A CIVILIAN GUIDE TO RIVER RESOURCE ECONOMICS -
IT'S NOT A DISMAL SCIENCE TO US!

Resource Economics puts dollar values on natural resources – like clean air and water, like forests, like a view, like the use of a beach. One way you measure such value is by asking people what they are willing to pay for clean air, or a septic system that works, or the return of bald eagles. One component of the value of a flowing stream is how many anglers use it and what they spend. In Ohio they spend about $7000 a river mile each year. In general, that is about $7000 "economic activity" or return to the community, that the river attracts. That is using market values

If the river is in really good condition it may bring in a lot more fishing income than that. And because it is so attractive an area people will want to live near it and will pay more to do so. There may be a lot of other uses as well.

River Resource Economics is what Rivers Unlimited invented to restore degraded rivers. What's a degraded river? Yes, a polluted one. But also one with unsightly river banks. An unattractive corridor. Forty percent of the nation's waterways, and Ohio's, are not fishable or swimmable. Our idea was that if we could show that improving a river would bring money into the community – more than it cost to fix the river – the community and the state would engage in restoring the river.

After 5 years of study that we sponsored at Ohio State University, we've shown that communities can make money that way.

In the Muskingum River study we first looked at the river-related economy of 3 counties on the river: Muskingum, Morgan and Washington. Then we asked what certain improvements would cost. Third, we asked what the economic effect of those changes would be, in other words, how the river-related economy would change. In this case, each suggested improvement would more than pay its way. Beforehand we did not know.

What's the "river related economy"? It's the houses along the river – they are looked at as if they were all being rented, like a $50,000 house having an "equivalent rent" of say $600 a month. It's boat liveries and marinas and restaurants and motels and shops and museums. It's gas stations and fast-food joints. It's swimmers and picnickers and campers and people fishing, canoeing and kayaking. It's what's there now, plus all attracted development that is attributable to the changes you have made in the river corridor, watercourse and water quality.

It's important to see where the river related economy is now, so that after you improve things you can measure the difference between before and after. A year after you put in a bikeway or cleaned up the river and the fish multiplied, how much has the tax base risen? (Relative to the rest of the county, say, so it can be separated from any widespread changes, economic up- or downturns).

The following table tells the Muskingum story:
(Simplified; see the full study for interest rates, surveys, methodology etc.)

Factor	Cost	Benefit	Benefit/Cost	Benefit Minus Costs
Zoning	$144,000	912,000	6.35	$769,000
Septic	$4,641,000	$6,552,000	1.4l	$1,911,000
Greenway	$2,050,000	$11,261,000	6.49	$7,651,000
Locks	$11,635,000	$17,511,000	1.51	$5,876,000
Total	$18,470,000	$38,286,000	2.07	$19,816,000

The stream and its corridor can be a very valuable economic advantage – if the corridor is attractive, scenic – and the water is clean. Then the uses are fishing, boating, swimming; use as a park, bike trail, for picnicking; it will enhance the value of your house or business along the river; it will bring tourists, contribute to a better public image that can attract new business and residents, and allow a higher quality of life. It may attract liveries, marinas, museums, stores etc.

Conversely, if a river is degraded, its uses are limited to carrying off stormwater and wastewater, and perhaps some irrigation.

The uses of a good river draw people and businesses and each helps the local economy. For example, the Little Miami bikepath through 27 miles of Warren County, Ohio –

> Gets 150,000 visits a year, $13 spent per visit, plus $7 for equipment or $20 per visit total, = $3 million per year

The original cost of this abandoned rail right-of-way was $2 million. Its maintenance cost is probably no more than $100,000 a year.

So the bikeway is a huge economic benefit – for motels, restaurants, gas, shopping etc. It's also a recreational amenity for people in or near the corridor. The river is good for fishing and boating and houses along it fetch a higher price. Therefore the tax base rises and communities can pay for schools, fire, police, roads, parks.

A bikeway or greenway means a preserved corridor with trees, a publicly protected river, no more building or clearing to disturb the natural course of the river.

