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Is the conversion of land from agricultural production to a bioreserve boon or bane for economic development?

The Cache River Bioreserve as a case study

R.J. Beck, S.E. Kraft, and J.H. Burde

ABSTRACT: This article reviews issues confronting policy makers when evaluating economic benefits and costs when converting land from agricultural production to a "bioreserve" to protect and/or restore endangered ecosystems (e.g., wetlands, cypress swamps/bottom land hardwoods) while providing a flow of recreational and wildlife/ecological services. Using IMPLAN, a regional input-output model, the overall economic gains and losses from this land-use change are assessed. The results show that while a large proportion of the total economic benefits are experienced by resource suppliers outside the core region containing the bioreserve, total economic activity is expected to increase as a result of the land-use shift from agricultural production to environmental preservation.

Key words: land-use change, bioreserve, economic development, watershed planning, regional input-output analysis.

Changes in land use are frequently suggested by conservationists as necessary to protect soil and water resources or to protect/restore endangered ecosystems. While the proposed changes in land use upon implementation result in positive ecosystem benefits, the economic impacts to the regional economy can be positive or negative. The belief that there will be negative economic impacts from the proposed land-use changes for conservation purposes can lead to strong opposition to the change. Increasingly, sustainable economic development is used to rationalize the proposed land-use changes (Wackernagel and Rees 1996; Ecological Sustainable Development 1996). Consequently, conservationists need to understand how to apply tools of economic analysis that permit measuring the economic impacts of the proposed land-use changes. This paper presents a general model for evaluating the economic benefits of shifting land from agricultural to nonagricultural conservation uses.

A functioning economic system rewards suppliers of resources while meeting multiple societal goals accommodating shifting consumer demands, means of production, and political, economic and social forces. Ron Shaffer (1989) suggests that, "economic development is the sustained, progressive attempt to attain individual and group interests through expanded, intensified, and adjusted use of available resources." For effective policy formation, methods of evaluating alternative outcomes for programs designed to meet societal goals are necessary.

Methods of valuing natural resources and environmental benefits are becoming part of the ecological-economic literature (Bartelmus 1994; Jenkins n.d.; Mitchell and Carson 1989), but balancing the benefits to society of policies designed to increase the current and future stream of environmental benefits against the social costs of such actions is not straight forward (Batisse 1982; Forman and Godron 1986). As an initial step in identifying the issues and developing a framework for examining these tradeoffs, a cost-benefit analysis can be employed. This assertion is not without critics. Many would argue that such an analysis is inappropriate because of the problem of measuring costs and benefits in monetary terms of environmental goods/services.

This paper identifies those transactions for which markets reflect monetary values. Cost-benefit analysis involves an *ex ante* estimation and evaluation of the net benefits associated with alternative states

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(Sassone and Schaffer 1978). To accomplish this analysis, the net economic impact of a regional project is defined as the difference between existing economic activity in the region with a quantity of land used for one activity (i.e., production agriculture) compared with economic activity that is projected to occur when land is devoted to an alternative recreational/wildlife activity (e.g., the preservation of endangered ecological resources while providing a flow of recreational and wildlife/ecological services). This approach is similar to the with/without scenarios used in project analysis (Gittinger 1982; Hamilton et al. 1991). The "project" is the transition of land use. In this example, the shift in land use occurs as a "bioreserve" (Jenkins n.d.; Noss 1992) is established in an area with an endangered ecosystem. The "without" portion of the analysis is land used in the existing ways to produce agricultural commodities and provide income for land owners. The "with" portion of the analysis is the shift in land use from agricultural to providing a flow of recreational and wildlife/ecological services.

Defining economic impact area

To evaluate economic activity in a region requires an inventory of existing uses of land, and then attaching economic values to activity associated with that land use. One economic state "without" is paired to another economic state "with", comparing the net outcomes derived from the two states. Some people prefer the status quo, the "without" scenario (e.g., production agriculture), as their economic welfare suffers as a result of the change in policy. Others will likely prefer the change in land use, believing that every person's welfare has improved due to the expected enhancement of flow of environmental services resulting from the change in land use. The economist performing the analysis is guided by one overriding criterion "everybody's preferences count" and are counted equally in the evaluation of the alternative economic states: some benefit from the project, others lose. To operationalize the cost-benefit analysis, the concept of potential Pareto superiority can be employed (Hicks-Kaldor formulation of Pareto optimality). In brief, it means that an economic state is preferred if the change in land use is better than an economic state without the change. Those who gain by the transition in land use have the potential to compensate those who lose; and upon completion of the transition, they are no worse off after compensating those who lost welfare as a result of the change in land use. If the transition is perceived as a win-win situation, then the real and perceived benefits of the change are likely to result in a recommendation to proceed with the change in land use (Bator 1958; Hamilton et al. 1991; Shaffer 1989).

