# Our Future ?

## A Vision for a Land, Water, and Economic Ethic in the Upper Mississippi River Basin

Missouri Coalition for the Environment • April 2012

## Contributions

Primary Author: Brad Walker

Editing and Reviewing: Kat Logan Smith, Cecily Smith, Christine Favilla, Lorin Crandall, Laura Kimes

Design and Layout: Meghan Lewis

Essayists: Donna Anderson, Robert Criss, Fred Kirschenmann, Ken Lubinski, and Nicholas Pinter

## Acknowledgements

We would like to thank The McKnight Foundation for their support that made this report possible.

## Contact

Brad Walker, *bwalker@moenviron.org*

# Our Future ? A Vision for a Land, Water, and Economic Ethic in the Upper Mississippi River Basin

## Table of Contents

# Chapter One: Introduction

> "(D)o we not already sing our love for and obligation to the land of the free and the home of the brave? Yes, but just what and whom do we love? Certainly not the soil which we are sending helter-skelter down river. Certainly not the waters, which we assume have no function except to turn turbines, float barges, and carry off sewage. Certainly not the plants, of which we exterminate whole communities without batting an eye. Certainly not the animals, of which we have already extirpated many of the largest and most beautiful species."[1]
>
> -Aldo Leopold

In his seminal 1948 essay "The Land Ethic" Aldo Leopold spoke of the need for an ethic "dealing with man's relation to land and to the animals and plants which grow upon it." He went on to say that our only relation with land is "strictly economic, entailing privileges but no obligations." Little has changed since 1948 as far as our land ethic, in some ways we seem to have even less regard or respect for our land today than 50 years ago. This ethical deficiency manifests itself visibly in our nation's largest river basin, the Mississippi. Draining 41 states and two Canadian provinces, the Mighty Mississippi and its communities suffer continually because the vision that guides the people whose aggregated choices shape its destiny fails to value a healthy, thriving river system for the generations who follow. It is time for a new vision.

The magnificent, rich, and complex natural ecosystems of the Upper Mississippi River are in danger. In less than two hundred years, human activities have radically manipulated the river's banks, channels and floodplains. The primary modern-day river economies of agriculture and navigation began with, and continue to be supported by, policies rooted in short-term, shortsighted priorities. In the meantime, the river and her communities lose aquatic and other wildlife, and the wetlands and floodplains that provide unrecognized but critical benefits from flood protection to vibrant fisheries.

This report discusses the problems Missouri Coalition for the Environment and others see in our current relationship with the river. We need a change in vision and in action. For the river's sake, and our own long-term prosperity, we need to develop a rational ethic for how we live within our Upper Mississippi River environment.

The vision we propose requires a change from the status quo. It requires transforming "accepted" economic, management and related policies to include the needs of all the Mississippi River's living communities, in order to ensure the health, economic security, and other social benefits for both present and future generations. It's called "strong sustainability."

## Why Did We Prepare This Report?

> "We have lived by the assumption that what was good for us would be good for the world. We have been wrong. We must change our lives so that it will be possible to live by the contrary assumption, that what is good for the world will be good for us. And that requires that we make the effort to know the world and learn what is good for it. We must learn to cooperate in its processes and to yield to its limits"[2]
>
> -Wendell Berry

The U.S. Army Corps of Engineers is the single federal government agency whose decisions most profoundly impact the Mississippi River basin and its communities. From dams to levees from the headwaters in Minnesota to the canals at New Orleans, the Corps acts and reacts to the river, its inhabitants, and its neighbors. The Corps is planning to offer in the near future a 200 year vision for the Mississippi River that we believe is likely to leave the generations that follow us poorer, weaker, indebted, and more vulnerable instead of stronger, resilient, and more prosperous. We offer a contrary vision.

Like the rest of our country, the Upper Mississippi River basin has, and continues to suffer accelerated environmental degradation because we have no adequate, thoughtful, holistic long-term plan for its management.

As an organization, the Missouri Coalition for the Environment (MCE) is disturbed with the lack of future legitimate and reasonable planning for the Upper Mississippi River (UMR) basin. MCE advocates a new vision to guide management of the UMR - a long term, multi-generational vision based on the principle of "strong" sustainability. *Ultimately, it is a vision that demands we move from policies and actions that manage the UMR solely for human benefit to managing our economic and other activities within the capacity of the river system.*

## What Is The Report About?

This report provides a science and social-based, long-term vision for the Upper Mississippi River basin that places humans within nature, not outside or independent of it. Our vision considers future generations and acknowledges that we are completely dependent upon a healthy environment for our development, prosperity and survival. There is an inherent understanding and acceptance that certain essential services and functions of our environment cannot be compromised because they cannot be synthesized, replicated or replaced by us.

This report is not about saving pristine land where people hike or watch nature. It is about saving enough of the essential natural resources for our children and grandchildren to give them the chance for a rewarding life as residents of the Mississippi River basin. It defines sustainability in the most fundamental terms: the ability of humans to thrive indefinitely through disciplined stewardship of ourselves and our environment.

MCE does not believe that our vision is utopian; rather we believe the current path is fatally flawed in its mistaken assumption that we are independent from natural laws and resource constraints. We do not provide a concise and definitive path to the vision's goals nor do we cover every aspect of concern. We do provide suggestions for general changes that should be pursued, explain why we believe that we need to move toward those changes, and briefly discuss what the results may be.

## What Do We Hope To Accomplish?

Our report addresses our concerns and documents a vision that is more appropriate and attainable over a long period with the assumption that we accept the natural resource constraints, have the political will to change, and then begin adjusting our society to accommodate our vision. We assert that the challenge is to build the strong sustainability framework in this century.

We also acknowledge that this is our vision and by placing it out to the public it is subject to review, discussion, debate, criticism and comment. In fact, we hope it will generate a deeper, more inclusive discussion among organizations, management professionals, the general public and decision makers. Most of all, we hope that it inspires individual people to make decisions that will lead us to a healthy, thriving and restored river system before the 22nd century

## Vision and Values

> "Nothing is easier than becoming rich in America; naturally, the human spirit, which needs a dominant passion, in the end turns all its thoughts toward gain…as one digs deeper into the national character of the Americans, one sees that they have sought the value of everything in this world only in the answer to this single question: how much money will it bring in?" [3]
>
> -Alex de Tocqueville

In contrast, consider Bolivia, a mountainous South American nation:

> "Bolivia is on the verge of passing a series of laws that would give nature equal rights to humans.
>
> The new law will establish 11 rights for nature, including the right to life and to exist, the right to continue vital cycles and processes without human alteration and the right to pure water and clean air. The others are the right to balance, the right not to be polluted and the right to not have cellular structure modified."[4]

To prosper and develop a society must have a plan for

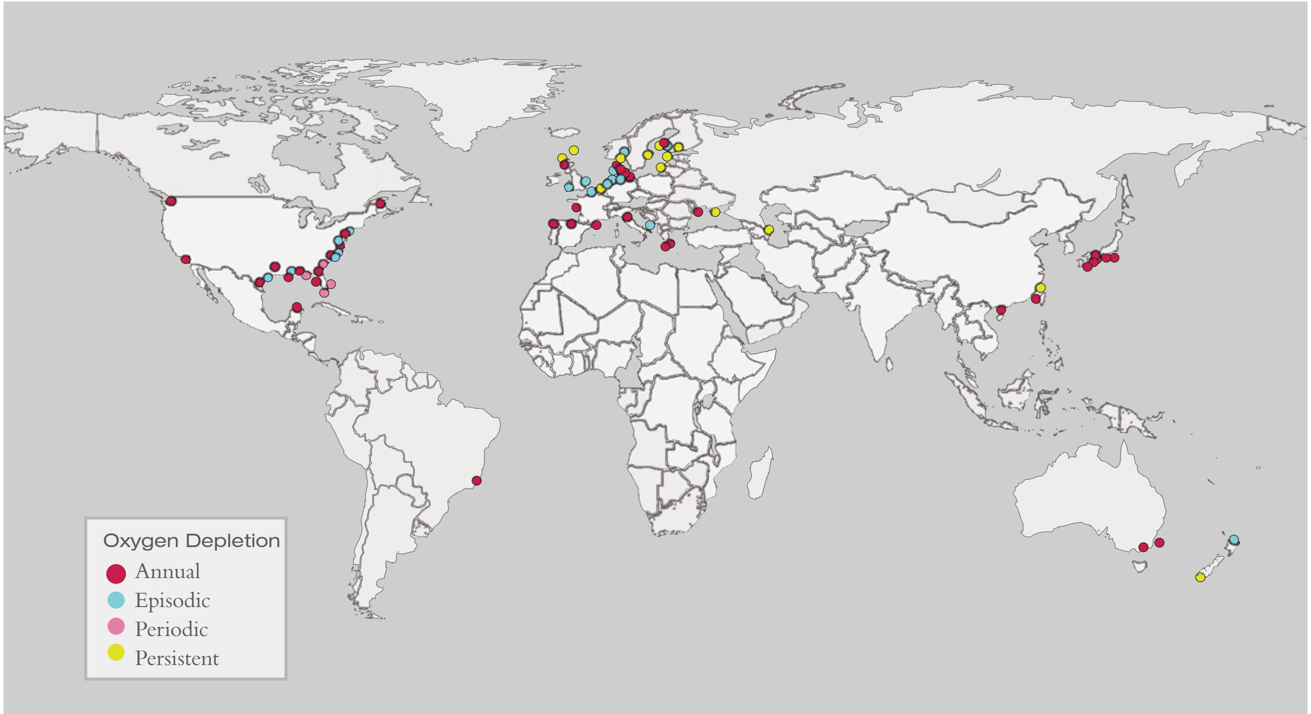



**Figure 1-1:** World Dead Zones

Dead zones are coastal regions around the world stressed by agricultural run-off.
Source: GEO Year Book 2003, United Nations Environment Programme.

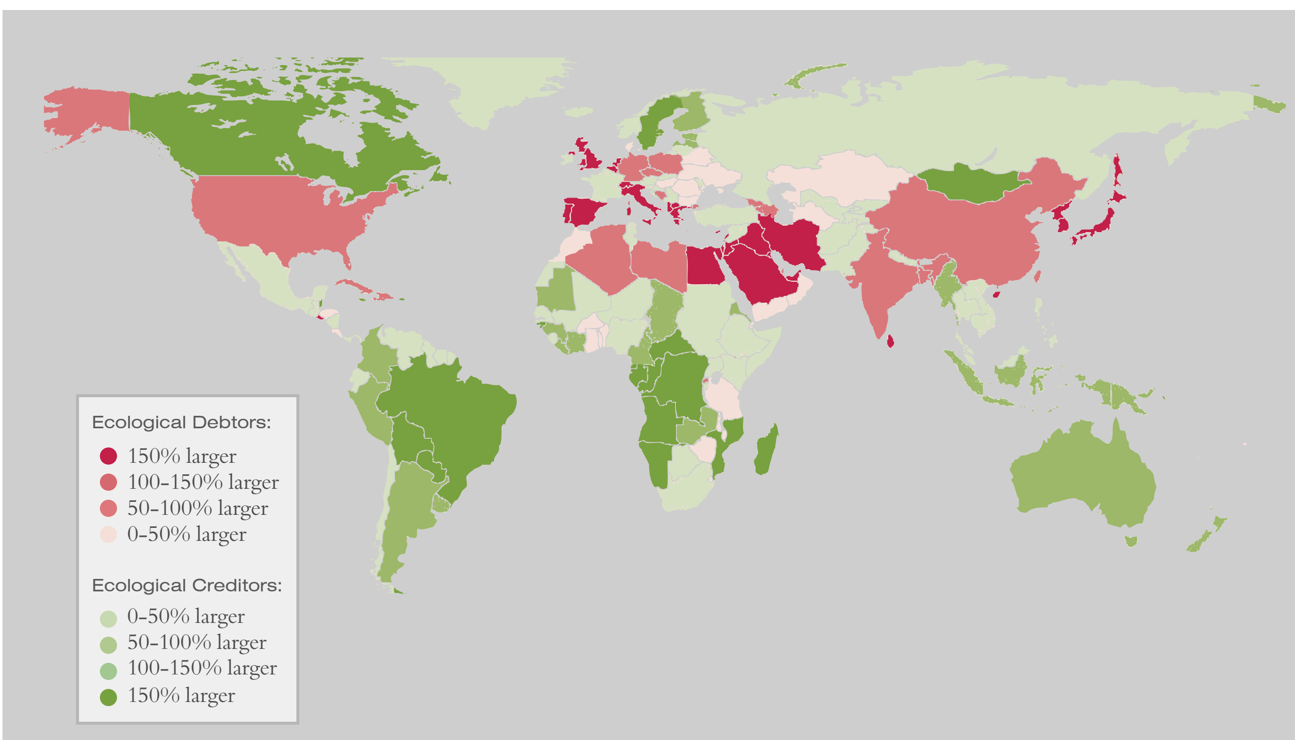



**Figure 1-2:** Ecological Footprints

Source: Global Footprint Network 2009 Annual Report, 2008, Ecological Footprint Status by Nation the future, a path to follow which benefits those living today and provides opportunities for those to come. The lack of a holistic vision is not limited to regions like the Mississippi River Basin. In general, we see our country as having no real plan for its long-term future. It allows, even promotes, development with no concern for limits whether they be limited availability of land, water, or energy – it is an outdated continuation of our 1800's frontier mentality that perceived our nation as one of boundless opportunity and endless resources. Harsh realities confront communities when they reach or exceed their resource limits, for example, when upstream users drain rivers' waters or competing interests deplete aquifers. The pain and expense of these realities can and should be avoided through comprehensive visioning with a long-term view and a strong sustainability framework.

