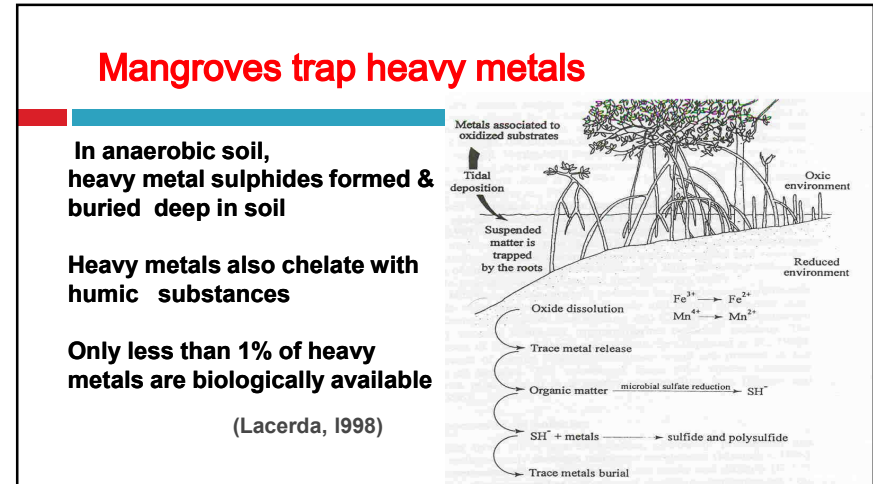
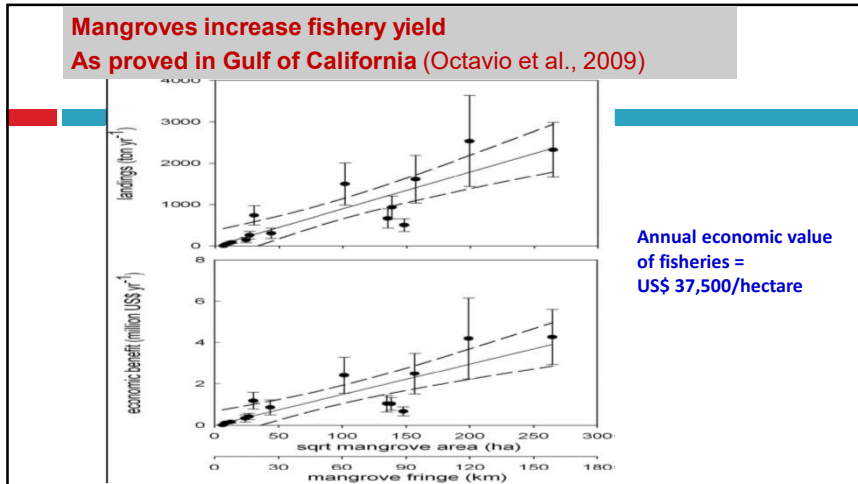
- In 1987, the storm caused serious damage to a 3 km-stretch of the sea-dyke that needed to be repaired at a cost of VND 6 Bio (at present value/ USD 300,000).
- The same dyke undamaged by the 2005 typhoon, being now protected by a mangrove forest of more than 1 km in width. A small outer mini-dyke suffered some damage and needed to be fixed at an estimated maximum cost of VND 100 Mio (USD 5,000).

3 km of seadyke (300 ha of planted mangroves)

VND 5.9 Bio (USD 295,000)

It take 5-10 year to recovered the soil which was submerged under the sea water from the typhoon





