

Forest carbon estimate and REDD+ implications in Bangladesh

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Research Letter

A new estimate of carbon for Bangladesh forest ecosystems with their spatial distribution and REDD+ implications

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ABSTRACT
In tropical developing countries, reducing emissions from deforestation and forest degradation (REDD+) is becoming an important mechanism for conserving forests and protecting biodiversity. A key prerequisite for any successful REDD+ project, however, is obtaining baseline estimates of carbon in forest ecosystems. Using available published data, we provide here a new and more reliable estimate of carbon in Bangladesh forest ecosystems, along with their geo-spatial distribution. Our study reveals great variability in carbon density in different forests and higher carbon stock in the mangrove ecosystems, followed by in hill forests and in inland Sal (*Shorea robusta*) forests in the country. Due to its coverage, degraded nature, and diverse stakeholder engagement, the hill forests of Bangladesh can be used to obtain maximum REDD+ benefits. Further research on carbon and biodiversity in under-represented forest ecosystems using a commonly accepted protocol is essential for the establishment of successful REDD+ projects and for the protection of the country's degraded forests and for addressing declining levels of biodiversity.

Key words: carbon budget, forest conservation, forest ecosystem, REDD+, Bangladesh.

Introduction
Globally, about 60% of the carbon is stored in forests, with about 12-20% of anthropogenic greenhouse gas (GHG) emissions being attributable to forest degradation and loss (Baccini et al. 2012; Houghton et al. 2012; Paoli et al. 2010; Clark et al. 2001). In tropical region, reducing emissions from deforestation and forest degradation (REDD+) is a new climate change mitigation mechanism that aims to promote carbon sequestration by compensating tropical countries for conserving their forests (Angelsen et al. 2009; Parker et al. 2009). REDD+, in

Highlights

- We estimate 231.8 million Mg of carbon stored in Bangladesh forest ecosystems, with nearly 49.4% stored in the mangrove forests alone;
- We find 179.1 million Mg Carbon in forest biomass and 72.7 million Mg carbon in soil;
- The hill forests have the highest potential for forest carbon enhancement and REDD+ in the country.

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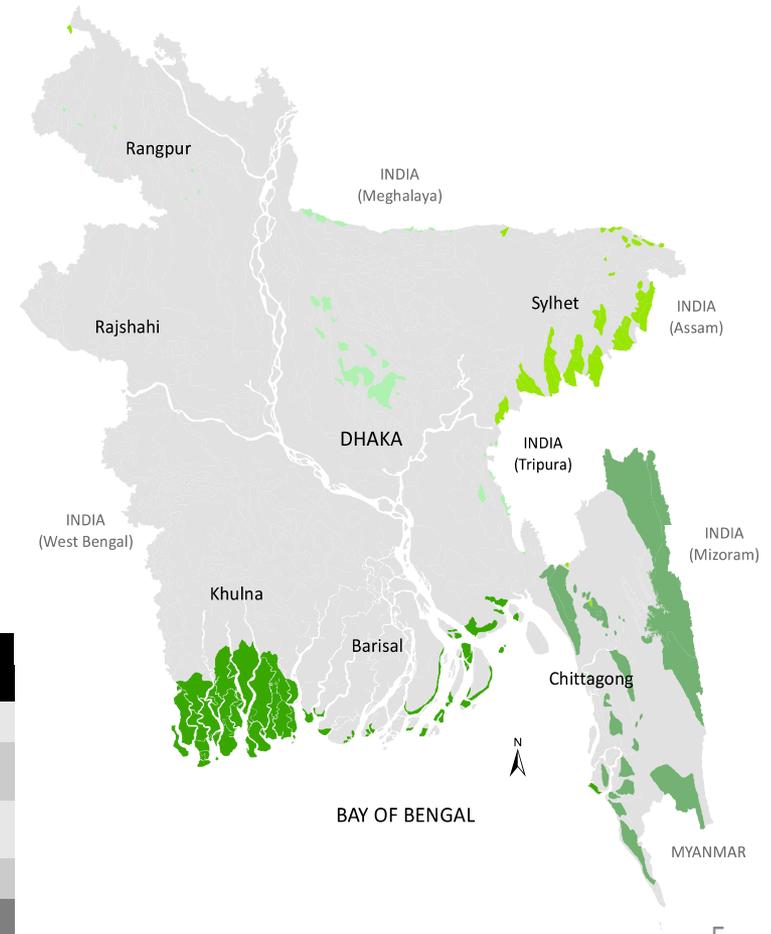
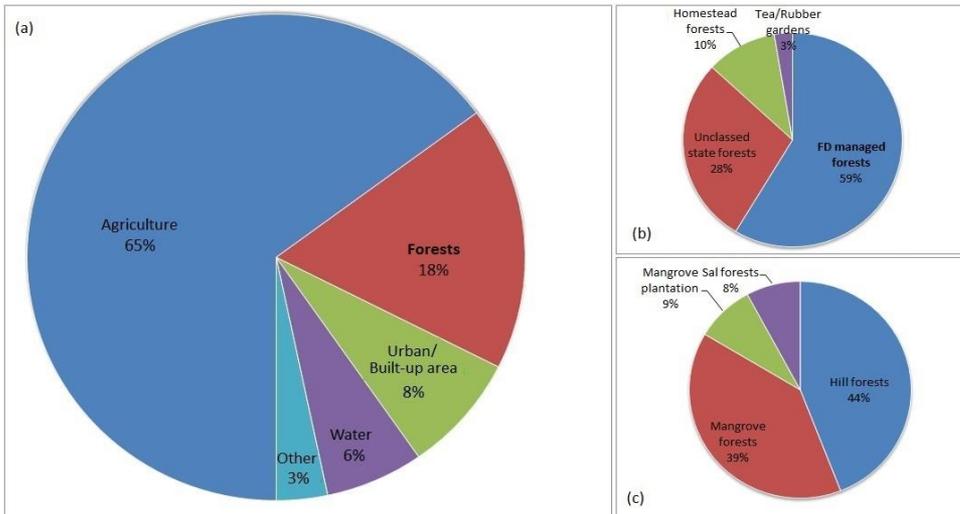
Background

