

CHALLENGES AND STRATEGIES FOR ECOSYSTEM RESTORATION OF A SINKING DELTA PLAIN

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INTRODUCTION

Coastal erosion is a major global problem and is most acutely felt along developed coastal areas where coastal communities and infrastructures are threatened by storm surge flooding. This situation gets compounded to a bigger challenge around most of delta plains which are rapidly subsiding. The degree and magnitude of challenges associated with erosion and submergence along muddy deltaic coasts is intricately related to population density. It is estimated that about 500 million people in the world live on river deltas (Syvitski et al., 2009). Coastal populations and their associated industries/economies (oil & gas, fisheries, port and commerce etc.) are thus threatened by rapid degradation of the deltaic landscapes. This situation is further complicated by sea level rise and high-energy events such as hurricanes (cyclones, typhoons).

MISSISSIPPI RIVER DELTA PLAIN

The Mississippi River Delta Plain (MRDP) in Louisiana (Figure 1) is an ecocatastrophe that derives from combination of human intervention punctuated by natural causes, which has triggered subsurface geological and geophysical processes that degrade the coastal landscape (Khalil et al., 2018). Since the 1930s, the extremely high rate of land loss in coastal Louisiana threatens a range of key national assets and locally important communities. Preservation and restoration of Louisiana's environmentally sensitive wetlands, marshes and barrier islands is in the national interest.

A large-scale effort to restore the MRDP is underway, an effort made more challenging by reduced sediment supply from the Mississippi River, rising sea levels, separation of the delta plain from the river by levees, oil and gas activities, and navigation infrastructure. Restoring deltaic habitat in coastal Louisiana requires forethought and strategic planning. It also requires the consideration of a range of possible future environmental drivers that may be the result of regional phenomenon outside of local control. Because accommodation space is growing and sediment resources are limited, it is understandable that the entire coastal zone cannot be preserved.

RESTORATION - CHALLENGES AND STRATEGIES

Managing complex ecosystem environments of coastal Louisiana in which the natural and socio-economic systems are highly integrated is inherently difficult. In addition, deltaic environments are uniquely challenged due to the interdependence and delicate balance of water, land and economic systems and future uncertainties regarding the magnitude and rate of climate change impacts. Adaptive Management is notably critical in coastal Louisiana as most of the strategies adopted for restoration of this highly degraded ecosystem are a first-

of-their-kind, either in scale or scope, and do not have well-established boiler plate/text book templates to follow. Adaptive Management of coastal Louisiana encourages an integrated and flexible approach to land and water management that takes into consideration the risks and uncertainties. It promotes solutions that are sustainable even if conditions change by providing a mechanism for robust decision making.

Adaptive Management is a new program being designed to streamline the implementation of various restoration strategies recommended in the Coastal Master Plan (CPRA, 2012, 2017) by maximizing its long-term benefits through institutionalization of the lessons learned. It is further differentiated from lessons learned as it represents the larger, structured process for resolving uncertainties and integrating new knowledge into the planning, design, construction, and operation of projects, as well as providing adaptation pathways to allow maximum flexibility for future management decisions. The Adaptive Management as a strategy (1) allows for flexibility in implementation as conditions change, (2) allows for resolution of uncertainties to improve future decision-making, and (3) enables the modification of constructed projects while informing the development of future projects. Strategizing this approach is expected to overcome several challenges for ecosystem restoration of MRDP. By allowing flexibility in implementation as conditions change, the Adaptive Management Program is also essential to the long-term performance of these projects and the achievement of the greatest amount of positive ecosystem improvement via coastal restoration. It is thus expected that application of Adaptive Management principles to the management of our coast will improve decision-making, will build institutional knowledge and capacity to continually improve our understanding of the system, and will facilitate the informed adjustment of management actions to best achieve long-term sustainability of our coast (Raynie 2017).

There are some great lessons to be learned from the world's sinking deltas in general and MRDP in particular as how human interventions compromise the ecosystem by disrupting natural process. Critical to the restoration of this complex ecosystem is the understanding that sustainability can only be achieved by replicating and restoring the geomorphic forms via sedimentological restoration followed by ecological restoration to restore ecological functions. Thus robust sedimentological restoration is key to a sustainable ecosystem restoration of MRDP (Khalil et al., 2018).

From the above it is apparent that central to problems as well as solutions is the "sediment". Human activities that disrupt natural sediment transport to the delta as fluvial loads negate a sustainable coast. Globally, degrading shorelines need frequent artificial infusion of sediment. Coastal communities have lately realized the importance

and value of sediment for their very existence if a sustainable ecosystem is to be maintained.

SEDIMENT MANAGEMENT PLAN

As stated earlier Sedimentological restoration plays a critical role in the ecosystem restoration of MRDP (Khalil and Raynie, 2015). In addition, ecological restoration can only be achieved on stabilized coastlines where sediment budgets have been restored. To this end, the main challenges for sedimentological restoration are, understanding sources and sinks, and predicting the rate of land growth under restoration strategies that include river/sediment diversions, marsh creation, and barrier island restoration. Critical to implementation of these strategies is the understanding that sediment dynamics and availability are not haphazard, but related to underlying/subsurface geology. Therefore, this complex problem cannot be fixed until there is a good understanding of the underlying geological setting and processes. The overarching solution to the problem is a holistic approach that develops a robust regional sediment management plan.

CONCLUSION

This presentation will review the challenges faced, their causes, and recent advances supporting an integrated approach to coastal sustainability by strategizing the recommendations of Coastal Master Plan (CPRA, 2017). Also included is an overview of the geological setting of MRDP as it relates to sediment resources in coastal Louisiana as an adjunct to emphasizing the need for a regional approach to managing sediment.

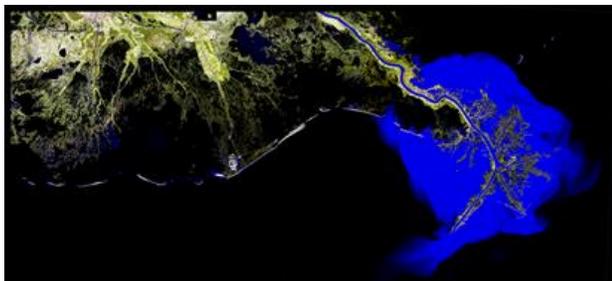


Figure 1 - Landsat 8 image of Part of degrading Mississippi River Delta Plain including Bird's Foot Delta

REFERENCES

Coastal Protection and Restoration Authority of Louisiana (CPRA), 2017: Louisiana's Comprehensive Master Plan for a Sustainable Coast. CPRA, 167p

Coastal Protection and Restoration Authority of Louisiana (CPRA) 2012. Louisiana's Comprehensive Master Plan for a Sustainable Coast. CPRA, Baton Rouge, LA: 189p. <http://lacoast.gov>.

Khalil, Raynie (2015): Coastal Restoration in Louisiana: An update. Shore & Beach, Vol. 83, pp. 4-14.

Khalil, Freeman, Raynie (2018): Sediment Management for Sustainable Ecosystem Restoration of Coastal

Louisiana. Shore & Beach, Vol. 86, pp. 17-27.

Raynie 2017. CPRA's Adaptive Management Program: Overview. Coastal Protection and Restoration Authority, Baton Rouge, LA. 33p.

Syvitski, Kettner, Hannon, Hutton, Overeem (2009): Sinking Deltas due to Human Activities. Nat. Geosci. 2:pp. 681-86.