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Issues and Challenges in Coastal Management

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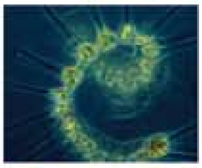

BLUE CARBON

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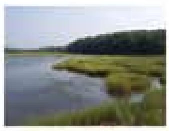

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Important websites

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3. *www.annauniv.edu*
4. *www.annauniv.edu/iom/home.htm*
5. *www.southasialoicz.org*
6. *www.ncscm.org*

Editor's Note

coast track

Issues and Challenges in Coastal Management

"Out of all the biological carbon captured in the world, over half is captured by marine living organisms hence it is called blue carbon" (Nellemann et al., 2009). First introduced by UNEP in cooperation with FAO and UNESCO, the concept of ***"Blue Carbon"*** emphasizes the ability of marine and coastal ecosystems to sequester carbon. Oceans play a significant role in the global carbon cycle and represent the largest long-term sink for carbon and also store and redistribute CO_2. Blue Carbon emphasizes the key role of marine and coastal ecosystems, which are dominated by marine vegetation such as mangrove forests, sea grasses, and brackish water wetlands. These coastal ecosystems store massive quantities of carbon for centuries and could provide an immediate and cost-effective tool to counter the impacts of climate change. Blue carbon has enormous ability to sequester and store large amounts of carbon, and coastal marine ecosystems show great climate mitigation potential, if conserved and managed effectively. It is believed that coastal and marine ecosystems complement the role of terrestrial forests (Green Carbon) in taking up carbon emissions through sequestration.

This issue of **Coast track** provides an insight into the basic concepts and the role of mangroves in the global blue carbon initiative. It also highlights the various carbon footprints that could be followed on a daily basis to mitigate carbon emissions.

Editor

BLUE CARBON

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The oceans are the reason why earth is called the Blue Planet. The prefix blue is now used in two other important terms as well – in discussions about water footprint and carbon. While Blue Water Footprint refers to the volume of freshwater that evaporated from the global blue water resources (surface water and ground water) to produce the goods and services consumed by the individual or community, Blue Carbon refers to the carbon that is captured by living organisms in the ocean. It is a subset of the biological carbon (or green carbon) captured in the world. Blue carbon forms more than 55% of the green carbon.

COLOURS OF CARBON

Can carbon have colours? Yes, in modern day parlance. It all begins with carbon sequestration - The uptake of CO_2 into a reservoir over long (several decades or centuries) time scales, whether natural or artificial. Right now, carbon is described in four colours:

GREEN: carbon taken up and stored in vegetation
BLACK: Soot and particles formed by incomplete combustion
BROWN: Greenhouse gases such as carbon dioxide
BLUE: carbon stored in the ocean

Why has the term become so important today? It is mainly in response to the problem of black carbon and climate change. Black and brown carbon are formed through the incomplete combustion of fossil fuels, biofuel and biomass. Thus, they are important climate forcing agents. On the other hand, blue and green carbon are sequestered carbon – which means that they have the ability to reduce the quantities of black and blue carbon in the atmosphere. With climate change becoming high on the list of priority concerns, these two carbon pools are becoming important in the agenda for action to combat climate change.

In this article, we take a closer look at blue carbon, but to understand its importance, one needs to look at the carbon cycle.

The Carbon Cycle:

Carbon, 15^{th} most abundant element in the Earth's crust, fourth most abundant element in the universe by mass, is present in all known lifeforms. This abundance, together with the unique diversity of organic compounds and their unusual polymer-forming ability at the temperatures commonly encountered on Earth, make this element the chemical basis of all known life. Carbon cycles between the biosphere, lithosphere, pedosphere, atmosphere and hydrosphere. It is now usually thought of as including the following major reservoirs of carbon interconnected by pathways of exchange[1]:

- The atmosphere
- The terrestrial biosphere, which is usually defined to include fresh water systems and non-living organic material, such as soil carbon
- The oceans, including dissolved inorganic carbon and living and non-living marine biota
- The sediments including fossil fuels

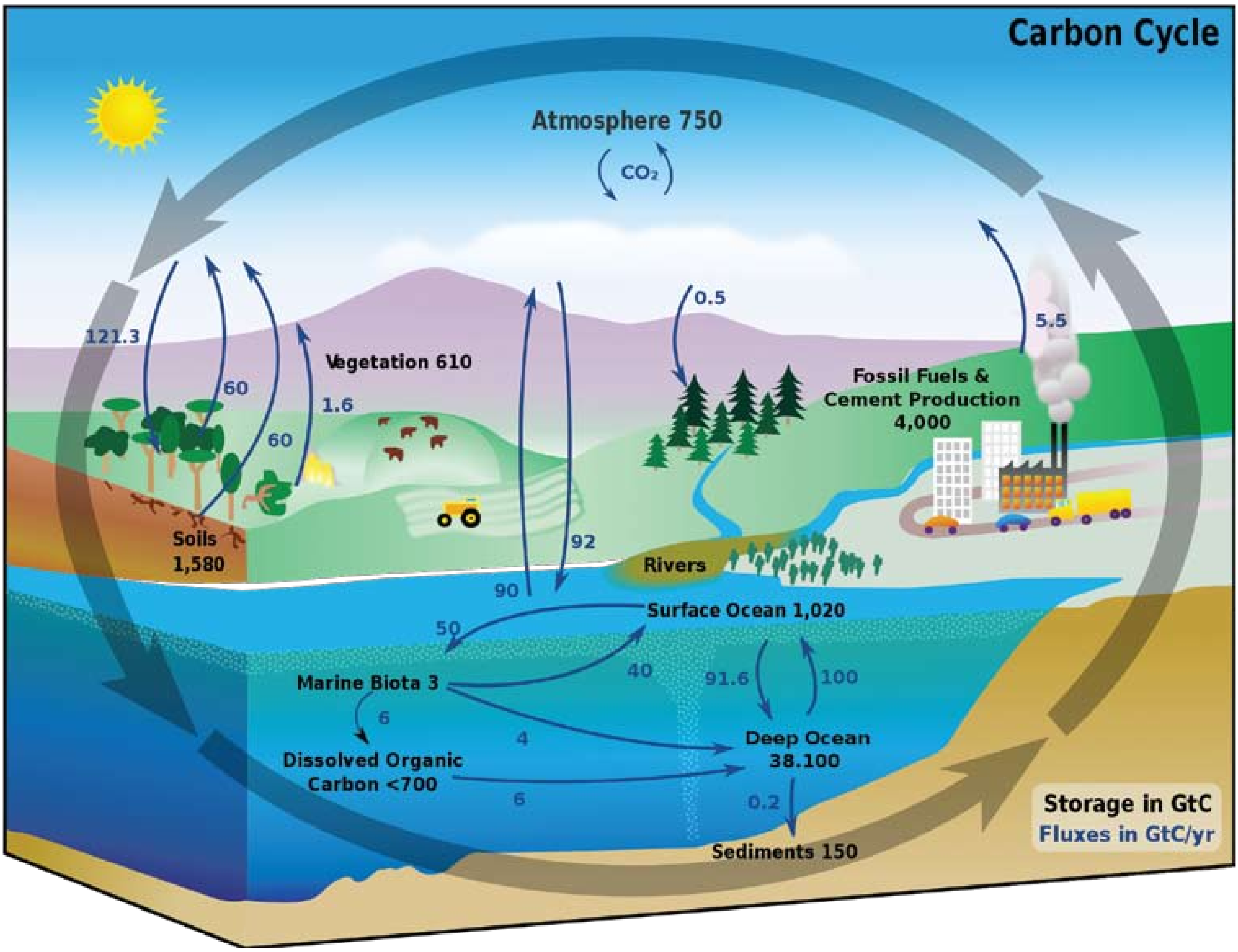
[1] Carbon-cycle: http://en.wikipedia.org/wiki/Carbon_cycle

- The Earth's interior, carbon from the Earth's mantle and crust is released to the atmosphere and hydrosphere by volcanoes and geothermal systems.

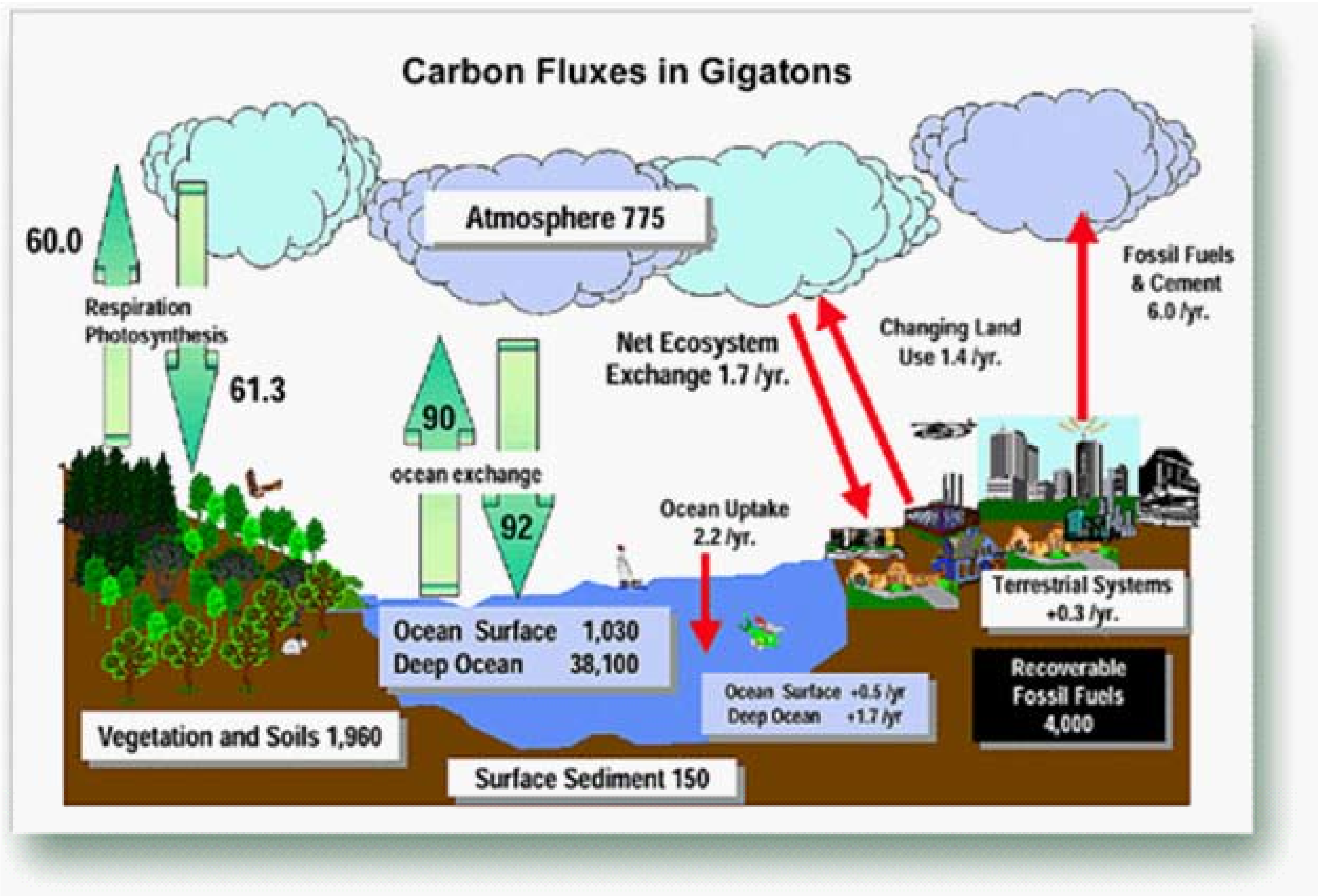
Today's focus is on trying to understand ways in which carbon can be removed from the atmospheric pool and hence the focus has been on trying to understand the importance vegetation can play in the carbon cycle. Figure given below provides an idea of the carbon fluxes on the earth. As can be seen, the pool size of vegetation and soil is about 1960 giga tonnes.

