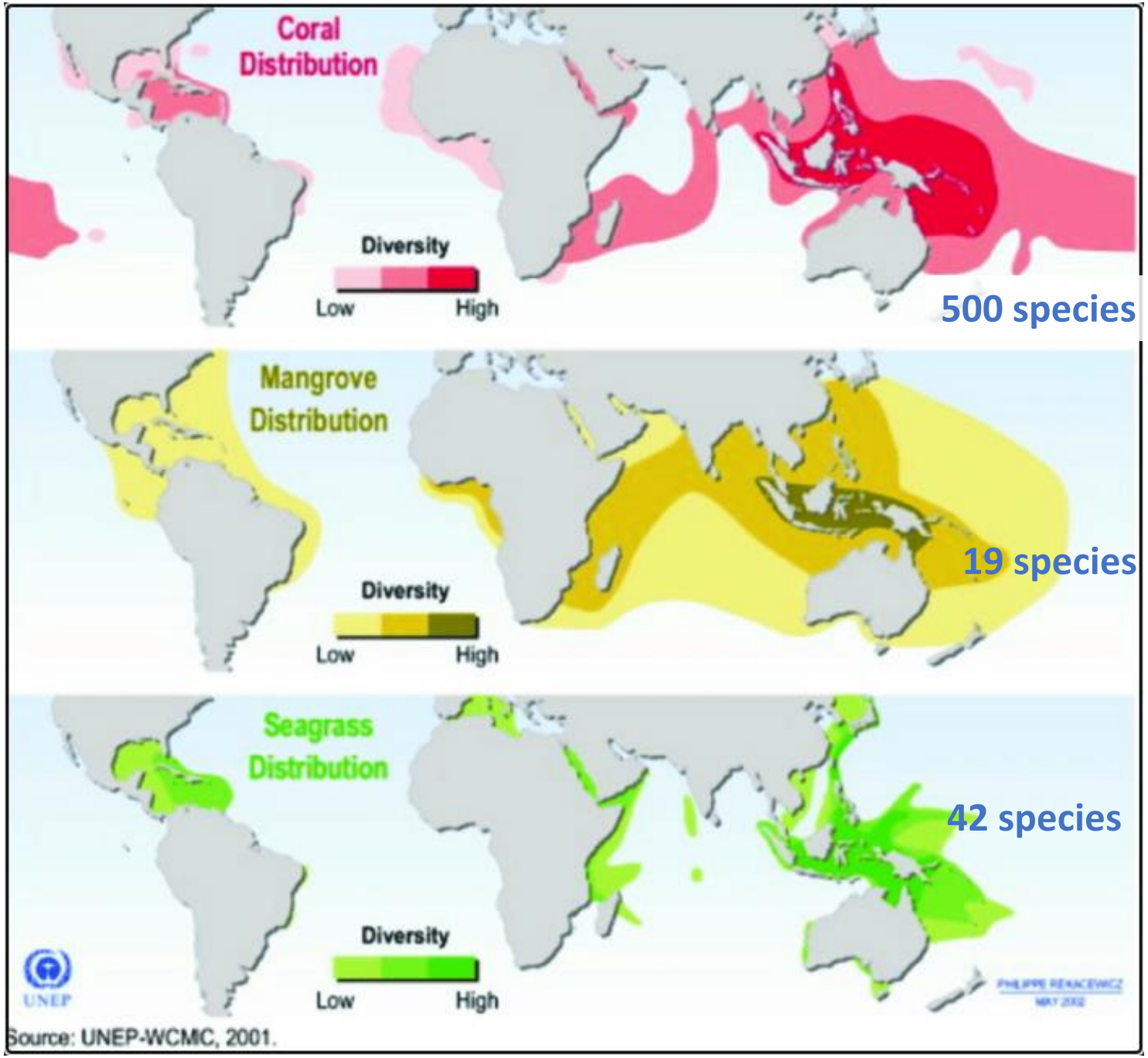
# Philippine Biodiversity




**500 species / 2.5 million hectares**

**19 species / 2.73 million hectares**

**42 species / 0.3* million hectares**

* Only 10% of original

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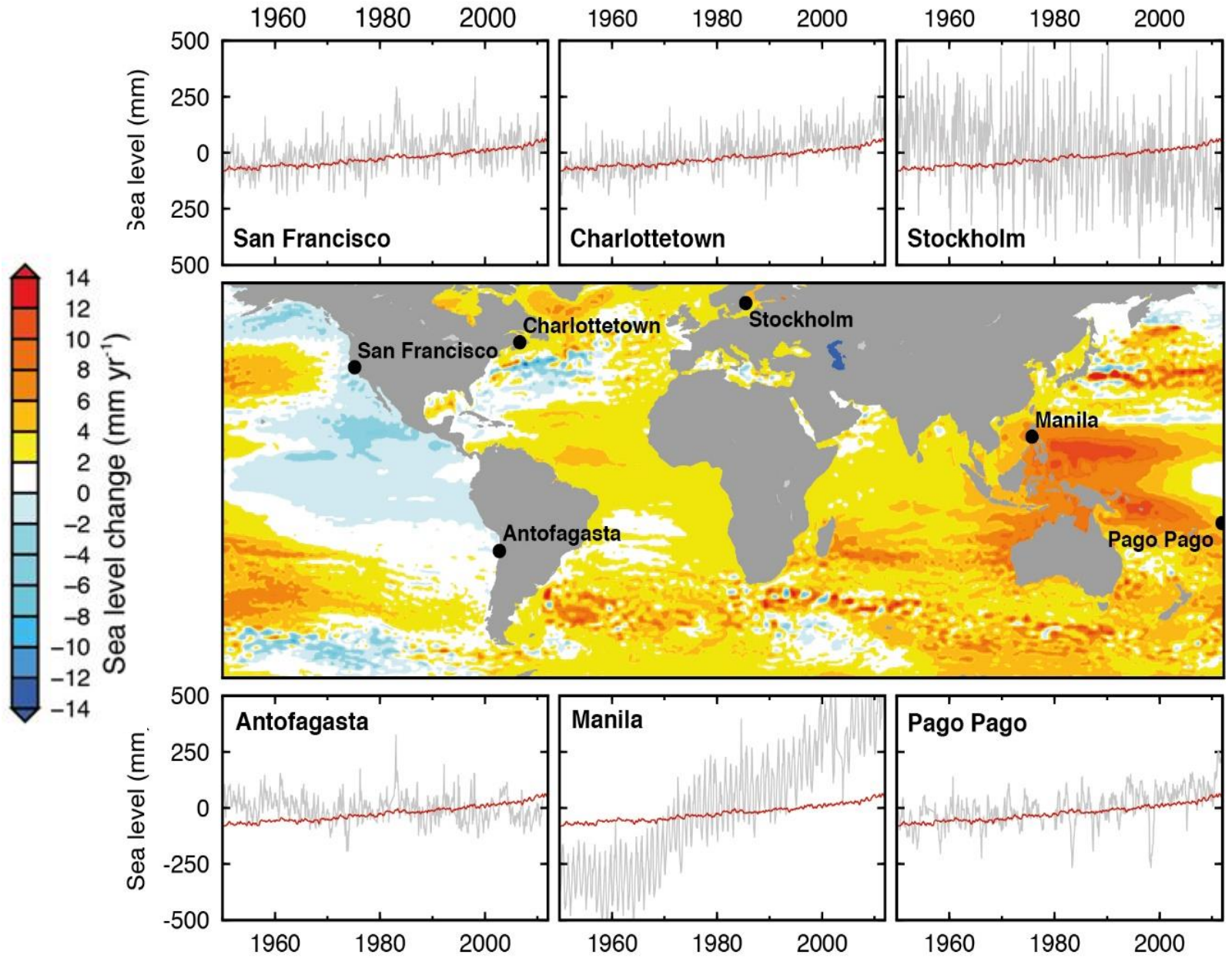
# sea level rise