How do we use this technical study? The river town, or group of users, officials and landowners meets to discuss the river, perhaps filling out a questionnaire to help them develop the full idea of what they want their river to be - what they want it to do for them. Get rid of a dam? Take out concrete walls and put in natural riverbank protection (trees, bushes, root masses, geotextiles (soil bioengineering))? Remove dilapidated structures, restore historic ones, stop sewer overflows? Provide access for anglers and

small boats? Reforest a river bank, make a park there? See pages on **Community Questionnaire, Consideration of Attributes, and Potential Benefits Table.** The chart and explanations can help communities understand what the river can offer them.

How to apply economic methodology to an individual stream?

1. The community considers the possibility its river could become an economic asset, or a bigger one than it is.

2. Community reviews a Community Questionnaire and concludes what it wants, what its vision of the future is.

3. It then decides to do a cursory study of certain attributes of the river, using the RU-OSU methodology.

COMMUNITY QUESTIONNAIRE

(suggested; change to suit)

How do you envision your community's future?

- Residential, retirement homes ☐
- Commercial, malls, downtown ☐
- Tourism ☐
- Industrial ☐
  - Light ☐
  - Heavy ☐
  - High tech ☐
  - Food-beverage ☐
- Recreation – land and water ☐
- More jobs ☐
- Bigger tax base ☐
- Upgraded housing ☐
- Need for parks ☐

How many houses per mile of river?
Approximate property value
Population density
Unemployment rate
Median income

Recreation:	High Interest	Medium Interest	Low Interest
Fishing			
Boating			
Camping			
Picnicking			

Hunting			
Biking, Hiking			
Birdwatching			

Access
Zoned? Yes ___ No ___
Abandoned road or rail line along river? Yes __No ___
Endangered or threatened species presence? Yes ___ No ___
Are dams in the river stretch being considered? Yes ___ No ___
How many? ___
Is there a dam proposed?

Describe river corridor:
(aerial photos if possible)
Floodplain maps
Tree cover – 1, 2, 3 or more rows deep
Degree of channelization as percentage of river length
Degree of bank erosion as percentage of river length
Abandoned factories
Junk, culm, slag piles

Describe instream water quality:
Pristine □
Polluted by
Industrial □
Urban, Combined Sewer Overflows, Sanitary Sewer Overflows □
Septage □
Dump or mine leachate □
Agricultural – silt □ nutrient □ pesticide □
(Refer to 303(d) list of impaired waters of the state)
Local water supply
Surface – from the river Upstream □ Downstream □
Groundwater □
Threats □
Imported water □

POTENTIAL BENEFITS TABLE

Cost-Effective Improvement Or Attribute	Potentially Benefited Sectors																
	Economic									**Environmental**							
	jobs	banking	real estate	recreational infrastructure	tax base	property values	tourism	fishing	recreation	fish	birds	air quality	forest cover	views	health	water quality
Greenway	X	X	X	X	X	X	X		X	X	X	X	X		X	X	
Septic	X	X	X		X	X	X	X	X	X	X				X	X	
Zoning	X	X	X	X	X	X	X						X	X		X	
Rec. Repair	X	X	X	X	X	X	X	X	X						X		
Dam Removal or renewal	X	X			X	X	X	X		X	X			X		X	
Water Quality	X	X	X	X	X	X	X	X	X	X	X	X			X	X	
Stream Restoration	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

CONSIDER THESE ATTRIBUTES

This is only to call attention to some of the improvements that can be made to rivers that can bring economic benefits to the community, and only some of the possible factors involved. It isn't meant to be exhaustive or complete - just a checklist to be amplified.

Greenway

Attracts development at river-protective arm's length
Protects water quality - filters runoff
Enhances wildlife habitat and attracts birds
Profound economic activity - $20 per visit per person in a Little Miami River study
Alternative transportation - save fuel, reduce pollution, get exercise
Cooler surroundings, cooler water, more oxygen for the fish
Visual protection for the scenic river
Tourism
Public image

Difficulties of putting together linear properties or easements, or designing to circumvent obstructions.

Zoning

Restrict floodprone development
Require floodplain management
Control setback of development from river bank
Protect riverview
Set septic system requirements based on land carrying capacity - no discharge to stream
Control height of buildings for scenic quality
Specify park land
Determine non-conformance of junkyards, dumps, gravel mining, timber harvesting, noise (as from race tracks etc.)