Green Carbon

The basic process by which plants absorb carbon is photosynthesis where plants fix CO_2 from the atmosphere in the presence of sunlight. This carbon is used to build stems, roots and leaves. Plants, like all living beings, respire releasing carbon dioxide but the net effect is one of uptake and removal from the atmospheric pool. Many plants, especially crops, have relatively short lives and release the carbon that they have sequestered back into the atmospheric pool. Forests, on the other hand, accumulate carbon over decades and centuries. It is only when forests are disturbed (e.g. when trees are cut down and there is large scale deforestation), that net effect is an addition of CO_2 into the atmospheric pool. However, because of the bidirectional exchange process, it has been difficult to quantify the exact amount of carbon sequestered by vegetation. While tropical forests are considered to be important in the carbon sequestration process, exact details are difficult to obtain. The tropical forests of India and its vulnerable carbon stocks have been inadequately studied[3] and it is only now that some systematic attempts are being made to obtain such estimates.



Source: http://earthobservatory.nasa.gov/Features/CarbonCycle/carbon_cycle4.php



Source: The National Energy Technology Laboratory (NETL)[2]

Blue Carbon

Blue carbon can be visualized as a subset of green carbon. The ocean's vegetated habitats, in particular mangroves, salt marshes and seagrasses, cover <0.5% of the sea bed. What is of importance here is that carbon captured by living organisms in the oceans is stored in the form of sediments from mangroves, seagrasses and saltmarshes. These form earth's blue carbon sinks and account for more than 50%, perhaps as much as 71%, of all carbon storage in ocean sediments. They comprise only 0.05% of the plant biomass on land, but store a comparable amount of carbon per year, and also store it for thousands of years and thus rank among the most intense carbon sinks on the planet[5].

Carbon Sequestration

Carbon sequestration in the terrestrial ecosystems can be defined as the net removal of CO_2 *from the atmosphere into long-lived pools of carbon. The pools can be living, above ground biomass (e.g. trees), wood products with a long useful life created from biomass (e.g. lumber), living biomass in soils (e.g. roots and microorganisms), or recalcitrant organic and inorganic carbon in soils and deeper subsurface environments. It is important to emphasize that increasing photosynthetic carbon fixation is not enough. This carbon must be fixed into long-lived pools. Otherwise, one may be simply altering the size of fluxes in the carbon cycle, not increasing carbon fixation.*

R.C. Dahlman and G.K. Jacobs[4]

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2 http://www.netl.doe.gov/technologies/carbon_seq/overview/what_is_CO2.html

3 Ningthoujam, R.K. 2010. Monitoring the Indian tropical carbon flux – need for a holistic approach. Current Science 99(3): 276-277

4 Dahlman, R.C and G.K. Jacobs. Recent challenges for Carbon Sequestration in Terrestrial Ecosystems. http://www.anl.gov/PCS/acsfuel/preprint%20archive/Files/45_4_WASHINGTON%20DC_08-00_0718.pdf

5 Nellemann, C., Corcoran, E., Duarte, C. M., Valdés, L., De Young, C., Fonseca, L., Grimsditch, G. (Eds). 2009. Blue Carbon. A Rapid Response Assessment. United Nations Environment Programme, GRID-Arendal, www.grida.no

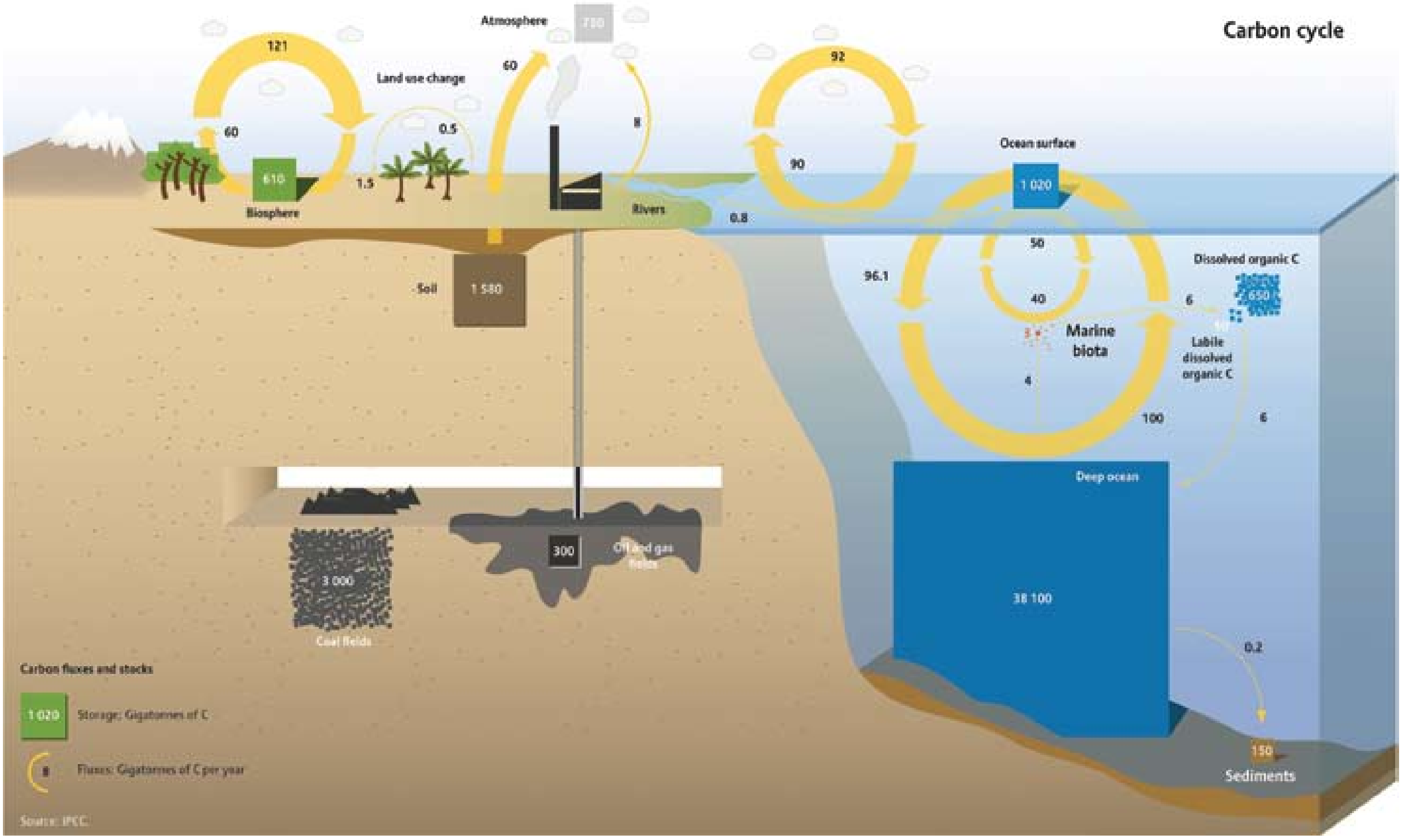
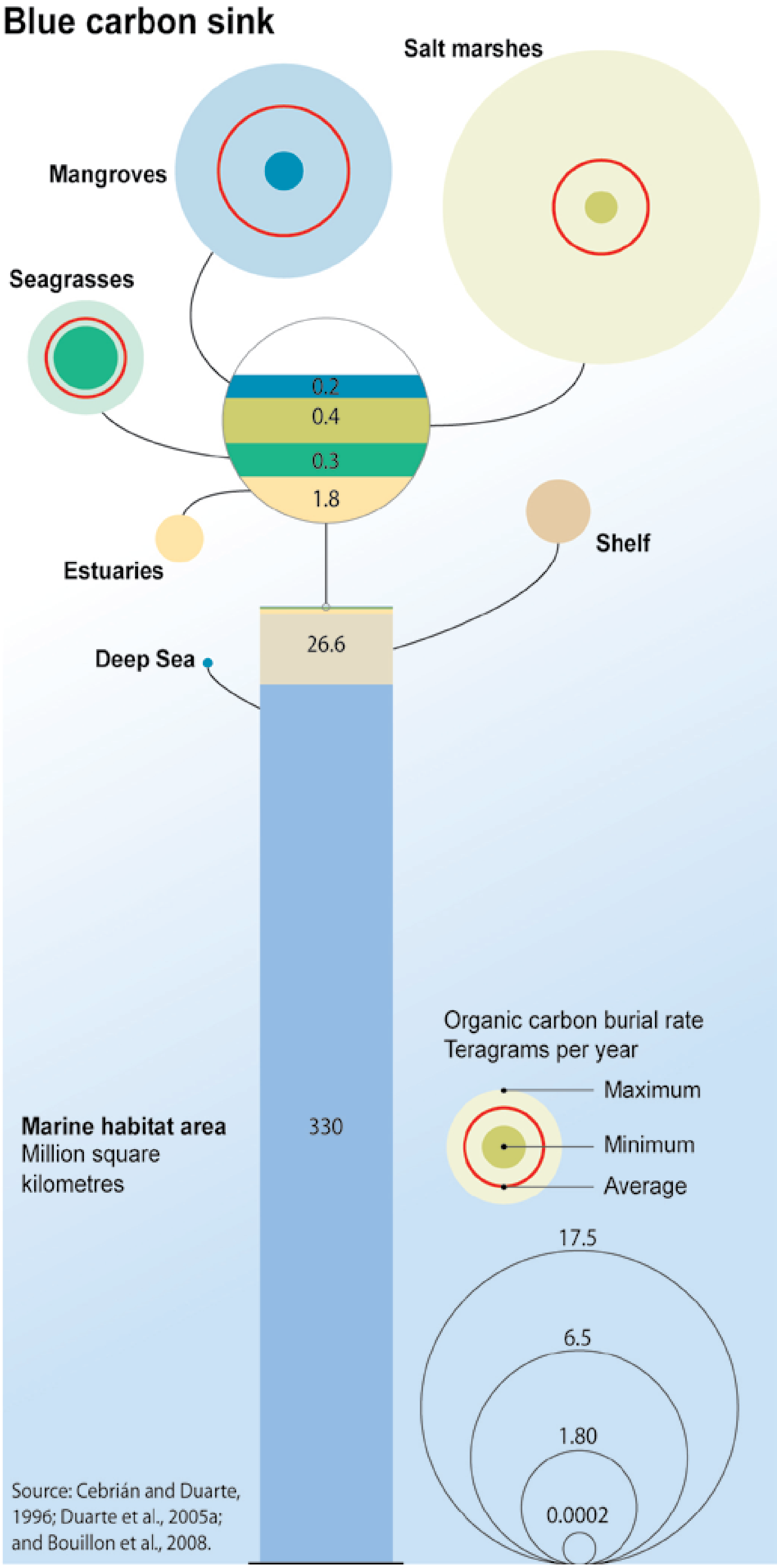


FIGURE: Carbon Cycle[6]. Blue and green carbon process. Oceans are crucial in the global carbon cycle. It was here where life first evolved; they are the source of our wealth and development. The living oceans capture over half of all the Green carbon – the carbon bound by living organisms through photosynthesis. Graphic: *Riccardo Pravettoni, UNEP/GRID-Arendal*

The large carbon sequestration capacity of coastal habitats arises in part from the extensive below-ground biomass of the dominant vegetation. Thus, much of the primary production is belowground, generating extensive carbon deposits in the sediment[7] that can be as deep as 8m. Mangroves are one of the most productive ecosystems - the standing stock of carbon in above-ground mangrove biomass is estimated to be 7990 gC per m^2. However, in all these habitats the percentage of buried carbon strongly depends on environmental conditions. The table below provides summary data on the comparison of carbon stocks and long-term accumulation of carbon in coastal marine ecosystems at the global level.