The adversely affected parties are likely to say this is acceptable in theory, but how can it work in practice? A second question is that the timing of the impact also is different. Therein lies the crux of the problem. These actions affect people of different values, income levels, occupations, and socioeconomic status. How can an assessment and comparison of economic activity with and without the transition be accomplished? Table 1 catalogs the benefits and costs of creating the bioreserve using land that has been in agricultural production. The table indicates how farmers, others in the vicinity of the bioreserve, and others in the society can be affected by the formation of the bioreserve. Entries reflect items that can be measured in monetary units as well as some items that are not so measured. Furthermore, a procedure can be used that builds on the circular flow of an economic system. Households provide labor, capital, management, and land services to firms who combine these resources producing valued commodities and services and rewarding the suppliers of the inputs according to the market value of those inputs. Suppliers of resources use the wages, rents, interest, and profits to purchase produced goods and services provided by firms. If a measuring of these rewards and payments can be accounted for using the "with" and "without" criterion, then the net economic activity generated with the project and without the transfer in land use can be assessed.

Land use without the bioreserve is determined and the net rewards to suppliers of resources assessed. With the formation of the bioreserve and the associated land-use changes, the net rewards to suppliers of the resources can be assessed again and the two assessments can be compared to determine losses or gains from the change. Using this approach, if net economic activity from "with" (i.e., with the bioreserve) is equal to or greater than net economic activity without the bioreseve, then it is assumed that the net benefits of the change in land use outweigh the costs, and gainers could potentially compensate losers and still be no worse off as a result of the change. Note that this methodology only accounts for value in terms of payments to resource suppliers (e.g., those resources that pass through markets to which monetary values can be assigned). It is not accounting for the value of the unused natural resources (land, water, air, forests, and minerals) nor is it estimating the flow of environmental services and amenities associated with land use in either scenario.

Defining geographic economic impact area

The measurement of economic impact of the alternative states should be consistent with the geographic domain of the respective states. This geographic domain is likely to vary for the two alternative states. Agricultural producers farming in the area designated to "produce recreational and wildlife/ecological services" (i.e., the bioreserve) are directly affected. Suppliers of agricultural services, especially those selling to farmers in the bioreserve, also are affected. Net income accruing to input suppliers associated with agriculture and related agribusinesses need to be identified and valued. The point is that most, if not all, of the primary and secondary economic linkages connected with agricultural land use can be expected to lie within the market area of the affected businesses. For example, the agriculture sector uses diesel fuel for tractors and

Table 1. Benefits and costs of bioreserve creation (present value)

	Farmers	Others	Society
Benefits			
Protect and restore endangered ecosystem		X	X
Wetlands protection		X	X
Cypress swamp/hardwood		X	X
Intrinsic values		X	X
Recreational benefits		X	X
Soil and water protection	X	X	X
Costs			
Loss of revenue from producing agricultural commodities	X		X
Loss of business to forward and backward links to agriculture		X	X
Loss of revenue to taxing bodies		X	X
Critical agricultural mass	X	X	X
Community issues decided by outsiders	X	X	X

combines. The wholesaler of diesel fuel will probably be within an 83-km (50-mi) radius of the farm while the refinery's market area serves several states. Only the economic value added by economic activity (wholesalers and retailers) in the project area should be counted.

Diffusion of positive, secondary impacts across space for services of land resources other than agricultural is likely to be more widespread and less concentrated than for agriculture. For example, values of land can exhibit both use and option values (Fisher and Hanemann 1987). The use value of the land for purposes other than agricultural production is the utility enhancement of all people who experience satisfaction from the creation and functioning of the bioreserve. This use value can be monetized by noting the number of people willing to travel alternative distances and their expenditures associated with experiencing the bioreserve. This value can be captured by distances traveled to the bioreserve, and for expenditures incurred while traveling to and visiting the area. The geographic area that serves as the market area for these visitors is the appropriate "region of analysis."

