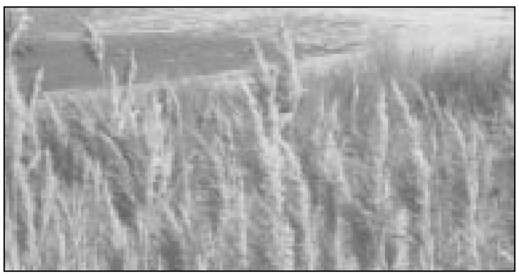
C A S E   S T U D Y   7

WETLAND RESTORATION IN LOUISIANA



Situation

Coastal wetlands in Louisiana play an essential role in the vitality of commercial and sport fishing and recreational hunting. But these wetlands are being devastated by a host of continuing human activities that range from population growth to artificial levees for flood control to the mining of offshore oil fields. Wetland restoration is critical and poses difficult choices that must take into account short and long-term costs.

Background

The Louisiana coastal zone is one of the Nation's foremost geological, biological, and cultural resources. Containing 40 percent of the country's coastal wetlands, it includes 2.5 million acres of marshes (fresh, brackish, and saline) and 637,400 acres of forested wetlands. The Louisiana coastal zone, created by the Mississippi River, is the most active deltaic land mass in North America, draining 40 percent of the 48 contiguous states and substantial areas in the Canadian provinces.[1]

Between 50 to 75 percent of Louisiana's residents live within 50 miles of the coast. These inhabitants benefit from the numerous resources and resource services that wetlands provide. They are the source of livelihood to a substantial number of people including fishers and foresters. Even those who do not depend economically on marshes benefit from the hurricane and flood protection they provide through absorption of storm surges and mitigation of flood damage. The coastal zone also serves valuable water quality treatment functions.

[1] Coastal wetland formation: The land forms within the coastal zones (with the exception of salt domes) were formed as a result of the dynamic interactions between river deposition, waves and currents, and subsidence. Over the past several thousand years, the Mississippi River has periodically changed course. This "delta switching" causes some areas of land to build while others deteriorate. When the river shifts into a new channel, land is built rapidly. The river builds a delta out into shallow shelf areas until its course becomes long, sinuous and inefficient, at which time it changes course to follow a shorter, more efficient route to the Gulf. It is this change which switches the location of the delta. The periodic switching has resulted in a series of delta lobes in various stages of abandonment and deterioration. These lobes, deprived of riverine sediment, slowly break up and erode. However, because a new delta was always building, a natural balance between sinking and accretion existed. At any one location there could be land gain or land loss. In fact, for the past 5,000 years, there has been a net coastal land gain in the Mississippi deltaic plain of between one and two square miles a year. However, the natural cycle of deltaic development — the continuous building and eroding of river basins — is no longer operative today due to human intervention (Coastal Resources Program-Louisiana Department of Transportation and Development. 1978. The Value of Wetlands in the Barataria Basin).

While the natural beauty and abundant wildlife of the wetlands attract tourists from all over the country, the region possesses a unique cultural diversity that includes Native Americans, European immigrants, and Cajun ancestry.

Commercial importance of the Louisiana coastal wetlands includes major economic activities related to commercial fishing, recreational hunting, and sport fishing. Fishing is Louisiana's oldest industry and its prominence is directly attributable to the area's extensive marsh and estuarine system.[2] The region supports the largest coastal finfish and shellfish fisheries in the country, producing two billion pounds of fish and shellfish annually. The Louisiana Wildlife and Fisheries Commission issued over 63,000 commercial fishing licenses in 1985, including almost 16,000 commercial shrimp licenses. The recreational hunting and fishing activity of the region are also substantial. The Louisiana coastal zone leads the Nation in trapping of fur-bearing animals and operates a highly regulated harvest of alligator skins.[3]

Coastal Wetland Decline — Causes and Conflict

For decades artificial levees, managed by the U.S. Army Corps of Engineers with Congressional, State, and public support, have confined the Mississippi River to its present channel, preventing a change of course and the associated development of new delta regions. The purpose of the levees is to contain overflows for navigation and flood control. However, the ecological balance and productive capacity of the adjacent wetlands are adversely affected by the lack of additional fresh water and nutrient-rich material. The river control structures confine the sediments to the river channel and transport it to deep Gulf of Mexico waters so that most of these sediments are discharged over the edge of the continental shelf, forever lost to the sediment-starved coastal zone. In addition, the Mississippi's tributary dams and other activities have significantly reduced the sediment load carried by the river.

