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FUNCTIONS AND VALUES OF PRAIRIE WETLANDS: ECONOMIC REALITIES

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Abstract. *Land and water resources of the Prairie Pothole Region support important economic and ecologic activities. Scarce resources, such as wetlands, should be allocated among these activities such that society's well being is enhanced. Such allocation requires knowledge of the relative values of resources, something that has been largely missing in the wetland literature. This paper describes the practical realities of wetland economics, using the Prairie Pothole Region as an example. Ongoing human and economic activities in the PPR are presented as an introduction to the economy of the area. The purpose for economic valuation of wetlands—achieving the "greatest good"—is briefly discussed. The connection between wetlands and human values is described. Five types of wetland valuation methods are discussed: market, surrogate/proxy, revealed preference, stated preference, and benefits transfer. Finally, some suggestions are made to add value to all types of wetland science by enhancing the collaboration among wetland scientists.*

The economic reality is that "economics is the reality" in public policy making. In other words, economics should not be treated as an impediment or adversary to sound wetland management but should be considered its best ally. We often hear that "you can't put dollar values on wetlands," but, in fact, until there are some reasonable estimates of value, wetlands policies will not be optimal for society (except by chance).

The principles of human values were hammered out among economists decades ago, and little else needs to be done in the area of economic theory that would be useful to the wetland policy debate. Concepts surrounding wetland economics came out of the decade of the Seventies in fair shape (Leitch and Ekstrom 1989). Additional theoretical foundations of wetland economics were developed during the late Seventies and in the Eighties, as the theories of microeconomics and welfare economics were melded into a

new discipline called resource and/or environmental economics (Randall 1987; Pearce and Turner 1990; Coker and Richards 1992; Freeman 1993). Scattered attempts at empirical work have appeared since the Sixties but, for a number of reasons, those with appropriate training and background in economics have been reluctant to get involved with empirical assessments of wetlands. However, there is no shortage of literature on economic values of wetlands authored by non-economists, most of which suffers from a lack of disciplinary rigor.

This article addresses the practical realities of using wetland economics to value wetlands in an area such as the Prairie Pothole Region (PPR) (Fig. 1). Ongoing human and economic activity in the PPR are presented as an introduction to the economy of the area. The purpose for economic valuation of wetlands is briefly discussed. The connection between wetlands and human values is described. A brief overview of wetland valuation methods is presented to demonstrate the realities of applied science. Finally, some suggestions are made to add value to all types of wetland science by enhancing the collaboration among wetland scientists.

Economic Profile of the Prairie Pothole Region

Located in the central plains of North America, the Prairie Pothole Region is an area of more diversity than its name implies. Nearly 12,000 years ago, glaciers laid down a blanket of glacial till over the bedrock of the Northern Great Plains (Wills 1972). Today that glacial till supports agricultural practices that dominate the pothole region's economy. From the time of the European settlers' arrival over a century ago, agriculture has been the primary way of life for the people of this region. However, agriculture is not the pothole region's only source of economic activity. Mineral mining and oil production also help in the role of supporting the region's resource-based economy. Stretching from the north-central portions of Iowa to south-central Alberta and from western Minnesota to the foothills of the Rocky Mountains, this corner of North America offers society more than just prairie potholes or a commons for buffalo.

In the 1860s, a settler in the Prairie Pothole Region might have acquired a 160-acre tract of land that would be enough to support both the family's food and financial needs (Benedict 1953; Bolino 1966). Typical farm sizes now range from 350 acres in north-central Iowa to 1,150 acres in Saskatchewan, with many units being several thousand acres. In the PPR, there are more than 128 million acres of land under crop production, capable of producing over $10 billion in crop receipts annually (Table 1).