Option values or intrinsic values are values attached to the resource itself, the rare and irreplaceable species. The preservation of the rare species by land use designed to protect these species is a value "above and beyond" the use value of the resource. The geographic area for these options values might well be people residing anywhere, although people living closer to the bioreserve may exhibit greater levels of option values than people at greater distances. In this case study, only use values are accounted for; option values are recognized, but are not considered in the analysis.

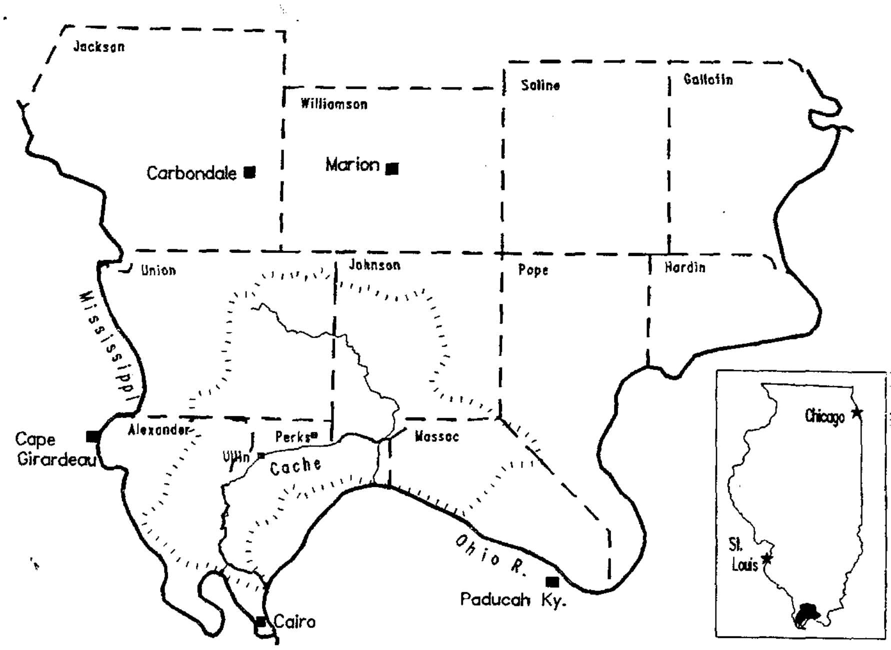

Figure 1. Location of Cache River Watershed–Illinois

The project area

The Cache River watershed encompasses a 1,944 km^2 (451,000 ac) area of five southern Illinois counties (Alexander, Johnson, Massac, Pulaski, and Union) (Figure 1). The watershed, located near the confluence of the Mississippi and Ohio Rivers, is at the juncture of four physiographic provinces: Central Lowlands, Interior Low Plateau, Coastal Plain, and Ozark Plateau. Consequently, the area is rich in biological diversity. Given the establishment of the Cache River bioreserve, the "with" scenario in the context of this paper, there were benefits and costs associated with the changing land-use patterns.

This analysis incorporates an evaluation of a bioreserve with a core area containing a critical ecological resource that must be protected and/or restored (Batisse 1982; Jenkins n.d.; Noss 1992). For the Cache River bioreserve, this resource is wetland and forest communities within a 20,000 ha core area where the Nature Conservancy, U.S. Fish and Wildlife Service, Illinois Department of Natural Resources, and Ducks Unlimited Inc. are coordinating efforts to protect and restore natural ecological communities. Surrounding the core is a buffer area within which land uses have profound effects on the continued vitality of ecological resources in the core and the performance of the regional economy.

The challenges of economic development and natural community restoration in the Cache River bioreserve include (1) identifying in a diversified, although sparse, regional economy, economic development opportunities in the watershed that will replace or enhance economic activity after establishment of the bioreserve, and (2) proposing alternative land-use scenarios that are ecologically compatible with preservation of natural communities throughout the watershed (Hisock 1986).

The bioreserve area is rich in threatened ecological resources but is located in an impoverished rural economy (Table 2) with few economic linkages among business establishments within the region and minimal infrastructure to take advantage of potential economic opportunities. To build the analysis on the use-value concept of the bioreserve, the value of the land for use as a bioreserve can be reflected by expenditures of visitors attracted to the bioreserve and the value-added of these expenditures to the local economy.