## Beginning Where We Are

Social and environmental indicators provide a starting point for questioning whether we are managing our "national priorities" in a way that truly serves the best interests of the current population and the environment we share, and more importantly, future generations and the environment they will inherit. Consider:

- Congress has failed to create any new comprehensive pro-environmental legislation since the establishment of the Superfund in 1980. [5] Nor has the U.S. ever established an adequate, long-term energy policy for the country.
- Each of us has traces of hundreds of toxic chemicals in our systems that have not been tested for their effects on our health. [6]
- The natural resource systems that undergird life on earth are stressed including soil, water, climate and energy. [7, 8, 9, 10] (for an example see Figure 1-1)
- Americans use 2 to 2-1/2 more land area to support our lifestyle than we have within our borders. [11] (see Figure 1-2)
- The U.S. educational system is no longer the best in the world; in fact it ranks as just average in reading and science and below average in math, behind 14 other countries including Canada, Japan, Australia, Norway, Estonia and Poland,[12, 13]
- Wealth disparity has increased to nearly the same as occurred in the late 1920's before the Great Depression. [14, 15] In 1964 a CEO in the U.S. made about 26 times the average worker, but by 2005 this disparity had increased to nearly 160 times.[16]
- Corporations, lobbyists, and the wealthiest people influence all aspects of politics at an unprecedented level. [17, 18]
- The U.S. national debt is over $15 trillion, up from about $6 trillion in 2000.[19]

The condition in which we find our nation – in record debt, in unending war and conflict, and facing declining standards of living for the vast majority of our people and their children  is the inevitable outcome of the belief system that undergirds the decisions that got us here. That belief system falsely devalues the contributions of ecological systems and denies our dependence on them. The costs of holding that belief are climbing as resource constraints emerge, forcing a reconsideration of its premise.

## Missouri Coalition for the Environment's Vision

The current state of the region has led us to develop our own vision for the Mississippi River Basin considering things typically avoided or ignored, such as the natural and ecological processes and capacities and the limits of resource supplies. We must uphold baseline natural processes and understand that undermining the baseline will jeopardize the human condition. Or as it has been elegantly stated "The essence of sustainability is to both develop a mature ethical attitude toward nature and a mature physical relationship with nature, which involves exploiting nature in an appropriate manner."[20]

MCE has performed this visioning task because we strongly believe that the current path is extremely faulty and is not the result of any comprehensive and realistic visioning process which, at its base, often responds only to the simplistic question, "how much money will it bring in?", while ignoring the counter balancing question, "how much will it cost us, other living creatures, and our descendants?" Thus, significant change should be an essential part of the process. This will require challenging some of our past decisions, something Americans tend to avoid. It will require an analysis of the long-term cost side of the balance sheet. Although many projects we have pursued have provided short-term economic benefit, these benefits often have been offset, even overshadowed, by either social or environmental negative consequences, or both.

The challenge will not be limited to identifying and understanding poor decisions with the intent of simply adjusting or fine-tuning them to improve the outcome. In some cases the challenge may be agreeing that a solution may be to make major changes or even abandon the activity completely and start over.

We recognize that we, as humans, also have our own biases. Nevertheless, we strive to present a vision that is fair for people living today, fair for those people living 100 years or longer in the future, and is supported by facts.

Major considerations for a valid vision for the Mississippi River Basin should be based on:

- A long-range vision, more than 50 years;
- All aspects including social, environmental, and economic must be considered in a proper, reasonable and legitimate perspective and priority;
- The fact that natural resources are limited and form the foundation of our economy.
- Agreement that our knowledge is limited, especially concerning ecosystem services and functions, thus requiring a precautionary approach;
- Strong consideration for future generations; and
- Current and accurate information and data must be used for planning and decision making.

Therefore our vision will be based upon a "strong" sustainability model that "emphasizes that the human sphere is embedded in a natural system ('biosphere') and assumes that natural limits ought to constrain our actions. Artificial (human-made) capital can only sometimes substitute for natural capital."[21] Strong sustainability will be discussed in further detail in Chapter 4 "Our Framework for Sustainability" of this report.

---

1 Leopold, Aldo , 1948, "The Land Ethic"

2 Wendell Berry, 1995, Private Property and the Common Wealth: Another Turn of the Crank, Counterpoint, Washington DC

3 Alexis de Tocqueville, 9 June 1831, Letter to Ernest de Chabrol, Tocqueville Reader: p. 41

4 Climate Wire, 2011, Bolivia set to grant nature equal rights to humans, http://www.eenews.net/climatewire/print/2011/04/12/8

5 Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), PL96-510

6 Environmental Working Group, 2005, Toxic Chemicals By the Hundred Found in Blood of Newborns, http://www.ewg.org/news/toxic-chemicals-hundred-found-blood-newborns

7 Secretariat of the Convention on Biological Diversity (2010) Global Biodiversity Outlook 3. Montréal, 94 pages.

8 Borenstein, Seth, 2011, Biggest jump ever seen in global warming gases. AP, http://news.yahoo.com/biggest-jump-ever-seen-global-warming-gases-183955211.html

9 NASA, How Hard Are We Pushing The Land?, http://www.nasa.gov/topics/earth/features/carbon-capacity.html

10 World Resources Institute, 2011, New Web-Based Map Tracks Marine "Dead Zones" Worldwide, http://www.wri.org/press/2011/01/new-web-based-map-tracks-marine-dead-zones-worldwide

11 Global Footprint Network, 2009, 2008 Annual Report – Ecological Footprint Status by Nation

12 Huffington Post, 12-7-10, U.S. Falls In World Education Rankings, Rated 'Average', http://www.huffingtonpost.com/2010/12/07/us-falls-in-world-education-rankings_n_793185.html

13 Organisation for Economic Co-operation and Development (OECD), 2009, Programme for International Student Assessment 2009 Results: Executive Summary, http://www.pisa.oecd.org/dataoecd/34/60/46619703.pdf

14 Reich, Robert, 2010, The New Tax Deal: Reaganomics Redux, Robert Reich's Blog

15 Fieldhouse, Andrew and Ethan Pollack, 2011, Tenth Anniversary of the Bush-era Tax Cuts, Economic Policy Institute Policy Memorandum #184

16 Washington Post with Bloomberg, Ratcheting up pay with peer comparison, http://www.washingtonpost.com/business/economy/ratcheting-up-pay-with-peer-comparison/2011/10/03/gIQAKT1FJL_graphic.html

17 Kroll, Andy, 2010, How the Oligarchs Took America, Mother Jones

18 Saad, Lydia, 2011, Americans Decry Power of Lobbyists, Corporations, Banks, Feds, Gallup, http://www.gallup.com/poll/147026/americans-decry-power-lobbyists-corporations-banks-feds.aspx

19 US Debt Clock.org , http://www.usdebtclock.org/, accessed 1-16-12

20 Nelson, Michael and John Vucetich, 2010, True Sustainability Needs an Ethical Revolution, The Ecologist

21 The Case for Strong Sustainability, Konrad Ott: in: Ott, K. & P. Thapa (eds.) (2003).Greifswald's Environmental Ethics. Greifswald: Steinbecker Verlag Ulrich Rose. ISBN 3931483320. Retrieved on: 2009-02-16, page 62

## *Taming the People* - K. S. Lubinski

Last year I participated in a science exchange in Kolkata, India, with colleagues from the Upper Mississippi and Ganges rivers. A hydrologist from the Indian Statistical Institute, Professor Sengupta, at least 85 years old and weighing no more than 100 pounds, had to be helped onto the stage by a graduate student. Nevertheless, he finished his presentation with a simple but formidable admonition to the engineers in the room. He filled his lungs, pointed directly at the engineers (most of whom had spent their entire careers designing flood control structures) and said "Don't tame the river. Tame the people!" This from a man whose densely populated and generally poor country has suffered from countless great floods.

I can't think of a more appropriate subtitle to the Missouri Coalition for the Environment's vision. Sooner or later, humans, as individuals, communities or entire civilizations, either accept that there is a limit to how far their natural resources can be stretched, or suffer horrible consequences. Ironically, many of us in the agriculturally-rich heartland seem to have forgotten (or have never been taught?) the concept of carrying capacity. Perhaps our bounties of sunshine, soil, grain and water have lulled us into taking nature for granted. Or maybe our high tech life style promotes the unsupported belief that there is no end to squeezing ever more golden eggs out of our goose.

I've witnessed some instances of increased ecological awareness during my life, but they have been few, and fewer still during the last couple of decades. Most recently I listened to local fishermen and hunters berate plans to protect the river's fish and wildlife by reducing the human footprint within the Upper Mississippi National Wildlife and Fish Refuge. Why? Because they've always been able to fish, hunt and otherwise do what they want at such and such a spot, and it is their right to do so. Nature of course couldn't care less about such self-proclaimed rights. Further back in time, during one of the mussel booms on the river, I often shared experiences with commercial clammers. At one time these men had a reputation for policing their own activities and thus promoting sustainable harvests. But profits were high then, and in response to my suggestion that they consider additional voluntary harvest limits, I was promptly labeled as a communist. "Socialist" might be the more popular tag today.

So from my perspective, far too many people still look upon the river as an infinite resource to be ignored or improved and domesticated for either profit or pleasure. Something worth considering – when individuals lose contact with and appreciation for the unpredictable and untidy "naturalness" of the river, can we realistically expect the big players, like agri-business or transportation, to do otherwise?

*For Lubinski's complete essay, please see Chapter 6, Expert Contributor Essays*

# Chapter 2: Upper Mississippi River Background

## Early History of the Upper Mississippi River

*-Nicholas Pinter, Southern Illinois University, Carbondale*

Any review of "human influences" on any American river should at least note that this history does not entirely begin with the arrival of Europeans[1], but Native American influences are seen mainly on smaller streams, and the impacts seem to be orders of magnitude less profound than modern modifications. The UMR was first seen by Europeans in 1673, when the expedition led by Louis Jolliet and Pere Jacques Marquette made its way down the Wisconsin River from the Great Lakes. The first permanent settlement west of the Mississippi was Ste. Genevieve (now Ste. Genevieve, Missouri), founded in 1735. St. Louis followed in 1764. The Lewis and Clark expedition made some of the first hydrologic measurements of the Mississippi River during its first winter encampment in 1803-04 at Camp Dubois, near the Mississippi-Missouri confluence north of modern day St. Louis. Compared to its modern hydrology, the early 19th century Mississippi system had less variability in its flow and more regular seasonal timing, consistent with the impacts of basin development, channelization, and dam construction.[2]

The Mississippi and other rivers were the focus of early exploration because they provided avenues of transportation across the continental interior. Pere Marquette traveled by canoe. The subsequent trappers and traders traveled by canoe or using flat bottomed "bateaux".[3] Lewis and Clark utilized canoes, shallow pirogues, and a keelboat, the last larger but still with the shallow drafts required by the river at this time. Westward expansion and settlement on the heels of Lewis and Clark saw trade and river navigation continue to utilize the Mississippi and other rivers. Transport was by canoe or, for larger cargos, by keelboat, the latter vessels requiring as little as 3-4 ft of draft.[4]

Over the course of the 19th century, increased populations along the Mississippi led to demands for larger capacity. Beginning about 1820, keelboats gradually were supplanted by stern- and side-wheeled paddleboats of the steamboat era. During the 20th century, steamboats were in turn supplanted by the diesel-driven multi-barge towboats that are the dominant vessel of river navigation today. This evolution in navigation technology drove demands for increasing the depth of the river and progressively more intensive regulation of the Mississippi River, which has been a driver (THE major driver, many would argue) of the extensive river modifications of the 20th and 21st centuries outlined in the section below.

## "Industrialization" of the Upper Mississippi River

*-Nicholas Pinter, Southern Illinois University, Carbondale*

The Mississippi River has been extensively modified during the past 100-200 years, primarily: (1) to facilitate river navigation, and (2) for flood control. In addition, its contributing basin has also changed extensively in ways that strongly affect the hydrology of the river. The first systematic U.S. Government activity on the Mississippi River began in 1824 with removal of "snags" (trees and other large debris in the channel) in order to facilitate navigation.[5] In an ill-fated attempt to eliminate snags at their source, a program of riverbank clearing was undertaken beginning in 1835, which triggered a wave of channel widening as the river pushed against the now unanchored, treeless banks.[6] Increased bank erosion and more silt in the river was the unintended consequence of removing the trees along the river banks. Now the river's channel grew shallower as eroded soil filled its channel.