Ecosystem type	Standing carbon stock (gC per m^2)	Total global area (*1012 m^2)	Global carbon stocks (PgC)[8]	Longterm rate of carbon accumulation in sediment (gC per m^2 per year)		
	Plants	Soil		Plants	Soil	
Tidal Salt Marshes			Unknown (0.22 reported)			210
Mangroves	7990		0.157	1.2		139
Seagrass meadows	184	7000	0.3	0.06	2.1	83
Kelp Forests	120-720	na	0.02-0.4	0.009-0.02	na	na

[6] UNEP/GRID-Arendal, Carbon Cycle, UNEP/GRID-Arendal Maps and Graphics Library, http://maps.grida.no/go/graphic/carbon-cycle1 (Accessed 6 April 2011)
[7] Chmura et al. 2003 - Global carbon sequestration in tidal, saline wetland soils
[8] PgC. - One petagram=one billion metric tons



As mentioned earlier, the blue carbon sinks in the ocean are distributed among the various forms of vegetation. An estimate of their distribution is provided in the graphic

Blue Carbon Sinks[9]: The carbon captured by living organisms in oceans is stored in the form of sediments from mangroves, salt marshes and seagrasses. Benefiting from the excellent conditions available to support plant growth, vegetated coastal habitats rank amongst the most productive habitats in the world, comparable in production to the most productive agricultural crops. Blue carbon sinks are strongly autotrophic, which means that these ecosystems fix CO_2 as organic matter photosyntheticaly in excess of the CO_2 respired back by biota, thus removing CO_2 from the atmosphere. Some of this excess carbon is exported and subsidises adjacent ecosystems, including open ocean and beach ecosystems. The remaining excess production of mangrove forests, salt-marshes and seagrass meadows is buried in the sediments, where it can remain stored over millenary time scales, thereby representing a strong natural carbon sink.

Graphic: Riccardo Pravettoni, UNEP/GRID-Arendal

[9]UNEP/GRID-Arendal, Blue Carbon Sinks, UNEP/GRID-Arendal Maps and Graphics Library, http://maps.grida.no/go/graphic/blue-carbon-sinks

Role of Mangroves in Blue Carbon story

When one thinks of coastal vegetation, it is mangroves that come first to our mind. Other coastal vegetation are tidal salt marshes, seagrass beds, kelp forests and coral reefs. All these littoral vegetation types are known to fix carbon extensively.

In India, the major seagrass meadows exist along the southeast coast (Gulf of Mannar and Palk Bay) and in the lagoons of islands from Lakshadweep in the Arabian Sea to Andaman and Nicobar in the Bay of Bengal. Andaman and Nicobar, Lakshadweep, Gulf of Mannar (Tamil Nadu), Gulf of Kachchh (Gujarat) are well known for their coral reefs, each are being unique and distinct in their diversity The Rann of Kachchh is a salt marsh but has been poorly studied. Mangroves exist along both east and west coasts and in this paper, the focus is on mangroves and their role in the blue carbon story.

Mangroves

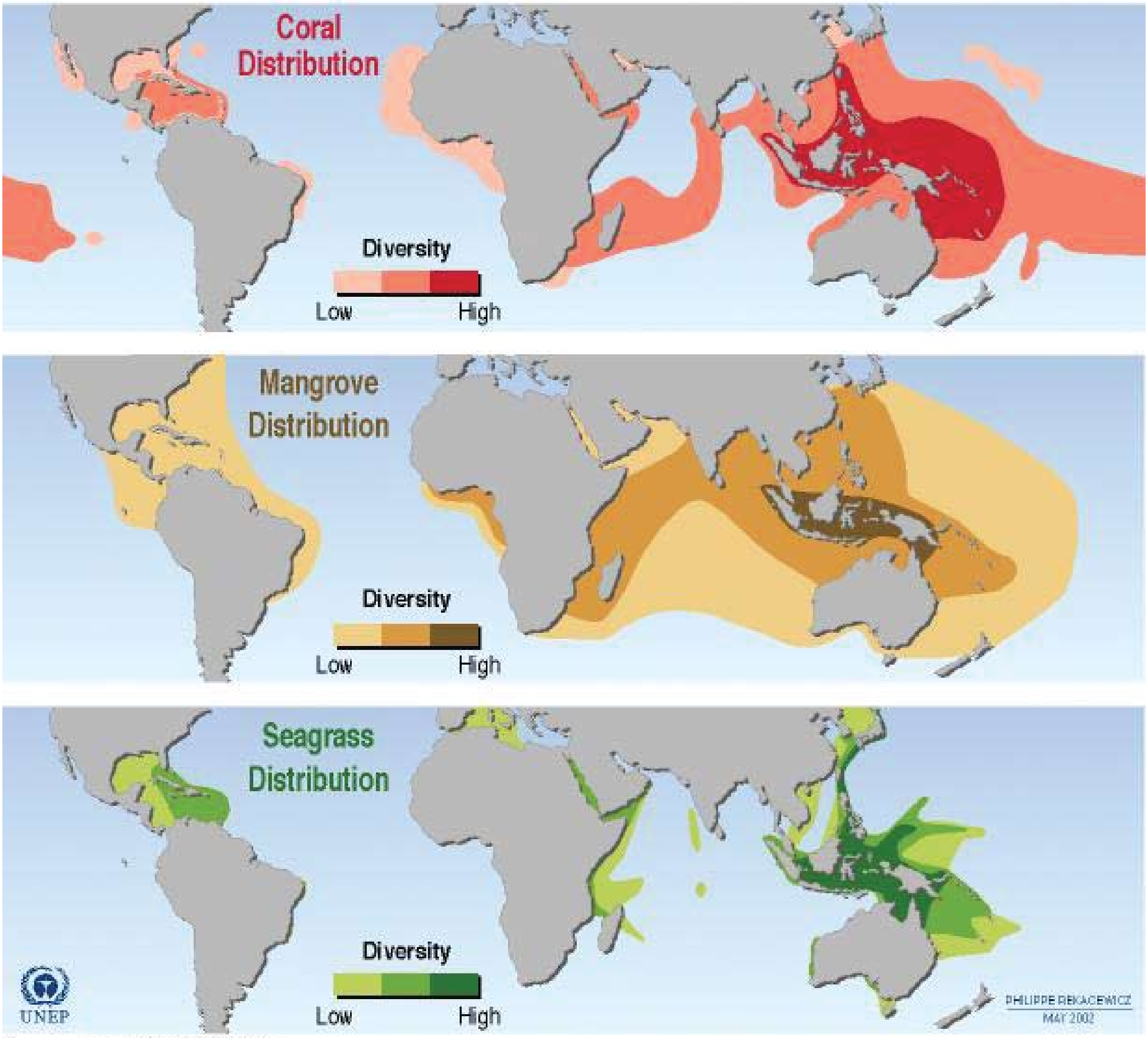
Mangroves live where no other trees can survive – in that area between land and sea that is flooded by tides for part of the time. Because mangroves are found in this transition zone – where the tide rises and falls daily, where salinity changes with this rise and fall of the tide and where the content of oxygen in the soil is low – both the flora and fauna of this ecosystem have developed very distinct adaptations.

Globally, mangroves cover an area of about 160,000 km^2. Once upon a time, they are believed to have occupied three quarters of tropical coastlines but their spread has declined steeply because of anthropogenic stresses ranging from reclamation for aquaculture and salt pond construction, ports & harbours, industries and settlements, over-harvesting for timber and fuel-wood production, mining, oil spills, and damming of rivers that alter salinity levels .

Mangroves refer to both a particular kind of vegetation and the ecosystem. Mangroves are salt tolerant trees and other plant species from a range of families. Estimates indicate 16-24 families and 54-75 species worldwide with greatest diversity in south-east Asia. The largest remaining single block is the Sundarbans which straddle India and Bangladesh. The special adaptations mangroves - of aerial and salt filtering roots, buttress roots, salt filtering leaves and vivipary - allow them to survive in particularly hostile conditions of changing water levels, salinities and unstable soil.

Mangroves are best known for the shelter they provide for young fish. They serve as breeding grounds for shrimp and provide timber and other produce used by local villagers. Their ability to buffer wave impact on shorelines has been known for long. In fact the Tamil name for mangrove is ‘alaiathi’, that which cushions wave impact. Mangroves were in the headlines after

Global Distribution of Coral, Mangrove and Seagrass Diversity



Source : UNEP-WCMC, 2001.

Source: UNEP/GRID-Arendal

the 1999 Orissa Supercyclone when it was shown that habitations sheltered by mangroves were less affected. A similar effect was observed after the tsunami in 2004 that devastated large swathes of the shoreline especially in the Andaman and Nicobar Islands and Tamil Nadu on the mainland in India. It is therefore not surprising that growing mangroves as bioshields has become a top priority for many nations to protect coastlines.

In India, mangroves are classified under 'ecologically sensitive ecosystems' and come under CRZ-I in the 2011 CRZ Notification and in fact, in case mangrove area is more than 1000 sq m, a buffer of 50 meters along the mangroves are to be provided. Thus mangroves provide a variety of provisioning services and supporting services which are fairly well documented. Their contribution to carbon sequestration is increasingly being appreciated as well.

Mangroves and C sequestration

Like all other green plants, mangroves take up carbon (as CO_2) from the atmosphere and "fix" it into sugars and other organic compounds during the process of photosynthesis. Carbon fixation or 'carbon sequestration' as it is often known includes different pools:

- Above ground: primary production of leaves, stems and wood
- Below ground: primary production of coarse and fine roots

Over time, dead leaf litter and woody debris fall to the forest floor where they are consumed by local fauna, remineralized into the atmosphere, exported to adjacent coastal environments or buried in mangrove sediment.

Mangroves are considered among the most productive of ecosystems. Using a global area of mangroves of 160,000 km², the net primary production was recently estimated at 218 ± 72 Tg C yr-1 (Bouillon et al. 2008), with root production responsible for ~38% of this productivity, and litter fall and wood production both ~31%.