The unique and diverse plant and animal communities that remain in the Cache River watershed have led to the designation of 58 sites as Natural Areas by the Illinois Department of Conservation; and two sites have been designated as national Natural Landmarks by the U.S. Department of Interior. As many as 100 species of plants and animals on the Illinois threatened and endangered species list are known to occur within the watershed (U.S. Soil Conservation Service 1987). The Cache River basin also supports 10 globally rare or endangered species and ecological communities. For purposes of this analysis, the expected economic value to the region of protecting these rare and endangered species is that visitors would be drawn to the area to observe the ecological community, and spend money earned elsewhere within the area.

Although the biodiversity of plant and animal life is high in the region, the sustained economic viability of the area is threatened as evidenced by low per capita incomes, high unemployment rate, outmigration, and low rates of labor force participation. Between 1980 and 1990, human population declined 2.6%, with the population ending the decade with 61,867 people (Table 2). Only 37.1% of

Table 2. Prevailing economic indicators in counties containing the bioreserve

	5-county area a	State of Illinois b	(a/b) 100
Population, 1990	61,867*	11,430,602	.54
Population, 1995	63,554	11,829,940	.54
Labor force, 1990	22,979	6,029,000	.38
Labor force, 1995	26,227	5,999,000	.44
Economically Active Population†, 1990	37.1	52.7	70.4
Economically Active Population, 1995	41.3	50.7	81.5
Per capita income, 1989, $	11,802	18,870	62.5
Owner-occupied housing, $ Median value, 1990	32,737	80,900	40.5
% of personal income from wages and salaries, 1990	38.8	65.0	59.7
% of personal income from transfer payments, 1990	27.0	13.1	206.0
Number of farms, 1987	1,898	88,786	2.1
Average value of land & buildings, 1987/acre	$674	1,262	53.4
Average value of land & buildings, 1992/acre	$762	1548	49.2
Change in number of farms, 1987-1992	-11.2%	-12.6%	88.9
Change in value of land and buildings, 1987-1992	+13.1%	+22.7%	57.7
Market value of products sold, per farm, $, 1992	$44,919	94,535	47.5
Market value of products sold $1,000, 1992	75,735	7,336,864	1.0
Total cropland, 1992 (thousand acres)	361	24,164	1.5
% of farm operators with farming as principal occupation, 1992	48.6	61.7	78.8
% of farm operators who worked 200 or more days off-farm, 1992	37.9	31.0	122.3

Source: U.S. Census Bureau 1994a, 1994b, 1997

* The five-county area consists of Illinois counties of Alexander, Johnson, Massac, Pulaski, and Union.

† Economically Active Population (EAP) is equal to the number of persons in the labor force divided by the total number of persons times 100.

Table 3. Expected visitors to the bioreserve's core area and its surrounding buffer area

		Core area		Buffer area
Year	Nonconsumptive visitor days (number)	Hunting/ waterfowl visitor days (number)	Hunting/except waterfowl visitor days (number)	Waterfowl hunting clubs visitor days (number)
Base year (1991)	1,524,000	35,000	54,000	unknown
Year 5	1,600,000	37,000	36,000	2,000
Net increase over 1991	76,000	2,000	2,000	
Year 10	1,760,000	40,000	59,000	5,000
Net increase over 1991	236,000	5,000	5,000	
Year 15	1,970,000	45,000	64,000	10,000
Net increase over 1991	446,000	10,000	10,000	

Estimates based on (Illinois Dept. of Conservation n.d., 1989a, 1989b, 1991, Missouri Dept. of Conservation 1989)

the region's population was in the labor force compared to the statewide average of 53%. The average 1990 per capita income in the area was 63% of the state average (U.S. Census Bureau 1994a). By 1995, however, there was some improvement in the economy with 41.3% of the region's population economically active, Table 2.