In 1881, Congress authorized a comprehensive channel improvement project to deepen the channel and reduce the impacts of siltation, in part to rectify the earlier bank clearing; by 1900, there were ~300 wing dams in the Middle Mississippi River (MMR) reach below St. Louis with a cumulative length of roughly 285,000 ft.[7] Wing dams help prevent silt from entering the main channel and speed the current in the main channel to help it maintain depth. The 1927 Rivers and Harbors Act authorized a 9 ft deep navigation channel up to St. Louis[8], and almost $19 million was spent on 768 new wing dams and new revetments between 1930 and 1945. Numerous wing dams also were built on the UMR above St. Louis , but this strategy was later recognized as ineffective on the upper river. The 1930 Rivers and Harbors Act extended the 9 ft channel upstream to Minneapolis, to be achieved by constructing 24 locks-and-dams[9], an effort completed by 1940.[10] The pooled reaches of the UMR today consist of a series of slackwater pools at low flows, with minimum navigation depths maintained by those dams.

Through the 19th and especially during the 20th centuries, settlement and progressive development led to a profound transformation of the floodplains of the UMR. Maps and vegetation surveys by the General Land Office (GLO) made through the early 19th century showed that much of the floodplain was dominated by grassland prairie, with riparian floodplain concentrated on islands, valley slopes, and ravines.[11] This widespread grassland likely was maintained by periodic flooding and frequent broadcast burning. Within the UMR basin, a major timber boom began around 1875, with at least 200 sawmills along the UMR and its tributaries and employing more than 100,000 lumberjacks at its peak.[12] Clearance of land and floodplain modification for agriculture varied broadly by region, but became regionally important through the late 19th and 20th centuries.

Hydrologically, conversion of native land to agriculture locally caused up to six-fold increases in flood flows[13] as well as significant soil erosion and downstream flux of sediment. These impacts were later moderated after adoption of soil-conservation practices in the 1930s.[14] Agriculture on floodplain land was also facilitated by the widespread emplacement of tile drainage, which likely had significant effects on storm runoff, but these effects are difficult to quantify because the extent and timing of tile-drain construction are poorly documented. Finally, late 20th century urbanization significantly worsened flooding in small urban catchments[15, 16] but had relatively small impacts on rivers as large as the Mississippi and its major tributaries.[17]

Agricultural development as well as the growth of towns and cities has led to the progressive growth of levees on the UMR floodplains. Originally, large floods on the Mississippi extended from bluff to bluff, a distance spanning several miles along most of the river (floods "miles wide and a foot deep"). Initial levee construction protected local population centers; at St. Louis for example, a natural floodplain 7 to 12 miles wide was already constricted down to just 2000 feet wide by 1903.[18] The Illinois State Drainage and Levee Act of 1879 made state funds available to organize levee districts and protect and develop agricultural floodplain land.[19] Early agricultural levees generally were no higher than about 6-10 feet above flood stage.[20] In the 20th century, Federal funds were made available for much more ambitious levee projects. Along the MMR for example, nine Federal levee projects, generally protecting to the 100- to 500-year (0.2% to 1% probability) level were complete by 1960, and five others were under construction.[21] Along the UMR, at least 8,000 miles of levees have been constructed, including 2,249 miles built by the U.S. Army Corps of Engineers.[22]

## Bending the Upper Mississippi River to Human Uses

Regardless of their impacts on the UMR, all the alterations in the river were motivated by the pursuit of profit and the river has remained a notable contributor to the economies of the basin. In virtually all areas, the past exploitation of the river's and the basin's resources has been increased through modern technology and methods. The rationale behind this exploitation is the continuing historical belief that all natural resources are primarily ours to consume, coupled with the belief that all economic growth is a benefit.

For decades we have been formally using a process of designating the Authorized Purposes for major rivers and reservoirs in the country to manage resource uses.

The 'Authorized' Purposes include hydroelectric power generation, water supply, water quality, irrigation, flood control, navigation in support of commerce, recreation and fish & wildlife. The management of the river is then based upon the authorized use(s).The underlying beliefs that support the Authorized Purposes process remain primarily based upon human resource exploitation with, at best, secondary consideration for long-term health of the river ecosystems. The authorized purposes of the dams and associated pools on the UMR are generally limited to navigation and to a lesser degree recreation according to the U.S. Army Corps of Engineers (USACE) document Authorized and Operating Purposes of Corps of Engineers Reservoirs[23]

The process that resulted in the 1972 Clean Water Act was a major admission that our rivers and streams were becoming severely polluted and that we could not continue to dump our waste products into them without dire impacts, including actually being set on fire. The Cuyahoga River went ablaze from combustible pollutants at least 13 times before 1969 and became the symbol for cleaning up rivers in the nation.[24] Unfortunately, largely due to the difficulty of identifying and quantifying specific individual polluters one of the major polluters, agriculture, was largely exempted from the act by requiring only voluntary participation in Best Management Practices developed to minimize farm pollution.[25] The voluntary designation allowed in the Clean Water Act has failed and today our rivers remain heavily impacted by sediments, chemicals and nutrients running directly off of farm fields or out through farm drain tiles buried below the fields.

The 'Authorized' Purposes of our rivers according to the U.S. Army Corps of Engineers:

- Hydroelectric power generation
- Water supply
- Water quality
- Irrigation
- Flood control
- Navigation in support of commerce
- Recreation
- Fish & wildlife

With the establishment of the Environmental Management Program (EMP) in the 1986 Water Resources Development Act, an important result of the long battle fighting the environmental impacts of the proposed Melvin Price Locks and Dam near Alton, Illinois, a specific program for repairing degraded ecosystems within the UMR finally emerged. [26] However, Congress did not provide enough funding or specific authorization for EMP to be a full-scale restoration program for the river. The Program has been used more as an experiment to develop methods to restore the river to some acceptable level within the constraints of the primary authorized purpose of the river – navigation for commerce, and the primary land use in the basin – agriculture.

The numerous human uses of the UMR Basin are typically aimed at increasing economic growth of the region or local area. The authorized purposes of the UMR remain today as documented in the 1994 Authorized and Operating Purposes of Corps of Engineers Reservoirs.

## Other Uses of River Resources:

Despite management preferences for navigation and commerce, the use and enjoyment of the UMR has never been restricted to navigation. Non-damaging river uses, when pursued within sustainable levels and methods, are highly important to local economies. Activities such as hunting, fishing, recreation and tourism within the UMR Basin can bring income to local economies while they enhance understanding and appreciation for the river's resources. Unfortunately, there have been winners and losers, as well as noticeable changes in the quality and experiences in these activities, when rivers are altered and highly managed.

Before the Corps' extensive river alterations, local economies benefited greatly both economically and aesthetically from hunting, fishing, recreation and tourism. Some of these activities are now limited because of the management of the UMR primarily for navigation, especially by the construction of dams.

The dams have interrupted the free flow of the river creating "slack water" pools behind them that collect sediments and pollutants and alter the river's hydrology by raising the water level and eliminating the seasonal pulses or floods. These habitat changes have impacted fish species in particular altering the conditions they evolved within. Because the deep pools are more akin to reservoirs than a river, large recreational boats tend to dominant over the smaller boats and canoes that are better suited for a river and that most people can afford. Islands that were inundated by the creation of the pools as well as submerged bank areas that no longer exist contained habitats for many mammals. These losses have reduced hunting opportunities. Tens of thousands of acres of unique riverine floodplains and wetlands were submerged by the pools and can no longer be accessed for tourism. To determine the change in value of these activities to our economy today would require a detailed differentiation analysis of the activities between the unaltered and altered ecosystems. We expect it would also be further complicated by the subjectivity of the value of particular activities.

Several incidental or consequential river uses such as irrigation and public water system extraction have evolved after the construction of dams on the UMR created large pools. These uses have taken advantage of the higher water levels though the dams are not essential to many of these uses such as supplying water. Cities along the free-flowing portion of the river, including St.

Louis, draw water from the river without a dam. The three large hydroelectric power generation facilities with dams on the UMR were constructed independently from the navigation use. In these pools the navigation system took advantage of the dam to construct locks. Of note, none of the UMR dams were constructed for flood protection or control and provide no measurable value in this regard.

---

1 Stinchcomb, G.E., T.C. Messner, S.G. Direse, L.C. Nordt, and R.M. Stewart, 2011. Pre-colonial (A.D. 1100-1600) sedimentation related to prehistoric maize agriculture and climate change in eastern North America. Geology, 39: 363-366

2 Ehlmann, B.L., and R.E. Criss, 2006. Enhanced stage and stage variability on the lower Missouri River benchmarked by Lewis and Clark. Geology, 34: 977-980

3 Branyan, R.L., 1974, Taming the Mighty Missouri: A History of the Kansas City District Corps of Engineers 1907-1971, Kansas City, MO: U.S. Army Corps of Engineers, Kansas City District, 128 pp.

4 Vestal, S., 1945 (reprinted 1996). The Missouri. University of Nebraska Press: Lincoln, 368 pp.

5 Dobney, F.J., 1978. River Engineers on the Middle Mississippi: A history of the St. Louis District, U.S. Army Corps of Engineers. Washington: U.S. Government Printing Office

6 Ibid

7 Westphal, J.A., and Clemence, S.P., 1976, SLD Potamology Study (S-7): Rolla, University of Missouri, The Institute of River Studies, 59 p.

8 Chen, Y.H., and Simons, D.B., 1986, Hydrology, hydraulics, and geomorphology of the Upper Mississippi River System: Hydrobiologia, v. 136, p. 5-20

9 Wiener, J.G., C.R. Fremling, C.E. Korschgen, K.P. Kenow, E.M. Kirsch, S.J. Rogers, Y. Yin, and J.S. Sauer. 1998. Mississippi River. In Mac, M.J., P.A. Opler, C.E. Puckett Haecker, and P.D. Doran, eds., Status and trends of the nation's biological resources. Reston, Virginia: U.S. Department of the Interior, U.S. Geological Survey. 1: 351–384.

10 Chen, Y.H., and Simons, D.B., 1986, Hydrology, hydraulics, and geomorphology of the Upper Mississippi River System: Hydrobiologia, v. 136, p. 5-20

11 Fremling C, B Drazkowski 2000 Ecological, institutional, and economic history of the Upper Mississippi River. Resource Study Center, St. Mary's University of Minnesota, Winona.Hall, B.R., 1991. Impact of agricultural levees on flood hazards. U.S. Army Engineer Waterways Experiment Station Technical Report, HL-91-21, 36 pages.

12 Ibid

13 Knox, J.C., 1999. Long-term episodic changes in magnitudes and frequencies of floods in the Upper Mississippi river valley. In: A.G. Browne, T.A. Quine (Eds.), Fluvial Processes and Environmental Change, John Wiley & Sons: London, pp. 255-282

14 Potter, K.W., 1991. Hydrological impacts of changing land management practices in a moderate-sized agricultural catchment, Water Resources Res. 27, 845-855

15 Van SIckel, D.R., 1979, Effects of urbanization on streams. In Water Problems of Urbanizing Areas. Proceedings of the Research Conference, New England College, Henniker, New Hampshire July 16-21, 1978. The American Society of Civil Engineers, New York, p 259-270.

16 Changnon, S.A., and Demissie, M., 1996. Detection of changes in streamflow and floods resulting from climate fluctuations and land use-drainage changes, Climatic Change 32, 411-421

17 American Society of Civil Engineers, 1996. Handbook of Hydrology, 2nd ed., ASCE Manuals and Reports on Engineering Practice 28, American Society of Civil Engineers: New York

18 Stevens, G.T., 1979. SLD Potamology Study (S-3). St. Louis Division, U.S. Army Corps of Engineers, Contract #DACW-43-76-C-0157. 43 pages

19 Chen, Y.H., and Simons, D.B., 1986, Hydrology, hydraulics, and geomorphology of the Upper Mississippi River System: Hydrobiologia, v. 136, p. 5-20

20 Dyhouse, G.R., 1985. Levees at St. Louis--More harm than good? in W.R. Waldrop (ed.), Hydraulics and Hydrology in the Small Computer Age: Proceedings of the Specialty Conference. American Society of Civil Engineers Hydraulics Division, p. 390-395

21 Dobney, F.J., 1978. River Engineers on the Middle Mississippi: A history of the St. Louis District, U.S. Army Corps of Engineers. Washington: U.S. Government Printing Office

22 Tobin, G.A., 1995. The levee love affair: A stormy relationship? Water Resources Bulletin, 31: 359-367

23 USACE, 1994, HEC Publication PR-19, Authorized and Operating Purposes of Corps of Engineers Reservoirs

24 Cleveland Historical, Cuyahoga River Fire, http://clevelandhistorical.org/items/show/63

25 Federal Water Pollution Control Act of 1972, Sec. 319, Nonpoint Source Management Programs

26 Shallat, Todd, 2005, Collossus Above St. Louis: Remaking the Mississippi at Melvin Price Locks and Dam, Illinois Heritage, http://www.lib.niu.edu/2005/ih050710.html

The impacts of the historical river-system modifications outlined above have been extensively researched, and those full results are beyond the scope of the short review here. My research group has focused on historical changes in flooding and the mechanisms that have driven these changes. Such research starts with a single question – Are floods on the Mississippi River system getting worse and more frequent over time? This assertion has been repeated, in both the scientific literature and in the popular press, during recent years, and not without reason. The 2008 flood crest on the UMR was the 2nd ~500-year flood in 15 years and the 3rd or 4th 100-year flood in ~35 years at several locations. At St. Louis, the precise record of stages (flood levels) stretches back 150 years, and the 10 highest crests have all occurred within the past <70 years. The chance of this flood history being a random distribution is less than the chance of flipping a coin 10 times in a row and having them all come up "heads." In fact, the assertion that flood dynamics on the MMR and UMR have changed dramatically can be tested statistically. And once verified (see below), the mechanisms driving those changes can be precisely determined.