Carbon sequestration by Mangroves

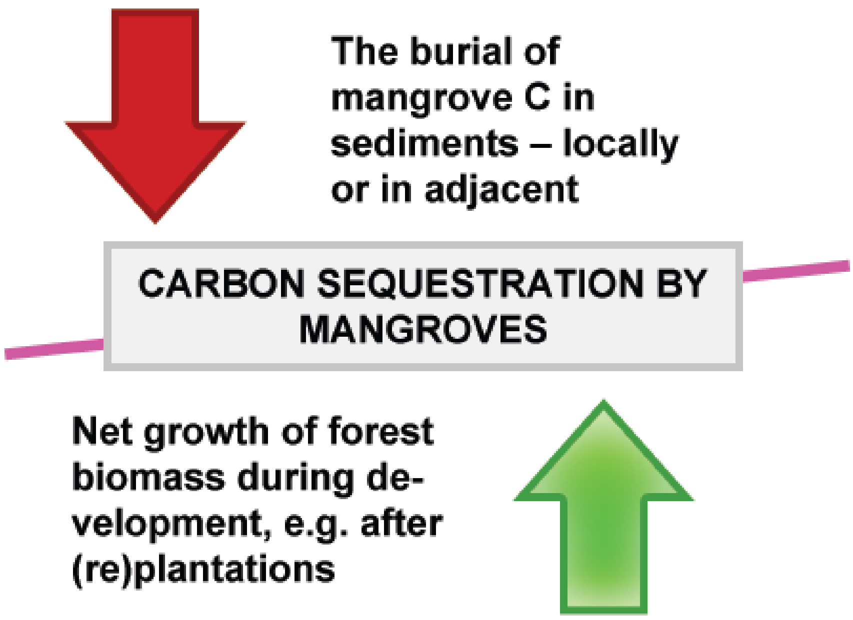
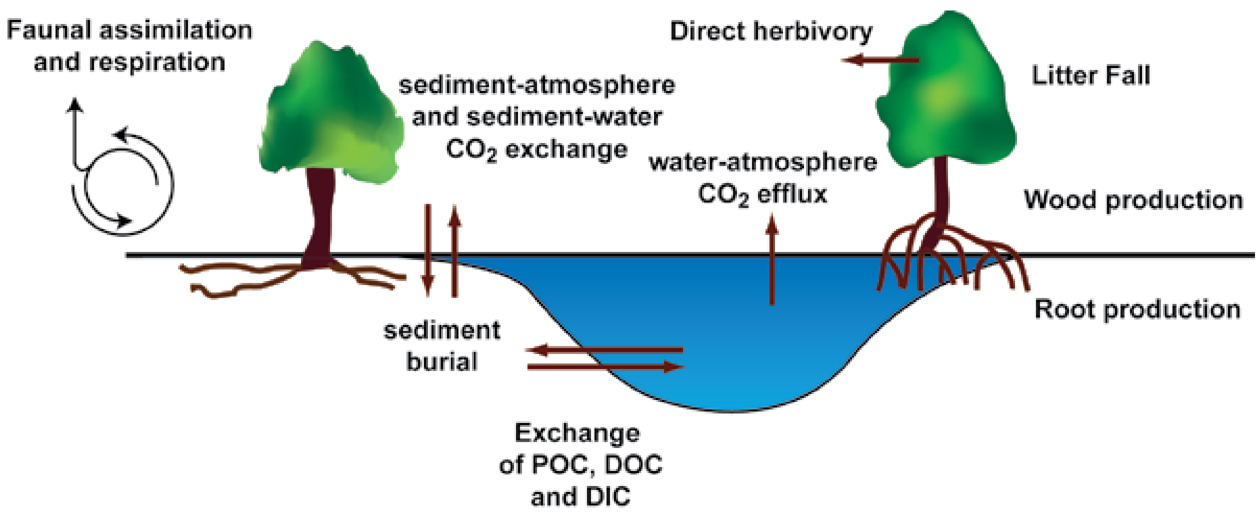
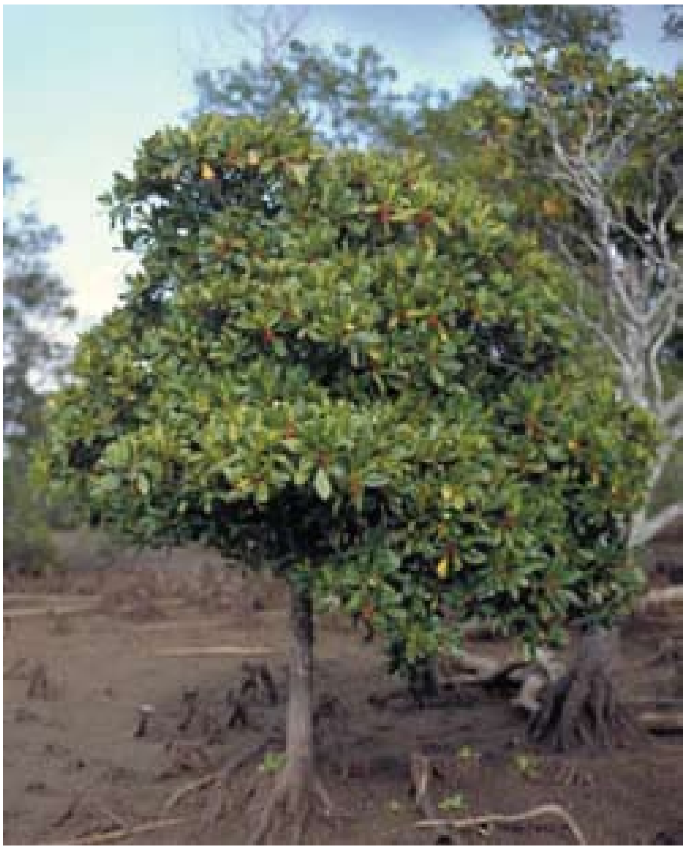


Diagram of Carbon Cycling and Storage in Mangrove Ecosystem



Their huge buttress roots have the ability to filter out the silt so that the water that flows through the mangroves and reaches the ocean is less turbid. The importance of mangroves in the blue carbon story is because of the fact that they pile most of their carbon on the ocean floor unlike terrestrial forests which keep most of it in trees and branches; in fact up to five times that stored in tropical forests.



Not only this, the silt that they accumulate actually raises the ground level. This means that as the sea level rises, the ground level also rises. As pointed out by Prof. Gail Chmura, "As the levels of both the ocean surface and the mangroves soil rise, so too does the amount of carbon sequestered in the earth – and it can stay there for millennia" . This also means that if mangroves are destroyed, substantial amounts of carbon can be released back into the atmosphere. For example, it is estimated that over the last 100 years, 1,800 square kilometers of wetlands were drained in California's Sacramento–San Joaquin River Delta in the US, emitting two gigatons of CO_2 that had been accruing in the plants and soils for thousands of years. Between 10 million and 15 million tons of CO_2 continues to be released from the Sacramento Delta each year, an amount equivalent to around 3 percent of California's total greenhouse gas emissions .

Mangroves in India

India has 3% of the global mangroves and 5% of Asian mangroves but the role of mangroves in carbon budget is not understood due to dearth of data. India has 4445 km^2 of mangroves and the annual organic carbon burial is estimated at = 0.617855 Tg C. 1698 km^2 of salt marsh vegetation exist along the Indian coast and their annual carbon burial rate is estimated at 0.256398 Tg C. Seagrasses cover 1391 km^2 and contribute to the burial of 0.115453 Tg C annually. In a presentation made at the International Workshop on Deltas in 2009, Prof Kathiresan of Annamalai University explained that examination of soil carbon in relation to depth in Vellar estuary (Cauvery delta, Tamil Nadu, India) indicated that burial rates were much higher in the case of luxuriant mangroves. The carbon stock in the sediment was found to increase with age as shown in field studies in artificially developed mangrove ecosystems. As the total carbon in the soil increases, the number and biodiversity of cyanobacterial species also increases. There is need to know about the role of insects which feed extensively on mangrove leaves, the role of natural and anthropogenic stress factors as well as the role of climate change on carbon burial. A clear difference in the particulate organic carbon in the water regime may be seen in Rhizophora lined creek, Avicennia lined creek and open waters. Avicennia lined areas had higher organic C content compared with Rhizophora lined waters, which in turn had some twenty times as much organic C compared with open water areas. Diel and seasonal variations can also be observed.

It must be pointed out that more data based on large numbers of samples throughout coastal India are warranted. These include data on tidal export of DIC and CO_2 efflux from sediment and waters.

Carbon credits from mangroves

In February 2011, an international effort to protect coastal wetlands by assigning them carbon credits was launched in Paris. The aim is to do for some wetland plants — mangroves, seagrasses and salt marshes –

An estimate of the Carbon budget in mangrove forest ecosystems of India is given in Table 1[6] below:

Component	Net Primary Production (%l)	Component	Fate of mangrove production %
Litter fall	31.2	Burial in sediment	8.7
Wood	31.2	CO_2 efflux	19.3
Root	37.6	POC export	9.7
		DOC export	11.0
		Mineralization of carbon (DIC)	51.3
Total	100	Total	100

Annual net primary production of mangroves in India is 6.05604 trillion grams carbon.
Indian mangroves contribute to 2.8% of global mangrove primary production of 218 trillion grams of carbon

what carbon credits have done for trees. The 'blue carbon' concept aims to protect some of the most endangered wetlands by assigning credits to their stored carbon which then can be traded on a carbon market, according to Emily Pidgeon, director of the marine climate change programme at Conservation International . The International Working Group on Coastal "Blue" Carbon was formed in February 2011 to address the global significance of climate change mitigation through the sequestration of carbon by coastal ecosystems – specifically mangroves, tidal marshes and seagrasses. The working group reviews current scientific knowledge of coastal carbon, develops guidelines for maximizing storage and sequestration of coastal carbon and provides recommendations for quantifying and monitoring carbon, and emissions thereof, in coastal systems. The working group is convened by Conservation International, International Union for Conservation of Nature (IUCN), and the Intergovernmental Oceanographic Commission and consists of 22 scientists from around the world. Funding for the group has been provided by the Waterloo Foundation, National Aeronautics and Space Administration (NASA) and the United Nations Environment Programme (UNEP) .

Conclusion

Combating climate change requires action on many fronts of which one of the most important seen today is reduction in the CO_2 levels in the atmosphere. Natural sequestration of carbon is carried out by green plants of which the littoral vegetation have been found to contribute an important share. Littoral vegetation such as mangroves not only help in the carbon sequestration but also in protecting shorelines from impacts due to other effects of climate change such as increasing storm surges and sea level rise.

It is a matter of concern that mangrove vegetation worldwide is on the decline, under threat from a variety of anthropogenic causes. It is therefore imperative that the total area under coastal vegetation is increased so that multiple benefits are obtained.

References

[1] UNEP/GRID-Arendal, Distribution of coral, mangrove and seagrass diversity, UNEP/GRID-Arendal Maps and Graphics Library,http://maps.grida.no/go/graphic/distribution-of-coral-mangrove-and-seagrass-diversity

[2] Bouillon, Steve, Victor H. Rivera Monroy, R.R. Twilley and James G. Kairo, "Mangroves". Laffoley, D.d'A. & Grimsditch, G. (eds). 2009. The management of natural coastal carbon sinks. IUCN, Gland, Switzerland. 53 pp

[3] Quoted in Bouillon et al., 2009

[4] Zwick, Steve. Cancun: The Allure – and Elusiveness – of Mangroves as Carbon Sinks. 30 Nov 2010. http://www.ecosystemmarketplace.com/pages/dynamic/article.page.php?page_id=7441&section=home

[5] Boyd, Robynne. 2011. Opportunity to Fight Climate Change. Scientific American, March 10, 2011. http://www.scientificamerican.com/article.cfm?id=blue-carbon

[6] Kathiresan, K, Carbon Cycling in Mangrove Ecosystems. From the presentation made at the Workshop on Deltas: Coastal Vulnerability and Management , IOM-AU, Chennai, December 2009.

[7] Vaidyanathan, G., 2011. "Blue Carbon" Plan takes shape. Nature – News. Published online 21 February 2011, Nature, | doi:10.1038/news.2011.112

[8] Minimizing carbon emissions and maximizing carbon sequestration and storage by seagrasses, tidal marshes and mangroves. Recommendations from the International Working Group on Coastal Blue Carbon. http://www.marineclimatechange.com/marineclimatechange/bluecarbon_recommendations_files/bluecarbon_recommendations_3.28.11.FINAL.HIGH.pdf

CARBON FOOTPRINT

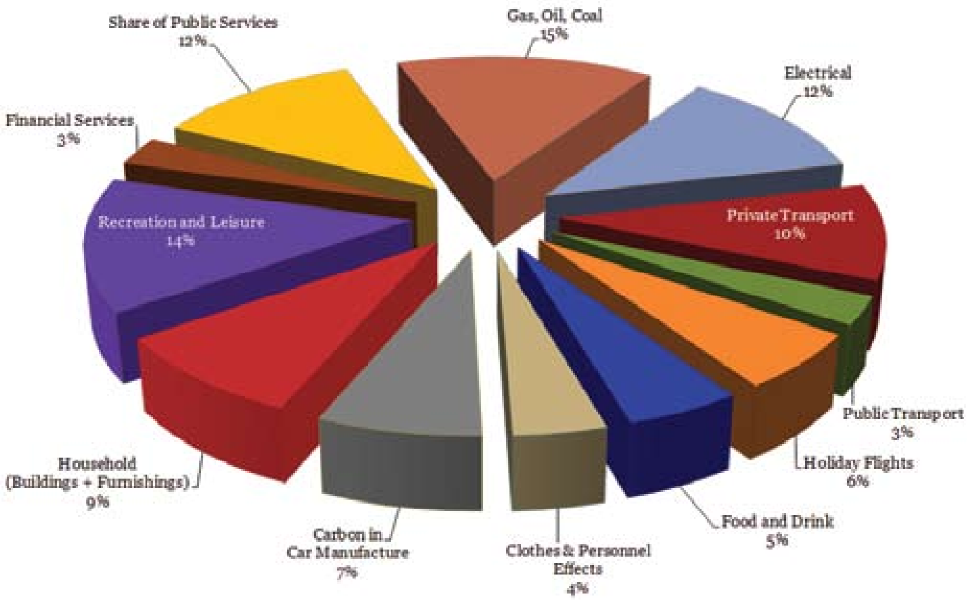
A carbon footprint is a measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc.

The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.