The benefits and costs of changing land-use patterns were projected based on ecological and socioeconomic perspectives. A replicable framework is illustrated to integrate socioeconomic and ecological parameters, and model impacts associate with land-use changes in an economically sparse rural watershed. This approach applied geographical information systems (GIS) to simulate and evaluate ecological changes resulting from land-use changes, and economic modeling using a hybridized regional input/output model (IMPLAN) (Alward et al. 1989; University of Minnesota 1989) and the Small Area Assessment Model (SAAM) (Antle and Robinson 1990) maintained by the Army Corps of Engineers. For a comparison of IMPLAN with other regional models see Rickman and Schwer (1993).

Analysis

Using this bioreserve concept, ecological analyses were integrated with an economic model to assess the ecological and economic impacts of projected land-use scenarios. This study also estimated the regional economic impacts of shifting land use in the core area from agricultural production to the restoration of wetlands and other natural communities and production of attendant wildlife/recreational/ecological values. This change in land use incorporated the restoration of natural communities and the development of wildlife habitat within the core area. Additionally, changes in the recreational portion of the economy over three 5-year periods were reviewed at 5 years, 10 years, and 15 years. This allowed for an anticipated gradual increase in entrepreneurial activity by investors seeking to satisfy the growing demand for commercial recreational services. Greater entrepreneurial and business activity would result in the opportunity for a larger proportion of the demand for goods and services by visitors to the area being supplied locally. This is difficult to document, but there has been some improvement in employment opportunities, Table 2, suggesting an overall improved economy. Through the regional input/output model, a proportion of nonresident demand (i.e., the demand for services and products coming from visitors) could be specified that could be met by local businesses.

Estimating the economic benefits to the region capturing local value-added expenditures by visitors was accomplished in the following manner. Average annual visitor-days to the region in the absence of the project were determined. These data were collected from visitation surveys conducted in the region and from planning documents prepared by the Illinois Department of Conservation (recently renamed Department of Natural Resources) (Illinois Dept. of Conservation 1989a, 1989b, 1991; Whitton 1992a, 1992b). The expected increase in non-consumptive, waterfowl hunting and hunting visitor-days other than waterfowl with the project were estimated. Based on visitor data in the southern Illinois region and from information on similar wildlife areas in Missouri (Missouri Dept. of Conservation 1989) (Table 3). These data suggest that after the first 5 years of the project there would be an increase of 76,000 non-

Table 4. Summary data for determining recreational impacts in bioreserve's core area

Activity/expenditure	1991	Impact scenario Year 5	Year 10	Year 15
A. Non-consumptive	1,524,000	1,600,000	1,760,000	1,970,000
net increase over 1991		76,000	236,000	446,000
	Expenditure	RPC*	RPC*	RPC*
Food and drink	$5.05	60%	70%	85%
Transportation	$2.91	50%	60%	75%
Lodging or camping	$1.33	60%	70%	85%
Equipment	$6.47	30%	40%	50%
Guide fees	$0.16	80%	85%	90%
Special expenditure	$0.14	50%	55%	60%
Total per VAD†	$16.06			
Total expenditure	$24,475,440	$1,220,560	$3,790,160	$7,162,760
B. Hunting/waterfowl	35,000	37,000	40,000	45,000
net increase over 1991		2,000	5,000	10,000
	Expenditure	RPC*	RPC*	RPC*
Food and drink	$21.42	60%	70%	85%
Transportation	$10.09	50%	60%	75%
Lodging or camping	$10.52	60%	70%	85%
Equipment	$6.47	30%	40%	50%
Guide fees	$0.47	100%	100%	100%
Special expenditure	$1.32	50%	55%	60%
Total per VAD†	$50.29			
Total expenditure	$1,760,150	$100,580	$251,450	$502,900
C. Hunting, other	54,000	56,000	59,000	64,000
net increase over 1991		2,000	5,000	10,000
	Expenditure	RPC*	RPC*	RPC*
Food and drink	$6.04	60%	70%	85%
Transportation	$4.81	50%	60%	75%
Lodging or camping	$3.13	60%	70%	85%
Equipment	$7.17	30%	40%	50%
Guide fees	$0.47	80%	85%	95%
Special expenditure	$1.00	50%	55%	60%
Total per VAD†	$22.62			
Total expenditure	$1,221,480	$45,240	$113,100	$226,200
Total expenditure A+B+C		$1,366,380	$4,154,710	$7,891,860
D. Local expenditure Totals for A, B, & C above				
Food and drink		$263,232	$930,370	$2,147,865
Transportation		$125,480	$456,756	$1,085,145
Lodging or camping		$77,028	$267,491	$620,228
Equipment		$254,044	$638,048	$1,511,010
Guide fees		$11,420	$36,444	$73,389
Special expenditure		$7,640	$24,552	$51,384
Total local expenditures		$738,844	$2,353,661	$5,489,021
E. Apportioned to IMPLAN sectors and local expenditure totals distributed				
Other wholesale trade		$85,765	$277,943	$646,777
Other retail trade		$79,219	$221,044	$519,617
Hotels and lodging places		$77,028	$267,491	$620,228
Eating and drinking places		$193,739	$684,752	$1,580,829
Auto repair and services		$75,288	$274,054	$651,087
Hunting guides/club		$11,420	$36,444	$73,389
Total net local impacts		$522,458	$1,761,728	$4,091,927