**Historical sea level trends shows the western Pacific experiencing the highest rise**




IPCC conservatively estimated global sea-level rise at 30-60 cm with the Western Equatorial Pacific region likely experiencing higher than global estimates.

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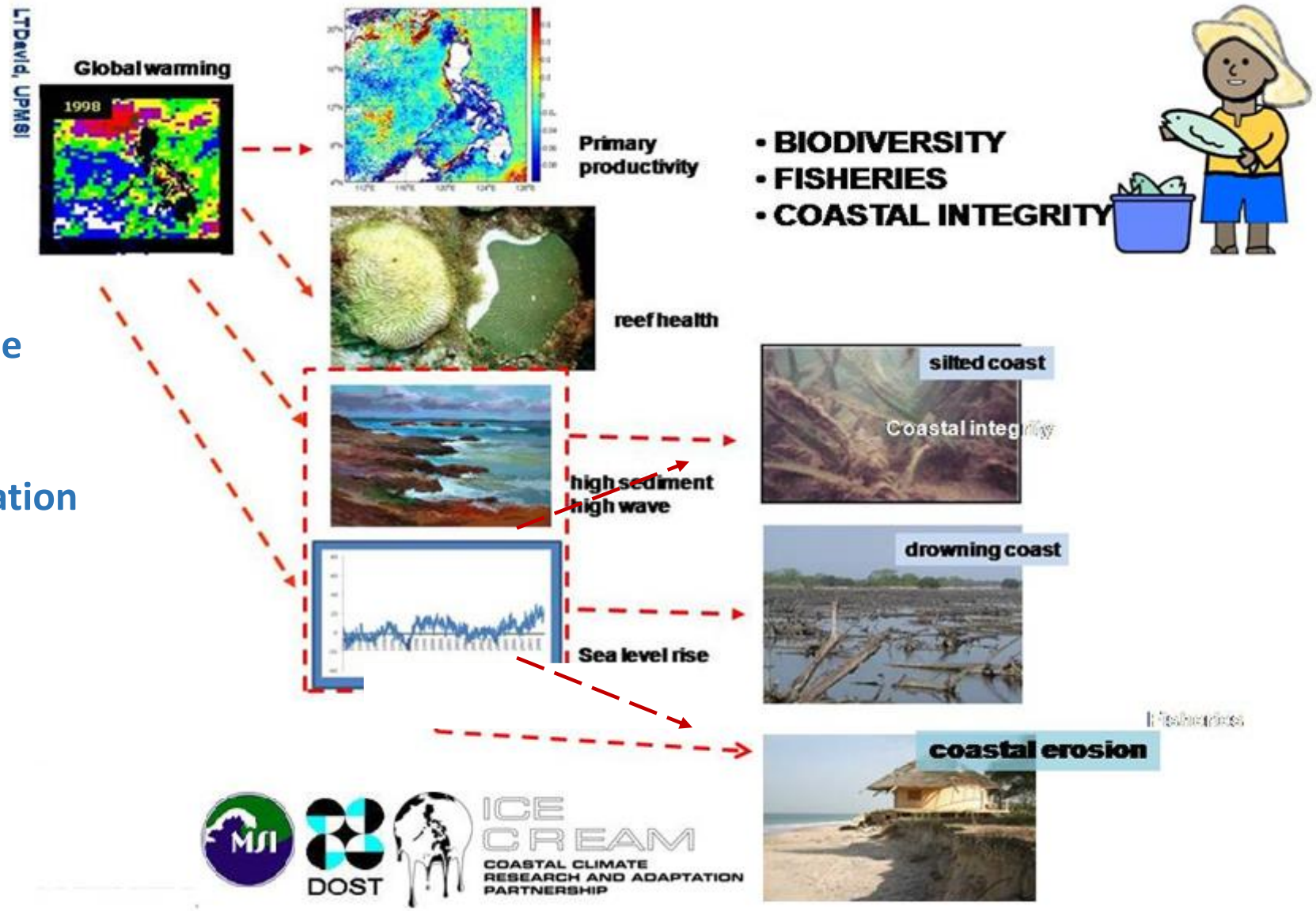
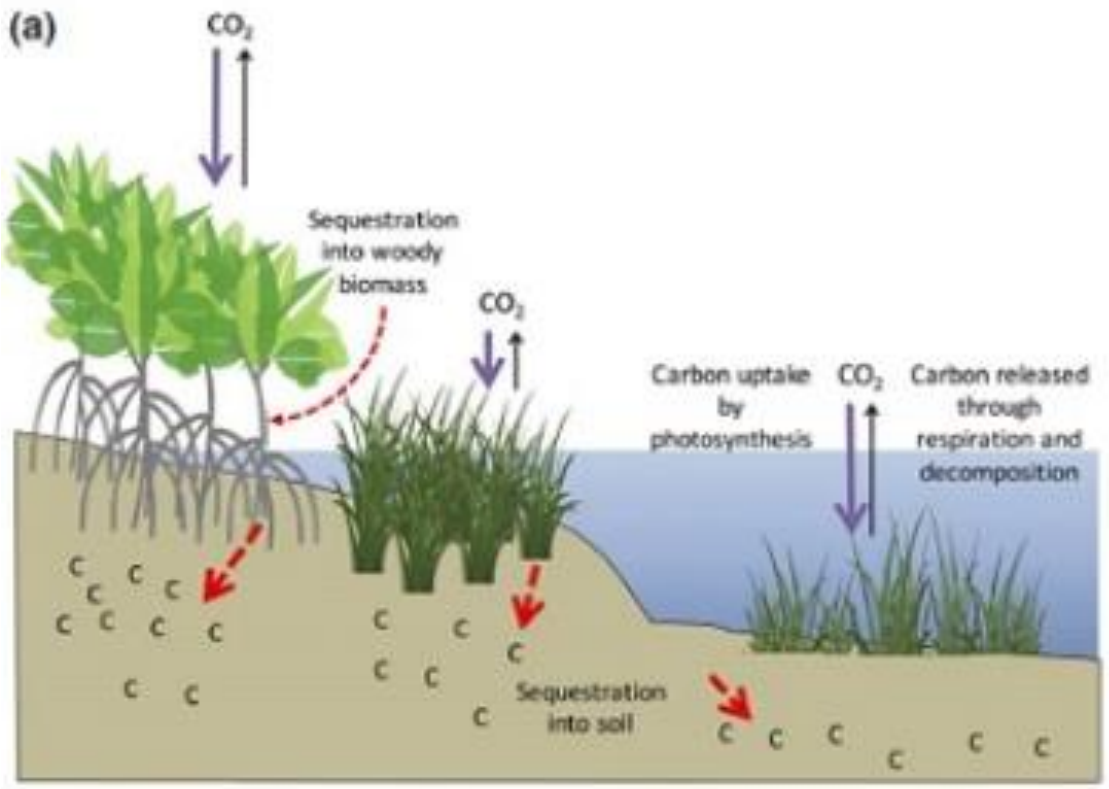
# Sea Level Rise and Implications to the Philippines as an Archipelagic Nation