Septic/Sewer System

Ensure community does not degrade water quality in river
Increase riverfront property value
Increase tax base
Protect public health
Improve public image
Provide the infrastructure necessary to accommodate commerce, industry, residential development

Water Quality in the River

Contributes to residential and commercial property value
Important for public health
Permits low cost public water supply - lower treatment costs
Influences fish populations: size, quantity, diversity, health, edibility - fishing expenditures

Body-contact recreation, children
Industrial water supply for high-tech industries, beverage, food, pharmaceuticals
Public image
Endangered species - preserve and increase populations

Dam Removal

Dam removals improve river water quality. They reintroduce natural flow regimes reviving health of downstream stretches. They increase oxygen content, very favorable to fish and mollusks. They permit fish and mussel travel upstream. They reduce downstream riverbank erosion. They accommodate canoe and kayak recreation. Their natural flooding enriches farmland. Dams that are not there need no maintenance and are no threat to life or property. Most dams were built with inadequate consideration of their costs and benefits and substantial numbers of them could not be built today because they couldn't stand rigorous economic analysis.

Removing a dam converts a reservoir to a natural river. The river may not accommodate powered marine equipment that the reservoir did. Residences will no longer be "on the water". Different fish will live there. There will be no particular floodwater storage, or hydropower. There may be no water supply storage, although upland reservoirs can be built, with river water pumped in. (*See link to dams)*

Streambank Restoration

This includes everything from patching an eroded bank to restoring the natural meander pattern in an entire channelized stream, perhaps with a 2-channel design to provide flood height reduction.

There can be a major cost issue because a channelized stream takes up less land area than a natural stream, so some productive area may be lost. The work to reestablish a natural system may be costly.

Potential benefits include:

Greatly reduced erosion
Greatly reduced siltation
Better water quality
No significant maintenance costs compared to a channelized stream
Reduced or no taxes for maintenance
Wildlife corridor and benefits to wildlife
Return of fish and fishing
Natural flood damage limitation
Higher riparian property and residential value

Higher tax base
Recreational opportunities
Greenway opportunity

After considering all the potential attributes of an improved stream and coming to preliminary decisions, visit the Muskingum Study as a model and do a simple estimate of fixup costs and fixup benefits on their river – to get some feel for how promising each change might be. If it looks favorable and realistic to them they may want to commission a more detailed and accurate benefit/cost study as a convincing document for public support and for getting funding to proceed.

This is the first time we have invoked dollars as a reason to save rivers. Environmental reasons have been too slow – 35 years to get 3/10ths of one percent of the nation's river miles into the protection of the National Wild and Scenic Rivers System. And 35 years to get 1.1% of Ohio's river miles into protection of the Ohio Wild and Scenic Rivers System.

The old arguments for restoring rivers are fine – we want fish and wildlife, clean water, beautiful scenery, recreation. But now we have a new and influential tool. In many cases we can show how a river community can expand its economy by improving its river. That is what city managers strive for! Because it means they can increase funding for schools, fire and police protection, sewers, roads and public buildings.

Here is some common economics terminology you may encounter, expressed in the most simple terms:

Market Value – what an item or a property actually costs if you buy it

Travel Cost Method – how far do or would people travel to use the river (or woods etc.) and at what cost

Willingness to pay – in dollars, for recreation, catching a fish, a walk in the woods, to know that a beautiful place will be preserved, to see a rare animal or bird. Determined by surveys

Contingency Valuation – same as above

Hedonic Valuation – a breakdown of the individual attributes and what they are worth, as in a house – a porch, air conditioning, a basement, a river view – the total of all adds up to the value of the house, and it permits the researcher to estimate the true value of a house near a river, because of the influence of the river

Benefits Transfer – if you know the economic benefits conferred by a bikeway in one place you can estimate what they would be if you put a bikeway in another place – making certain allowances for confidence that you're comparing apples to apples

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The logic of pressing for economic studies. River restoration had advanced very slowly. Holding the line for river water quality and corridor beauty has been difficult and costly. If these actions can be shown to bring more dollars into communities than they cost, restoration and protection will both accelerate - the political community will make it happen:

1. Many rivers are degraded – both the quality of their waters and their corridors, therefore they cannot provide the full potential of economic, environmental and social benefits.
2. Communities are not aware that restored rivers can make money for them.
3. Resource economics can develop the methodology for communities to study their rivers for possible improvement.
4. If authoritative studies show big potential rewards, remedial action will follow.