Any discussion of flood trends must distinguish between the volume of river or flood flow (its "discharge") from the height of that flow (river "stage"). Several studies have tested whether flood flows on the Upper Mississippi and other rivers have systematically increased over time. Analyses of both river discharges and flood-producing precipitation have identified statistically significant increases at many locations across the eastern two-thirds of the country during the 20th century (Changnon et al., 2001; Groisman et al., 2001; Milly et al., 2002; Ya et al., 2004). In contrast, Lins and Slack (2005) saw trends in moderate floods but no discernible trends in the largest events. Such differences are expected when different statistical techniques are applied to noisy data sets like flood volumes, where long-term trends can be masked by year-to-year variability. Trends in flood flows over time emerge decisively and unequivocally where the changes are truly extreme, such as in northern Europe, where climate change has driven flood volumes up to 30% higher over the past ~century (e.g., Pinter et al., 2006).

Any systematic change in flood flows (discharges) at a given location represents the sum total of all runoff controls in the basin, including climate change, land-use shifts, as well as flood reductions from dams constructed upstream. Looking again at discharges over time, and thus the cumulative effects of all of the above effects, Pinter et al. (2008) tested for trends in both discharge time series at 68 stations on the Mississippi and Lower Missouri Rivers. We identified 11 significant trends in flood discharges, all of them positive and all on the Upper Mississippi (11 of 21 total sites). No other site anywhere on the Mississippi-Missouri system showed any other statistically significant change in flood flows, consistent with the findings of Pinter et al. (2002) that construction of the large mainstem dams on the Missouri River (Fort Randall, Garrison, Gavins Point , Oahe, and Big Bend Dam) have counterbalanced discharge increases over time due to climate and/or land-use change over the past ~100 years.

*For Pinter's complete essay, please see Chapter 6, Expert Contributor Essays*


# Chapter 3:
# Contemporary Myths Impacting the UMR

Four major "myths" directly affect the environment and economy of the UMR Basin.

These four myths form a structure of myths, one supporting another, that allows believers to ignore the realities of the natural world and justify an unsustainable consumption of river basin resources. Figure 3-1 provides this structure in a simple graphic.

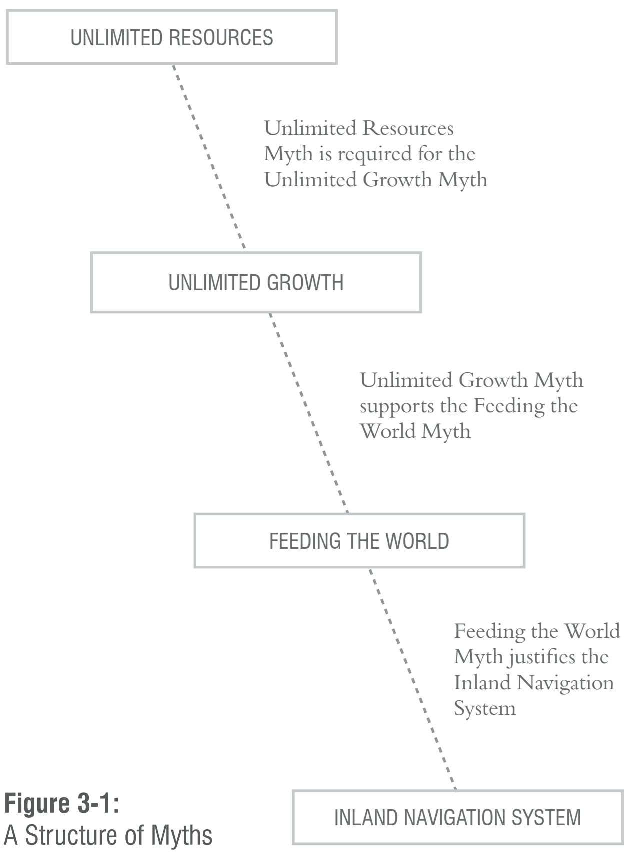



**Figure 3-1:**
A Structure of Myths

## MYTH 1:
## Unlimited Resources Are at Our Disposal

> "A student question about the collapse of the Easter Island society: 'How on earth could a society make such an obviously disastrous decision as to cut down all of the trees on which it depended?'" [1]
>
> -Jared Diamond

> Spring skies; vast tracts of oak;
> Blue-gray wings; red breasts with fawn and white
> --sweet billions overhead.
> Thundering flocks; infinite numbers,
> Black with multitudes - 240 miles long;
> One mile wide; sometimes 3 days passing
> -- into the maw of extinction.
> Gone forever, September 1, 1914 [2]
>
> -J. E. Sutter, *Extinction of the American Carrier Pigeon*

*The Truth: Resources are limited at human time scales*

A primary cause of the collapse of some past major civilizations is the depletion of essential resources from growing populations coupled with environmental degradation. Increasing evidence documented in recent writings[3] has indicated in these cases the societies were living beyond the carrying capacity of their land, in essence ignoring or being unaware of the natural laws of biology and physics. Despite our nearly instantaneous communication transmissions and gravity defying technology, modern humans are not exempt from these natural laws or from civilization collapse. In fact, we may be more susceptible due to our larger population, reliance upon nonrenewable resources and the unsustainable economic development that the use of nonrenewable resources has allowed.

We live in a world of finite resources, virtually all of which have been created with solar energy, like fossil fuels for example. What we "create" is simply the alteration, manipulation, or combination of these resources, in effect just adding value through our labor and innovation to them.

In the early 20th century, almost concurrent with the construction of the dams on the Upper Mississippi River, the U.S. became an industrial power. At that time we were also the leading exporter of crude oil[4], the liquid that would generate the power of modern America's ascent to the top of the world's economies after World War II.

Oil has been so valuable because:

1. One barrel of oil contains 5.8 million BTUs of energy (equal to the amount of sunlight shining on a 100 square foot surface for over 180 hours)
2. Of its versatility of uses, transportability, and ease of extraction (at least through most of the 20th century)

Oil allowed us to move from solar-based societies to a non-renewable based society. Our industrial and agricultural production grew to depend on oil-cheap oil- and other petroleum products to run machines, manufacture fertilizer, chemicals, and equipment, and ship finished products, and harvested crops. Increasing uses of oil, and substitutions of oil for other naturally occurring resources, created complex commodity interdependencies that hide the extent of our oil dependency.

Our entire economy became based upon the belief that supplies of oil were unlimited and would always be inexpensive; this belief has spawned several corollaries including "Feeding the World" and "The Benefits of Upper Mississippi Navigation." Yet, as William Catton states, this belief is grounded in "phantom," not actual, carrying capacities:

> "Phantom carrying capacity means either the illusory or the extremely precarious capacity of an environment to support a given life form or a given way of living. It can be quantitatively expressed as that portion of a population that cannot be permanently supported when temporarily available resources become unavailable." [5]

In 1990 the world used about 70 million barrels of oil each day. Today we use between 85 and 90 million barrels each day. The U.S. Energy Information Administration is predicting that the world daily use will rise to over 100 million barrels each day by 2020.[6] A growing portion of this volume has to come from what are called unconventional and unreliable sources such as tar sands that are extracted in Canada, piped to

### *Are Tar Sands the Energy Answer?*

Per the Oil Shale and Tar Sands Programmatic EIS Information Center "Tar sands (also referred to as oil sands) are a combination of clay, sand, water, and bitumen, a heavy black viscous oil. Tar sands can be mined and processed to extract the oil-rich bitumen, which is then refined into oil. The bitumen in tar sands cannot be pumped from the ground in its natural state; instead tar sand deposits are mined, usually using strip mining or open pit techniques, or the oil is extracted by underground heating with additional upgrading."[7]

Problems With Tar Sands

- Energy Return on (Energy) Invested is low, between 1 and 6 to 1[8]
- Uses vast amount of water, 2 to 4 barrels of water per barrel of oil produced, 48.7 billion gallons in Canada in 2008[9]
- Requires government subsidies to justify exploration and extraction; as much as $2.8 billion[10] annually for about 505 million barrels in Canada
- Destroys large areas of natural land
- Pollutes water and air systems[11]

Athbasca Tar Sands - Alberta, Canada
Source: SkyTruth, May 2005. http://www.flickr.com/photos/skytruth/4169377268/

the U.S., and refined in a Conoco-Phillips Wood River, Illinois refinery located next to the Mississippi River.

Oil is arguably the most precious commodity (other than air and water) ever discovered. Today there are no more essential or irreplaceable nonrenewable resources as important to our life style than petroleum products – crude oil and natural gas. Yet the pricing of this valuable and finite resource fails to reflect its true cost or even its value to us. Oil prices have never been based on the amount that can be energy-efficiently extracted from the earth, which is measured by the Energy Return On Investment (EROI). Oil prices have instead been based upon its short-term availability, typically constrained only by technological limitations, political upheavals or natural disasters and the money speculators would wager.

Figure 3-2 below compares the EROI of energy sources and in regards to crude oil, the change in the EROI over time.

We have witnessed the initial upheaval of our faltering dependency upon oil during the 2008 oil price explosion to over $140 per barrel. Some dismissed this, at least in part, as caused by speculators running the price up, but many others believe it is the early ripples of "peak oil" or the point at which half of the total recoverable oil in the world has been extracted. Whatever the cause, food prices that climbed as a result of the oil price hike have not returned to earlier levels. And instabilities in the Middle East, disasters like the BP oil spill and other events routinely jolt oil prices. The expensive and risky development of unconventional petroleum sources such as from the deep ocean, tar sands, oil shale and natural gas fracking strongly support the peak oil scenario. In short, the days of cheap, easily obtained oil are over. From now on getting oil will cost more and pose more risks than ever.

Geologist M. King Hubbert predicted in 1956 that the lower 48 states petroleum production in the U.S. would peak in 1969 – he was off by just a year.[12] Subsequent estimates from petroleum experts for world-wide peak oil have ranged from as early as 2006 to 2020.[13, 14, 15]

The U.S. has only a small portion of the world's oil reserves, as seen in Figure 3-3 on the following page. We import about 2/3rds of the oil we consume.

Important and essential resources do either become depleted or eventually become too costly to extract. However, the U.S. economy has been dependent upon ignoring this fact. Oil is not the only important resource that is approaching a peak; phosphorus, clean water, fertile soils, and forests are among resources that are rapidly declining or threatened. The consumption economy has created ecological debt.

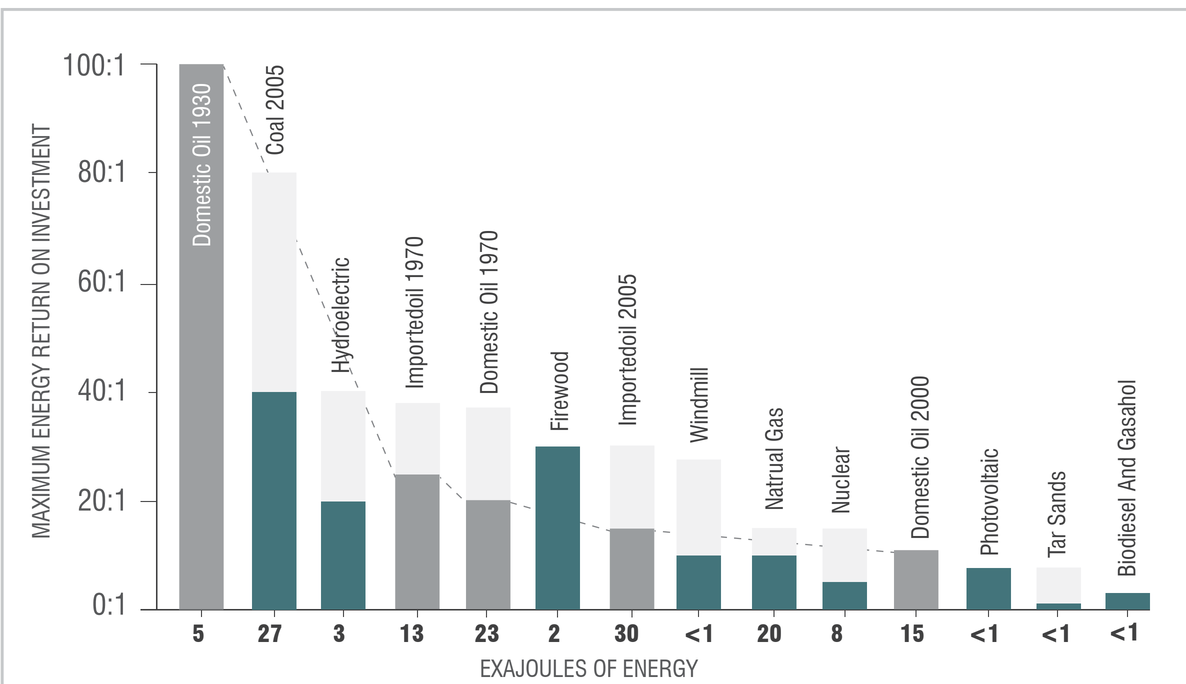



**Figure 3-2:** Comparing Energy Return on Investment (EROI)

Source: Charles A.S. Hall and John W. Day, Jr. in "Revisting the Limits to Growth after Peak Oil" in American Scientist, May-June, 2009

