A Case Study of Climate Change Mitigation and Adaptation in New Orleans

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Climate Change Adaptation and Restoration in New Orleans

- Hurricane Katrina Impacts
- Mississippi Delta
- Wastewater infrastructure design using wetland assimilation
- Climate Change Adaptation and Mitigation
Hurricane Katrina August 28-29, 2005
Facing the Future

- Multi-Billion Dollar Deficits
- Significantly Decreased Staff
- Higher Operation Costs
- 45% Less Revenue
- Largest Emitter in the City
- Nutrient Limits
- FEMA Policies Designed to Restore Infrastructure to Pre-Katrina Conditions
Global Climate Change
Central Gulf Coast Most Vulnerable in the U.S.

- More intense flooding from hurricanes
- Coastal inundation and degradation
- Direct effects to coastal biota
- Increased evapotranspiration rates
- More intense rainfalls
- More droughts
- Saltwater intrusion

Sustainable Water Resource Management!
Sea Level Rise

- IPCC predicts a mean of 80 cm in the 21st century. Some say a meter or more.
- Relative sea level rise (RSLR) = Eustatic sea level rise + subsidence
- Relative Sea Level Rise in the delta 1.25-1.75 Meters in the 21st century
Over the last 5,000 years, switching of the Mississippi River channel formed the present day delta.
Coastal Louisiana has lost an average of 34 square miles of land, primarily marsh, per year for the last 50 years. From 1932 to 2000, coastal Louisiana lost 1,900 square miles of land, roughly an area the size of the state of Delaware. If nothing more is done to stop this land loss, Louisiana could potentially lose approximately 700 additional square miles of land, or an area about equal to the size of greater Washington D.C. - Baltimore area, in the next 50 years.

For more information about the land loss analysis or to see an animated time series of wetland change, visit www.LaCoast.gov/LandLoss
Increasing Adaptive Capacity

- Adaptation of vulnerable human and ecological systems.
- Need to adapt to an already-changing climate
  - Hurricane protection
  - Off-set relative sea level rise (RSLR)
    - Increase vertical accretion
NATURE'S SURGE BUSTER

Scientists with the LSU Hurricane Center say Hurricane Katrina provided graphic proof of how marshes and wooded wetlands provide natural armor that can save levees during storms.

WITHOUT WETLANDS, LEVEES ARE PUMMELED

Large sections of the MR-GO levee that had little or no wetlands separating them from Lake Borgne disintegrated.

WETLANDS TAKE THE BRUNT OF THE STORM

The 20-Arpent Canal levee remained standing. The difference was the buffer of marsh and wooded wetlands, researchers said.

KATRINA'S WESTERN EYE WALL

KATRINA'S PATH
PEARL RIVER – (EYE OF KATRINA)

INTACT CYPRESS

FALLEN OAKS
Key adaptation technique is restoration of coastal wetlands

Wetland Assimilation
Effluent discharged into wetlands:

- Increases accretion to offset RSLR
- Carbon sequestration mitigates climate change
- Hurricane surge protection and floodwater retention increases resiliency of the built environment
- Freshwater in effluent protects against drought and buffers saltwater intrusion
- Numerous social and economic benefits
Enhanced Accretion

(Rybczyk et al. 2002)
Cypress Restoration of Bayou
Bienvenue Central Wetland Unit
Carbon Pools in Wetlands

- Trees
- Herbaceous vegetation
- Forest floor litter
- Dead wood
- Soil
Accretion After the 1927 Flood

Organic Soil Formation & Carbon Burial
Primary Carbon Mechanisms

- C emitted during wetland loss
  - 13,911 g C/m² in the top 50 cm of soil
    - 75% and 50% oxidation
- Burial = organic soil formation (roots)
  - 150 g C/m² yr⁻¹ and 450 g C/m² yr⁻¹
- Biosequestration = above ground wood
  - 750 g C/m² yr⁻¹
WETLAND ASSIMILATION

Sequestration rate = prevented wetland loss and planted cypress

22 tons CO2e/ac/yr

Central Wetland Unit 12,000+ hectares over 50 years

32,951,000-34,468,000 tons CO2e

Annual emissions of six million cars
Wetlands and Climate Change

Wetland restoration measures that help wetlands to accrete at a rate to counter submergence due to sea level rise and subsidence will have increased rates of carbon sequestration.
Assumptions

- Extrapolations from peer reviewed studies
- CH₄ and N₂O have not been included in the model yet.
- Carbon sequestration is highly dependent upon the health and productivity of the wetland!
- Each site is specific and will require testing.
CHALLENGES

Wetland offsets are not official: Wetlands restoration activities alone are not considered as an option for carbon offsets in domestic or international mitigation regimes. No existing protocols or “route to market”.

Barriers to entry:

- Regulatory in nature
- Psychological: land use based carbon sequestration perceived as not permanent
- Scientific: science to support the volume of carbon sequestered is limited.
Adaptation and Mitigation

- A carbon market that incorporates land use change and wetlands could provide global carbon-related benefits while giving local water managers a funding mechanism to adapt.
Multi-Benefit Adaptation

- Restore Critical Infrastructure
- Restore 12,000+ hectares of Wetlands
- Mitigate Climate Change
- Protect Infrastructure, Employees, and Ultimately Protect Citizens
- Protect Public Health
- Contribute to the Economy
- Financial and Energy Savings
- Protect the Culture
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WASTE IS A RESOURCE OUT OF PLACE
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LOUISIANA WETLAND LOSS

Carbon oxidized during wetland loss and lost degraded carbon sequestration capacity

1900 square miles 1932-2000
282 million tons of CO2e

24 square miles continue to be lost each year
700 square miles of marsh loss by 2050

91 million tons of CO2e
Other Greenhouse Gases

- The generation of methane and nitrous oxide can offset benefits (23 times and 310 times more powerful than carbon dioxide).
- The proportional release is variable and dependent upon many factors.
- Monitoring is required to quantify other GHG above background.
- Wetland restoration projects can be operated in a way that minimizes methane and nitrous oxide.
Features That Can be Controlled to Maximize Benefits

- Water levels
- Salinity (sulfate)
- Pulsing
- Nutrient form and loading rates
- Tree or plant species
- Available iron (precipitates sulfides and reduce \( N_2O \)) (River and ferrate disinfection)
- Nutria control
FUTURE SCIENCE NEEDS

Explain carbon pool interactions.
Quantify carbon mechanisms in wetlands.
Quantify the generation of other GHG.
Quantify avoided release due to alternative management strategies.

Fate and transport of C during wetland loss
Pulsing regimes
Chemical form of the nutrient
Loading rate
Salinity (sulfate)
Value of Carbon Credits

- US 2-6 dollars per ton 2010-2015
- Up to 30 dollars a ton by 2020 (legislation)
- Central Wetland Unit Value Over 50 Years
  - 34,000,000 tons CO2e
  - 68-200 Million Current Market
  - 1 Billion Potential Market
- Other GHGs?
Policy Implications

- Building an ecosystem services framework for looking at sustainable water management will facilitate the integration of the municipal water, conservation, and energy sectors.

- Emergency management policies need to be overhauled to give latitude to pursue more resilient sustainable alternatives.

- A carbon market that incorporates land use change and wetlands could provide global carbon-related benefits while giving local water managers a funding mechanism to adapt.