Carbon dioxide is a so called greenhouse gas causing global warming . Other greenhouse gases which might be emitted as a result of your activities are e.g. methane and ozone. These greenhouse gases are normally also taken into account for the carbon footprint. They are converted into the amount of CO_2 that would cause the same effects on global warming (this is called equivalent CO_2 amount).

Few people express their carbon footprint in kg carbon rather than kg carbon dioxide. You can always convert kg carbon dioxide in kg carbon by multiplying with a factor 0.27 (1’000 kg CO_2 equals 270 kg carbon).

The carbon footprint is a very powerful tool to understand the impact of personal behaviour on global warming.



The pie chart above shows the main elements which make up the total of an typical person’s carbon footprint in the developed world. Source: http://www.carbonfootprint.com/carbonfootprint.html

Leaving Tracks: The Carbon Footprint

FACT: Global Warming Is Destroying Our World!

- Carbon footprint is a measure of the impact of our activities on the environment, and in particular on climate change.
- It relates to the amount of greenhouse gases we are producing in our day-to-day lives through burning fossil fuels for electricity, heating, transportation etc.

Using coal, natural gas, or oil for electricity, heat or transportation releases carbon dioxide (CO_2) into the atmosphere. These daily carbon dioxide emissions make up your **CARBON FOOTPRINT**

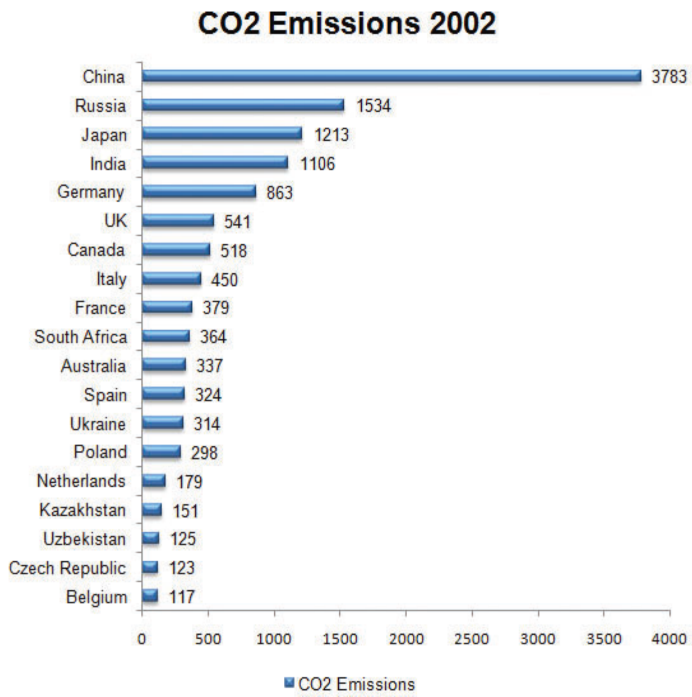
PRIMARY FOOTPRINT is a measure of our direct emissions of CO_2
- burning of fossil fuels
- domestic energy consumption& transportation (e.g. car and plane).

SECONDARY FOOTPRINT is a measure of the indirect CO_2 emissions from the whole life cycle of products we use - those associated with their manufacture and eventual breakdown.

Our decisions on the following add up to our secondary footprint.

1. We eat vegetarian food - or non vegetarian food.
2. We buy / grow organic food - or not.
3. We use mostly seasonal food - or not.
4. We buy local food and goods - or not.
5. We think of packaging while buying things - or not.
6. We buy new furniture and appliances - or second hand
7. The things we use get recycled or composted - or not.
8. We try to avoid burning of fuel on transportation - or not.
9. We try to use common vehicles for travel - or not.
10. We bring a bag when we go shopping - or require a plastic bag from each shop

The following graph shows the total CO_2 emission in million tons by country for the year 2002
Data source: World Resources Institute (WRI)



S.No	Particulars	Consumption amount	Amount of CO_2 release to the atmosphere
1	Use of Electricity	1 KWhr	10 kg
2	Heating oil	5 litres	13 kg
3	LPG	2 litres	3 kg
4	Burning of wood	250 kg	33kg
5	Travelling by car	1000 km	200 kg
6	Using Motorbike- up to 125 cc	1000km	84kg
7	Using Motorbike- 125 to 500 cc	1000 km	108kg
8	Travelling by bus by 1 person	1000km	1075kg
9	Travelling by train by 1 person	1000 km	60kg

Our ‘carbon footprint’ is a measurement of all greenhouse gases we individually produce. It is measured in units of tonnes (or kg) of carbon dioxide equivalent

Why Care?

- Too much CO_2 from our daily activities hurts the planet’s climate
- Measuring carbon emissions can be tricky

Make sure to turn off or fix dripping taps and save about
20 kg CO_2 per year

Turn off the tap while brushing your teeth and save about
3 kg CO_2 per year

Make sure to use the washing machine only when it’s full and save about
45 kg CO_2 per year

When buying bottled water or soda, buy 1.5 l bottles instead of the equivalent amount in 0.5 l bottles and save about
9 kg CO_2 per year.

Switch off your air conditioner every day for four hours when you’re not in the house in summertime and save about
300 kg CO_2 per year

Use a reusable bag each time you go shopping and save about
8 kg CO_2 per year

Before you print a document or e-mail consider whether you really need to do it and save about
7 kg CO_2 per year

Turn off five 60 W lights in hallways and rooms of your house when you don’t need them and save about
270 kg CO_2 per year

Dry clothes naturally instead of using a tumble dryer and save about **280 kg CO_2 per year**

Here's a list of simple things you can do immediately to reduce your contribution to global warming. The items in this list will cost you no money at all and will in fact save you money.

- Turn it off when not in use – lights, television, DVD player, Hi-Fi, computer etc.
- Unplug your mobile phone when it has finished charging and all appliances when not in use
- Fill the kettle with only as much water as you need
- Take a direct flight
- Defrost your fridge/freezer regularly
- Purchase and Pay bills online
- Make time for errands
- Do your weekly shopping in a single trip
- Go for a run rather than drive to the gym
- Use cold water for dish and clothes washing
- Don't buy over packaged products
- Buy organic and local fruit and vegetables, or try growing your own
- Avoid frozen fruit and vegetables which are out of season, they may have been flown in
- Reduce consumption of meat
- Reduce, Reuse, Recycle

CLIMATE CHANGE POLICY: DIMINISHING CARBON FOOTPRINTS

Nearly a third of the world's energy consumption and 36% of carbon dioxide (CO_2) emissions are attributable to manufacturing industries.

What industries can do to reduce CO_2 emission

- Greener methods of power generation
- Biofuel instead of fossil fuel
- Carbon Capture and Storage Technology
- Replacing out dated power-hungry computers
- with new 'greener' desktops
- Switching off electrical/electronic gadgets overnight
- revaluate their day-to-day practices (printing documents etc.)

KYOTO PROTOCOL

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions .These amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.

The major distinction between the Protocol and the Convention is that while the Convention encouraged industrialised countries to stabilize GHG emissions, the Protocol commits them to do so.

Recognizing that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the Protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities."

The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh in 2001, and are called the "Marrakesh Accords."

OTHER CARBON EMISSION REDUCTION STRATEGIES

CARBON OFFSET

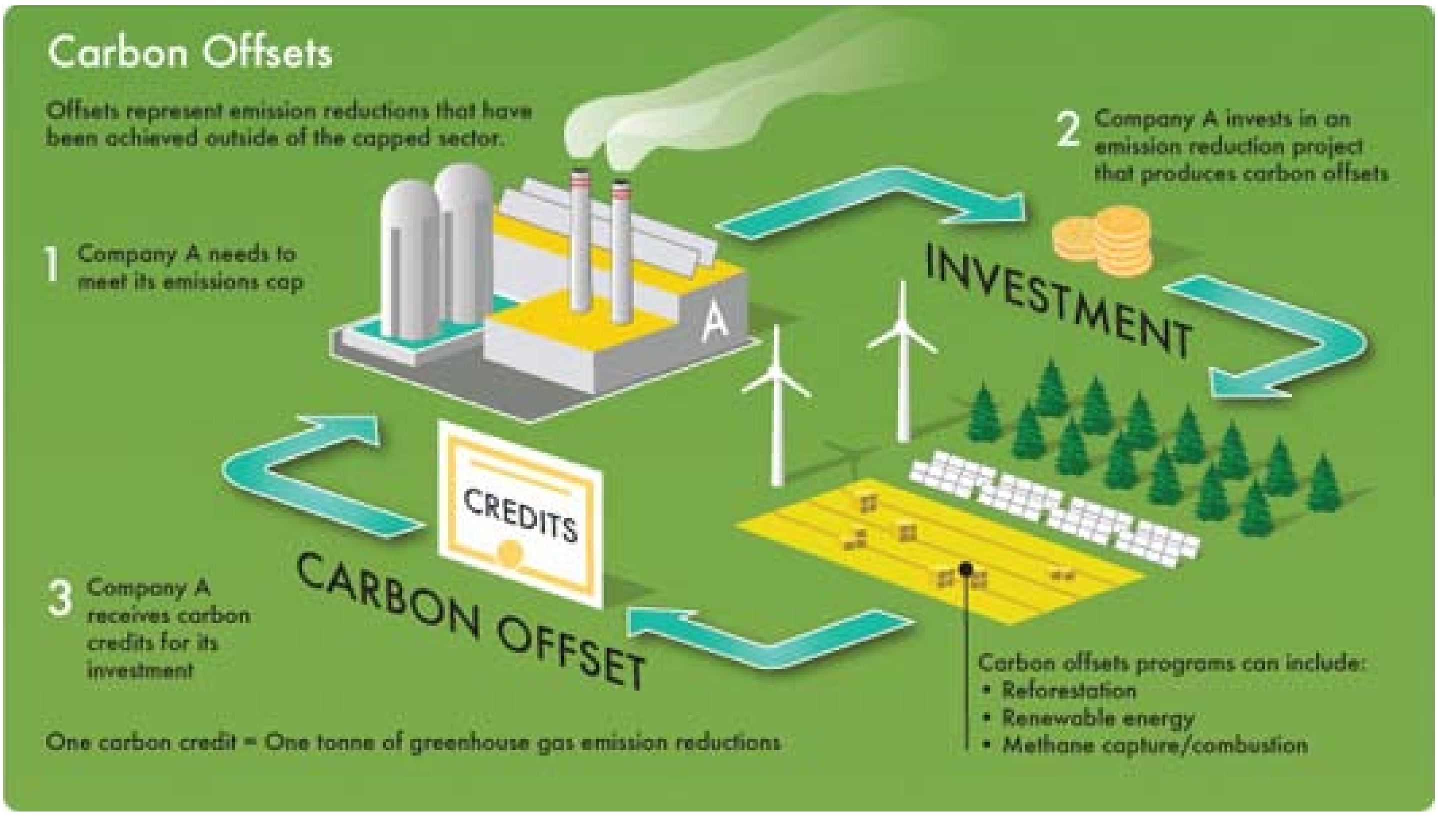
A carbon offset is a reduction in emissions of carbon dioxide or greenhouse gases made in order to compensate for or to offset an emission made elsewhere.

GREEN TAXES

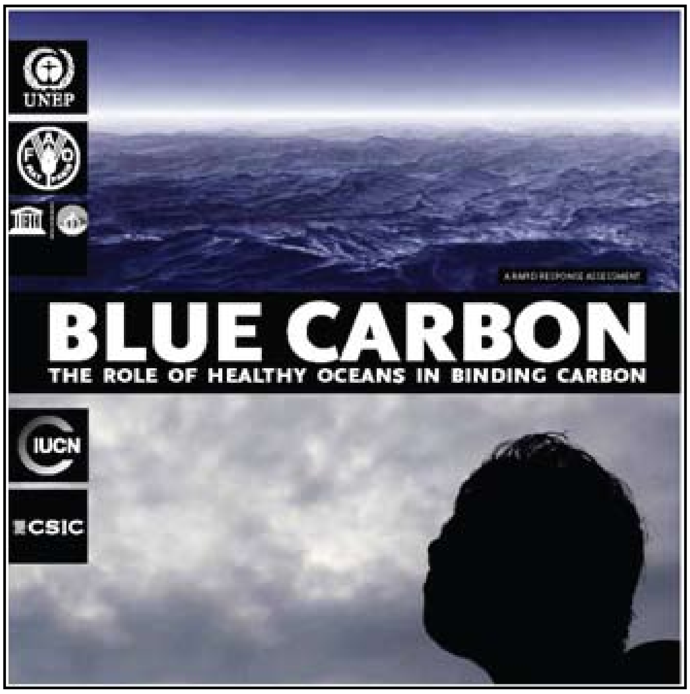
Green taxes (also called "environmental taxes" or "pollution taxes") are excise taxes on environmental pollutants or on goods whose use produces such pollutants. Economic theory suggests that taxes on polluting emissions will reduce environmental harm in the least costly manner, by encouraging changes in behavior by those firms and households that can reduce their pollution at the lowest cost. In practice, green taxes-even indirect ones, on proxies for emissions or on related goods-have rarely been imposed.