The change in effort to extract any energy resource is measured by the EROI or the amount of energy returned for the energy exerted. In 1930 in the U.S. the EROI ratio was about 100 to 1for crude oil. By the 1970s the ratio had dropped to about 30 to 1 during which we were increasing our oil imports as well as our usage. But by the early 2000s it had further decreased to somewhere between 11 and 18 to 1.[16] It is estimated that a ratio in excess of 3 to 1 is the minimum EROI ratio that a society can drop to and still be sustainable, although when the transporting and using of the energy are included the minimum EROI can be up to 10 to 1.[17] For comparison, corn-based ethanol has an EROI of less than 2.0.[18]

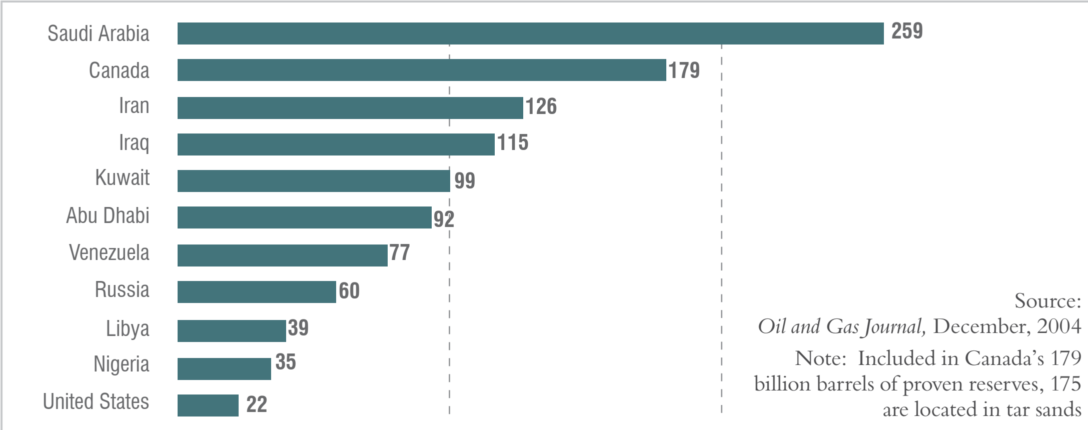



**Figure 3-3:** Oil Reserves by Country (Billion Barrels as of December 2004)

When the UMR states were being settled in the early 1800's the landscape was a vast fertile prairie with abundant plant and animal life. The prairie topsoil was between 6 inches and more than five feet thick and had taken thousands of years to form.[19, 20] It is estimated that about 50 percent of the rich prairie topsoil in Iowa has been lost over the last 150 years.[21]

In an Environmental Working Group 2011 report soil erosion rates in Iowa farmland continue to be unsustainable. The authors estimated the rate to be between two and twelve times higher than the sustainable rate that the U.S. Department of Agriculture's Natural Resources Conservation Service estimated was occurring.[22]

E.F. Schumacher said it as clearly and succinctly as can be:

> "it does not require more than a simple act of insight to realize infinite growth of material consumption in a finite world is an impossibility." [23]

## MYTH 2:

## Unlimited Economic Growth

*The Truth: Resources constrain growth; Economic metrics are insufficient to measure ecological and human health, well-being and sustainability*

Coupled with the erroneous belief in unlimited resources is the belief in unlimited economic growth. This belief in unlimited economic growth relies upon another set of beliefs; that wealth is derived primarily from human labor and our ability to overcome the limitations of natural resources through resource substitutability. But as we have addressed above, we are really just adding value to natural resources and we depend on key resources for which we have found no equivalent substitute.

Economic growth, considered by some as a measure of economic welfare, is crudely measured as the gross domestic product (GDP). GDP is the total sum of a country's economic activity, essentially everything that people and corporations produce.[24] GDP was developed as a planning tool during World War II to help estimate the national income.[25] It has become the primary measure used by the investment world and our government to assess U.S. economic strength and security; every American knows that if the GDP is "up" it means growth and prosperity, but "down" means recession or, even worse, depression.

In actuality, GDP ignores the difference between activities that improve our well-being and those activities that actually hurt our well-being. GDP, as calculated, considers both constructive and destructive or beneficial and harmful activities as good for the economy.[26] For example, terminal cancer and the economic activity it generates are measured with the same metric as getting a college degree: in both cases GDP sees positive economic activity. GDP can only be justified as a valid indicator of economic welfare theoretically, and within an economic system that has disconnected itself from dependency upon natural resources. Ours has not.

When adjustments are made to the GDP index to measure negative impacts – primarily by adding a minus sign to the value of the economic activities that are destructive or harmful, thus taking into account the depletion of resources – the upward trend over the last 30 years becomes a flat trend instead of a steady rise.[27] This means that since about the late 1970's we have been in a period of what has been termed "uneconomic growth" where the amount of natural resources (ecosystem services) we are losing is greater than the economic benefits we receive from them .[28] Or more simply, we are living in ecological indebtedness.

Alternate indicators have been developed to adjust for the difference between positive and negative economic activities. For example the creation of a new plant facility making useful products and creating new jobs would generally be positive activity. However, the

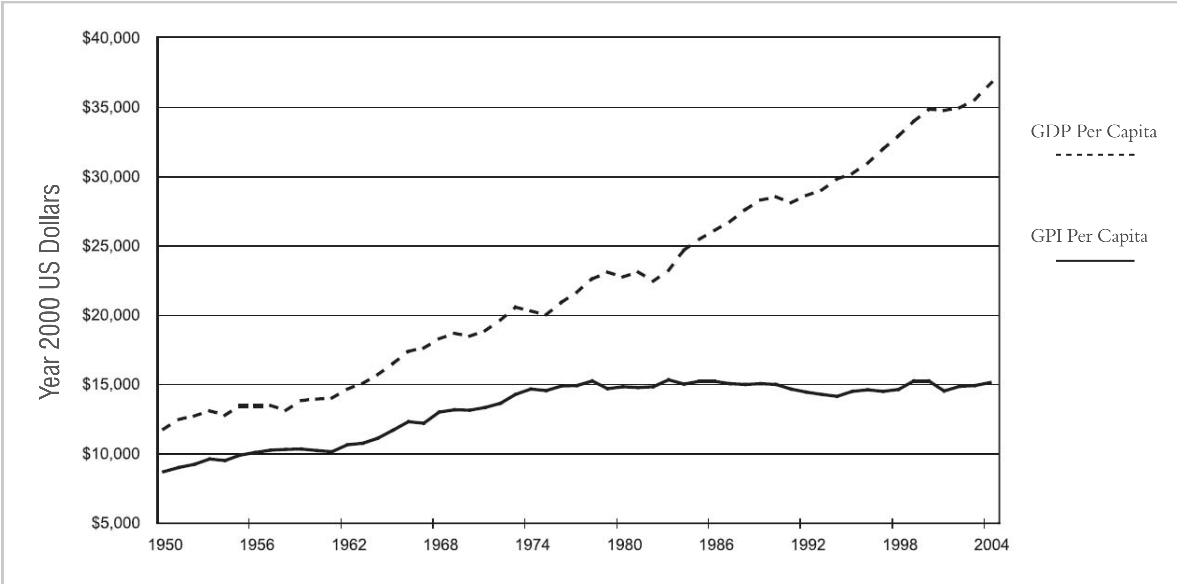



**Figure 3-4:** Real GDP and GPI Per Capita 1950 - 2004

Source: Talberth, D. J., C. Cobb, et al. 2007. The Genuine Progress Indicator 2006: A Tool for Sustainable Development. Oakland, California: Redefining Progress

cleanup of a natural disaster or fighting a war would generally be considered negative activity. The Genuine Progress Indicator (GPI) is one of the indicators that attempts to make these adjustments. The Figure 3-4 above compares GDP and GPI from 1950 to 2004. The disparity between the two indicators up to the mid-1970s consistently tracked the differences between the two indicators. But divergence grew since the mid-1970s influenced by many factors including "uneconomic" growth[29] indicated by the flatness of the GPI- little genuine progress has been made. This is often expressed as the belief that today's youngsters will not be as well off as their parents and grandparents.[30]

In 2007 an international conference was held in Brussels to discuss the usefulness of GDP. The conclusion was that "GDP is unfit to reflect many of today's challenges, such as climate change, public health, education and the environment."[31]

Conservationists are making the connection between our degraded environment and economic growth. An article in the fall 2009 The Wildlife Professional magazine argued that the growth in our economy "removes structural elements of ecosystems, depletes non-renewable resources, physically displaces healthy ecosystems and their services and degrades other ecosystems with waste." The article's authors further stated we were focused on symptoms, not on economic growth, the root cause.[32]

The belief in unlimited growth has politics primarily to thank for its existence. With a time horizon stretching only to the next election, elected officials are unwilling to seek long-term solutions that may require generations. Herman Daly explained that there are "bone crushing problems" such as growing populations, unjust economic distribution, unemployment and environmental degradation that will be extremely difficult to solve and the ultimate solutions will be considered radical by some.[33] It has become politically expedient to say that the solution to each of these problems is more economic growth, without supporting evidence of that being true or possible. This allows politicians to ignore our current reality, push the problems off to future generations, and lay the blame on others when the increase in GDP does not solve these problems. Without an open admission that for quite some time our growth has been uneconomic, the hard decisions and changes will not be made.

As of early 2012 farmers, truck drivers, and housewives throughout the basin were paying nearly $4.00 and over $4.00 per gallon for gas and diesel. Adjusted for inflation in 1992 the price of gas and diesel was less than $1.80. Health care costs have skyrocketed for Americans. Twenty years ago the cost per person was less than $3,000 per year[34] but by 2009 they had skyrocketed to over $8,000[35] per person which is significantly higher than any other industrial nation though we lag behind most other industrial nations in good health indicators.

*It has become politically expedient to say that the solution to each of these problems is more economic growth, without supporting evidence of that being true or possible. This allows politicians to ignore our current reality, push the problems off to future generations, and lay the blame on others when the increase in GDP does not solve these problems.*

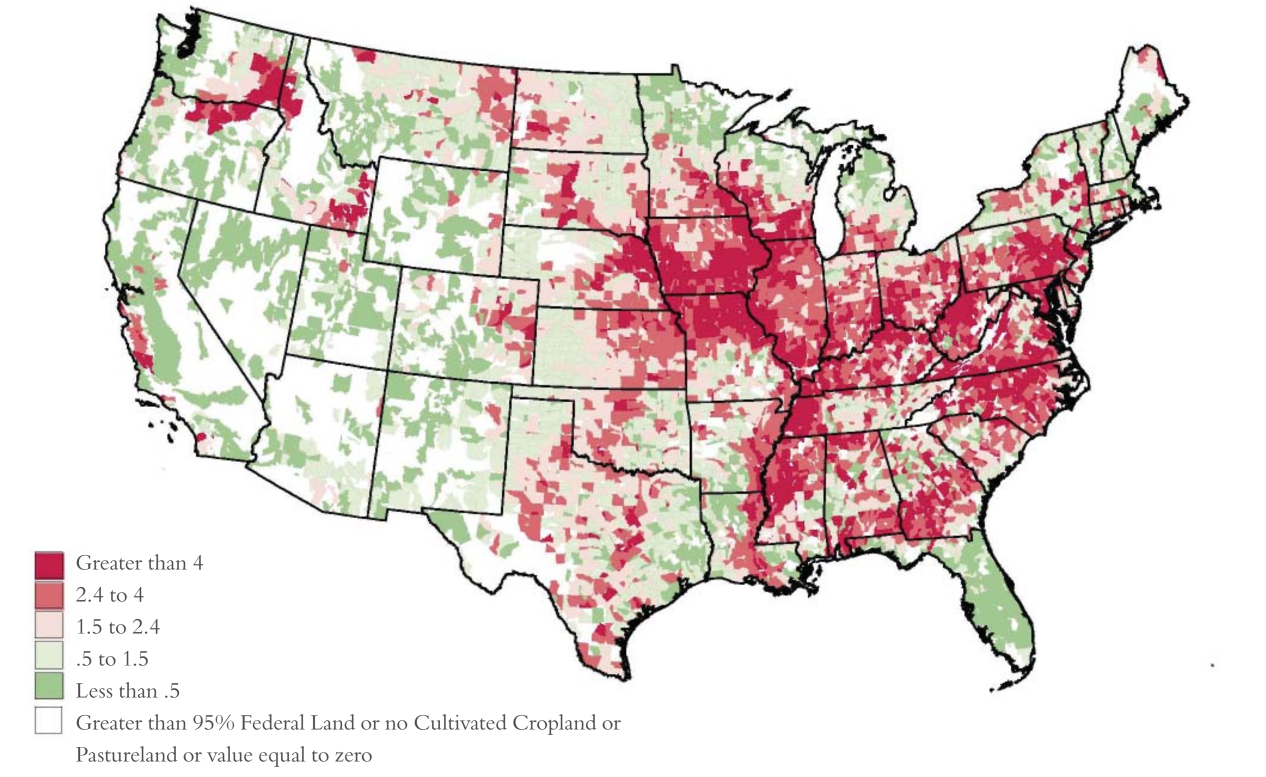



**Figure 3-5:** Rate of Soil Loss from Sheet & Rill Erosion

Source: US Department of Agriculture, Natural Resources Conservation Service, Resource Assessment Division. July 2000.