- Tropical forests store 25% of global carbon (C) and home to about 70% of the world's biodiversity.
- Globally, deforestation and forest degradation is the second largest anthropogenic source of carbon dioxide (~20%) to the atmosphere, after fossil fuel combustion.
- Tackling deforestation and forest degradation is the cheapest option for reducing human-induced emissions and thereby addressing the climate change.
- Global forest carbon credits are valued at over US\$100 billion/year and are an emerging growing sector.
- The average value of the price of sequestered carbon in the internationally recognized market averaged US\$9.20 per tonne (Mega grams/Mg).

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- The REDD+ mechanism under the United Nations Framework Convention on Climate Change (UNFCCC) seeks to compensate developing countries for avoided emissions that would have otherwise occurred under business as usual scenarios.
- REDD+ mechanism, involves payments made based on emission reductions that have been measured, reported, and verified (MRV) relative to the baseline reference levels.
- Subject to various safeguards (e.g. biodiversity conservation, provision of ecosystem services, protection of indigenous rights).
- About 20% of Bangladesh's GHG emissions are from LULUCF activities, although the contribution of the country to global GHG emissions is rather low (less than 0.2%), with per capita CO₂ emissions one of the lowest in the world (~0.37 metric tons) (WRI 2014; World Bank 2014).

LULCF in Bangladesh



FD-managed forests in Bangladesh

| Forest type | Area (million hectare) | Percentage (%) | |
|---------------------|---------------------------|-------------------------|-----------------------|
| | | # country's forest area | # country's land area |
| Hill forests | 0.67 | 44.1 | 4.5 |
| Mangrove forests | 0.60 | 39.6 | 4.1 |
| Mangrove plantation | 0.13 | 8.5 | 0.9 |
| Sal forests | 0.12 | 7.9 | 0.8 |
| Total | 1.52 | 100 | 10.3 |



Methods

- Systematic review ($n=13$);
- Aboveground biomass carbon in tree using existing allometric model;
- Belowground carbon in soil up to 30 cm depth;
- Geospatial distribution and uncertainty modeling.

National-level estimates of biomass carbon in FD-managed forests in Bangladesh

| Source | Carbon density* (Mg ha ⁻¹) | Carbon stock (Million Mg) | Remark |
|----------------------|---|------------------------------|---------------------------|
| Saatchi et al. 2011 | 70.5 | 107.2 | Based on satellite data |
| Gibbs and Brown 2007 | 158 | 240.2 | Based on forest inventory |
| Gibbs et al. 2007 | 65 | 98.8 | Based on harvest data |
| IPCC 2006 | 93 | 141.4 | Based on harvest data |
| DeFries et al. 2002 | 137 | 208.2 | Based on harvest data |
| Brown 1997 | 92 | 139.8 | Based on forest inventory |
| Mean | 102.6 | 155.9 | |

*using median value when providing a range.

Findings

179.1 million Mg carbon in biomass and 72.7 million Mg carbon in soil.

Aboveground biomass carbon in different forest types of Bangladesh

| Forest type | Carbon density* (Mg ha ⁻¹) | Source |
|-------------------------------|--|--------------------------|
| Hill forests | 103.4 | Mukul 2014 |
| | 115.6 | Ullah and Al-Amin 2012 |
| | 73.6 | Alamgir and Al-Amin 2007 |
| | 92.0 | Shin et al. 2007 |
| Mangrove forests [‡] | 98.9 | Rahman et al. 2014 |
| | 126.7 | Donato et al. 2011 |
| Sal forests | 153.9 | Kibria and Saha 2011 |

*using median value when providing a range.