* RPC: Regional Purchase Coefficient indicating the proportion of nonresident demand that is met by local business establishments.
† VAD: Visitor Activity Day is one visitor per one activity day
‡ Apportionment is achieved on the basis of margining the level of expenditure to the appropriate IMPLAN sectors.
Source: Expenditure data derived from Missouri Dept. of Conservation (1989)

consumptive visitor days, 2,000 water fowl hunting visitor days, and 2,000 non-waterfowl hunting visitor days in the bioreserve area (Table 3).

The IMPLAN program estimates the proportion of demand for a particular sector's output that is purchased from local suppliers and calls this the regional purchase coefficient (RPC) for the respective sectors. The model adjusts these RPCs to reflect expanding entrepreneurial activity in the region (Table 4). For example, in Table 4 the RPCs for food and drink associated with nonconsumptive activity start at 60% in year five and increase to 85% by year 15. These estimates were used to develop a sensitivity analysis of the average daily expenditure of a visitor and the amount s/he was expected to spend locally (Table 4). Each visitor activity day (VAD) for a nonconsumptive visitor was projected to spend a total of $16.06. This expenditure was allocated across a number of economic sectors (e.g., eating and drinking establishments, service stations, etc.) of the local economy. The proportion of the $16.06 that was spent locally is derived by examining the expenditure amount for an economic sector and multiplying it by the corresponding RPC. These values were then summed across the number of visitors for each type of visitor. Table 5 presents similar data for activities taking place outside of the core area where the land-use change will take place. This is called the "buffer" area. The largest anticipated change in this area that will take place as a result of the establishment of the bioreserve is the hunting of waterfowl associated with hunting clubs. Similar to the procedure suggested by Siegel and Leuthold (1993), using IMPLAN, the data from Tables 4 and 5 were then used to change final demand in the affected sectors and to estimate the direct, indirect, and induced effects of the expected change in final demand. As part of the bioreserve, planning called for the construction and operation of a visitor center. The potential impact of this on the local economy was also estimated by increasing the number of persons employed in the corresponding economic sectors.

Similarly, the establishment of the bioreserve will reduce agricultural output causing a reduction in agriculturally related economic activity in the region. As with the positive impact of visitors to the region, the accompanying negative economic impacts of a reduction in agricultural production were estimated. A summary of the economic effects of reducing

Table 5. Summary of data for determining recreational impacts in the buffer area

Activity/expenditure		Impact scenerios		
A. Off-refuge visits (hunt clubs)	1991 Unknown	Year 5 2,000	Year 10 5,000	Year 15 10,000
	Expenditure	RPC*	RPC*	RPC*
Food and drink	$21.42	60%	70%	85%
Transportation	$10.09	50%	60%	75%
Lodging or camp	$10.52	60%	70%	85%
Equipment	$6.47	30%	40%	50%
Club fee and/or	$46.64	100%	100%	100%
Special expenditure	$1.32	50%	55%	60%
Total per VAD† Total expenditures	$96.46	$192,920	$482,300	$964,6000
B. Local expenditures				
Food and drink		$25,704	$74,970	$182,070
Transportation		$10,090	$30,270	$75,675
Lodging or camp		$12,624	$36,820	$89,420
Equipment		$3,882	$12,940	$32,350
Guide fees or licenses		$93,280	$232,200	$466,400
Special expenditure		$1,320	$3,630	$7,920
Total local expenditures		$146,900	$391,830	$853,835
Local percentage of total		76.15%	81.24%	88.25%
C. Local expenditure totals distributed and proportional to IMPLAN sectors				
Food and drink		$6,226	$18,349	$44,696
Transportation		$2,968	$9,027	$22,061
Lodging or camp		$12,624	$36,820	$89,420
Equipment		$18,918	$55,178	$134,004
Guide fees or licenses		$6,054	$18,162	$45,405
Special expenditure		$93,280	$233,200	$466,400
Total net local impacts		$140,070	$370,736	$801,985