While the income of most Americans has not grown, the costs for them to live a productive and healthy life are constantly increasing – a reality of uneconomic growth. Fossil fuels still power our lifestyles, but they are getting more expensive and less accessible.

## MYTH 3:
## The Midwest is Feeding the World

*The Truth: The Midwest is not even feeding itself; The Midwest is feeding agricultural companies, often monopolies.*

On Halloween, 2011, the United Nations said the world's population had reached 7 billion people with a projection of over 9 billion by 2050 and more than 10 billion by 2100.[36] Since 1960 when the population was 3 billion, the amount of productive land has shrunk from about 7 acres per person to about 3 acres per person, with less than 1 acre of arable land capable of producing food currently available per person.[37]

Food to eat, like water to drink, is necessary for survival. Many Americans grew up hearing that our country's farms, in particular the Midwest's grain farms, could and would "feed the hungry." Intense debates over food availability have contributed to changes in how we grow food, and these changes have themselves led to the furtherance of policies impacting many resources, including the Upper Mississippi River.

In fact, agricultural practices and policies in the United States have evolved to achieve the "singular goal" of "maximum, efficient production for short term gain." [38] The economic goal has been to make food cheap.

Agriculture has transformed most of the Midwest since the invention and development of the steel plow in the 1830s, which was used to break the prairie ground. Today it is estimated that less than 10 percent of the original prairie remains[39] in some farming areas in the UMR Basin, or the Corn Belt as it is more commonly known in the agricultural community. In Iowa the numbers are even worse with only about one tenth of one percent of the original prairie remaining.[40] Prairie lands do a much better job than farmed fields of holding soil, infiltrating rain water, providing habitat, sequestering carbon, and preventing water pollution.

When the U.S. was established the topsoil depth averaged about 9 inches. Over the last two centuries we have lost nearly a third, or about 3 inches, of topsoil. In areas of extensive farming we have lost even more topsoil in less time. About 50 percent of the rich prairie topsoil in Iowa has been lost over the last 150 years. It has been estimated that about 30 percent of the U.S. farmland has been abandoned because of erosion of valuable topsoil and other land degradation impacts.[41] Figure 3-5 above shows that the Corn Belt states are the largest contributor to erosion problems affecting our Midwest rivers.

Over time farming has moved from a solar-based system that used human and animal power to an industrialized system that is totally reliant upon fossil fuels, chemicals and synthetic or nonrenewable nutrients. With this change farms went from growing a vast array of plants for direct human consumption to producing corn and soybeans used primarily as animal feed, food additives or fuel; our agricultural diversity has disappeared. For example, in 1920 Iowa farmers grew six crops and raised four animals on half of the farms. There were lesser volumes of up to a total of 24 crops and animals on these farms as well. Even by the early 1950's there were a total of about 26 crops and animals raised in varying volumes. By 2002 the numbers had dwindled to two crops grown and two animals raised on half of the farms, with a total diversity of just ten plants and animals on all farms – a transition to the modern monoculture agribusiness model.[42]

This transition has also helped spur an increase in the food we import and the distance food travels within the U.S. With the nation's finest farmland dedicated to a handful of grain crops (primarily wheat, corn, soybeans, and rice), Americans increasingly obtain much of their lettuce, carrots, peaches, berries, onions, potatoes and other foods elsewhere.

The industrialization of agriculture prompted the national growth in fertilizer use from less than seven million tons annual in the 1920's to over 22 million tons in the 1950's to more than 52 million tons by 2000. Synthetic nitrogen was promoted by the manufacturers of explosives who converted their plants after World War II to making this product. It is made from ammonia that comes out of a process that converts the hydrogen from methane or natural gas.[43] The use of synthetic nitrogen increased from virtually none to nearly 3 million tons in the late 1950's to about 12 million tons in the early 2000's.[44]

Concurrently, the use of pesticides in the U.S. increased even faster; an estimated 17,000 tons were used in 1945 but by 2007 we used about 550,000 tons of more concentrated pesticides.[45, 46] Not only has the volume increased but the number, types and toxicity of pesticides has grown. The chemical industry is producing different, more powerful, and too often more harmful, pesticides to combat the adapting insects and weeds.[47] Still, agricultural pests continue to evolve to tolerate the poisons. These synthetic nutrients and chemicals, which are essential to industrialized agriculture's yields, have had a dramatically negative impact upon the water quality of UMR Basin's rivers and the Gulf of Mexico.

As the diversity of what is grown on farms dwindled, so did the number of companies serving farmers. The consolidation of agriculture-related companies has been dramatic over the last several decades. This combining of companies has occurred both on a horizontal and vertical level providing unprecedented influence over agriculture and food activities by a very small number of companies:

- Seeds: Five companies dominate this market and in the last 15 years bought out over 200 companies[48]
- Beef Packers: Four companies controlled 83.5 percent of the U.S. market in 2005[49]
- Corn Exports: Three companies controlled 81 percent of the U.S. market in 2001[50]
- Terminal Grain Handling Facilities: Four companies controlled 60 percent of the U.S. market in 2001[51]
- Fertilizer: World phosphorus is controlled by three companies[52]
- Pesticides: Four companies controlled 75 percent of the world market in 2008[53]
- Food Retail: Five companies controlled 48 percent of the U.S. market in 2005[54]

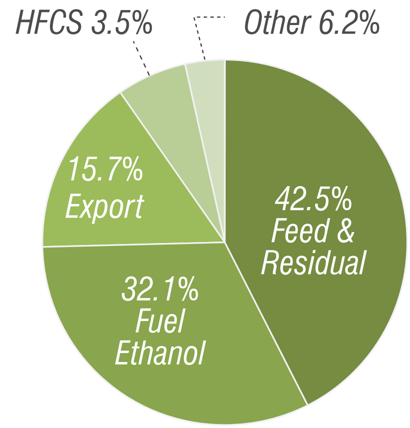
Prior to the 1980s, these companies would not have been allowed to control such large portions of markets because anti-trust and anti-monopoly laws were enforced to protect farmers, local companies and consumers from economic, health and safety transgressions.

For at least 60 years the U.S. has consciously moved to abandon a diverse agricultural system for industrialized monocultures and factory animal farming and have aligned national priorities and funding to accomplish this. The emphasis upon primarily three crops; corn, wheat and soybeans, and the confinement of livestock have increased certain aspects of production efficiency within all of these commodities, especially yields per acre for crops. The bushels per acre or acres per farmer measures of efficiency however present a very misleading assessment of the true efficiency of the industrialized agriculture system.

In the growing of each commodity large portions of the costs for inputs and outputs, especially those pertaining to the environment, equipment manufacturing, and energy use, are externalized or ignored. When all costs and impacts are included, using efficiency measures such as net production value per acre or energy usage per bushel the production efficiency of industrialized agriculture is reduced. For example, particularly for corn and soybeans[55] this would include the subsidies farmers receive for growing them as well as the highly subsidized inland waterways navigation system[56] used

(in million metric tons)

| | |
|---|---|
| Feed & Residual | 141.0 |
| Export | 52.1 |
| Fuel Ethanol | 106.7 |
| HFCs | 11.7 |
| Starch | 5.8 |
| Sweeteners | 5.8 |
| Cereal/Other | 4.9 |
| Beverage Alcohol | 3.4 |
| Seed | 0.6 |
| TOTAL FSI | 138.9 |
| TOTAL USES | 332.0 |




Source: National Corn Growers Association, World of Corn 2010

**Figure 3-6:** U.S. Corn Usage by Segment, 2009

to export them. Also, in the Midwest, concentrated hog operations benefit from federal farm loans through the Farm Services Agency for construction of the facilities, and they also often receive cost-share funds for construction of waste lagoons, waste application systems, and even waste transport.[57]

A more realistic and useful measure would be the volume of the total productive output of food per acre. Smaller, more diverse farms, where the farmer understands and works within natural systems, can supply up to 10 times the volume of food per acre than large industrialized farms.[58, 59, 60]

The dominance of agricultural monocultures is especially prevalent in the UMR Basin with about 60 percent of the land in agriculture primarily growing two crops, corn and soybeans, neither of which is primarily for direct human consumption. The dominance of these two crops in the "Corn Belt", the area of perhaps the most fertile prime farmland in the country, is attributable largely to subsidies. The corn and soybean farmers in the five UMR states received over $45 billion in direct government subsidies between 1995 and 2009.[61] During 2009 the corn ethanol industry received $7.7 billion in government subsidies.[62] In the same time period farmers growing fruits and vegetables for human consumption received virtually no subsidies.

This movement to monocultures has also transformed the UMR Basin agriculture to agribusiness where the primary focus is producing cheap commodities in the highest volume possible. Ironically for U.S. consumers, agribusiness has increased the distance foods travels within the U.S. as well as the amount of the food we import. A USA Today article in 2007 stated that according to government agencies the U.S. imports about 80% of our seafood, 45% of our fresh fruit and 17% of our fresh vegetables.[63] By 2010 we imported $14.5 billion in seafood, $10.7 billion in fruits and $8.6 billion in vegetables.[64] The late Calvin Fremling, a prominent UMR ecologist observed:

> "To see the ultimate dysfunctionality of an export-based farm economy one need look no farther than Iowa-the country's quintessential farm state. Because corn and soybeans (most of which are not consumed directly by humans) make up 95 percent of Iowa's crops, Iowa imports more than 80 percent of its food (Crosbie 2001). The state that "feeds the world" can't feed itself.[65]

We grow so much corn and soybeans that we have had to invent new uses for the grains to deal with the surpluses, from high-fructose corn syrup (now called corn sugar) to provide a cheap sweetener for our sodas to the inefficient biofuels to supplement our insatiable appetite for fuel for our cars and trucks (See Figure 3-6 above).

Tom Philpott[66] succinctly sums up our national corn strategy:

> "So low-quality meat (fed with corn) and sweetener (HFCS), a shoddy alternative car fuel, an agrarian crisis visited upon our neighbor to the south (Mexico) ... that's more or less the corn crop"

A 2011 report[67] by the Institute for Agriculture and Trade Policy's compared export destinations to wealthy countries within the Organization for Economic Cooperation and Development (OECD) to the countries that the United Nation's Food and Agriculture Organization (FAO) designated as Low-Income Food Deficient (LIFD), the countries with the world's most serious malnutrition problems. Our export-based agribusiness economy might make more sense if our corn and soybeans exports were in fact being used to feed the world's hungry billions. The truth is that in 2009 the majority of corn, 72 percent, went to wealthy nations and just 9 percent to poor countries. The majority of soybeans, 83 percent, went to wealthy nations and just 1 percent to poor countries. Further, the U.S. cropland planted in crops directly consumed by people like wheat, rice and peanuts, dropped between 6 percent and 27 percent from 2000 to 2009. These declines were largely the result of increased planting of corn and soybeans.

Gene Logsdon[68] best exposes the myth of our feeding the world in this quote:

> "The whole issue of 'feeding the world' seems specious to me. What does it mean, actually? All my life in farming I have heard government urge us to 'gear up' to 'feed the world.' It sounds so noble and we all fall for it because we think it means we will finally make some money. Now I understand that the expression is merely a euphemism for 'Push American grain overseas and keep grain cheap here so the American consumer can afford to buy more cars, television sets, houses, and ten trillion gadgets." We 'geared up,' we raised bumper surplus crops and still people all over the world starve to death. Today 'feed the world' is the forked-tongue hypocrisy that mega-companies utter while they try to monopolize the food industry."

## MYTH 4:
## The Benefits of UMR Navigation

*The Truth: The Costs of maintaining UMR navigation outpace the benefits to the public*

Since at least the early decades of the 20th century there has been a symbiotic relationship between agriculture and navigation within the UMR basin. These two interests, more than any others, have influenced the construction of navigation infrastructure within the UMR and its larger tributaries.

Even before the 1907 six-foot channel project was completed, navigation and agricultural lobbyists began urging Congress to authorize a 9-foot channel project

| Congress authorized construction of a 4-1/2 foot deep channel | Congress authorized a deeper 6 foot channel | Congress authorized construction of the 9-foot channel | Completed 9-foot channeland 23 navigation dams |
|---|---|---|---|
| **1878** | **1907** | **1933** | **1940** |

**Figure 3-7:** Navigation Construction on the UMR

The navigation projects on the UMR were built over about 60 years, each project creating a deeper and more extensive channel in the river bed. And each was a response to the failure of the previous efforts to expand navigation on the river

(See Figure 3-7). Massive in scale, this project included constructing a series of navigation dams from St. Paul, Minnesota to St. Louis, Missouri that created a series of slack water pools behind each constructed dam inundating tens of thousands of acres of valuable river habitat.

| Type | Acres |
|---|---|
| Forest | 26,140 |
| Wetlands | 3,572 |
| Grasslands | 16,257 |
| **Total** | **45,969** |

**Figure 3-8:** Flooded Pool Areas

Early environmental damage, based upon 1890 land coverage information, from the modifications of the UMR for navigation - Tens of thousands of acres of productive wetlands, forests and grasslands flooded as a result of Lock &Dam construction from Pool 3-Pool 26. Source- Habitat Needs Assessment. (Impaired areas not inundated are not included.)

Not all people living within the UMR region believed that the 9-foot channel project was a good idea. Project opponents forecasted damage to the river's ecosystems and/or believed the construction and long-term operation and maintenance costs of the project would not justify its professed benefits.