Extream weather condition: Temperature



*Sonneratia sp.* In the Red River Delta

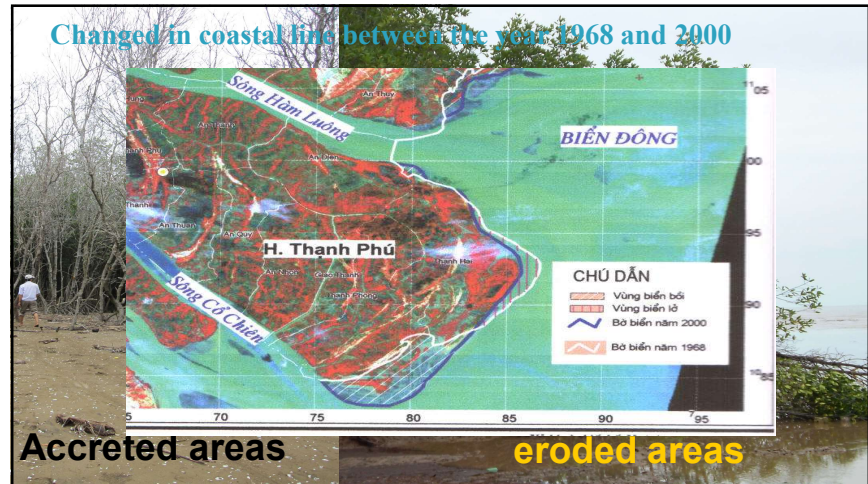
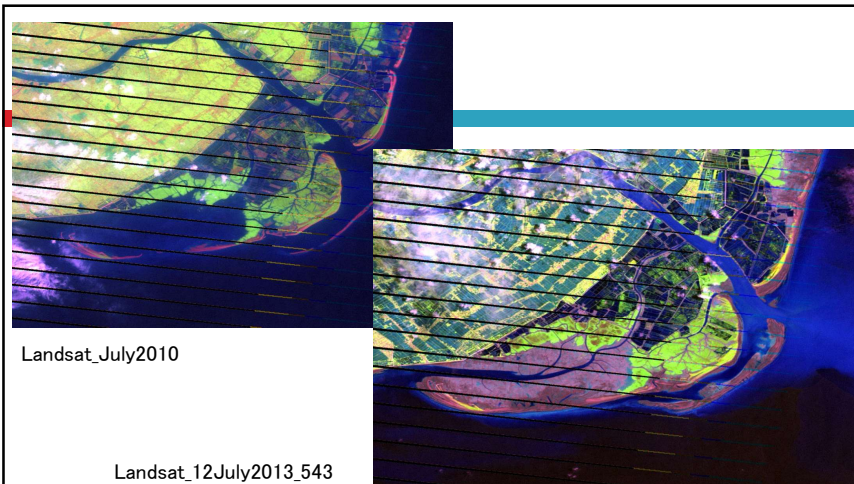
Extream weather condition: Temperature



*Kandelia sp.* in the Red River Delta, August, 2011

Insects





## What are the reasons?

**Inundation (water level)?**

**Salinity?**

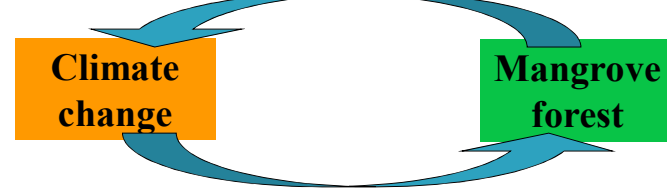
**Density ?**

**Barnacle?**

**Extreme weather?**

...

The roles of mangrove forest in climate change adaptation and mitigation

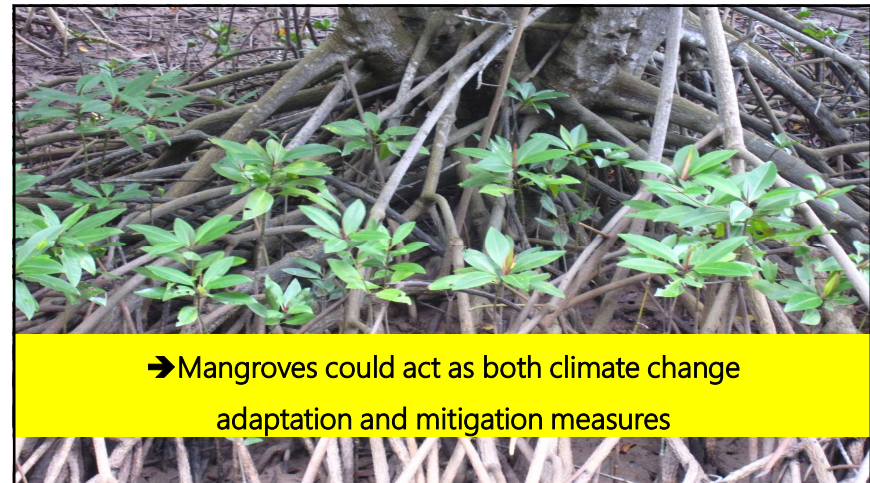


The impacts of Climate change on Mangrove forest

## Conclusions

- The restored mangrove ecosystems have provided food security and livelihoods to the poor coastal inhabitants through the service provision of **fisheries nursery and habitat** and **regulation of protecting the coastal communes** from natural disasters (typhoon, waves) and **carbon sequestration**.
- In turn, these ecosystem products and services **both directly and indirectly contribute significantly to the coastal households** all the way up to the national food security and economy

Although the assessments in this research could not quantify all the values of mangroves in the locality, the results show the **important role of restored mangrove forest in the contribution of forest products and other services to food security**.



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