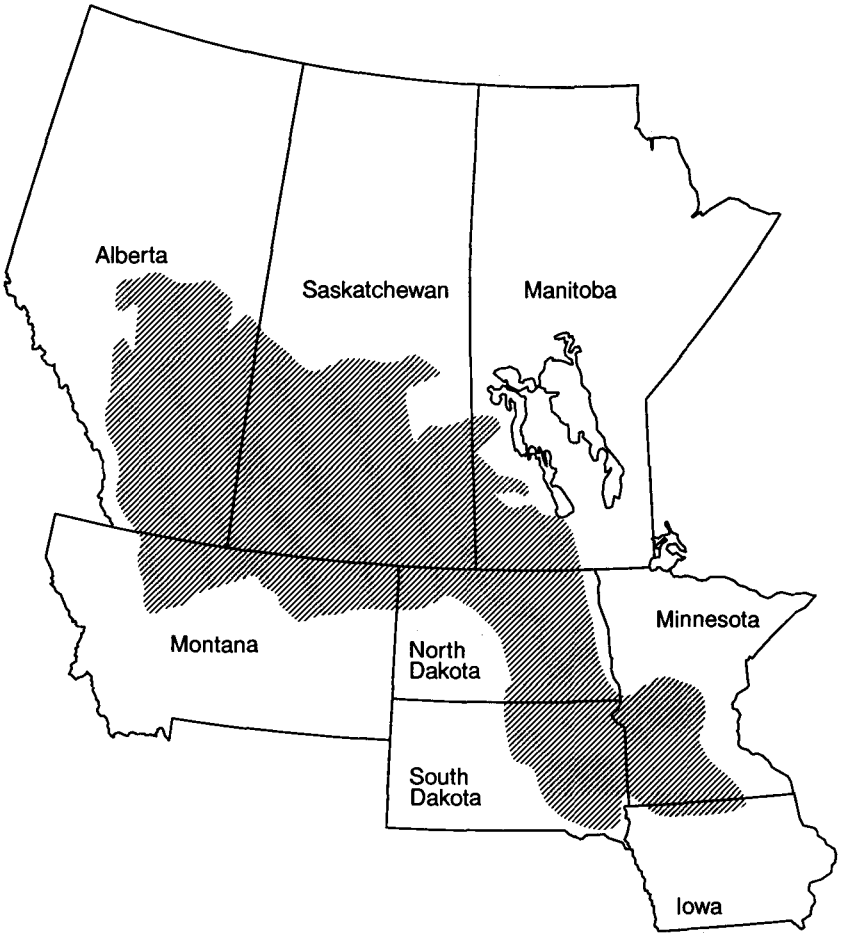

Figure 1. North America's Prairie Pothole Region.

Within the United States portion of the PPR, small grains and row crops such as wheat, barley, corn, and soybeans are some of the commonly produced crops. Canadian farmers produce primarily wheat and barley in the PPR, but also grow other crops such as canola and hay. Livestock also plays an important role in the agricultural sector of the economy. Between the United States and Canada, more than 27.5 million head of cattle, sheep, and hogs help support the livestock industry in the PPR (Table 1).

TABLE 1
PRAIRIE POTHOLE REGION SELECTED STATISTICS

	Prairie Pothole Region of		
	United States	Canada	PPR Totals
Human Population	2,189,000	3,617,000	5,806,000
Cropland (acres)	42,112,000	86,082,000	128,194,000
Livestock (#head)	12,933,000	14,656,000	27,589,000
Crop Sales (US$000)	$5,265,000	$6,447,000	$11,712,000
Livestock Sales (US$000)	$4,274,000	$5,275,000	$9,549,000
Coal Production (metric tons)	6,415,000	20,020,000	26,435,000
Oil Production (barrels)	15,660,000	274,800,000	290,460,000

Sources: U.S. Bureau of the Census (1997); U.S. bureau of the Census (1994); Minnesota Agricultural Statistics Service (1996); Iowa Agricultural Statistics Service (1996); South Dakota Agricultural Statistics Service (1996); Montana Agricultural Statistics Service (1996); North Dakota Agricultural Statistics Service (1996); Energy Information Administration (1995); Rathge and Olson (1993); Montana Oil and Gas Conservation Division (1996); Statistics Canada (1997); Natural Resources Canada (1997).

Paleozoic-aged rocks contain a variety of energy resources, including oil and natural gas, which gave birth to the fossil fuel industry of the PPR. Together, the United States and Canada produce nearly 16 million barrels of oil annually in the Prairie Pothole Region (Table 1). Lower-grade coal deposits, mostly lignite and subbituminous, in the Northern Great Plains are becoming increasingly important resources. These deposits are Late Cretaceous to Early Tertiary strata and are most extensive in the Williston and Powder River Basins of Montana, Wyoming, and North and South Dakota (Wicander and Monroe 1993). About 26.5 million metric tons of coal are mined annually in the PPR (Table 1). Potash mines near Regina and Saskatoon, Saskatchewan, account for 85% of Canada's potash output (Statistics Canada 1997).

This profile is a reminder that the Prairie Pothole Region is valuable to society for its resource-based industries as well as for its wetlands. This region is not only an agricultural mecca, but also an area rich in fossil fuels. It is important to understand that agriculture and mining are major contributors to the Prairie Pothole Region's economy. Their existence, as well as the economic sectors that support them and are supported by them and an extensive transportation, communications, and utilities infrastructure are necessary for the sustained economic success of the region. It is also important to recognize that the region has few, if any, unclaimed resources. In other words, all resources, including location, are presently being put to use by individuals, groups, or governments. Therefore, to reallocate any of the region's resources, it is necessary to have an understanding of their relative values to society.