*RPC: Regional Purchase Coefficient indicating the proportion of nonresident demand that is met by local business establishments.
†VAD: Visitor Activity Day is one visitor per one activity day
‡ Apportionment is achieved on the basis of margining the level of expenditure to the appropriate IMPLAN sectors.
Source for expenditure data in part A are derived from Missouri Dept. of Conservation (1989)

Table 6. Agricultural impacts of establishing recreation/preservation activities in core areas

			Impact scenario	
Activity	Total	Year 5	Year 10	Year 15
Land acquisition*		40%	65%	100%
Total land area (ha)	15,183	6,073	9,869	15,183
Row crops (ha)	9,474			
-10% FWS lease (ha)	8,526	3,411	5,542	8,526
Feed grains	29.1%			
Corn crop (ha)	2,480	907	1,612	2,480
Impact per ha†	$543.03			
Impact amount	($1,346,572)	($538,629)	($875,272)	($1,346,572)
Food grains	12.9%			
Wheat crop (ha)	1,124	441	717	1,124
Impact per ha†	$322.29			
Impact amount	($355,719)	($142,288)	($231,218)	($355,719)
Oil crops	58.0%			
Soybean crop (ha)	4,943	1,977	3,213	4,943
Impact per ha†	$436.70			
Impact amount	($2,158,517)	($863,407)	($1,403,036)	($2,158,517)
Net direct impact	($3,860,808)	($1,544,324)	($2,509,525)	($3,860,808)
Total effect of agricultural land-use change	($5,219,249)	($2,087,700)	($3,392,570)	($5,219,249)

* Assumes acreage purchases follow distribution of refuge boundary, GIS analysis.
† Assumes crop budgets follow national average costs of production and county average level of production.

the level of agricultural activity in the area is presented in Table 6. These data are presented over a 15-year period assuming a phased purchase of land from willing sellers and the possibility of some of the land being rented back for crop production. For example, in the fifth year with 40% of the total land placed in the bioreserve, there would be a reduction of annual, total economic output of $1.5 million.

IMPLAN provides a mechanism for estimating the direct, indirect, and induced economic effects on resource suppliers in the region of both the positive effects of increased visitors to the area and the negative effects of a reduction in agricultural activity. The ecological portion of the project indicates that establishment of the core area without development of a recreational component will have a positive effect on the development of habitat for wildlife and restoration of ecological functions (Beck et al. 1993). However, land-use changes in the core area will have a negative effect on the economy due to the loss of agricultural production (Table 7). After the first five years the projected shift of land out of agricultural production into the creation of the bioreserve should cause an annual reduction in industrial output of $2.088 million, a reduction in personal income of $0.809 million, and a loss of 22 jobs. In contrast, after the first five years of the project, the operation and maintenance of a visitor center in conjunction with the local economic effect of other visitor expenditures in the core area should result in an increase of $2.746 million in total industrial output, a $1.134 million increase in personal income, and a gain of 42 jobs.

After five years, the net result of the expected economic activity resulting from the bioreserve is that an overall increase of economic output is expected to occur. This increase, according to the IMPLAN model, is on the order of $0.658 million of increased economic output occurring in the region, an increase of $0.324 million in personal income, and an increase in employment of 20 jobs (Table 7). This result is similar to the conclusion reached by Douglas and Harpman (1994) who found that the outdoor recreation sector of an economy is relatively labor intensive. Over the 15 years for which projections were made, the positive economic impacts would continue to increase based on the increase in visitors and the increase in the proportion of goods and services purchased locally by these visitors. The impacts of economic activity in the buffer area surrounding the bioreserve are also

Table 7. Summary of economic impacts of anticipated land-use changes in the core and buffer areas of the Cache Bioreserve