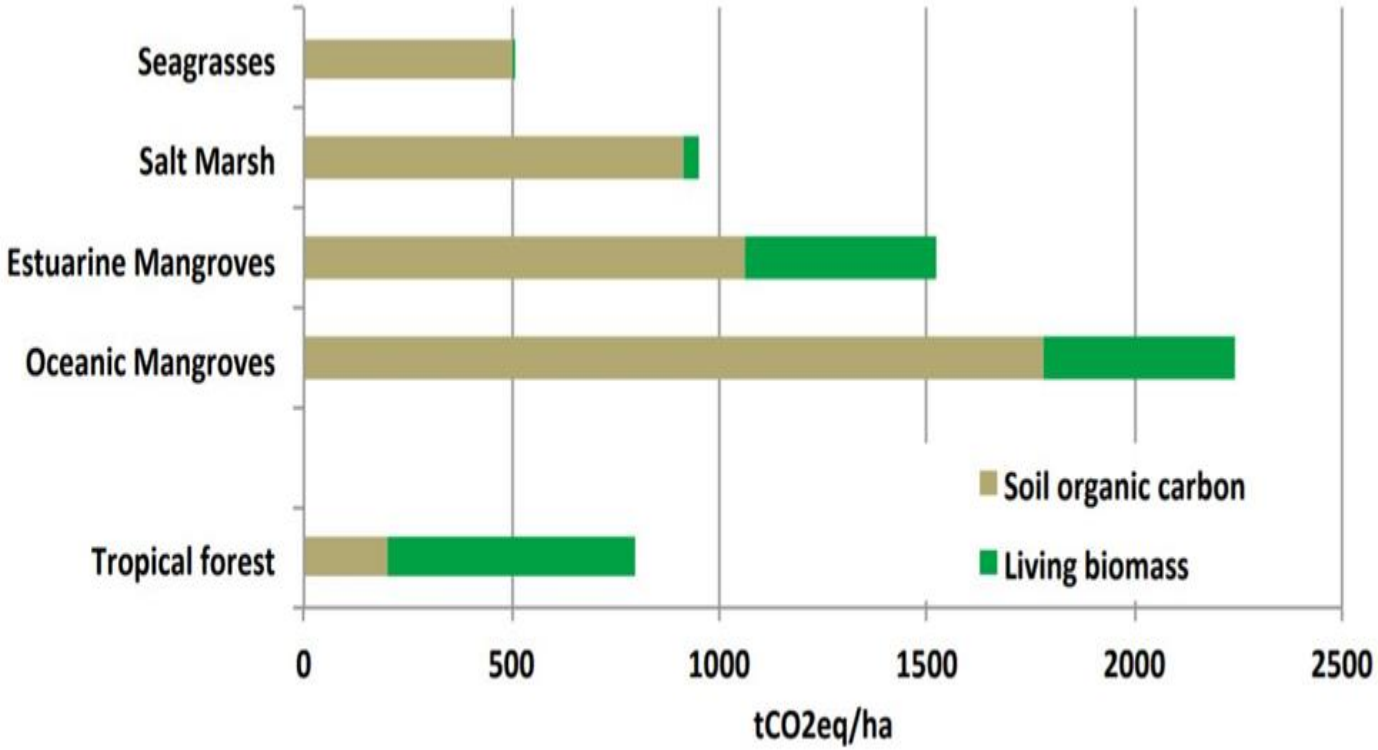
## CLIMATE CHANGE

- Temperature increase
- Bigger storms
  - Increase floods
  - More sedimentation
- Sea level rise



# Consequence - Release of sequestered carbon




Total carbon sequestered per hectare habitat (Murray et al. 2011).

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# Making seagrass protection and mangrove rehabilitation a priority for the Philippines

1. Debt for Nature Swap

"DNS swaps are financial transactions where debt owed by a developing country is reduced or converted by the creditor in exchange for guaranteed payments towards conservation goals by the debtor country."