In addition to flood control activities, another major cause of coastal erosion is construction of navigation, oil recovery, and access canals. Canals adversely impact the wetlands by interfering with sheetwater flow, allowing destruction by wave action, reducing nutrient exchange, decreasing interface, and increasing salinities. Spoil banks, created by the deposition of material dredged from the canals also result in wetland deterioration. Approximately 8 percent of the marshes in coastal Louisiana have been converted to canals and associated spoil banks.[4] Other activities, such as land reclamation projects for agricultural, urban, and industrial purposes, have also destroyed many acres of viable wetland. The pollution from toxic chemicals and oilfield brines contributes to wetland degradation as well.

Wetland loss due to flooding as a result of subsidence-related sea level rise is another problem. Sea level rise occurs as land forms shrink, resulting in a relative rise in water level. Scientific evidence exists which suggests that sea level rise may accelerate significantly due to atmos-

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[2] *Ibid.*, p. 36.

[3] U.S. Department of the Interior. 1994. The Impact of Federal Programs on Wetlands, Vol. II. A Report to Congress by the Secretary of the Interior. Washington, D.C., p. 143.

[4] Coalition to Restore Coastal Louisiana. 1987. Coastal Louisiana: Here Today and Gone Tomorrow? A Citizens' Program for Saving the Mississippi River Delta Region to Protect Its Heritage, Economy, and Environment. Draft for public review, p. 10.

pheric warming resulting from the greenhouse effect.[5] These rises would led to increased flooding and additional loss of coastal wetlands.[6]

The cumulative impact of human activities and natural processes on the coastal zone has been devastating. At the turn of the century, coastal Louisiana contained 4.07 million acres of wetlands. By 1978, 22 percent of the wetlands had been lost. Conservative estimates indicate that another 3 million acres have been lost since then. Current loss rates are estimated to be about 0.75 percent per year. It is projected that if losses are not reduced, another 167 million acres of Louisiana coastal wetlands will disappear or be converted by the year 2000. These predictions indicate that the Gulf shoreline will advance inland as much as 33 miles in some areas. About 1,200 businesses, residences, camps, schools, storage tanks, electric power substations, water control structures, and pumping stations would require protection or relocation. Furthermore, the U.S. Army Corps of Engineers estimates that without action to reverse projected wetland losses commercial fish and shellfish harvests will decline by 30 percent by the year 2040.[7]

The threatened disappearance of Louisiana coastal wetlands have potentially staggering economic, cultural, and environmental consequences. The loss of habitat for coastal fish, shellfish, and wildlife species would be colossal. The loss for social and cultural functions which depend on proper ecological functioning of the coastal zone would also be devastating. Furthermore, the present Louisiana coast would become uninhabitable as flooding moves further inland.

Coastal Wetland Restoration Management Plan

The prospective losses of wetland functions and services have motivated implementation of a wetland restoration policy. That policy is based on the belief that technological ingenuity and management can separate wetland destruction from some of the causes of that destruction, navigation, flood control, oil and gas production, and urban development. The short-term costs of employing advanced techniques and restoration strategies will undeniably be substantial; the long-term costs, however, of not employing environmental engineering technologies and not implementing management and restoration strategies may be far greater. A restoration program might concentrate on three tasks:

1. Enhancement of sediment and fresh water input into the coastal zone and capture of resuspended sediments

2. Repair or restoration of disturbed wetlands and barrier island transacted by exiting canals

3. Phase-out and halt to construction or expansion of canals.

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[5] Some scientists predict that sea level rise by 2075 may range from 38 to over 200 centimeters depending on the global level of combustion of fossil fuels and emissions of other greenhouse gases.

[6] Coalition to Restore Coastal Louisiana, *op. cit.*, p. 10.

[7] U.S. Department of the Interior, *op. cit.*, p. 154.

Benefits and Costs of Wetland Restoration Strategies

A wetland restoration policy for the Louisiana wetlands coastal zone must manage all of its uses, both short term and long term. One key factor in developing a plan — recognition of the conflicts over multiple uses and societal tradeoffs — is determining the economic value of the wetlands. Economic values provide a basis for realistic appraisal of the wide-ranging social impacts generated by various proposed restoration developments. Thus, the overall benefits and costs of maintaining and restoring Louisiana's coastal wetland resources must be assessed.

A benefit-cost analysis can be conducted by assigning a dollar value to a unit-acre of wetland. However, the economic value of the services provided by wetlands is difficult to appraise due to the lack of a market mechanism for directly pricing those functions. For example, the benefits derived from the wetland's provision of food for commercial fish species and fur-bearing animals have often been ignored. Other values typically disregarded because of the difficulty in assigning economic value are recreational opportunities provided by the wetlands, such as hunting, crabbing, bird watching, swimming, and camping.[8]

Furthermore, the economic value of the protective services provided by wetlands, for instance, storm and flooding protection and the absorption of urban and agricultural waste products, are also difficult to assess, as are the option value and existence value. The option value is the amount which non-users place on a unique resource to know that it is there and could be used, while the existence value is the amount which non-users place on the knowledge that the wetlands exist, even if they never intend to use them directly.