‡include mangrove plantation.

Cont..

Belowground soil carbon in different forest types of Bangladesh

| Forest type | Carbon density* (Mg ha ⁻¹) | Source |
|------------------------------|--|------------------------|
| Hill forest | 51.0 | Mukul 2014 |
| | 23.1 | Barua and Haque 2013 |
| | 50.5 | Ullah and Al-Amin 2012 |
| | 54.0 | Miah et al. 2009 |
| | 80.1 | Chowdhury et al. 2007 |
| | 97.7 | Shin et al. 2007 |
| | 39.7 | Islam et al. 2001 |
| Mangrove forest [‡] | 33.6 | Rahman et al. 2014 |
| | 43.9 | Donato et al. 2011 |
| Sal forest | 58.5 | Kibria and Saha 2011 |
| | 38.1 | Isalm and Weil 2000 |

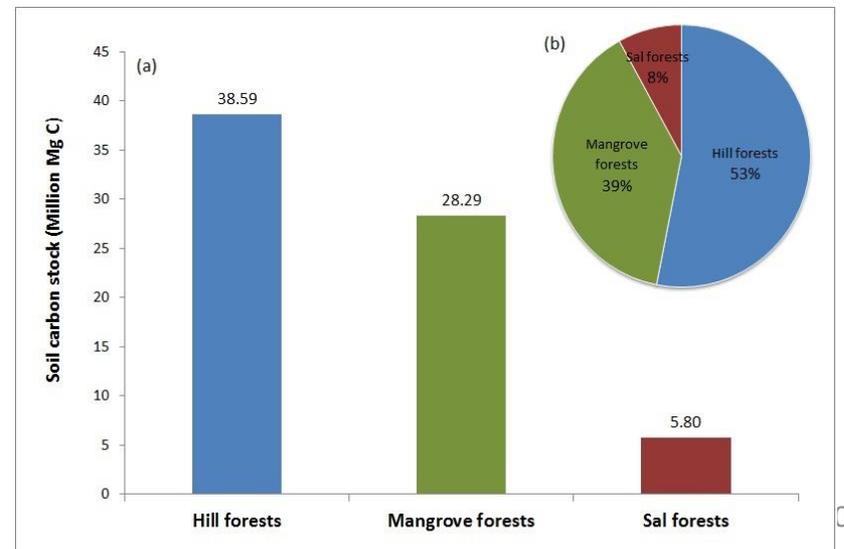
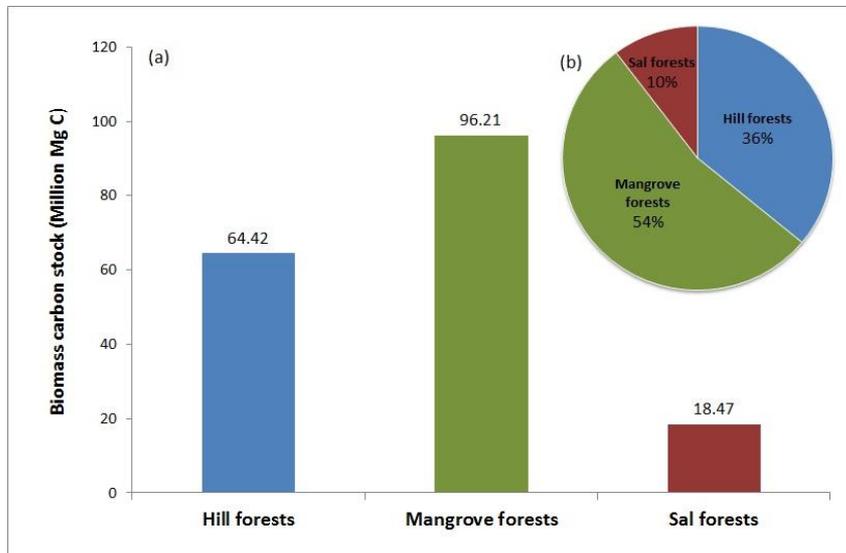
*using median value when providing a range.

‡includes mangrove plantation.