- WWF

- Brazil, Peru, Colombia, …

2. Adaptation - Mitigation partnership

Convince the country with natural resources to take care of their mangroves (& seagreass) as part of their adaptation measures

Convince countries with carbon deficit to co-invest in this endeavor

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***Avicennia marina and Sonneratia alba*** very good sediment traps

Intertidal 10.5 kg/m$^2$y*
Mid-tidal 39 kg/m$^2$y**

Both measured using radiotracer $^{210}$Pb
Alongi et al., 2005
Walsh & Nittrouer, 2004

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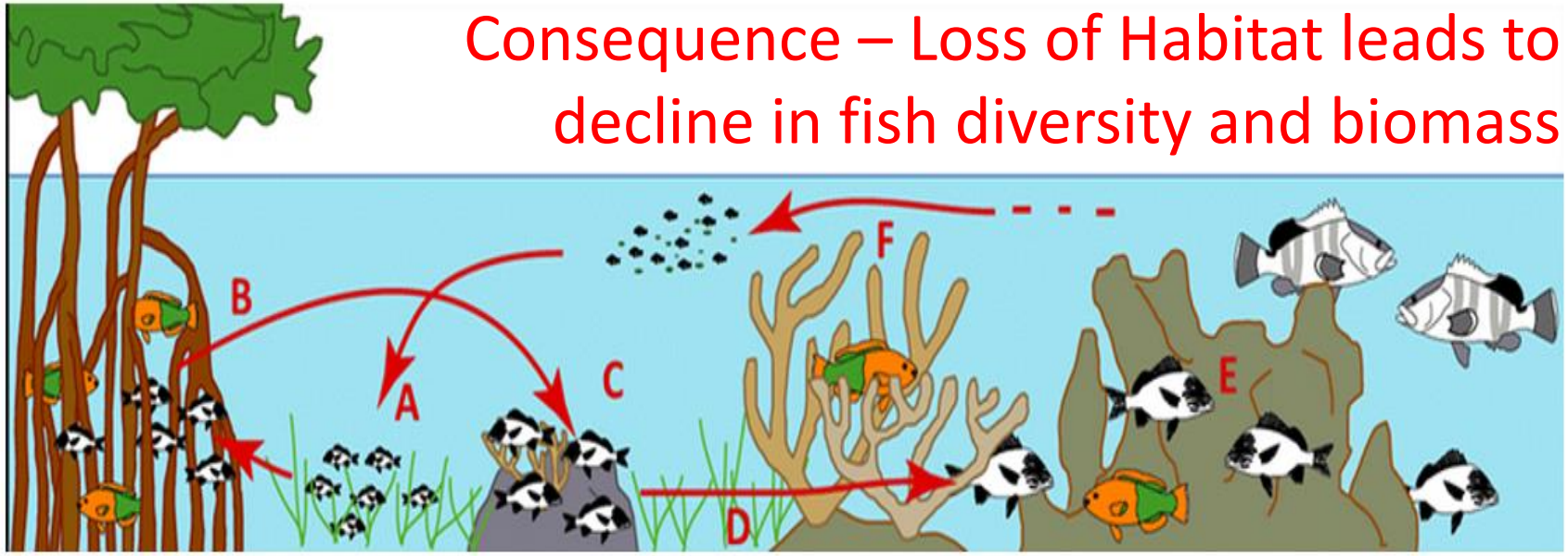
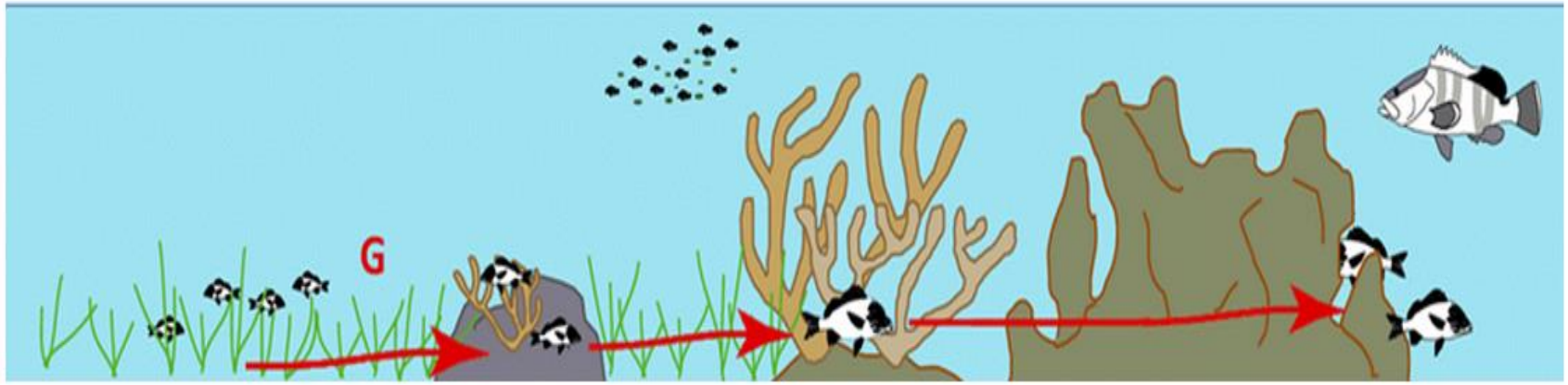
# Consequence – Loss of Habitat leads to decline in fish diversity and biomass


**silted coast**

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Loss of habitat typically result in the decline of smaller-bodied fishes that are dependent on the habitat for shelter and bigger ones dependent on habitat as nursery