Type of impact	Economic effect level of change: Total industrial output ($MM)	Total personal income ($MM)	Employment (no. jobs)
Agricultural land use 5 yr	(2.088)	(0.809)	-22
Operation and maintenance of visitor center 5 yr	1.951	0.830	26
Recreational 5 yr	0.795	0.304	16
Combined agricultural,operation and maintenance and recreation			
5 yr	0.658	0.324	20
10 yr	0.942	0.395	37
15 yr	3.003	1.201	96
Buffer area hunting clubs			
5 yr	0.233	0.097	6
10 yr	0.614	0.254	15
15 yr	1.335	0.550	33

Source: IMPLAN Reports (University of Minnesota 1989)

Table 8. Economic impact of establishment of bioreserve: A comparison of the net impacts in the core counties and the surrounding counties.

	5-county core area*	6-county adjacent area†	Total change‡
Total economic output (thousand $)	+891	+661	+1,552
Total personal income (thousand $)	+422	+313	+735
Total employment	+26	+19	+45

* From IMPLAN model using five-county area as impact area.
† From SAAM model (Antle and Robinson 1990), comparing five-county area and economic spillovers into six-county, adjacent areas.
‡ Note these changes are the projected after five yr from the creation of the bioreserve.

presented in Table 7.

These results imply that after five years the net result of the establishment of the bioreserve should increase total economic activity in the five-county area of the bioreserve. Thus, in the context of this paper, the bioreserve should be preferred to the land remaining predominately in agricultural production, because of the expected increase in total economic activity in the five-county region.

There are two caveats to this result. The first is that the people affected by the two scenarios are in most cases not the same people. Farmers and people related to agricultural and agribusiness enterprises will be negatively affected. People who own and work in establishments that satisfy the demands of visitors to the region may not have been original residents of the area. So, even though overall economic activity is expected to increase, distribution of the benefits from that increased activity is of issue. Benefits will accrue in small amounts to a diffused, organizationally unfocused group. Those who are adversely affected are geographically concentrated, experience extreme economic hardship, and are not likely to view the land-use change benignly.

The second caveat has to do with the spatial diffusion of the economic effects. Visitors to the area will stay in places that offer reasonable accommodations, other attractions, and alternative activities. The five-county area offers few of these types of activities. The analysis was also performed examining the diffusion of expenditures by visitors using the Small Area Assessment Model (SAAM) maintained by the Institute for Water Reserves of the Army Corps of Engineers (Antle and Robinson 1990). Results of the analysis suggest that because of the nature of the existing economy of the five counties, about 57% of the impacts would be in an area surrounding the five counties of study (Table 8). This surrounding area has existing infrastructure and business establishments that can accommodate the needs of visitors.This suggests that (1) there are expected opportunities for business expansion in the five-county core region, and (2) geographic domains of economic impact differ depending on the type of economic activity considered. To reiterate, the geographic domain of the agricultural and agribusiness community is well delineated, visible, and measurable. The geographic domain of the use of the bioreserve is not as straightforward. Identifying and measuring the circular flow of economic activity suggests that the economic value of the creation of the bioreserve is only measurable if visitors are attracted by the unique attributes of the bioreserve and more importantly in the process register their satisfaction by purchasing locally produced goods and services.

Summary and conclusions

This study demonstrates an approach to assess the benefits and costs of a projected change in land use that results in identifiable costs and not so identifiable gains. It is normative in the sense that there are gainers and losers. But if the gainers could potentially compensate the losers and neither groups be worse off, then the potential Pareto superiority criteria suggest that creating the bioreserve for conservation purposes is a desirable change.

Using IMPLAN, a regional input-output model, the effects of the land-use change on the affected agricultural sectors and on those sectors affected by nonconsumptive visitors and hunters can be estimated. Results show that while people employed in agriculture and related enterprises will suffer as a result of the creation of the bioreserve, the increase in economic activity in the region as a result of the bioreserve outweighs these losses. Resource suppliers in negatively impacted sectors potentially could be reimbursed by those gaining from the project. Secondly, this analysis shows that a large proportion of the total economic benefits are experienced by resource suppliers outside the five-county area that offer amenities not currently available in the study area.

Using this approach, economic and ecological constraints can be imposed and evaluated in an iterative process that will lead to the formulation of bioreserve management plans and land-use scenarios that accomplish socioeconomic and ecological objectives.

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