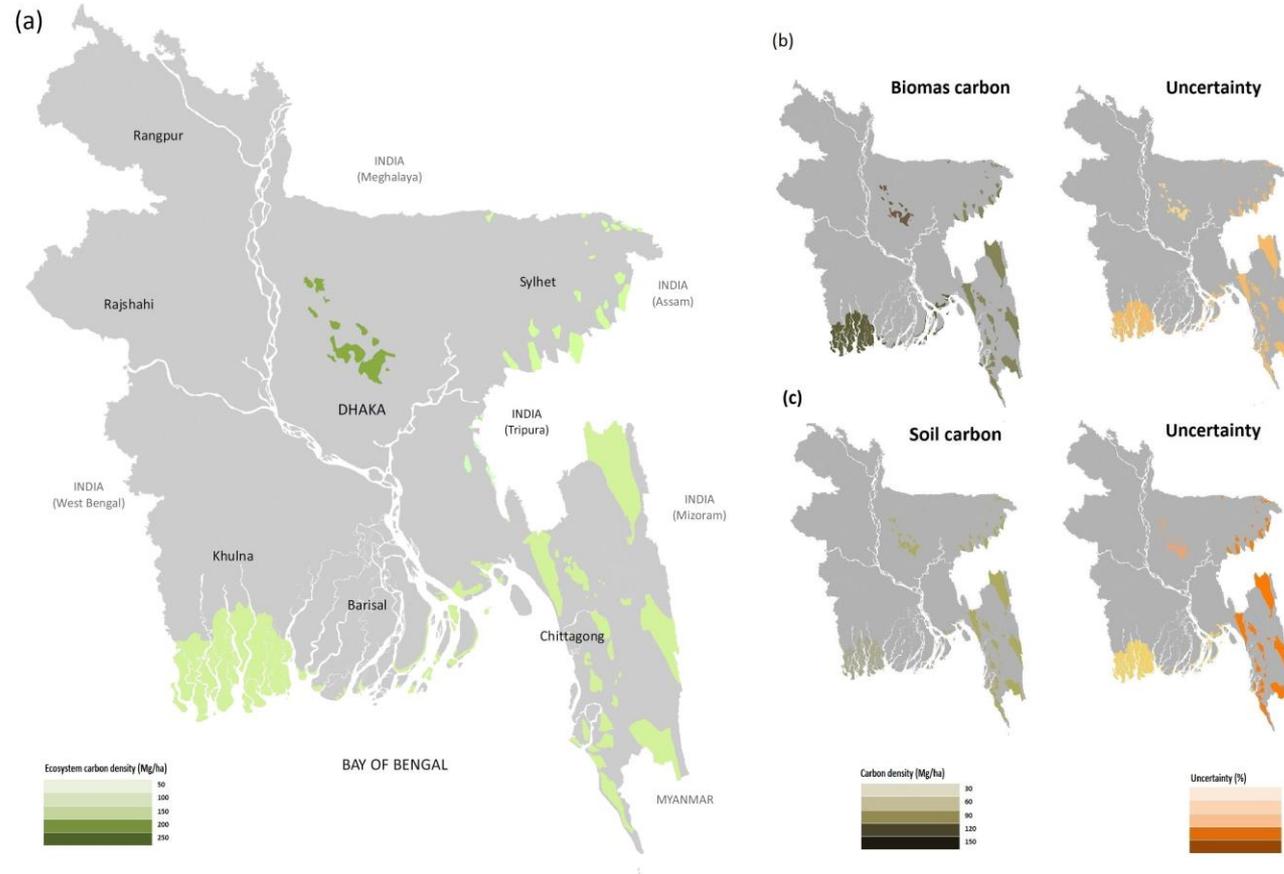
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Carbon density in major forest types of Bangladesh

| Forest type | Carbon density (Mg ha ⁻¹) | | |
|------------------------------|---------------------------------------|---------------|-------|
| | Biomass | Soil | Total |
| Hill forest | 96.1 (±17.86) | 57.6 (±27.13) | 153.7 |
| Mangrove forest [‡] | 131.8 (±17.21) | 38.8 (±7.28) | 170.6 |
| Sal forest | 153.9 (0) | 48.3 (±14.42) | 202.2 |
| Mean | 127.3 | 48.2 | 175.5 |



Cont..



Map showing the density and spatial distribution of carbon in Bangladesh forest ecosystems; (a) total ecosystem carbon, (b) biomass carbon and uncertainty, and (c) soil carbon and uncertainty.

Climate-resilient Bangladesh

The forestry sector although overlooked and highly degraded in the country could generate substantial amount of revenue that could be used for forest conservation and local community development and thereby could secure a more resilient forest sector and rural livelihoods in the country!

The message

Altogether, 251.8 million Mg carbon stored in Bangladesh's forest ecosystems, with nearly 49.4% stored in the mangrove forests alone. This estimate, however, based on a limited number of available field inventories. Further studies should cover underrepresented forest ecosystems in the country using a commonly accepted protocol and sampling strategy.

Due to diverse stakeholder engagement, coverage and the current state of forests, the hill forests of the country have the highest potential for forest carbon enhancement and REDD+.

Thanks !

Reference:

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