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DELTA WATERS: Research to Support Integrated Water and Environmental Management in the Lower Mississippi River

Concerns about hurricane protection and ecological health in the lower Mississippi River delta have grown in the 21st century, as ongoing challenges have been compounded by such events as Hurricanes Katrina and Rita and the Deepwater Horizon explosion. The Water Institute of the Gulf was established in Baton Rouge in 2011 to provide scientific and engineering advice to the state of Louisiana for a variety of coastal restoration, ecosystem management, and hurricane protection projects. The National Research Council produced a report to guide the Water Institute's research to support integrated water resources management (IRWM). The following research opportunities are excerpted from the report.

STRATEGIC RESEARCH FOR INTEGRATED MANAGEMENT	
Research Synthesis	Preparation of a Mississippi River Delta Research Synthesis report offers an important research opportunity. This report could include a map of major research institutions and programs. It would require a robust geographic definition of the delta, a historical review of Mississippi River delta research and development, and a perspective on the international context for research.
Condition of the Gulf	A comprehensive state-of-the-Delta baseline for data across water, landscape, and human factors has not been established, which is a research gap and a research opportunity.
	The Water Institute could provide the central motivation and coordinating effort for the promising research opportunity of developing a "Condition of the Delta" assessment. This ideally would be conducted with broad collaboration among stakeholders and scientists working in the Delta.
Research Design for Water Diversions	The Water Institute could identify key decision-relevant scientific uncertainties in planned Mississippi River diversion projects, propose building experiments into project and policy design, and contribute to scientific monitoring of results.
	Design of scientific research to support adaptive management of large-scale ecosystem restoration projects is a significant research opportunity in the Mississippi River delta context.
	As some uncertainties will unfold during the course of diversion experiments, a "quick response" research grant program for internal and external applicants could facilitate rapid collection of perishable data in the event of environmental surprises and hazards.
Long-term monitoring	A research opportunity in complex deltaic systems is to help identify emerging decision-relevant variables and time scales, and then to propose cost-effective adjustments in monitoring programs, including new data sources, methods, and technologies.
Human settlement and occupation	There are research opportunities for analyzing land use and settlement patterns and trends, and for explaining how projects and policies influence those trends in ways that advance or constrain the paths and prospects for integrated water and environmental management.
Tectonics and Deltaic Zonation	More detailed mapping of major geologic areas of relative stability, major land loss vulnerability, and land building potential could help guide research on diversions and coastal protection project performance.
SCIENCE-POLICY ANALYSIS: AN EMERGING RESEARCH FRONTIER	
Science-Policy Research	There is a growing body of international research on science-policy studies of deltaic vulnerability and sustainability. At the same time, there are expanding opportunities for rigorous comparative research on science-policy programs in other regions (e.g., the Netherlands) for integrated water and environmental management in the Mississippi River delta.
Collaborative Modeling, Negotiation, and Conflict Resolution	The Water Institute would have an excellent opportunity to promote, and lead, more advanced scientific stakeholder engagement in joint fact finding and modeling processes. A strong contribution to research on negotiation and collaborative modeling would entail some level of commitment to developing the required professional skills to create and lead collaborative modeling procedures.

The Louisiana Coastal Master Plan	There is an excellent opportunity to build a research program around multiple interacting types of restoration projects and policies.
	Near- and medium-term research opportunities include the integration of storm protection structures with delta restoration projects that emphasize natural or green infrastructure. This integrated approach could encompass and contribute to the objectives of a vigorous energy and marine transportation economy, storm risk reduction, commercial fisheries, recreational opportunities, and a healthy coastal ecosystem.
Citizen Science	The design of collaborative processes that mobilize members of the public to facilitate monitoring programs is another research opportunity. Part of this effort could include a leadership role for the Water Institute in developing digital information and communications technology with citizens in the lower Mississippi River delta.
	Hosting of international citizen-science workshops also could identify innovations in other deltas that have relevance for the lower Mississippi, and ultimately help transfer knowledge to those regions.
Developing Decision Support System Tools	Development of Decision Support System applications represents another science-policy research opportunity. This work initially could help support restoration project implementation, encourage integration of structural and nonstructural water and environmental management alternatives, and also encourage participatory stakeholder and citizen-science programs.
RESEARCH COORDINATION AND ORGANIZATIONAL OPTIONS	
Research Coordination	The Water Institute will have opportunities to build working, collaborative relationships with a rich variety of research and educational institutes, and private industry—including energy exploration and development firms, fisheries, tourism, and the maritime transportation sector. Examples include hosting international seminars, scholar exchange, and establishment of a special delta research journal.
COMPARATIVE RESEARCH: TRANSFERRING AND APPLYING KNOWLEDGE	
Transferring and Applying Knowledge	The Water Institute could define those traits that best characterize the Mississippi River delta, and begin to establish connections and comparisons with a small, diverse set of other delta regions.
	To help prioritize its own international studies and collaborations with other delta regions, a simple framework of international research *aims* and *methods* could be developed to screen, rank, and select its international activities.
	In the near term, a small set of strategic Gulf-centric deltaic comparisons may be the main type of international research on analogies that the Water Institute undertakes.
	Over the medium-term, Water Institute scientists would benefit from strategic engagement in multi-delta comparisons, such as the Delta Alliance's study of vulnerability and resilience.
	In the longer term, the Water Institute may be in a position to develop a small number of continuous, cooperative problem-driven and thematic research programs with other delta regions. Examples include: 1) environmental/ecosystem restoration—Rhine, Danube, Irrawaddy; 2) natural hazards mitigation—Ganges-Brahmaputra, and Mekong; 3) energy industry, environment, and conflict—Niger, Yellow rivers, Indian Ocean, Arctic deltas; 4) sediment trapping and land loss—Mekong and Yellow; and 5) urban planning and flood risk reduction—in New Orleans, the Connecting Delta Cities program, Pearl, and Yangtze deltas.

For more information, visit the Water Sciences and Technology Board at http://dels.nas.edu/wstb or contact them at (202) 334-3422. Copies of *Delta Waters: Research to Support Integrated Water and Environmental Management in the Lower Mississippi River* are available for purchase or as free PDFs at www.nap.edu.