Well before construction the 9-foot channel respected economist Harold G. Moulton questioned the economic arguments to expand navigation on the UMR in the face of the growing availability of rail transport:

> "In order to prevent the almost complete diversion of traffic from the waterways it has been necessary for Governments to assume all, or nearly all, the fixed charges connected with water transportation, to pay for building, equipping, and maintaining the water routes, and to furnish free

Harold G. Moulton in 1912:

"a river such as the Mississippi, with ever caving sides and shifting bottoms, with periods of alternating floods and droughts, and the control of which is, in the opinion of engineers, a greater task than building the Panama Canal, is no more to be regarded as a natural highway of commerce than any artificial channel whatsoever." [69]

Voice of the Outdoors (Winona Republican Herald), stated in a column on July 26, 1930:

"……we are still against the alleged nine-foot channel under the dam form of construction. We are now more convinced than ever that it will be a gigantic commercial failure and will be impossible to maintain without spending millions of dollars each year in dredging operations." [70]

of charge to the water carriers. When thus relieved of all save the mere direct cost of operating the boats, it is usually, though not always, possible for the water carriers to offer rates which enable them to compete with railways, which are entirely self-supporting."[71]

The Izaak Walton League, a conservation organization instrumental in promoting the creation of the UMR National Wildlife and Fish Refuge in 1924, condemned the proposed plan in numerous pronouncements, stating that impacts of soil erosion and pollution must be controlled before the project began.[72]

Major Charles L. Hall, Engineer for the Rock Island Corps District, determined in two separate reports, in 1927 and 1929, that the 9-foot channel proposal "was economically unadvisable" and "would have disastrous environmental impacts." [73] Two successive Corps Chief of Engineers came to similar conclusions between 1926 and 1928. It was not until the replacement of the latter Chief, after President Hoover's election in 1928 with the appointment of a supporter of the project, that it had any traction within the Corps. It required the passing over of ten senior officers to get to one who was a known supporter of the proposal. [74]

As the debate over the proposed UMR dams continued into the 1930s, the arguments continued to echo their main concerns: opponents warned against the dam construction's damaging impacts to the environment and unfair subsidies;[75] proponents justified their support by claiming the project would provide needed jobs and competition to the railroads.[76] During the economic duress of the Great Depression, jobs were needed and so Congress approved construction of the 9-foot channel and 23 navigation dams on the UMR and appropriated $170 million for the project.[77]

After the locks were built there was a push by industrialized agricultural interests, including the U.S. Department of Agriculture, to grow as much of the major grains as possible for export, fueled by the myth discussed in the previous section that the only viable system to "feed the world" is through industrialization and its specialized monoculture products. About 60 percent of the U.S. corn exports travel down the UMR by barge to New Orleans.

Although the navigation industry touts the economic benefits of UMR navigation, the following table shows, as critics predicted, that U.S. taxpayers have had to heavily subsidize both the construction costs and the ongoing, current operation costs of maintaining the UMR as a navigation channel. We pay over $100 million per year to operate, maintain and dredge the UMR navigation system. Figure 3-9 below provides a rough estimate of historical and projected impact costs of the UMR navigation system (shown in estimated 2011 U.S. dollars):

| Historical Cost Estimates of the UMR Navigation System (in billions of US Dollars) | Total Cost | Navigation Industry Contribution/Obligation |
|---|---|---|
| Initial Construction of Locks and Dams Project, excluding Dam 19:[78] | $15.0 | $0 |
| Construction thru 1990 (including Melvin Price Locks & Dam and Lock 27): [79, 80, 81] | $2.0 | $0 |
| Rehabilitation of Locks & Dams:[82] | $1.0 | $0.5 |
| Operation and Maintenance of UMR System:[83] | $7.0 | $0 |
| Environmental Restoration Costs (EMP):[84] | $0.4 | $0 |
| Loss of Ecosystem Services (only includes inundated sections, does not include areas outside the boundaries of the1890 maps or other degraded ecosystems):[85] | $2.8 | $0 |
| Estimated Cost to Restore UMR Environment:[86] | $20.0 | $0 |
| Total Costs: | $48.2 | $0.5 |

**Figure 3-9:** Historical and Projected Impact Cost (Estimated 2011 U.S. Dollars)

Through 2010 about $391 million had been spent attempting to restore portions of the UMR with no contribution directly by the barge industry. The Upper Mississippi River Conservation Committee has estimated that tens of billions of dollars are required to bring the river back to a desired condition (not to a pre-navigation system level of productivity).

Since completion of the UMR navigation project, the inland waterways navigation industry has proclaimed itself the most cost efficient and environmentally sound"[87] form of commercial transportation in the country. Nicollet Island Coalition's 2010 report "Big Price – Little Benefit" provides an in-depth review of why these claims are unfounded.

*"Through 2010 about $391 million had been spent attempting to restore portions of the UMR with no contribution directly by the barge industry. The Upper Mississippi River Conservation Committee has estimated that tens of billions of dollars are required to bring the river back to a desired condition (not to a pre-navigation system level of productivity)."*

Aside from the huge system subsidies which are not reflected in the rates users of the system are charged, there is an ignoring of the non-linear paths of rivers that create a significant difference in the miles a barge and a train travel from loading to unloading points, as well as omitting the rail industry's use of unit trains that efficiently carry a single commodity large distances. Taking into account these adjustments rail transport is considerably more efficient that barges.[88] *See* barge traffic and efficiency information in Appendix A for additional information. Because pollution emissions are directly calculated from fuel efficiency, the industry's assertion on emissions is also false.

Construction of the UMR navigation system is an example of a large-scale, publically-funded infrastructure project motivated for limited-recipient gain for which its impacts upon the environment were not adequately considered. The system has not provided sufficient benefits to the public to compensate for the long-term ecosystem losses. The project has been driven by questionable economic motives, primarily grain exports but also coal shipping, which the production and use of are themselves both unsustainable.

1 Jared Diamond, "Collapse", page 419

2 J.E. Sutter, The American Passenger Pigeon (Ectopistses Migratorius), An American Holocaust

3 Diamond, Jared, 2005, Collapse: How Societies Choose to Fail or Succeed, Penguin Books

4 Fanning, Leonard M., 1945, Our Oil Resources, McGraw-Hill Book Company, Inc., NY

5 Catton, William R., 1982, "Overshoot: The Ecological Basis of Revolutionary Change"

6 U.S. Energy Information Administration, 2009, International Energy Outlook 2010

7 Oil Shale and Tar Sands Programmatic EIS Information Center http://ostseis.anl.gov/guide/tarsands/index.cfm

8 Turner, Chris, 2009," Dave Hughes's guide to the end of the fossil fuel age, http://www.walrusmagazine.com/print/2009.06-energy-an-inconvenient-talk/

9 Schneider, Keith and Sam Kean, 2010, "Tar Sands Oil Production, An Industrial Bonanza, Poses Major Water Use Challenges", Circle of Blue, http://www.circleofblue.org/waternews/2010/world/tar-sands-oil-production-is-an-industrial-bonanza-poses-major-water-use-challenges/

10 International Institute for Sustainable Development, 2011, "IISD report estimates value of subsidies to Canada's oil industry at $2.84 billion in 2008", http://www.iisd.org/media/press.aspx?id=179

11 Wakefield, Benjamin, 2008, Tar Sands: Feeding U.S. Refinery Expansions with Dirty Fuel, The Environmental Integrity Project, http://environmentalintegrity.org/pdf/publications/Tar_Sand_Report.pdf

12 Butler, Bill, 2004, The Great Rollover Juggernaut, http://www.durangobill.com/Rollover.html

13 Youngquist, Walter, 1999, The Post Petroleum Paradigm – and Population, Population and Environment: A Journal of Interdisciplinary Studies 20:4

14 Douglas-Westwood, The World Oil Supply Report 2004-2050 - 3rd Edition

15 Butler, Bill, 2004, The Great Rollover Juggernaut, http://www.durangobill.com/Rollover.html

16 Hall, Charles A. S., Stephen Balogh and David J. R. Murphy, 2009, "What is the Minimum EROI that a Sustainable Society Must Have?", Energies, Volume 2, Issue 1, pages 25 – 47, http://www.mdpi.com/1996-1073/2/1/25/pdf

17 Ibid.

18 Ibid.

19 History of Iowa From the Earliest Times to the Beginning of the Twentieth Century Volume 1, http://en.wikisource.org/wiki/Page:History_of_Iowa_From_the_Earliest_Times_to_the_Beginning_of_the_Twentieth_Century_Volume_1.djvu/47

20 On average it takes about 500 years to create an inch of rich topsoil. - Gallagher, Larry, 2010, "The joy of dirt" – Ode Magazine, http://www.odemagazine.com/doc/69/dirt/

21 Iowa Association of Naturalists, 1998, Iowa Agricultural Practices and the Environment, http://www.extension.iastate.edu/Publications/IAN104.pdf

22 Cox, Craig, Andrew Hug and Nils Bruzelius, 2011, Losing Ground, Environmental Working Group

23 Schumacher, E.F., 1975, Small is Beautiful: Economics as if People Mattered, Perenial Library /Harper & Row, Publishers

24 More formally defined as "The total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports."; http://www.investorwords.com/2153/GDP.html#ixzz1Dapnqcdo

25 U.S. Department of Commerce- Bureau of Economic Analysis, 2000, GDP: One of the Great Inventions of the 20th Century, http://www.bea.gov/scb/account_articles/general/0100od/maintext.htm

26 Costanza, Robert, 2008, Our three-decade recession, Los Angeles Times, http://www.latimes.com/news/opinion/la-oe-costanza10mar10,0,5656929.story

27 Venetoulis, Jason and Cliff Cobb, 2004, The Genuine Progress Indicator 1950-2002 (2004 Update), Redefining Progress

28 Daly, Herman, 1999, Uneconomic growth in theory and in fact, The First Annual Feasta Lecture, Trinity College, Dublin

29 Ibid, Growth is uneconomic when it increases environmental and social costs by more than it increases production benefits., page 3

30 Talberth, D. J., C. Cobb, et al. 2007. The Genuine Progress Indicator 2006: A Tool for Sustainable Development. Oakland, California: Redefining Progress.

31 Hillyard, David, 2009, Last chance to change our behavior, BBC News, http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/8242410.stm

32 Dawe, Neil K. and Geoff Mosley, Ph. D., 2009, Striving for Sustainability, The Wildlife Professional

33 Daly, Herman E., 1999, Uneconomic growth in theory and in fact, The First Annual Feasta Lecture, Trinity College, Dublin, page 13

34 Kaiser Family Foundation, 2007, Trends in Health Care Costs and Spending, http://www.kff.org/insurance/upload/7692.pdf

35 Wikipedia, List of countries by total health expenditure (PPP) per capita (OECD Data), http://en.wikipedia.org/wiki/List_of_countries_by_total_health_expenditure_%28PPP%29_per_capita

36 Gillis, Justin and Celia W. Dugger, 2011, "U.N. Forecasts 10.1 Billion People by Century's End", New Your Times, http://www.nytimes.com/2011/05/04/world/04population.html?_r=1&ref=africa

37 Wackernagel, Mathis and William Rees, 1996, Our Ecological Footprint (extrapolated from data)

38 Kirschenmann, Frederick's, 2011, Sustainable Agriculture in the Upper Mississippi in the 22nd Century", page ?

39 Kinzer, Stephen, 2004, American Prairie Overlooked No More, New York Times

40 Klinkenborg, Verlyn, 2003 , Keeping a Lost World Alive: A Last Remnant of Iowa's Tallgrass, New York Times Prairie

41 Pimentel, David, et al, 1995, Environmental and Economic Costs of Soil Erosion and conservation Benefits, Science, Vol. 267

42 Born, Holly, 2002, Montgomery County Food System Atlas - National Center for Appropriate Technology.

43 This process is called the Haber-Bosch process

44 The Fertilizer Institute, U.S. Fertilizer Use, http://www.tfi.org/Statistics/USfertuse2.asp

45 USEPA, 2011, Pesticides Industry Sales and Usage, http://www.epa.gov/opp00001/pestsales/

46 Pimentel, David, 2002, Encyclopedia of pest management, Volume 1, CCR Press

47 Pollution Issues.com, Agriculture, http://www.pollutionissues.com/A-Bo/Agriculture.html

48 Howard, Phillip, 2009, Visualizing Consolidation in the Global Seed Industry, 1996-2008, Sustainability

49 Hendrickson, Mary and William Heffernan, 2007, Concentration of Agricultural Markets, CR4 Concentration Ratio

50 Howard, Phil, 2006, Consolidation in Food and Agriculture: Implications for Farmers & Consumers, The Natural Farmer

51 Ibid

52 Taylor, C. Robert, 2010, Forget Oil, Worry About Phosphorus

53 Greenpeace, 2008, Greenpeace publishes pesticides industry ranking, http://www.greenpeace.org/eu-unit/en/News/2009-and-earlier/greenpeace-publishes-pesticide/

54 Hendrickson, Mary and William Heffernan, 2007, Concentration of Agricultural Markets, CR5 Concentration Ratio

55 Harvie , Alicia and Timothy A. Wise , 2009, Sweetening the Pot: Implicit Subsidies to Corn Sweeteners and the U.S. Obesity Epidemic, bal Development and Environment Institute, Tufts University, Policy Brief No. 09-01