From experience we know there is a strong likelihood that restoration will pay off. By "improve", we mean clean up the water, reforest the corridor, use natural means to armor riverbanks against erosion, remove dams and transform channelized streams to natural systems. The modern means today use hydrogeology, soil bioengineering, Rosgen analysis, dual channels and are a far cry from former practices.

River use, like land use, has changed over the years. Surface water isn't so important for transportation, for water power, for waste disposal as it was. Rivers now are appreciated more for fishing, property value (which becomes tax base), quality of life, swimming and other recreation; as parks, greenways, open space, birds and wildlife; for public image to attract "the right kind" of commerce, industry and residential settlements. As a nation we haven't understood the connection between an inviting river and a better economy.
In our studies we look at the river-related economy first. That is, riparian property value, fishing, boating etc., parks, marinas, sand and gravel mining etc. Then we ask, what if? What if the water were cleaner? What if the river corridor were well forested, derelict structures removed, eroding banks restored, dams gone? What could the river-related economy become?

Where rivers are somewhat degraded, restoration can increase regional economies a lot. Environmental interests want rivers restored. Communities want more economic activity. Both interests will be well served by studies guided by a template or handbook of "how to".

Resource economic studies show how to analyze river improvements to find out if they would be cost-effective.

In May 2000 we completed, with the Ohio State University, our Resource Economics study of the Muskingum River. It is a pilot study to determine what cost-effective investments in improving the river corridor and water quality could be made to help the regionally depressed economy. This is the forerunner of our template study that will generate a methodology to look at any degraded river stretch and determine the benefits and costs of improving corridor and water quality. This is the first time anyone has looked at the entirety of potential benefits rivers can offer with a view to realizing them, cost-effectively, in the regional economic interest.

We have sponsored and completed the following studies:

- Recreation and Property Valuation of a River Corridor: Muskingum River Phase I: by Fred Hitzhusen, Radha Ayalasomayajula and Amy McDermott, Dec. 1998
- Muskingum River Economic Valuation: Phase II, by Hitzhusen, Lowder and Ayalasomayajula, Apr. 2000
- Muskingum River Economic Valuation: Phase II Executive Summary, Dec.2000, same authors as above

  These 3 studied benefit-costs of river-protective zoning, an operative septic system, antique lock repairs and extension of a greenway – all to derive a methodology useful in other river attributes anywhere.

- Estimating Economic Benefits from River and Stream Protection, by Stephen Irvin, Apr. 2001
- A Study of Pesticide Use, Farming Practices and Community Drinking Water Treatment Costs in the Maumee and Great Lakes Basin, by Chris Murray, Oct. 2001
- Phase II of Estimating Benefits from River and Stream Protection. This gives us the means to value flowing water at a specific stretch of stream, based on its content of pollutants. Nationally, the value of the resource is not now taken into account in granting pollution permits or building water projects; it is considered to have no value, which is of course not so. Valuation of water quality would have a decided effect in protective decision making.

Our continuing studies address

- Dam removal, or renewal. The methodology study on the particular study river may show that removal will bring back a prolific walleye fishery. Dams are a major land use factor in communities, affecting water supply, property values, change in recreation, types of fish and wildlife etc.

- Early work on the cost-benefit factors in returning channelized streams to near-natural conditions where they can support fish and wildlife, buffer against farm runoff, reduce erosion and provide drinking water and recreation.

The "market" for this template or handbook, showing how to measure the potential assets or attributes of a stream, is immense:

Forty percent of the nation's waterways are not fishable or swimmable. That's 1,400,000 miles. We're forgoing about $9 billion a year because of denied sport fishing opportunities on rivers. Some 600,000 miles of river lie behind big dams. Some 10,000 small government dams were built in the 40's and 50's without funding for maintenance, are at the end of their 50-year design lives, and must be rebuilt or removed. Many thousands of miles of stream have been channelized, therefore destroyed for any purpose other than accelerated flow, but can be revived. Add to these the thousands of TMDL deliberations to be carried out, currently without benefit/cost consideration. If these decisions had fiscal integrity, that alone could help us keep that section of the Clean Water Act in an unfriendly Congress. The 60% of river miles presently fishable and swimmable are not all that good – they're not offering the full potential of their uses to the public and could be greatly improved. Lastly, the U.S. Fish and Wildlife Service says that "Economic benefits are the primary issue that will justify and drive river restoration projects in the future, not environmental justifications. When rivers are restored, aquatic resources also will be restored including federally threatened and endangered species …"

