State of Knowledge on Incentives of the Blue Carbon Approach

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Developing a Research Agenda for Carbon Dioxide Removal and Reliable Sequestration

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Questions

• What information is needed to assess the commercial viability of blue carbon crediting for wetland restoration and mitigation.

• What do we know about the co-benefits of the blue carbon approach and their economic values.

• What are the common knowledge needs/strategies for adopting nature-based solutions that could enhance blue carbon dioxide removal and reliable sequestration.
Key Points

- Avoided emissions / stop loss greater potential than sequestration.
- Restoration projects can offer both stop loss and reinitiated sequestration.
- Currently, blue carbon benefits of restoration projects only recognize on site carbon sequestration and not sequestered component of lateral flux.
- Projecting permanence of sequestered carbon over 100 year time frame is one of the more significant challenges for land-based carbon projects. Drives risk-based project development.
- Understanding the landscape context is critical is assessing blue carbon credit potential (particularly baseline and with project CH\textsubscript{4} fluxes, permanence [sensitivity to SLR, other human impacts]).
- Projects should incorporate lands upslope of existing tidal wetlands.
- Quantifying CH\textsubscript{4} fluxes in baseline is a significant challenge.
- Economics driven by scale and risk.
Which coastal ecosystems are blue carbon ecosystem?

• Established blue carbon ecosystems:
  – tidal marshes, tidal forest (including mangroves), seagrasses.

• Emerging / potential blue carbon ecosystems
  – Kelp farms
  – Hypersaline algal flats (arid environments)

• Other important non-coastal ecosystems
  – Seasonal floodplains.
Developing the Learning Curve

1. Recognize value of wetland management
2. Establish examples of good practice
3. Achieve multi-use functional landscape
4. Adaptation to climate change
5. Incorporate GHG fluxes and storage

Blue Carbon Interventions:
- Policy adjustment
- Management actions
- Carbon finance projects

Available at Silvestrum.com
## Key Methodology Development Issues

<table>
<thead>
<tr>
<th>Category</th>
<th>Requirement</th>
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<tbody>
<tr>
<td>Real</td>
<td>Demonstrate that reductions have actually occurred</td>
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<tr>
<td>Additional</td>
<td>Ensure reductions result from activities that would not happen in the absence of a GHG market</td>
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| Permanent         | Mitigate risk of reversals  
Verify reductions ex-post                                                      |
| Verified          | Provide for independent verification that emission reports are free of material misstatements |
| Owned unambiguously | Ownership of GHG reductions must be clear                                    |
| Not harmful       | Avoid negative externalities                                                 |
| Practicality      | Minimize project implementation barriers                                     |
Goal of Ecosystem Management (Adaptation)

Ordinate represents biophysical and socioeconomic parameters such as species diversity, water quality and flood levels.
Goal of Carbon Management

Source: Forest Trends
Example Blue Carbon Project Activities Recognized by the Verified Carbon Standard

**Conservation**
- Protection of at risk wetlands
- Improved water management on drained wetlands
- Sediment recharge to coastal wetlands
- Maintaining or recovering space for wetland roll-over

**Restoration / creation**
- Lowering of water levels on impounded wetlands
- Raising soil surfaces with dredged material
- Increasing sediment supply by removing dams
- Restoring salinity conditions
- Improving water quality
- Revegetation
- Combinations of the above

All of these are have demonstrated “co-benefits” and are components of nature-based solutions to climate risk reduction
Coastal Ecosystems: Long-Term Carbon Sequestration and Storage
Emissions from One Drained Wetland: Sacramento-San Joaquin Delta

Area under agriculture
180,000 ha

Rate of subsidence (in)
1 inch

1 GtCO$_2$ release in c.150 years
4000 years of carbon emitted

Equiv. carbon held in 25% of California’s forests

Accommodation space: 3 billion m$^3$
Sacramento San Joaquin Delta
2011 EC-based GWP for management wetland v corn field baseline:

\[
\text{MT } CO_2 \text{eq ha}^{-1} \text{ y}^{-1} = -10 + 6.5 + 0 \quad \text{Managed wetland} \quad \text{Corn field} \quad (25 + 2.5) = -31
\]

\[
\begin{align*}
\text{CO}_2 & \quad \text{CH}_4 & \quad \text{N}_2\text{O} \\
\text{GWP} & \quad \text{CO}_2 & \quad \text{N}_2\text{O}
\end{align*}
\]

A challenge for projects is quantifying both the with project and baseline GHG fluxes across a complex landscape.