# Consequence – Food availability and Livelihood

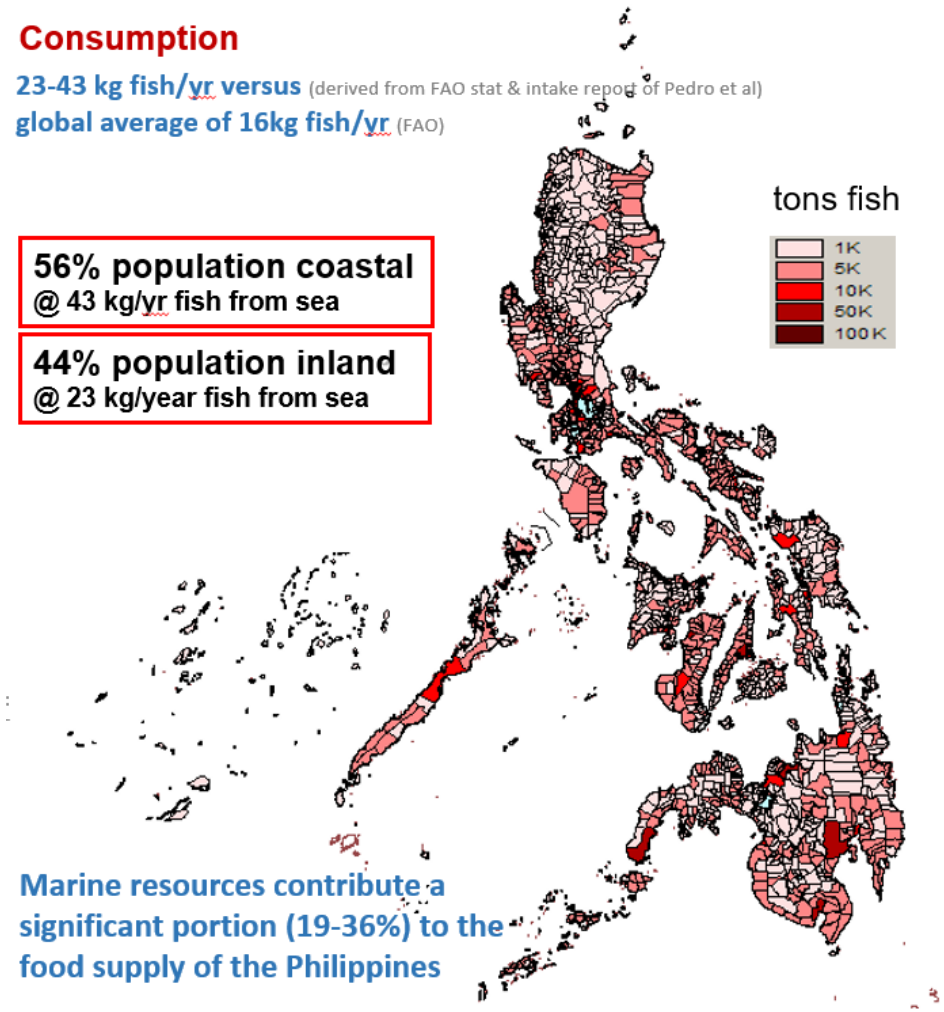
| Importance of fisheries to Philippine society | |
|---|---|
| Total fisheries production (2011) | 4.9 mt |
| Work force (direct) | 1.6 million |
| Municipal fishery | 27%<br>1.33 mt; 80 B |

**Consumption**

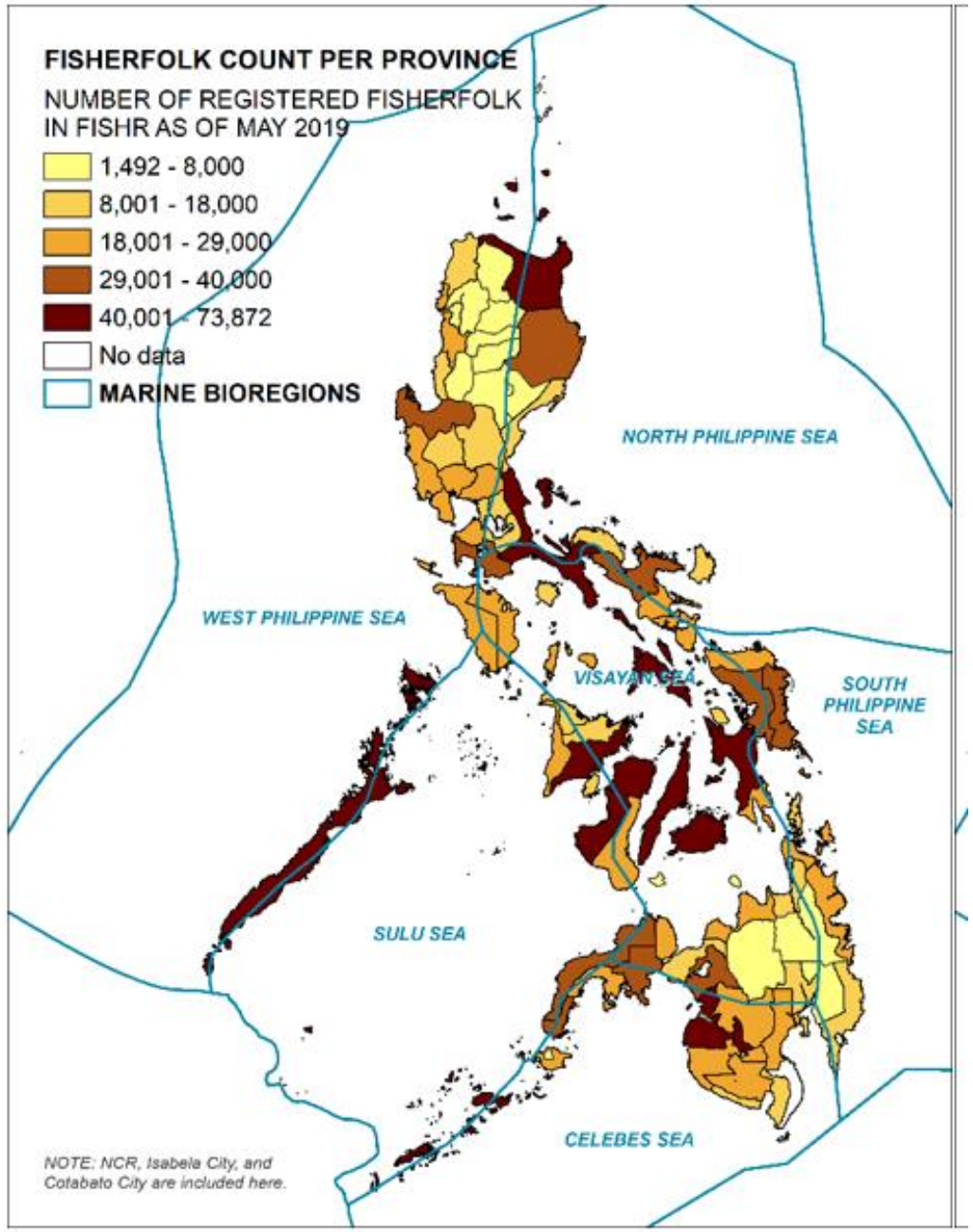
**23-43 kg fish/yr versus** (derived from FAO stat & intake report of Pedro et al)
**global average of 16kg fish/yr** (FAO)