Purpose for Economic Valuation of Wetlands

In pursuit of the "greatest good" now and in the future, society, through its decision makers, must make decisions about the allocation of scarce resources. Not making a decision is also a decision. It is not necessary to identify the "greatest good" or what is "socially optimum" at this point; that is the subject of much philosophical debate. All that is necessary is to acknowledge pursuit of the "greatest good" as a legitimate social goal, to recognize that individually superior decisions about wetlands do not necessarily sum to a social optimum (Danielson and Leitch 1986), and to recognize that all resources are in limited supply. In addition, all resources have some positive value as inputs now or in the future for contributing to the "greatest good." The relative value of the inputs is dynamic, site-specific, and a function of their abundance relative to other inputs and to time, technology, and other production factors.

Because of historical cultural practices, wetlands are today one of society's scarce natural resources. The social value of wetlands is neither infinite nor static (in time or place). Unless a policy choice is made that wetlands have infinite value (which still does not make it so!), an estimate of their finite value is necessary for good decision making (CAST 1994). Some have criticized the use of dollars as the indicator of wetland value. Economics does not require that values be measured in dollars, but it is a convenient common denominator. Some have argued that other common denominators—such as the BTU—are more appropriate for natural resources but their arguments have not been convincing when society is making choices among

a wide variety of resources (Odum 1979). Vague assertions, such as "But true value goes beyond money" (Farewell et al. 1997) negate the usefulness of any valuation attempt since the door is left open for an infinite value on all choices.

The purpose of sound economic valuation of wetlands is to ensure that they are managed appropriately from society's perspective to help achieve the "greatest good" now and in the future. Economics is how science is integrated into policy making (Lackey and Blair 1997). Any valuation, evaluation, or assessment scheme, such as protecting prairie pothole wetlands, that excludes economics (making choices) will only approach the "greatest good" by chance.

Human Values and Wetlands

Society (i.e., humans) values wetlands for one basic reason: because they can be used as resources (inputs) to provide satisfaction now and in the future (i.e., an indicator of the "greatest good"). People get satisfaction from the outputs (i.e., goods and services) available from wetlands and, to a lesser extent, from simply knowing that wetlands exist. Human satisfaction can be realized through consumptive or non-consumptive uses of wetlands or wetland outputs.

Consumptive uses of wetlands can include conversion to cropland, transportation infrastructure, industrial uses, or residential uses. Consumptive uses of wetland outputs include hunting, fishing, trapping, and harvesting of plants (including trees) from wetlands. Non-consumptive uses of wetland outputs include wildlife observation, landscape aesthetics, and the host of off-site benefits (e.g., flood control, atmosphere enhancement, water quality control). Non-consumptive uses of wetlands include several "non-use" values, such as option (the value of using it in the future), existence (just knowing it exists), and bequest (the value of knowing it will be available for future generations) values. Another type of value, intrinsic value, however, has little meaning for public decision making because if it can be argued to exist for one resource (e.g., wetlands), it can be argued to exist for all or most other resources (e.g., forests, prairies, theme parks), thereby not helping to make rational choices among resources.

Like the type of use (i.e., direct or indirect, present or future), value is not one-dimensional. Wetlands do not have unique, discrete, or static economic values. In addition to spatial and temporal variations, there are at least four social perspectives from which wetland value can be measured:

individual owner; individual user; regional; and societal (Leitch and Hovde 1996). Thus, attention must be given to clearly identify what and whose value is estimated.

Estimates of the human-based economic values of wetlands range from negative to priceless (Leitch and Ludwig 1995). Some prairie potholes have been estimated to be valued at well over $1,000 per acre (Hubbard 1989), while others have been estimated to have negative values for some functions, such as water quality or as a disease vector (Roberts 1997; Hazeltine 1992).

Wetland Valuation Methods

Economists value wetlands from a human perspective using a variety of market and non-market valuation methods (Scodari 1990, 1997; Leitch and Ludwig 1995). The methods are generally not controversial, as opposed to the results or interpretations of those results. Based on the lead author's experience, the sources of most criticism of wetland valuation studies are: (1) misapplication of basic economic principles; (2) disagreement with human-based value systems; or (3) assumptions about missing physical/biological/chemical wetland data with which to operationalize otherwise sound valuation models and methods.