CARBON TRADING VERSUS GREEN TAXES

- Green taxes not as efficient as carbon trading
- Money could be invested in finding alternate ways to reduce emissions (carbon offset)



RELEVANT READING



This is a Rapid Assessment Report produced by three United Nations agencies and leading scientists and launched during National Marine Month in South Africa in October 2009. The objective of this report is to highlight the critical role of the oceans and ocean ecosystems in maintaining our climate and in assisting policy makers to mainstream an oceans agenda into national and international climate change initiatives. While emissions' reductions are currently at the centre of the climate change discussions, the critical role of the oceans and ocean ecosystems has been vastly overlooked. http://grida.no/publications/rr/blue-carbon/

Key Findings from the Report

1. Of all the biological carbon, or green carbon captured in the world, over half (55%) is captured by marine-living organisms - not on land - hence the new term blue carbon.
2. Marine-living organisms range from plankton and bacteria to seagrasses, saltmarsh plants and mangrove forests.
3. The ocean's vegetative habitats, in particular, mangroves, salt marshes and seagrasses, cover less than 1% of the seabed.
4. These form the planet's blue carbon sinks and account for over half of all carbon storage in ocean sediment and perhaps as much as over 70%.
5. They comprise only 0.05% of the plant biomass on land, but store a comparable amount of carbon per year, and thus rank among the most intense carbon sinks on the planet.
6. Blue carbon sinks and estuaries capture and store between 235-450 Teragrams (Tg C) or 870 to 1,650 million tons of CO_2 every year - or the equivalent of up to near half of the emissions from the entire global transport sector which is estimated annually at around 1,000 Tg C, or around 3,700 million tons of CO_2, and rising.
7. Preventing the further loss and degradation of these ecosystems and catalyzing their recovery can contribute to offsetting 3-7% of current fossil fuel emissions (totaling 7,200 Tg C a year or around 27,000 million tons) of CO_2 in two decades - over half of that projected for reducing rainforest deforestation.
8. The effect would be equivalent to at least 10% of the reductions needed to keep concentrations of CO_2 in the atmosphere below 450 ppm needed to keep global warming below two degrees Celsius.
9. Combined with action under REDD, halting the degradation and restoring lost marine ecosystems might deliver up to 25% of emission reductions needed to keep global warming below two degrees Celsius.
10. Unlike carbon capture and storage on land, where the carbon may be locked away for decades or centuries, that stored in the oceans remains for millennia.

Currently, on average, between 2-7% of our blue carbon sinks are lost annually, a seven-fold increase compared to only half a century ago.

- In parts of southeast Asia losses of mangroves since the 1940s are as high as 90%.
- Large-scale restoration of mangroves has been successfully achieved in Vietnam's Mekong Delta and salt-marsh restoration in Europe and the United States.

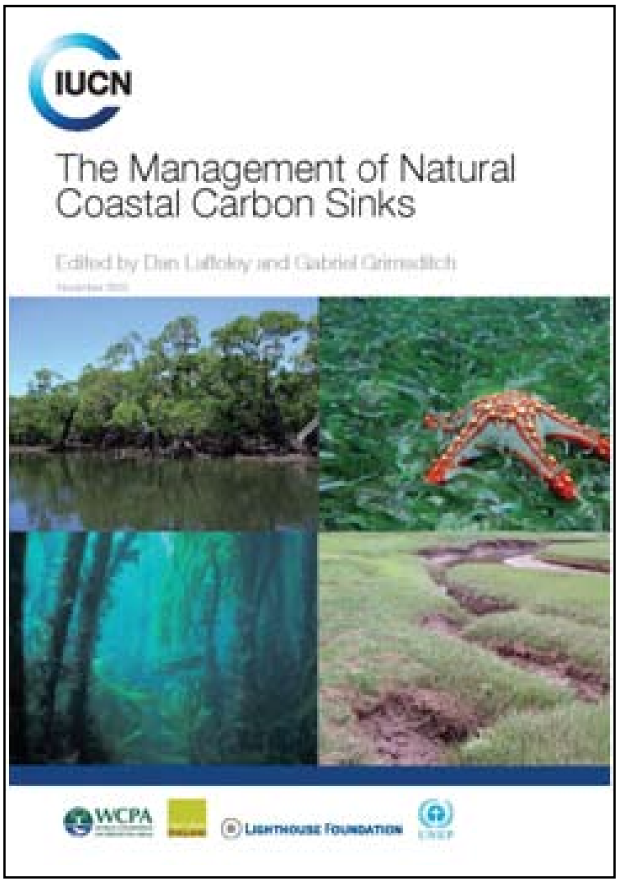
Countries with extensive, shallow coastal areas that could consider enhancing marine carbon sinks include India; many countries in southeast Asia; those on the Black Sea; in West Africa, the Caribbean, the Mediterranean, eastern United States and Russia.

In order to implement a process and manage the necessary funds for the protection, management and restoration of these crucial ocean carbon sinks, the following options are proposed:

1. Establish a global blue carbon fund for protection and management of coastal and marine ecosystems and ocean carbon sequestration.
2. Immediately and urgently protect at least 80%

of remaining seagrass meadows, salt marshes and mangrove forests, through effective management.

3. Initiate management practices that reduce and remove threats, and which support the robust recovery potential inherent in blue carbon sink communities.
4. Maintain food and livelihood security from the oceans by implementing comprehensive and integrated ecosystem approaches aiming to increase the resilience of human and natural systems to change.
5. Implement win-win mitigation strategies in the ocean-based sectors



Laffoley, D.d'A. & Grimsditch, G. (eds). 2009. The management of natural coastal carbon sinks. IUCN, Gland, Switzerland. 53 pp

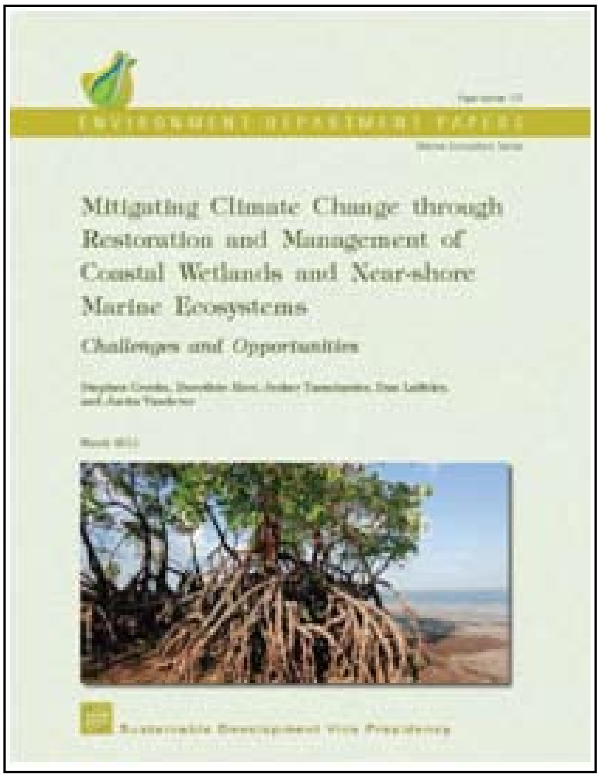
This report focuses on the management of natural coastal carbon sinks. The production of the report has been stimulated by an apparent lack of recognition and focus on coastal marine ecosystems such as tidal saltmarshes, mangroves, seagrass meadows, kelp forests and coral reefs to complement activities already well advanced on land to address the best practice management of carbon sinks.

The key findings of this report are:

- These key marine ecosystems are of high importance because of the significant goods and services they already provide as well as the carbon management potential recognised in this report, thus providing new convergent opportunities to achieve many political goals from few management actions.
- The carbon management potential of these selected marine ecosystems compares favourably with and, in some respects, may exceed the potenti al of carbon sinks on land. Coral reefs, rather than acting as 'carbon sinks' are found to be slight 'carbon sources' due to their effect on local ocean chemistry
- The chemistry of some specific marine sediments (for example salt marshes) suggests that whilst such habitats may be of limited geographical extent, the absolute comparative value of the carbon sequestered per unit area may well outweigh the importance of similar processes on land due to lower potential for the emission of other powerful greenhouse gases such as methane.
- There is a lack of critical data for some habitat types. Having comprehensive habitat inventories is critically important and this report highlights the urgent need, alongside recognising the carbon role of such ecosystems, to ensure that such inventories are completed for saltmarsh and kelp forests and then all such inventories are effectively maintained over time.
- These coastal marine ecosystems are also vital for the food security of coastal communities in developing countries, providing nurseries and fishing grounds for artisanal fisheries. Furthermore, they provide natural coastal defences that mitigate erosion and storm action. Therefore, better protection of these ecosystems will not only make carbon sense, but the co-benefits from ecosystem goods and services are clear.
- Significant losses are occurring in the global extent of these critical marine ecosystems due to poor management, climate change (especially rising sea levels), coupled to a lack of policy priority to address current and future threats.
- Certain human impacts – notably nutrient and sediment run-off from land, displacement of mangrove forests by urban development and aquaculture, and over-fishing - are degrading these ecosystems, threatening their sustainability and compromising their capacity to naturally sequester carbon. The good news is that such impacts can be mitigated by effective management regimes.
- Management approaches already exist that

could secure the carbon storage potential of these ecosystems, and most governments have commitments to put such measures in place for other reasons. These include biodiversity protection or achieving sustainable development. Agreed management approaches that would be effective include Marine Protected Areas, Marine Spatial Planning, area-based fisheries management approaches, buffer zones to allow inland migration of coastal carbon sinks, regulated coastal development, and ecosystem rehabilitation.

Greenhouse gas emissions that occur as a result of the management of coastal and marine habitats are not being accounted for in international climate change mechanisms (ie UNFCCC, Kyoto, CDM, etc) or in National Inventory Submissions. Not only does this mean that countries are underestimating their anthropogenic emissions, but also that the carbon savings from measures to protect and restore coastal and marine habitats will not count towards meeting international and national climate change commitments.



Crooks, S., D. Herr, J. Tamelander, D. Laffoley, and J. Vandever. 2011. "Mitigating Climate Change through Restoration and Management of Coastal Wetlands and Near-shore Marine Ecosystems: Challenges and Opportunities." Environment Department Paper 121, World Bank, Washington, DC.

- Carbon dioxide emissions from drained coastal wetlands are sufficiently large to warrant inclusion in carbon accounting and emission inventories, and in amendments of national and international policy frameworks to reduce emissions from the loss of these ecosystems. Further work is needed to quantify the magnitude of emissions from near-shore marine ecosystems such as seagrass beds. It is, however, clear that improved management of these systems would slow or reverse ongoing loss of carbon sequestration capacity. Sustainable management of coastal wetlands and marine ecosystems also offer a wide range of co-benefits, including shoreline protection, nutrient cycling, water quality maintenance, flood control, habitat for birds, other wildlife and harvestable resources such as fish, as well as opportunities for recreation.
- Human-caused drainage of coastal wetlands releases carbon from soils, turning them into a strong net source of GHG emissions, irrespective of their GHG balance in the natural state. Soils

vary in carbon content across the landscape but a "typical" coastal wetland soil releases 0.1 $MtCO_2$ per square kilometre for every depth meter of soil lost though with a wide range. Averaged over a 50-year period this equates to 2,000 tCO_2 km^{-2} yr-1, though rates of loss are particularly high in the first decade of wetland drainage.