The river resource economics studies completed and under way will give communities , federal, state and county planning agencies and NGO's (non-government organizations) the methodology by which they can test the economic feasibility of river restoration. Just as McDonald's knows with near 100% certainty that a certain location will be profitable – because of its research - we expect river interests to be able to tell that a proposed restoration will or will not profit a certain community.

Until now there has been no assurance that reducing pollution, siltation and streambank erosion, and increasing scenic beauty of a river corridor through reforestation could truly benefit a local or regional economy.

Individual river studies using data from our studies will for the first time provide a solid economic argument to proceed or not with improvements. Decision makers rarely have the luxury of proof that prospective investments are "no lose".

While the public interest also requires that the public's wishes be addressed and environmental justice be done, river advocates will have a more compelling logic, in no way contrary to these social issues, to advance restoration.

We expect these studies will revolutionize river preservation efforts by presenting the financial incentive to restore. This would then bring in not only cleaner waters but river corridors that are more scenic – from headwater streams to large watersheds. The research should bring us better laws and regulations. It should open up the latent potential

of degraded streams to serve the public in respect to recreation, riparian property values, increased tax base, more and better fishing, improved public health, better public image to advance desired development and tourism, and create new jobs not drawn from elsewhere. The effects of this work will be national.

Certain NGO's aware of our studies want studies of their own streams. The Mill Creek Restoration Project has funds to launch a study; Friends of the Great Miami seeks funding to complete a study under way. These are nearby and will support the methodology studies.

DAMS

1. Dams slow the flow of streams as they approach the dam itself, thus reducing dissolved oxygen. Rapid flow oxygenates water.

2. Dams cause impounded waters to be permanent floods, destabilizing river banks formerly subjected only to occasional high waters for short periods, therefore causing serious and continuing erosion. The Ohio River high dam series is a painful example. Impoundments increase siltation, our number one pollutant.

3. Dams interrupt normal, seasonal flows of rivers, changing flows to suit project purposes - recreation, pollution dilution, hydropower, water supply, flood damage limitation, optimum barge traffic water levels (Ohio River). Both downstream and upstream of dams, flows can no longer serve certain species formerly adapted to natural flow.

4. Dam releases, depending on how they are controlled, can be anoxic, too cold and can cause thermal shock to organisms. These release velocities (because of the "head" or pressure of the weight of water above the downstream, tailwaters) can cause heavy erosion, generating more silt.

5. Dams collect silt. This silt therefore cannot replenish the silt constantly being removed from the streambed by downstream flow. There is no bed load just below a dam. So the streambed erodes, increasing silt. If there is no equilibrium between bedload entering a stretch of river and leaving it, either a river will cut into its streambed and deepen and/or widen it or it will fill up with silt and cut new channels through and around the silt islands.

Again, instability, damage to aquatic organism habitat, erosion, silt.

6. Fish and mollusks cannot go upstream because of dams. Dams limit fisheries, even with fish ladders, which only certain fish will attempt.

7. Low flow while a dam stores up water: stream may dry up (downstream); heat up in the sun (reduces dissolved oxygen), permit algal accumulations.

8. Low flow downstream of a dam prevents dilution of fertilizer and pesticide runoff from fields and animal waste from feed lots and farms, hence increases concentration of toxics and nutrients which can damage aquatic organisms and limit their populations.

9. Dams, or rather impoundments, have limited lives. At some point they have lost significant storage capacity - they fill up with silt. They have to be dredged or drained and excavated, therefore

- destroying habitat of fish and wildlife
- muddying the waters in the impoundment and downstream for an indefinite period
- releasing toxics that may have collected and concentrated just above the dam, with potentially drastic effects on instream life and water quality

10. Dams may have to be removed because their condition – age or damage – may threaten downstream activities and they may cost too much to repair. It may also be in the economic interest of the community to return the river to a more natural condition to serve its original potential uses.