Despite the data and methodological limitations, analysts have developed several different methods by which to value wetlands, including (1) economic impact analysis (EIA); (2) willingness-to-pay (WTP); and (3) energy analysis (EA). These methodologies attempt to place economic value on wetland-related activities and services. In general, some of the major services provided by wetlands can be classified into the following categories: commercial fishing, recreational fishing, commercial trapping, and recreation (subdivided into economic impact expenditures for recreation and the estimated value of user benefits related to recreational activity), and storm protection.

Gross Economic Contribution Analysis. The gross economic contribution analysis for wetland valuation focuses on the question of gross impact on the economy. In other words, values for major activities associated with wetlands are estimated on the basis of gross benefits to the economy. A per-acre value for each of the wetlands-dependent activities is determined, and the respective values are summed to derive the total estimated monetary worth of a wetland acre in its natural state. Case Table 7.1 presents the estimated gross economic contribution of a wetland acre in Louisiana's Terrebonne Parish.[9]

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[8] Coastal Resources Program-Louisiana Department of Transportation and Development, *op. cit.*, p. 85.

[9] For consistency within the case study, the name of this coastal area has been changed. See the source, Coastal Resources Program-Louisiana Department of Transportation and Development, *op. cit.*, for additional information.

Case Table 7.1. Estimated Gross Economic Contribution of a Wetland Acre in the Terrebonne Wetlands.

Activity Director	Annual Return Per Acre	Present Value Per Acre
	Fishing and Hunting	
Commercial fishing	$286.36	$5,540.42
Non-commercial fishing	3.19	46.40
Commercial trapping (Pelts and meats)	11.69	170.05
	Recreation	
Economic impact of recreation expenditures	60.08	873.89
Economic value of user benefits from recreation	104.33	2,428.17
Total	$465.65	$9,058.93

WILLINGNESS-TO-PAY (WTP). The willingness-to-pay approach to wetlands valuation is based on the concept of consumer surplus — this is a measure of the amount a consumer would be willing to pay to continue receiving the good or service, over and above what the consumer is already paying. Thus, in the case of the Louisiana wetlands, WTP estimates the value of the wetlands based on an evaluation of society's willingness-to-pay to avoid the loss of an acre of wetlands or wetland area. Theoretically, this estimate represents the maximum society would pay rather than do without. WTP assumes that the resources employed to produce the good are not part of the value of the resource but are transferable to other uses. The difficulty with the technique is in obtaining true estimates from all the potential beneficiaries for all the direct and indirect goods and services provided by the wetlands. Costanza and Farber used WTP to assess the value of the Terrebonne Parish wetlands in Louisiana.[10] Case Table 7.2 summarizes their estimates of the WTP valuation wetland service categories. Column 2 shows the annual values on a per-acre basis. The authors note that it may not be appropriate to place the storm protection values on a per-acre basis.

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[10] Costanza, R. and S. Farber. 1985. The Economic Value of Wetlands in Terrebonne Parish, Louisiana. Final Report to the Terrebonne Parish Policy Jury.

Case Table 7.2. Summary of WTP valuation of Terrebonne Wetlands, using 1983 dollars*.

Valuation Category	Annual per Acre Value of Wetlands	Per Acre Present Value at Various Discount Rates	Per Acre Present Value at Various Discount Rates
(1)	(2)	(3)	(4)
		8%	3%
Commercial Fishery	$25.37	$317.00	$846.00
Trapping	12.04	151.00	401.00
Recreation	3.07	46.00	181.00
Storm Protection	128.30	1,915.00	7,549.00
Total	$168.30	$2,429.00	$8,977.00
Option and Existence	NA	NA	NA

***The present values for recreation and storm protection assume population growth rates of 1.3%**
Source: R. Costanza and S. Farber. 1995. *The Economic Value of Wetlands in Terrebonne Parish Louisiana*. A Final Report to the Terrebonne Policy Jury.