Summary of potential GHG reductions due to Soil building in coastal wetlands			
Wetland Type	Carbon Sequestration	Methane Production	Net GHG Sink
Mudflat (saline)	Low	Very Low	Low to Medium
Salt Marsh	High	Very Low	High
Freshwater Tidal Marsh	Very High	High to Very High	Neutral or variable
Estuarine Forest	High	Low	High
Mangrove	High	Low to High*	Low to High*
Sea grass	High	Low	High

*salinity dependent

Blue Carbon Portal: Created by GRID-ARENDAL, the Blue Carbon Portal aims to support the rapidly growing blue carbon community. It provides a virtual space to increase transparency and accessibility of information helping to connect, share ideas, resources, discuss issues, pose questions, and pass on news of meetings and their results. http://bluecarbonportal.org/

Blue Climate Coalition: The Blue Climate Coalition was formed in November 2009 to help advance coastal and marine conservation as part of the solution to climate change. Over 100 conservation groups and environmental stakeholders, and over 150 scientists together from 43 countries, have joined the Coalition's call to support blue carbon solutions for climate change. They prepared an open statement to the Delegates of COP16 calling for blue carbon solutions for climate change. The statement highlights yet another of the many vital roles played by coastal ecosystems such as mangrove forests, seagrass meadows, salt marshes and kelp forests – that of carbon sequestration. It also hints at the promising research to understand the role that whales, sharks and fin fish play as carbon sinks. The statement present four clear recommendations for action:

- Include the conservation and restoration of mangrove, saltwater marsh, seagrass, and kelp ecosystems in your strategies for climate change mitigation and adaptation;
- Establish a global Blue Carbon Fund for the protection and management of these important coastal ecosystems;
- Include blue carbon sinks in national REDD+ strategies and greenhouse gas accounting; and
- Support coordinated scientific research to better quantify blue carbon's role in climate mitigation, including the development of protocols and methodologies for monitoring, reporting, and verification of coastal and marine carbon sinks.
- The full text of the statement is available at https://sites.google.com/site/blueclimatesolutions/documents-resources

+ http://www.fao.org/news/story/en/item/36228/icode/

TIDBITS

SCIENTISTS OFFER WARNING AND PLAN FOR PROTECTING EARTH'S 'BLUE CARBON'

Arlington, VA / Gland, Switzerland / Paris, France — The destruction of coastal carbon ecosystems, such as mangroves, seagrasses and tidal marshes, is leading to rapid and long-lasting emissions of CO_2 into the ocean and atmosphere, according to 32 of the world's leading marine scientists.

That key conclusion highlights a series of warnings and recommendations developed by the new International Working Group on Coastal "Blue" Carbon, which convened its first meeting in Paris last month. The Working Group was created as an initial step in advancing the scientific, management and policy goals of the Blue Carbon Initiative, whose founding members include Conservation International (CI), the International Union for Conservation of Nature (IUCN), and the Intergovernmental Oceanographic Commission (IOC) of UNESCO.

Much of the carbon emitted when mangroves, seagrasses or tidal marshes are destroyed is estimated to be thousands of years old because the CO_2 stored in these ecosystems is found not only in the plants, but in layer upon layer of soil underneath. Total

carbon deposits per square kilometer in these coastal systems may be up to five times the carbon stored in tropical forests, due to their ability to absorb, or sequester, carbon at rates up to 50 times those of the same area of tropical forest. The management of coastal ecosystems can supplement efforts to reduce emissions from tropical forest degradation.

According to recommendations from scientists in the Blue Carbon Working Group, whose collaboration pools expertise from 11 countries on five different continents, the existing knowledge of carbon stocks and emissions from degraded or converted coastal ecosystems is "sufficient to warrant enhanced management actions now."

Dr. Emily Pidgeon, Marine Climate Change Director at Conservation International, and a leading blue carbon conservation scientist emphasized, "We have known for some time the importance of coastal ecosystems for fisheries and for coastal protection from storms and tsunamis. We are now learning that, if destroyed or degraded, these coastal ecosystems become major emitters of CO_2 for years after the plants are removed. In the simplest terms, it's like a long slow bleed that is difficult to clot. So we need to urgently halt the loss of these high carbon ecosystems, to slow the progression of climate change."

Draining a typical coastal wetland, such as a mangrove or marsh, releases 0.25 million tons of carbon dioxide per square kilometer for every meter of soil that's lost. Global data shows that seagrasses, tidal marshes, and mangroves are being degraded or destroyed along the world's coastlines at a rapid pace. In fact, between 1980 and 2005, 35,000 square kilometers of mangroves were removed globally – an area the size of the nation of Belgium. This degraded area still continues to release up to 0.175 gigatons of carbon dioxide each year — equivalent to the annual emissions of countries such as the Netherlands or Venezuela.

IOC Assistant Director-General and Executive Secretary Wendy Watson-Wright added, “Scientific studies have shown that although mangroves, seagrasses and salt marshes account for less than 1 percent of the total plant biomass on land and forests, they cycle almost the same amount of carbon as the remaining 99 percent. So the decline of these carbon-efficient ecosystems is a valid cause of concern.”

Over the course of three days in Paris, scientists concluded the meeting with a set of key priorities and recommendations:

Enhanced national and international research efforts: such as developing inventory and accounting methodologies for coastal carbon; conducting carbon inventories, conducting targeted research and monitoring to more accurately quantity the greenhouse gas emissions from coastal ecosystem loss, and establishing a network of field demonstrations to build capacity and community input.

Enhanced local and regional management practices: such as identifying and reducing the primary drivers of high-carbon coastal system degradation, (urban development, agriculture, aquaculture, pollutant and nutrient run-off, dredging, and introduction of artificial constructions), strengthening national to local conservation and protection measures of high-carbon coastal systems, and beginning restoration of lost/degraded systems

Enhanced international recognition of coastal carbon ecosystems: through established international bodies such as the Intergovernmental Panel on Climate Change (IPCC) and United Nations Framework Convention on Climate Change (UNFCCC)

Scientists emphasized that improved management of coastal marine ecosystems is not meant to become a patent roadblock to nations’ economic development or food production, but rather, a targeted strategy that prioritizes conservation of specific, unique, high-carbon coastal zones, which act like global sponges for global CO_2. They are recommending that nations and managers better recognize the vital services that these wetlands provide humanity, and prioritize their protection.

“The capacity of coastal wetlands to reduce climate change by capturing and storing carbon dioxide is considerable, but has been overlooked” says Jerker Tamelander, Oceans and Climate Change Manager for IUCN. “If valued and managed properly, coastal ecosystems can help many countries meet their mitigation targets, while supporting adaptation in vulnerable coastal areas.”

The working group will meet next in August, and continue their collaborative scientific study. Funding for the group has been provided by the Waterloo Foundation, National Aeronautics and Space Administration (NASA), and the United Nations Environment Programme (UNEP).

URGENT ACTION NEEDED TO HALT INCREASING CARBON EMISSIONS FROM DESTROYED, DEGRADED COASTAL MARINE ECOSYSTEMS

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INDIA LAUNCHES BLACK CARBON RESEARCH INITIATIVE UNDER ITS NATIONAL CARBONACEOUS AEROSOLS PROGRAMME

New Delhi, March 29, 2011

India today launched the Black Carbon Research Initiative as part of the National Carbonaceous Aerosols Programme (NCAP). This is a joint initiative of several government ministries and leading research institutions. It will be headed by Prof. J Srinivasan of the Indian Institue of Science, India's leading authority on black carbon.

Present at the launch was Prof. V. Ramanathan, Director of the Center for Clouds, Chemistry and Climate at Scripps Institute of Oceanography, and one of the world's leading authorities on Black Carbon. He congratulated the Ministry on this initiative and said, "This is one of the most ambitious programmes in the world on aerosol research and black carbon. Today is a culmination of over 25 years research from pioneering Indian scientists. India has positioned itself to be second to none in this area of research. Decades from now this programme will be recognized as giving India protection from natural and manmade disasters alike."

In his remarks, Shri Jairam Ramesh, Minister of State (I/C), Environment and Forests, acknowledged the efforts of all those involved in the Black Carbon Research Initiative. The minister said, " This is an important step forward, not just for India but for the international community" and also impressed upon the audience the importance of building the next generation of scientific researchers to continue such research.

With the launch of the Indian Network for Climate Change Assessment (INCCA) in October 2009, the Minister of Environment & Forests had announced a comprehensive study on Black carbon, not only to enhance the knowledge and understanding of the role of Black carbon in the context of global warming but also to address the sources and impacts of the black carbon on melting of glaciers. Black carbon is an aerosol or suspended particulate matter that is created through various anthropogenic and organic processes.

The Black Carbon Research Initiative builds on the existing work and sets out the science programme to respond to the scientific questions surrounding Black carbon. The science plan has been developed through an intensive consultative process and with the involvement of experts in the subject and builds upon the work of ISRO, MoES and other experts countrywide. The initiative is visualized as an ambitious programme with the involvement of over 101 institutions with 65 observatories nationwide.

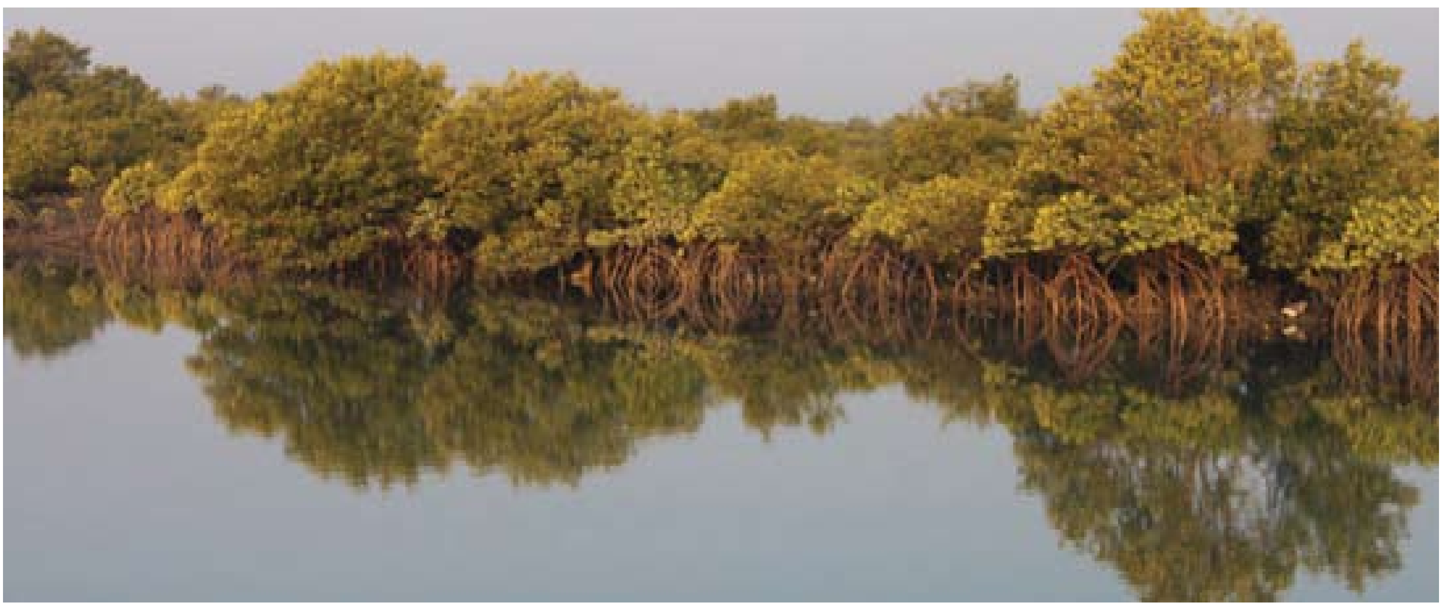
The study will lead to long-term monitoring of aerosols; monitoring of impact of BC on snow and; estimating magnitude of BC sources using inventory (bottom-up) and inverse modeling (top-down) approaches and modeling BC atmospheric transport and climate impact. The major expected outcomes are understanding the effect of change in albedo due to black carbon on seasonal snow and glacier melt; estimation of albedo and; reflectance of seasonal snow and glacier, glacier depth and mass balance, using airborne sensors like laser altimeter, ground penetrating radar and pyranometer; modeling effect of enhanced melting on glacier mass balance and retreat and; development of snow/glacier melt runoff models to understand the influence of changes in snow and glacier melt patterns.