**56% population coastal**
**@ 43 kg/yr fish from sea**

**44% population inland**
**@ 23 kg/year fish from sea**




**Marine resources contribute a significant portion (19-36%) to the food supply of the Philippines**

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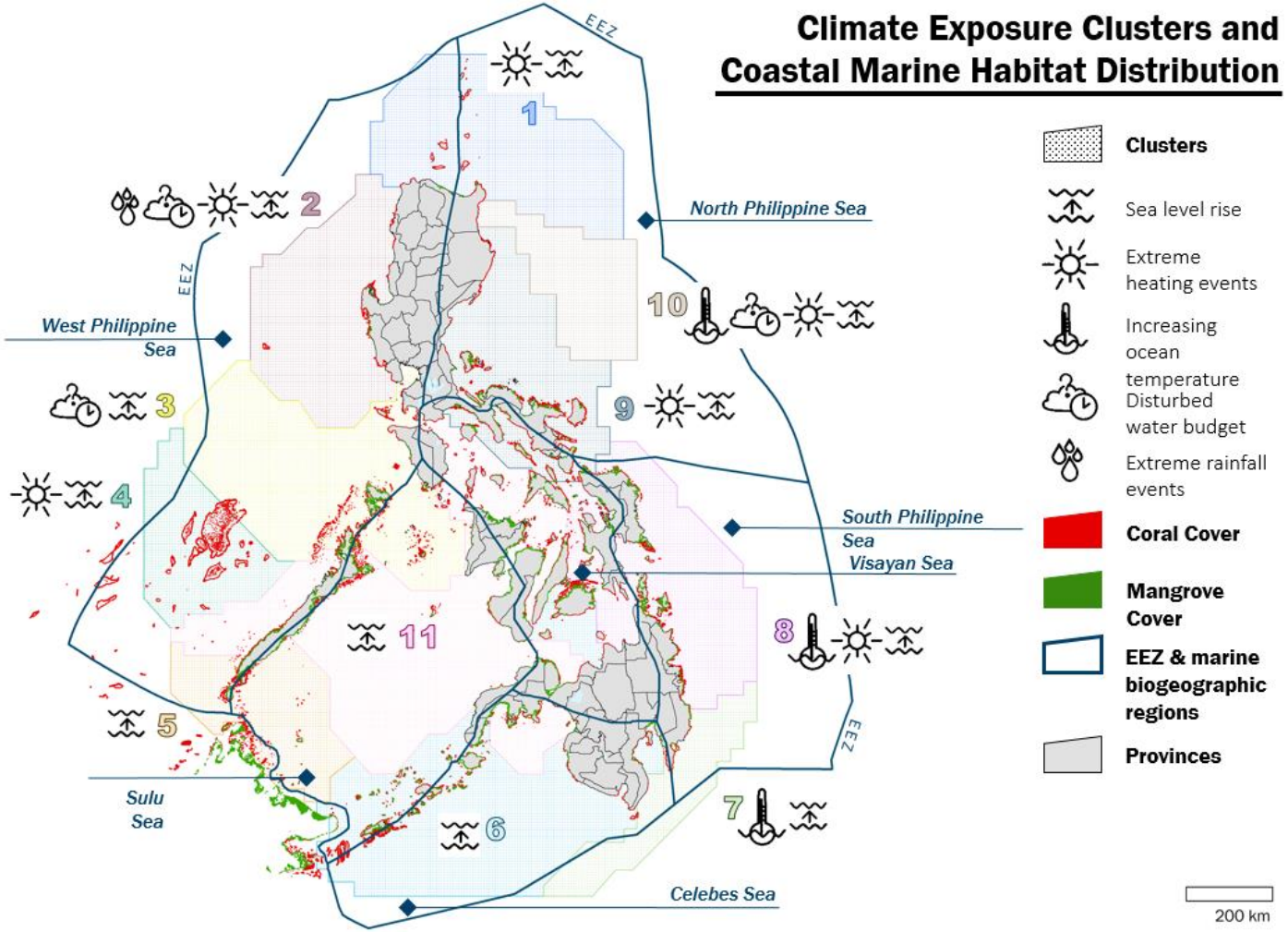
# Site-specific Losses




| Region | Province | Fisherfolk Count | Climate Change Vulnerable Habit that Needs Protection/Management | Other Interventions in Addition to Protection |
|---|---|---|---|---|
| ARMM | Maguindanao | 72,143 | Mangroves | Supplemental livelihood |
| | Lanao del Sur | 37,510 | | Supplemental livelihood |
| | Sulu | 65,259 | | |
| | Tawi-Tawi | 54,772 | | |
| XII | South Cotabato | 27,369 | Mangroves | Supplemental livelihood |
| | Cotabato City | 6,976 | | |
| III | Bulacan | 25,747 | Seagrass & mangroves | Supplemental livelihood |
| | Pampanga | 26,344 | | |
| VII | Bohol | 54,953 | Corals, mangroves + offshore | Strict implementation of 15-km municipal waters |
| | Cebu | 70,361 | | |
| VIII | Leyte | 55,511 | Corals, mangroves + offshore | Strict implementation of 15-km municipal waters |
| | Samar (Western Samar) | 39,533 | | |
| | Eastern Samar | 33,571 | | |
| V | Masbate | 48,822 | Corals & mangroves | |
| | Camarines Sur | 37,713 | | |
| VI | Negros Occidental | 48,007 | Corals, seagrass, mangroves + offshore | Strict implementation of 15-km municipal waters |
| | Iloilo | 48,577 | | |
| IV-A | Batangas | 39,030 | Corals, seagrass & mangroves | |
| | Quezon | 47,614 | | |
| | Cavite | 21,962 | | Supplemental livelihood |
| IV-B | Palawan | 73,872 | Corals & mangroves | |
| IX | Zamboanga del Norte | 33,527 | Mangroves | |
| | Zamboanga del Sur | 37,246 | | |
| I | Pangasinan | 37,898 | Corals, seagrass & mangroves | |
| II | Isabela | 33,945 | Corals & mangroves | |