ENERGY ANALYSIS (EA). In contrast to WTP, energy analysis looks at the supply side of wetland values, as opposed to the demand side. The method uses the total amount of energy captured by natural ecosystems in primary production as an estimate of their potential to produce economically useful products such as fish and wildlife. The energy captured in photosynthesis is the basis for the food chain that ultimately supports all the production in wetlands, or in any natural system. Therefore, a suitable analysis of the inputs to these systems might provide a convenient index of their ultimate value to society. However, there is no guarantee that all of the products of wetlands are useful to society, and some values to society (e.g., aesthetics and recreational value) are omitted in EA estimates. Case Table 7.3 presents a summary of EA based value estimates for Louisiana wetlands as assessed by Costanza and Farber. These values range from $6,400 to $10,602/acre using an 8 percent discount rate to $17,000 to $28,600/acre using a 3 percent discount rate. Their “best estimate” for the value of an acre of wetlands is a range: $2,429 to $6,400 per acre using an 8 percent discount rate, and $8,977 to $17,000 per acre using a 3 percent discount rate.

Exercise

The activities that have had the most damaging effects on the coastal region are primarily related to the major economic uses of the Mississippi River and coastal zone for navigation, flood

Case Table 7.3. Gross primary production and energy analysis-based economic value estimates for relevant Louisiana wetland and marine habitats.

Habitat type	Total Energy Captured Measured by GPP[a] kcal/m^2/yr)	Annual Equivalent Dollar Value[b] (\$/ac/yr)	Net Marsh-Aquatic Change in Annual Value (\$/ac/yr)	Present Value (\$/ac) assuming rate[i] 8%	Present Value (\$/ac) assuming rate[i] 3%
Salt marsh	48,000	624			
Salt aquatic	6,600	86	538	6,700	18,000
Brackish marsh	70,300	914			
Brackish aquatic	5,130	67	847	10,602	28,200
Fresh marsh	48,500	630			
Fresh aquatic	9,300	121	509	6,400	17,000
Coastal plankton	3,600	47 (Average)	631	7,900	21,000
Spoil banks[c]	13,000	169			

[a] GPP is gross primary production. Values are from Hopkinson 1979.

[b] Based on conversion factors of 0.05 coal equivalent (CE) kcal/GPP kcal 15,000 CE kcal/1983 dollar and 4,047 a^2/ac. The overall conversion factor from GPP (in kcal/m^2, to estimated economic value (in \$/ac/yr) is therefore: (05 x 4047) 15000x.013. See the ONR report for details.

[c] Estimated from values for upland systems.

[i] Rounded to nearest \$100.

Source: R. Costanza and S. Farber. 1995. *The Economic Value of Wetlands in Terrebonne Parish Louisiana.* Final Report to the Terrebonne Parish Policy Jury.

control, oil and gas production, and urban development. For years the manner in which these enterprises were carried out have resulted in wetland sediment starvation and delta destruction. In essence, the Louisiana coastal zone is engaged in an economic-ecologic conflict. The region's abundant variety of resources have allowed a wide diversity of economic activity. The utilization of these resources has led to both economic development as well as ecological degradation. Coastal wetland degradation will continue unless a coastal wetlands policy which restores deltaic functions is adopted.

Suppose that you have been asked to be a member of a task force to develop a wetland restoration policy for Terrebonne Parish. Given the information provided in this case study, consider the following questions:

1. What are some of the advantages and limitations of the "valuation" approaches outlined above?

2. What role can environmental valuation play in regional wetland restoration policy?

3. How would environmental valuation at the regional level differ from the use of economics at the site level?

4. The capitalized value of an annual stream of wetland benefits is highly dependent on the discount rate, which reflects the value which people today put on retention or production of a resource for future use, and the predicted value of coastal wetlands for fish and wildlife, recreation, water quality management, storm buffer protection and other functions in future years. One can expect that the value of the coastal Louisiana wetlands would increase if their resources were to become scarce through lack of proper management. What discount would you suggest be used in this analysis?

5. It has been suggested that, to date, existing legal mechanisms for regulating activities in the Louisiana coastal zone have not been sufficiently restrictive of access and navigation construction projects. A wetland restoration policy must develop more stringent regulatory programs in this regard by imposing mitigation requirements which will fully compensate for direct and indirect land loss where dredging of canals is permitted. Construction of access and navigation canals should be drastically restricted by mandating use of alternative means of access for oil and gas equipment. With regard to urban development, it has been suggested federal subsidies should be suspended (e.g., funds for low-income housing, mortgage insurance, and National Flood Insurance for urban development projects) in environmentally significant wetlands. These expenditures currently offer significant incentives for development that impacts important wetlands. They also set the stage for future federal outlays for damages caused by storms to developments located in naturally flood-prone areas. Strictly on economic grounds, would it make sense (in terms of sound public policy) to withhold incentives for developing areas subject to high flooding risks?

6. Which of the various economic approaches would be used by different stakeholders in the policy decision process? How would economic information be developed and presented by each group?

   - Developers
   - Local agencies making decisions regarding public investments
   - Interest groups
   - Public at large
   - Federal regulators/decision makers

7. How can the various economic approaches aid in developing consensus among stakeholders?