GREEN ACTION FOR NATIONAL DANDHI HERITAGE INITIATIVE (GANDHI) MEMORIAL PROJECT

(An Initiative by MoEF for Sustainable Coastal Zone Management in Dandi to promote Gandhian Ideology)

Few of the rationale of the project

- Gujarat is the only state having having more than 1650 km of coastline in the country. It stands first among the westerns states of India's coastal zone in terms of area under mangroves.
- The village Dandi and surrounding areas carry special significance in terms of having historical as well as environmental importance due to geographical location. It is very essential to preserve Mahatma Gandhi memorial located in the village having such great historical and ecological importance from the todal pattern and cyclonic conditions.
- The Dandi and surrounding areas face severe salinity-ingress problem due to high tidal influence impacing the fragile agriculture area. It is therefore imperative that the village environment should be conserved by adopting natural biological ways.
- The region is situated on the southern coastal area of Gujarat State, which is quite prone to cyclonic conditions. Raising a bio-shield will help mitigate the climatic adversities and protect coastal communities of Dandi and surrounding coastal villages.
- Communities of Dandi and surrounding villages wish to re-establish the original environment with proper development.



Blue Carbon: Conserving Ocean Vegetation

One of the most promising new ideas to reduce atmospheric CO_2 and limit global climate change is to do so by conserving mangroves, seagrasses and salt marsh grasses. Such coastal vegetation, dubbed "blue carbon," sequesters carbon far more effectively (up to 100 times faster) and more permanently than terrestrial forests. This makes the conservation of our costal habitats critical, and recently it has been gaining a lot of attention from climate and conservation communities alike.

According to the Scientific American, mangroves are tangled orchards of spindly shrubs that thrive in the interface between land and sea…these coastal habitats are recognized for their natural beauty and ability to filter pollution. Carbon is stored in peat below coastal vegetation habitats as they accrete vertically. Because the sediment beneath these habitats is typically anoxic, organic carbon is not broken down and released by microbes. If they were to be destroyed, all this carbon would be released back into the atmosphere.

And sadly due to coastal development, agriculture, and aquaculture, over 35% of mangroves, 30% of sea grasses, and 20% of salt marshes have been destroyed to date, resulting in a dramatic increase of CO_2 concentrations in the atmosphere. To put it numerically, according to the International Union for Conservation of Nature and Natural Resources, over the last 100 years, 1,800 square kilometers of wetlands have been destroyed, resulting in the release of two gigatons of CO_2.

Roger Ullman, Executive Director of the Linden Trust for Conservation in New York City says that "blue carbon is a source of emissions that hasn't been addressed by the climate community and therefore creates an opportunity to reduce emissions…these fabulous ecosystems…don't cover a very large expanse of territory, yet still provide enormously important services to humanity and are being destroyed three or four times faster than the rate of tropical forests." That is why preserving these habitats can be a crucial tool in fighting climate change.

Source: http://belgravereview.com/blue-carbon-conserving-ocean-vegetation/

"BLUE CARBON" – BURIED TREASURE FOR CLIMATE AND COMMUNITIES

Blue Carbon Initiative launches at COP16 to study mitigation potential of coastal marine systems

Cancun, Mexico – Carbon sinks along the world's coast lines, including mangroves, seagrasses, and tidal salt marshes, store massive quantities of carbon for centuries at a time, and could provide an immediate and cost-effective tool to counter the impacts of climate change, said Conservation International this week at a presentation on Blue Carbon in Cancun.

The event, "Blue Carbon: Valuing CO_2 Mitigation by Coastal Marine Systems", hosted by Conservation International (CI) in partnership with the International Union of Conservation Scientists (IUCN), posed the provocative question: are we missing major sinks and sources of carbon along our coasts?

According to scientists presenting their research, the answer is a resounding yes.

Dubbed "blue carbon" for their ability to sequester and store huge amounts of carbon, coastal marine ecosystems show great climate mitigation potential, if valued and managed properly. According to scientists at the event, total carbon deposits per square kilometer in these coastal systems can be up to five times the carbon stored in tropical forests, resulting from their ability to sequester carbon at rates up to 50 times those of tropical forests.

"What we've seen is that that these three main systems – mangroves, seagrasses, and salt marshes – are phenomenally efficient at storing carbon below ground in the sediment for centuries at a time," said Dr. Emily Pidgeon, the Marine Climate Change Program Director for Conservation International. "So it seems natural to us that oceans should be part of the climate change solution. It's been a bit puzzling to me as to why they haven't so far."

According to scientific analysis, coastal systems globally are being lost at an alarming rate, with approximately two percent removed or degraded each year, which is four times the estimates of annual tropical forest loss.

Other key findings reported about coastal marine system degradation at the presentation were:

- 29 percent of the world's seagrasses have been lost or degraded
- 35 percent of the world's mangroves have been lost or degraded
- 35,000 km^2 of mangroves were removed globally between 1980 and 2005, an area the size of the nation of Taiwan

"The loss of mangroves is like a one-two punch to our planet: first, it results in the rapid emission of carbon stores that in many cases have built up over centuries and the lost opportunity of future carbon sequestration from these areas, and second, it destroys habitats that are critical for fisheries around the world," said Pidgeon.

Also announced at the presentation was the launch of a new international consortium of scientists led by Conservation International called the Blue Carbon Initiative, whose members include CI, IUCN, the World Conservation Monitoring Center of the United Nations Environment Programme (WCMC-UNEP), the Intergovernmental Oceanographic Commission (UNESCO), and Restoring America's Estuaries.

"We have come together to study the mitigation possibilities and economic value of coastal marine ecosystems because they potentially give us one of the few low-cost options for actually removing carbon dioxide from the atmosphere, right now," said Pidgeon.

Over the next two to four years, the Blue Carbon Initiative aims to advise and develop:

- coastal management practices that conserve carbon stores
- local to national policies that emphasize the importance of coastal systems for climate change mitigation
- incentive mechanisms and carbon payment schemes that value the carbon stored and sequestered by coastal systems,
- a network of demonstration projects, potentially in the coastal systems of Indonesia, the Philippines, and the Eastern Tropical Pacific Ocean, and
- communication and capacity-building tools for coastal carbon management and incentives.

"It's important that the international community starts to recognize the potential value of these coastal ecosystems systems, and provide positive incentives for their conservation and restoration," said CI's International Climate Policy Director, Rebecca Chacko from UNFCCC talks in Cancun. "Once we understand the role these ecosystems play in climate mitigation, we may even be able to develop an international mechanism that can further help to protect and restore them."

An official side event of the 16th Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC), the presentation also reported for the first time select highlights from a summary World Bank report on coastal carbon which is due for release early next year.

"The science is available, but up until now there really hasn't been a coordinated activity to pull it all together and develop policy," said report author Dr. Stephen Crooks, Climate Change Consultant for Restoring America's Estuaries. "Our message is this: conservation is a high priority if you want to keep centuries of carbon in the ground – and not released into the air."

in the news...

Inauguration of National Centre for Sustainable Coastal Management (NCSCM), Anna University Campus, Chennai

The National Centre for Sustainable Coastal Management was inaugurated on 25 Feb 2011 by **Prof.Dr.P.Mannar Jawahar**, Vice Chancellor, Anna University, Chennai and **Shri. J. M. Mauskar, IAS**, Special Secretary, Ministry of Environment and Forests, Government of India, New Delhi. **Prof.R.Ramesh**, Director, Institute for Ocean Management, Anna University welcomed the gathering and **Prof.S.Shamugavel**, Registrar, Anna University, Chennai delivered the special address. Shri. J. M. Mauskar, IAS presided over the event.

Prof.S.Shanmugavel, Registrar, Anna University, Chennai, and **Dr.A.Senthil Vel**, Director, National Integrated Coastal Zone Management Project participated in the event.

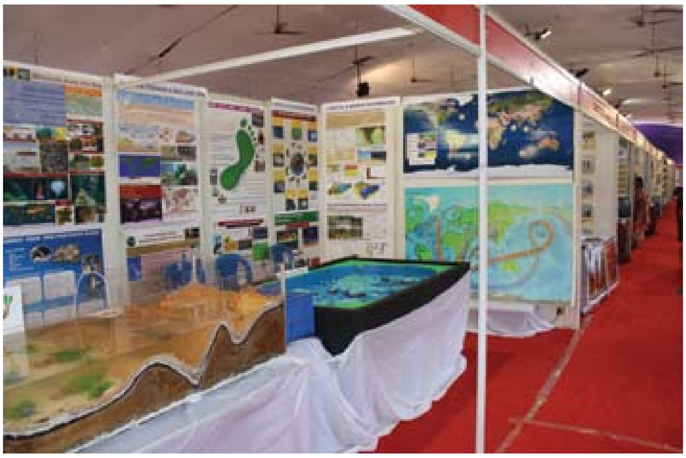
Prof.P.Mannar Jawahar, Vice-Chancellor, Anna University and **Dr.J.M.Mauskar,** Special Secretary, MoEF with the Certificate of Registration of Societies of National Centre for Sustainable Coastal Management (NCSCM)

Prof.P.Mannar Jawahar, Vice-Chancellor, Anna University and **Dr.J.M.Mauskar,** Special Secretary, MoEF inaugurating the National Centre for Sustainable Coastal Management (NCSCM) at Anna University Campus on 25 Feb 2011.

for more details visit www.ncscm.org

Events

CHENNAI SCIENCE FESTIVAL - 2011



The Chennai Science Festival - 2011 was organized from 29 January -2 February 2011 on three broad themes i) Food & Health ii) Energy and iii) Climate Change and Biodiversity. Public lectures and panel discussions on the above themes were conducted. In addition, school students from Chennai City participated in several quiz, elocution, essay writing, drawing competitions and prepared science models on the above themes.

Science Exhibition: A mega science exhibition consisting of a total of 96 stalls were exhibited on Food & Health, Energy and Climate Change and Biodiversity with an interface of "Science in Everyday Life". Several institutions- Governmental, Non-governmental, Schools, Colleges of Chennai City and various Universities from Tamil Nadu participated and exhibited posters and 3-D models on their ongoing programmes and activities. A total of ~34,000 people, including 24,000 students and about 10,000 of the general public from Chennai and urban areas visited the Science Exhibition-2011

As a part of the event, Panel Discussions were held on the three main themes during the days of the exhibition. The ENVIS Centre for Coastal Zone Management and Coastal Shelterbelt at Institute for Ocean Management, Anna University Chennai, coordinated and conducted the Panel discussion on "Climate Change and Biodiversity". Some of the impacts of climate change include change (especially increase) in the average temperature (global warming), changes in precipitation patterns and rise in sea levels. Some questions that were addressed in this discussion are:

- What is the connection between climate change and biodiversity?
- How does climate change affect biodiversity?
- How do the various impacts of climate change affect species individually and how do they affect ecosystems.
- What ecosystems are most likely to be affected?
- What is the role of biodiversity in mitigating the effects of climate change?
- Have some ecosystem goods and services already been impacted?
- What are some options for protecting our ecosystems?

The eminent speakers were:

- Prof. M.S.Swaminathan, Chairman, MSSRF, Chennai
- Dr.P.T.Manoharan, Emeritus Professor, Department of Chemistry, IIT-M
- Dr.Baldev Raj, Distinguished Scientist & Director, IGCAR, Kalpakkam

The audience for this panel discussion was predominantly school children, teachers and general public.

ENVIS staff explaining the Sea level rise model to school students

ENVIS personnel explaining the model on marine resources to students