Market values: Market values are simply economic values observable in actual markets. Compared to other economic sectors, few markets exist for wetlands or wetland goods and services. However, some wetlands are bought/sold in a marketplace as are some wetland goods and services. These market values need to be considered in light of buyers' intentions and "normalized" or corrected when necessary for market imperfections (e.g., relationships, institutions, or factors that skew market prices). Real estate values are one example of where market prices have been used to evaluate wetlands. Another example is estimating the market values of wetland plants harvested and sold for livestock feed.

Surrogate/proxy values: Economists have developed a number of techniques for estimating the economic values of non-market goods, such as wetlands, in the absence of more direct techniques. The concept of *defensive expenditures* is used as a proxy for valuing the flood control value of wetlands. For example, the cost of defending against flood damages that could have been prevented by wetlands is a proxy for the flood control value of wetlands. *Replacement costs* have been used to value wetlands in some instances,

either the cost to replace the wetland or its goods and services. Using the flood control example, the cost to replace the function provided by a wetland would be its replacement cost. Finally, the *next best alternative* is a method that assumes a resource is worth at least the cost of the next best alternative. There are other surrogate/proxy valuation methods, but the idea is consistent with the examples given here.

Revealed preference values: Revealed preference valuation relies on using data related to the wetland to "tease out" an implicit value for the wetland. For example, the portion of the total value of a waterfowl hunting experience can be estimated using revealed preference techniques. Likewise, the added value of living next to a wetland can be isolated from the price of housing. The hedonic pricing method uses regression analysis to identify the contribution individual components (e.g., a wetland) make to total value (Abelson 1996; Freeman 1993). The Travel Cost Method is a revealed preference technique that uses the differences in costs to travel to a site, something that can be observed, to help "reveal" the value of a site or amenity (Randall 1987).

Stated preference values: Perhaps the most common technique for valuing non-market goods, including wetland resources, is the Contingent Valuation Method (CVM). With the CVM, individuals are simply asked to state what value they place on non-market goods and services. They may be asked their "willingness to pay" or their "willingness to sell/accept" under various hypothetical conditions. Environmental economists have devoted considerable attention to perfecting CVM methods over the past two decades, and they are generally well accepted by the profession, but are drawing increasing criticism (Carson et al. 1996). Developing rigorous CVM survey instruments is not easy but there are many application articles available as well as numerous empirical examples in the literature (Willis and Corkindale 1995; Mitchell and Carson 1989).

Stated preference methods are used for valuing both use (direct and indirect) and non-use values. Non-use values typically include option, existence, and bequest values, but may have other labels. Basically, non-use values are those that individuals have for an amenity that result from not using the amenity today.

Benefits transfer: Using the values estimated for a site, situation, or amenity elsewhere as an estimate of the value of another site, situation, or amenity is

called benefits transfer—transferring the value estimate from one place to another (Taff and Leitch 1997). This has been a common practice reported in the wetlands literature, but one that has often led to misleading value estimates. For example, the U.S. Army Corps of Engineers' study of the role of wetlands on flooding in the Charles River Basin has been cited countless times as a possible value in other locations (Roberts 1997). Unless the circumstances are similar in the other locations, the Charles River results are not applicable. Another example of potential misuse of benefits transfer has occurred with the oft-cited study of Louisiana coastal marshes and their economic values (Gosselink et al. 1974).

Enhancing Wetland Valuation

Estimates of the social values of wetlands span a broad continuum, ranging from negative to infinite and everything in between. The primary shortcomings to more robust estimates useful for human decisionmaking are

- disciplinary barriers (e.g., communication) among the many scientific disciplines involved with wetlands,
- lack of attention to economic principles,
- the site-specific nature of most wetland values,
- lack of specification about the valuation context (i.e., both the value system and the value perspective), and
- shortage of useful physical and natural science information about relationships among wetlands and relationships between wetlands and other natural and human systems.

These shortcomings can be overcome, with adequate resources, through the scientific process. However, that process must be free of special interest pressures before some of the existing chasms are successfully bridged. Overcoming these shortcomings would lead to more confidence in estimates of wetland value, resulting in public policies that move society closer to the "greatest good." However, some of the philosophical differences will probably never disappear.

Conclusions

Economic activity is important to the almost six million human inhabitants of the Prairie Pothole Region. However, human activity in the PPR

impacts the natural environment, including wetlands. Economics is a paradigm that can help to make better decisions about allocating scarce resources among many competing uses in the PPR, including wetlands. Resource economics, as applied to wetland issues, is a maturing disciplinary area whose contribution is truncated due to several exogenous shortcomings. Until those shortcomings are largely overcome, resource allocation may not be optimal, nor will the "greatest good" likely be achieved for society, present and future, in the region. For example, the socially optimal use of wetlands in the Prairie Pothole Region is unlikely without more attention paid to their human values in economic terms.

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