Land use specific emissions factors required.

Net GWP Fluxes (from Eddy Covariance April 2011-2012)
Data provided by Lisamarie Windham-Myers

Annual Carbon Budget West Pond (2011 - 2012)
Management for soil carbon sequestration also provides carbon that builds and stabilizes coastal wetlands and supports fisheries.

We are not recognizing fate of exported but stored carbon in inventories.

Organic carbon inflows (litterfall), export to adjacent aquatic systems, and other pathways (decomposition and soil carbon storage). Width of each pathway is proportional to flow (g C m⁻² yr⁻¹) (Twilley et al. 1986)
3.4 million ha of mangroves and tidal marshes have been diked and converted to other land uses. This represents 40% of mangroves and almost all tidal marshes.

Historic Emissions: 6k MMtCO₂ released, loss of 20 MMtCO₂/yr sequestration.

Potential Emissions: 8.8k MMtCO₂ released, loss of 22 MMtCO₂ sequestration.

Between 2000-2012 highest rates of mangrove loss: Malaysia (13%), Cambodia (12%), Indonesia (8%), Vietnam (3%), Philippines (3%), Thailand (1%).

Aquaculture and palm oil largest drivers.
United States: Emissions of Interest

- Emissions and removals of CO$_2$ and CH$_4$ on intact and restoring vegetated wetlands (all coastal wetlands considered managed).
- Drainage and excavation activities
- Conversion of vegetated wetlands to open water
- Forestry activities on wetland soils
- CH$_4$ emissions from impounded waters
- Aquaculture
Summary of soil stocks, emissions and removals

- Marshes and mangroves hold in top one meter of soil 3,190 MMTCO$_2$
- Marshes and mangroves sequester net about 8 MMTCO$_2$e/yr.
- Drainage emits 0.7 – 1.9 MMTCO$_2$e/yr.
- Drained former wetland organic soils continue to emit 5 MMTCO$_2$e/yr.
- Methane emissions from tidally disconnected are estimated to be 1-3 MMTCO$_2$eq/yr. (Not yet included in inventory)
- Wetlands conversion to open water releases 1-7 MMTCO$_2$e/yr.
- Aquaculture emits 0.15 MMTCO$_2$e/yr of N$_2$O
- Current restoration accounts for only 0.02 MMTCO$_2$e/yr of new carbon sequestration
Landscape Considerations

Total Greenhouse Gas Sequestration*

- GHG budget driven by freshwater pond management
- Allow wetland migration – net GHG removals
- Hold the line – net GHG emissions

Science needs to support blue carbon projects

- Mapping of wetland extent and conversion
- Thresholds for mangrove building with sea level rise
- Observational and modeled relationships between productivity and C seq.
  (have for marshes not mangroves)
- Predictors of mangrove stress
- Projections of coastal response to climate change: 100 year timeframe
- Fate of carbon laterally transported from wetlands, including through erosion
- Capacity to monitor and model CH$_4$ spatially and temporally

Stressed mangroves? Collier County, Florida
Links with blue carbon projects with nature-based solutions – a practitioners view

• Base carbon projects on good practice for restoration and conservation
• Embed mitigation planning in a climate adaptation context
• Look to account across whole landscape to improve system wide resilience.
• Select project location with reference to landscape contact.
• Account for all greenhouse gases
• Include coastal forest, seasonal floodplains and sea grasses in GHG management
• Areas with high sediment availability and favorable topography will be the most resilient to sea level rise.
• While carbon sequestration has a permanence risk, avoided C emissions on drained lands and CH4 reductions by reconnecting impaired drainage areas offer zero permanence risk.