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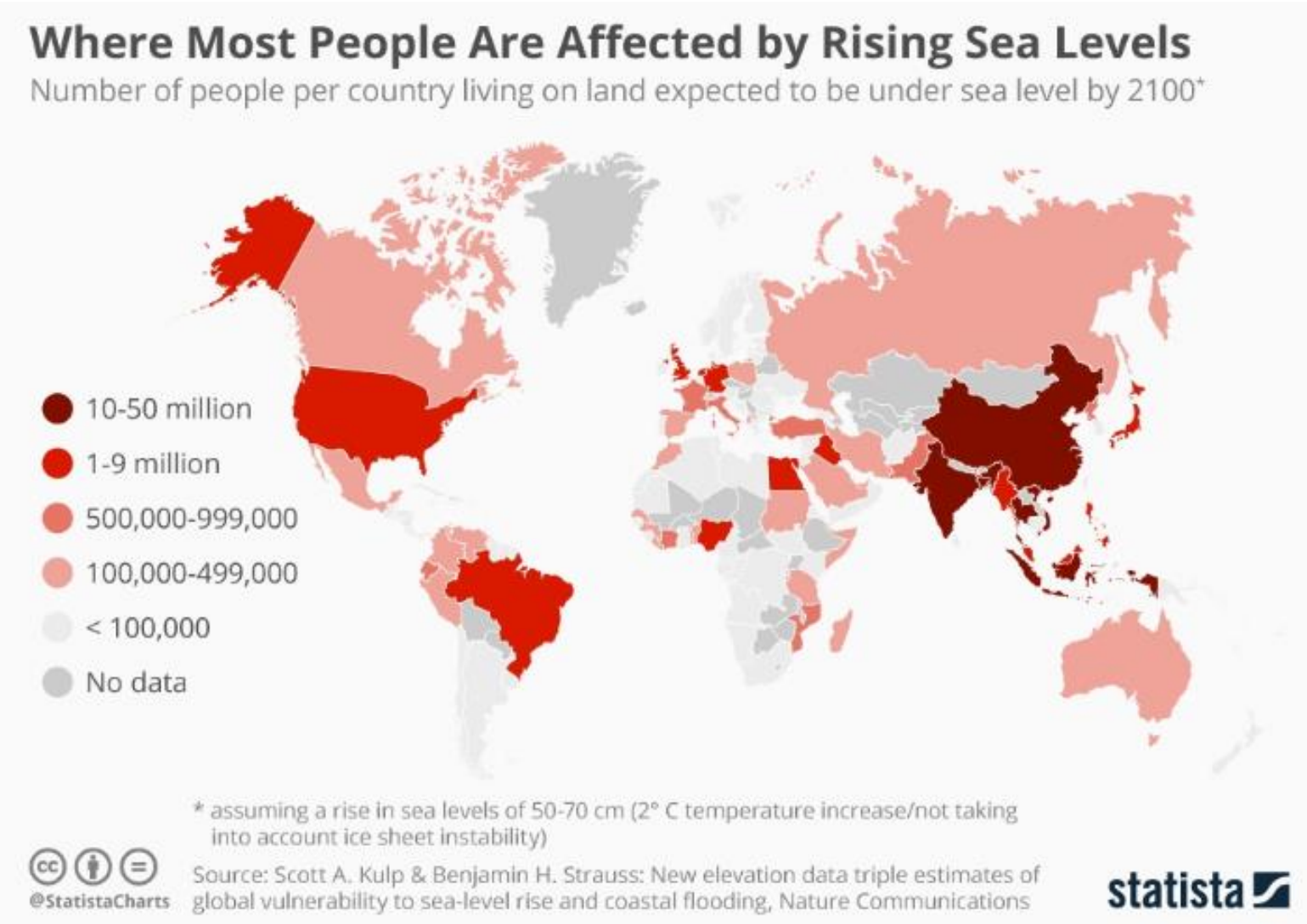
# Consequence – Coastal inundation & decreased integrity

| People living along the Philippine coasts | |
|---|---|
| Total population (2019) | 108,800,000 |
| 60% live along the coasts | 64,800,000 |




# Sea Level Rise exacerbates potential impact of storm surges

| Rank | Province | Max surge height (m) |
|---|---|---|
| 1 | Samar | 7.45 |
| 2 | Leyte | 6.84 |
| 3 | Palawan | 6.71 |
| 4 | Iloilo | 6.29 |
| 5 | Biliran | 6.26 |
| 6 | Camarines Sur | 6.17 |
| 7 | Quezon | 5.86 |
| 8 | Masbate | 5.45 |
| 9 | Southern Leyte | 5.32 |
| 10 | Bataan | 5.04 |

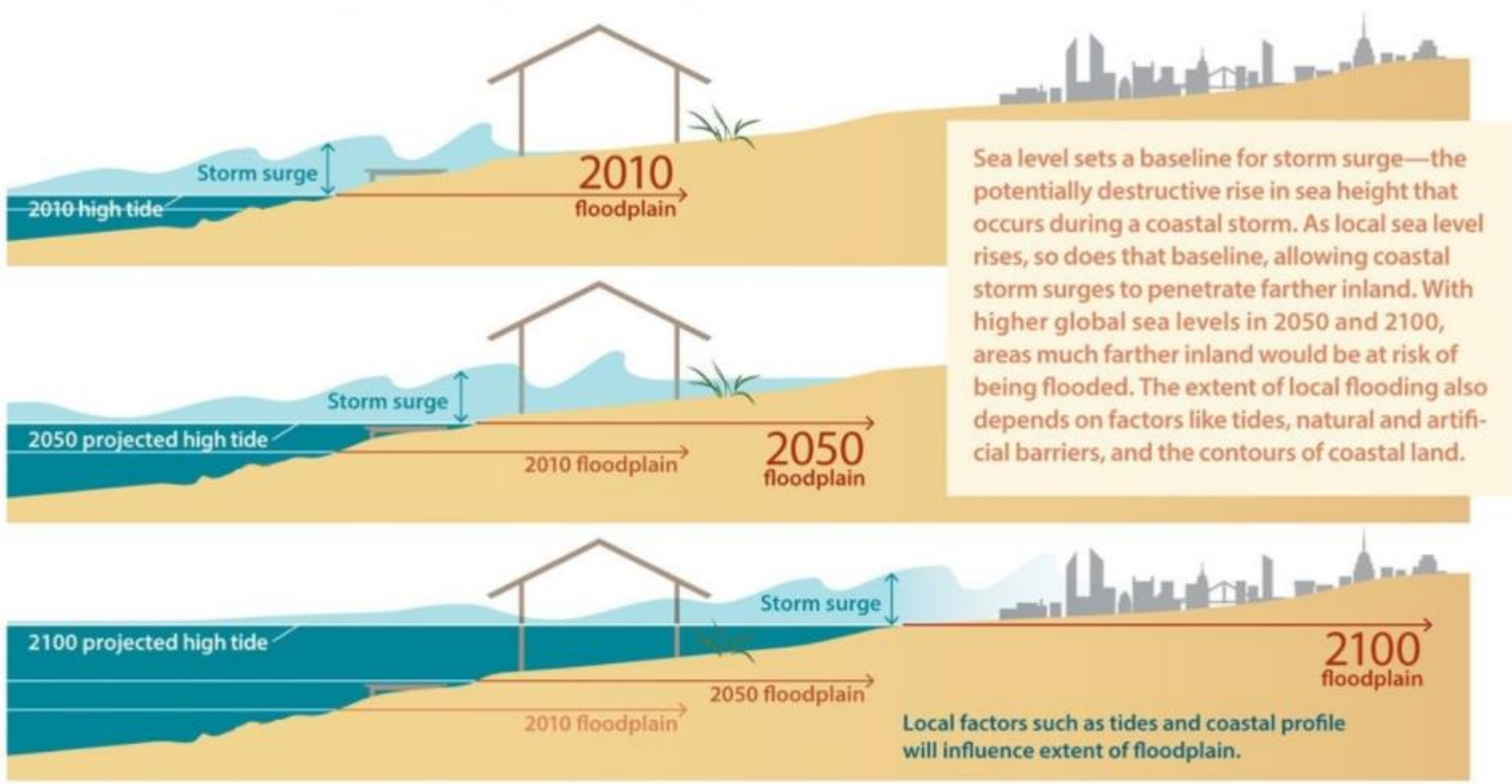



Image adapted from Union of Concerned Scientists 2013; www.ucsusa.org/sealevelrisescience

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# When Haiyan struck, Tacloban City was destroyed

But a few kilometres northeast, in Palompon, a mangrove plantation, located in an island a few hundred meters from the shoreline buffered the full impact of the **3.6 meter storm surge**.

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# Site-specific Inundation

| Region | Province | Sea Level Rise (SLR) + Moderate Flooding | Municipalities Affected |
|---|---|---|---|
| ARMM | Sulu | High | Small islands & Omar, Kalingalan Caluang |
| | Tawi-Tawi | High | Small islands & Bongao, Languyan |
| XII | Cotabato City | Very high | Entire Cotabato City |
| III | Bulacan | Very high | All coastal areas of Bulacan |
| VII | Bohol | Medium | Inabanga, Cadijay, Mahanay Island |
| | Cebu | Medium | Balamban, Cebu City, Mandaue City, Mactan |
| VIII | Eastern Samar | Medium | Guiuan, Salcedo, Gen. McArthur, Arteche, Oras, Dolores |
| V | Masbate | Medium | Aroroy, Milagros, Cawayan, Uson, Placer |
| | Camarines Sur | High | Cabusao, Canaman, San Jose |
| VI | Negros Occidental | High | Ilog, Pulupandan, Victorias, Manapla, Sagay |
| | Iloilo | High | Kalibo, Roxas, San Jose, Iloilo City, Dumangas, Concepcion, Numancia, New Washington |
| IV-A | Batangas | Medium | Nasugbu, San Juan, Batangas City, Balayan |
| | Quezon | High | Small islands, General Nakar, Infanta, Calauag, Macalelon |
| | Cavite | Medium | Cavite City, Noveleta, Naic |
| IV-B | Palawan | Medium | Taytay, Puerto Princesa City, Narra |
| IX | Zamboanga del Norte | Medium | Dapitan City, Dipolog City |
| | Zamboanga del Sur | Medium | Dinas, Pagadian City, Dimataling, Zamboanga City |
| I | Pangasinan | High | Bani, Lingayen, Dagupan, Mangaldan, San Fabian |
| II | Isabela | Medium | Palanan, Divilacan |

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| Country | Annual $CO_2$ emissions (in thousands of metric tons) | Percentage of global total |
|---|---|---|
| *World* | 28,431,741 | 100.0 % |
| China | 6,103,493 | 21.5 % |
| United States[11] | 5,752,289 | 20.2 % |
| *European Union*[12] | 3,914,359 | 13.8 % |
| Russia | 1,564,669 | 5.5 % |
| India | 1,510,351 | 5.3 % |
| Japan | 1,293,409 | 4.6 % |
| Germany | 805,090 | 2.8 % |
| United Kingdom | 568,520 | 2.0 % |
| Canada | 544,680 | 1.9 % |
| South Korea | 475,248 | 1.7 % |
| Italy[13] | 474,148 | 1.7 % |
| Iran | 466,976 | 1.6 % |
| Mexico | 436,150 | 1.6 % |
| South Africa | 414,649 | 1.5 % |
| Philippines | 137.154 | 0.37% |

Carbon Offset = ways to compensate for the production of greenhouse gas emissions

Carbon Sequestration = process by which $CO_2$ is removed or captured from the atmosphere, can be done by mangroves and seagrass

Mangroves

386 Mg/ha x 100 ha =
38,600 Mg or **38,600 tons**

Seagrass

108 Mg/ha x 100 ha =
10, 800 Mg or **10,800 tons**

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Mean and range values of soil organic carbon stock (to 1 m depth) for mangrove, tidal marsh and seagrass ecosystems and $CO_2$ equivalents. (IPCC 2013)

| ECOSYSTEM | CARBON STOCK Mg/ha | RANGE Mg/ha | $CO_2$ Mequiv/ha |
|---|---|---|---|
| Mangrove | 386 | 55 – 1376 | 1415 |
| Tidal salt marsh | 255 | 16 – 623 | 936 |
| Seagrass | 108 | 10 – 829 | 396 |

- How much carbon is stored in the biomass and top 1m of soil in <u>100 hectares of mangrove</u> forests?

  386 Mg/ha x 100 ha = 38,600 Mg of blue carbon stored

- And how does that relate to $CO_2$ emissions if all the organic carbon in the upper 1m of sediment is oxidized to carbon dioxide?

  Conversion factor = molecular wt of $CO_2$ (44) / molecular wt of carbon (12) = 3.67

  38,600 Mg of blue carbon x 3.67 = 141,662 Mg $CO_2$ released in the study area

**0.3* million hectares** → **3 million hectares**

* Only 10% of original

- How much carbon will stored in the biomass and top 1m of soil in 2.7 million hectares of mangrove forests?

  386 Mg/ha x 2,700,000 ha = 1,042,200,000 Mg of blue carbon can be stored

- And how does that relate to $CO_2$ emissions if all the organic carbon in the upper 1m of sediment is oxidized to carbon dioxide?

  Conversion factor = molecular wt of $CO_2$ (44) / molecular wt of carbon (12) = 3.67

  1,042,200,000 Mg of blue carbon x 3.67 = 3,824,874,000 Mg $CO_2$ released in the study area

  = 3,824,874 thousand metric $CO_2$

| Country | Annual $CO_2$ emissions (in thousands of metric tons) | Percentage of global total |
|---|---|---|
| *World* | 28,431,741 | 100.0 % |
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Adaptation - Mitigation  partnership

**mangrove rehabilitation and seagrass protection**

**Co- investing with tropical countries** in the rehabilitation of mangroves is a win-win situation

There is **Carbon Offset**

BUT more importantly,  the investment **secures jobs**, **provides food** for people, and ultimately **saves lives**

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