56 Nicollet Island Coalition, 2009, Big Price – Little Benefit: Proposed Locks on the Upper Mississippi and Illinois Rivers Are Not Economically Viable, www.iwla.org/bigprice, Page 24

57 Illinois Environmental Protection Agency, 2004, A Guide to Federal, State and Regional Loan and Grant Programs for Agribusiness

58 Science Daily, 2007, Organic Farming Can Feed The World, Study Suggests, http://www.sciencedaily.com/releases/2007/07/070711134523.htm

59 De Schutter, Olivier, 2011, Eco-farming can double food production in 10 years, http://www.rodaleinstitute.org/20110311_ecofarming-can-double-food-production-in-10-years

60 International Society for Ecology & Culture, ISEC's Local Food Toolkit – Factsheet, http://www.localfutures.org/local-food-resources

61 Environmental Working Group, Farm Subsidy Database, http://farm.ewg.org/progdetail.php?fips=00000&progcode=total&page=states

62 Wynn, Gerald, 2010, U.S. corn ethanol "was not a good policy": Gore, Reuters

63 Julie Schmit, March 18, 2007, "U.S. food imports outrun FDA resources", USA Today

64 ERS-USDA, 2011, U.S. food imports, value, by food group, http://www.ers.usda.gov/Data/foodimports/

65 Fremling, Calvin R., 2005, Immortal River: The Upper Mississippi in Ancient and Modern Times, University of Wisconsin Press, page 388

66 Tom Philpott, 3-25-10, 'Why are we propping up corn production, again', Grist

67 Olmsted, Julia, 2011, Feeding the World? Twelve Years Later, U.S. Grain Exports Are Up, So Too Is Hunger, Institute for Agriculture and Trade Policy

68 Gene Logsdon, 2003, Essential Agrarian Reader: page 161

69 Moulton, Harold G., 1912, Waterways Versus Railways, PhD Dissertation, University of Chicago: page 457

70 Fremling, Calvin and Barry Drazkowski, 2000, "Ecological, Institutional, and Economic History of the UpperMississippi River,: page 19

71 Moulton, Harold G., 1912, Waterways Versus Railways, PhD Dissertation, University of Chicago: pages 455-46 [Note: Mr. Moulton went on to be a nationally known economist and the first

President of the Brookings Institution]

72 Fremling, Calvin and Barry Drazkowski, 2000, "Ecological, Institutional, and Economic History of the Upper Mississippi River,: page 19

73 From Rock Island District History, Aquatic Staircase – Chapter 9: Pages 257-259

74 National Parks Service, , Gateways to Commerce, Chapter III, Opposition to the Channel, http://www.nps.gov/history/history/online_books/rmr/2/chap3.htm

75 National Parks Service, , Gateways to Commerce, Chapter VI, 1933: The New Deal and a New Emphasis on Public Employment, http://www.nps.gov/history/history/online_books/rmr/2/chap6.htm

76 National Parks Service, , Gateways to Commerce, Chapter II, The 1920s: Roots of the 9-Foot Channel Project, http://www.nps.gov/history/history/online_books/rmr/2/chap2.htm

78 USACE, 2003, Old Man River - St. Paul District History, http://www.mvp.usace.army.mil/docs/history/old_man_river.pdf

79 Inflation adjustment of $170 million original cost of the Nine-Foot Channel Project and associated dams on UMR and Illinois River

80 USACE, Locks 27 - Chain of Rocks Canal, http://www.mvs.usace.army.mil/rivers/locks-dams.html

81 USACE, Lock 19, http://www.mvs.usace.army.mil/floodfight/L-D/LD19.pdf

82 Lipe-Butterbrodt, 2002, The Project That Changed the River-Melvin Price Locks and Dam, Big River Magazine, http://whatnowdesign.com/documents/writ_6.pdf

83 USACE, various reports and documents

84 Assumed average of $100 million per year in 2010 dollars over 70 years

85 USACE, 2010, Report to Congress, Upper Mississippi River Environmental Management Program

86 MCE Estimated value of Figure 3.9 acres for Forests, Wetlands, and Grasslands since inundation for navigation dams

87 The Upper Mississippi River Conservation Committee (UMRCC), 2002, "A Preliminary Description of Habitat Objectives (And Estimated Costs) Needed to Achieve a Desired Level of Ecosystem Integrity on the Upper Mississippi River System" [This report estimate is based upon an approximated 40 percent amount from information in the UMRCC report footnoted above]

88 Levitz, Jennifer and Cameron McWhirter, 2011, Olds Locks Jam River Traffic, Wall Street Journal,

89 Nicollet Island Coalition, 2009, Big Price – Little Benefit: Proposed Locks on the Upper Mississippi and Illinois Rivers Are Not Economically Viable, www.iwla.org/bigprice.

## Sustainable Agriculture in the Upper Mississippi in the 22nd Century

- Frederick Kirschenmann

In recent years everyone involved in agriculture has indicated a desire to be---and claims to be---"sustainable." Whether farmer, food processor, retailer, or input supplier, claiming to be "sustainable" is now an important market-driven initiative.

The problem with such claims is that none of our modern food system is designed to be sustainable. The singular goal of our modern food system is maximum, efficient production for short-term economic return. All of modern agriculture---whether conventional, organic, or local---is under pressure to subscribe to this goal if it is to survive in today's market. By contrast, a truly sustainable agriculture, while being productive, must also subscribe to the goal of maintaining productivity. In other words, to truly conform to the requirements of a sustainable agriculture, such an agriculture must---in addition to being productive---be designed for resilience in the face of changing circumstances. To date, none of our food system has been designed to meet that goal.

The best model we have available for managing systems for resilience is wild nature. During its long evolutionary journey, nature has demonstrated its capacity to adapt to shocks and disturbances. So how can we use nature's wild system, and the way it is organized, to help us design a new agriculture for sustainability? That is the challenge and opportunity which now confronts us.

The emerging challenges as we enter the 21st century are becoming obvious. Our modern industrial food system---like so much of the rest of our industrial economy---is dependent on two major gifts of nature---1. the natural resources that fuel our food system---notably cheap fossil energy, fossil water reserves, fertilizers, land, seafood and a rich storehouse of biodiversity and genetic diversity; and 2. the natural sinks which absorb the wastes of our human activities. Herman Daly already warned us 30 years ago, that we are rapidly depleting these two essential resources which support our human economy and that we must now redesign our human economies---including our food and agriculture system---to function as a subsystem of the eco-system and to operate within those limits. Unfortunately, driven by the singular goal of maximum, efficient production for short term economic return, we have failed to heed Daly's advice.

Consequently we have now reached a point where these resources, so essential to our industrial production system, are in a state of depletion, and we have not, as yet, designed the necessary alternative systems.

*For Kirschenmann's complete essay, please see Chapter 6, Expert Contributor Essays*

# Chapter 4: Our Framework for Sustainability

> "Harmony with land is like harmony with a friend; you cannot cherish his right hand and chop off his left." [1]
>
> -Aldo Leopold

> '… at present no country is sustainable or even closer… Nobody knows how to meet these new demands. There is no proven recipe for success. In fact, no one has a clear sense of what success would be. Making progress towards ways of living that are desirable, equitable and sustainable is like going to a country we have never been to before with a sense of geography and the principles of navigation but without a map or compass. We do not know what the destination will be like, we cannot tell how to get there, we are not even sure which direction to take…'[2]
>
> -from Wellbeing of Nations

The Missouri Coalition for the Environment vision for the UMR moves us from managing the river basin solely for our benefit to managing ourselves within the capacity of the river system. It moves us from Myth to Truth and from Truth to Action.

MCE has become concerned about the trajectory of our historical natural resource exploitation of the UMR Basin, which focuses almost exclusively upon short-term economic benefits. Not only have these benefits largely gone to a relatively small segment of the population but the activities producing the benefits have dramatically damaged the terrestrial and aquatic environments.

The U.S. Corps of Engineers and others are promoting a plan for the future of the basin for 200 more years: a vision to "balance" economic growth and environmental impacts.[3] We are skeptical of a process led by any federal agency whose original mission from Congress has been to pursue projects across the country for economic development. And one that was so influenced by politics that its own lines of authority and expertise were subverted to achieve a singular political objective to benefit a narrow segment of the economy in pursuit of the UMR 9-foot channel. The Corps' consideration of environmental impacts was not required until decades later, with passage of federal environmental legislation such as the Clean Water Act. Congress' 1986 authorization of the Environmental Management Program did give the Corps direct responsibility for and oversight of UMR restoration projects; however, as noted in a 2011 report from the National Research Council this has created an internal inconsistency in Corps mission mandates and is likely unsustainable in its scope due to funding constraints.

> "it will be important for the Corps and water user groups to acknowledge the limits of water system benefits (e.g., water supplies, ecosystem goods and services), and the need to distribute limited resources among many, often competing, users." [4]

The Corps' 200-year vision was the main topic at the June 2010 America's Inner Coast Summit which included a presentation by John Ehrmann, Founder and Senior Partner, The Meridian Institute, titled "Vision for a Sustainable Mississippi Watershed." The presentation expressed the need for incorporating environmental, social and economic factors into a vision and then listed the following Common Principles "that can affect what happens 'on the ground'":

- Design the process to fit the realities of the situation
- Respect and value what is known and experienced at the local level
- Keep the process design simple and understandable
- Involve key players in the decision and formulation of the process
- Working in stages or phases can be helpful
- Create early opportunities for exchanging information, developing assumptions and gaining common understanding of the challenges being faced

While we agree these are all important principles[5], they are principles for the process of decision making. Although one can say concern for the environment is embedded in this process, that is not evident and we believe that it should be clearly stated as the fundamental principle, particularly to address the need to contradict the Corps' tendency to put economic benefits first.

Our vision is one based on sustainability. By "sustainability" we do not mean the traditional general definition established in 1987[6] because it is inadequate in defining important aspects of resources, does not address specifics of change in our actions and has become little more than a trendy buzzword. We are instead advocating a vision that is premised on "strong" sustainability.

## The Need to Move from Weak to Strong Sustainability

> "The economy is a wholly owned subsidiary of the environment, not the reverse." [7]
> - Herman Daly
>
> "Zero natural capital implies zero human welfare because it is not feasible to substitute, in total, purely 'non-natural' capital for natural capital."[8]
> -Robert Costanza

As stated above, we believe that the current approach to economic development and natural resource exploitation is unsustainable and destined to cause severe hardships if this pursuit is continued unabated. For the most vulnerable communities, the hardships have already come and many persist. For taxpayers, the bills continue to arrive. Many economists have concluded that "the depletion of environmental resources (source and sink resources) in pursuit of economic growth is akin to living off capital rather than income." [9] Academics have differentiated between our current level of sustainability (or lack thereof) with a level of sustainability that should be pursued for long-term health of our environment, our current well being and the well being of future generations. The current level has been termed weak sustainability and the level we should strive for is termed strong sustainability.

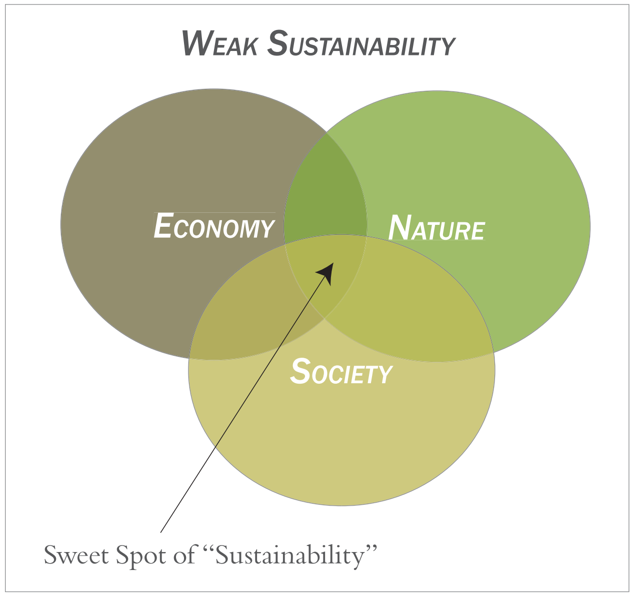



**Figure 4-1:** Weak Sustainability

*Weak sustainability* "argues that what counts is the overall value of the (intergenerational) bequest package (of resources). Natural and artificial capital are, in principle, substitutes. Therefore, the depreciation and degradation of natural capital is permissible under the idea of intergenerational justice if artificial capital is produced at the same rate."[10]

*Strong Sustainability* "emphasizes that the human sphere is embedded in a natural system ('biosphere') and assumes that natural limits ought to constrain our actions. Artificial capital can only sometimes substitute for natural capital." [11]

Strong sustainability also recognizes:

- Our lack of knowledge about how ecosystems function and the value of the services they provide humans


**Figure 4-2:** Strong Sustainability

## *Weak Sustainability Example: Pacific Island Country of Nauru*

Phosphate was found in Nauru in 1900 and mining rights were sold for a billion dollars. This has devastated over 80 percent of the country's landscape. The citizens now live off of the interest. The area mined on the island is essentially uninhabitable. They produce nearly nothing themselves and have to buy nearly everything including drinking water yet the country would have a sustainability score of 33 by neoclassical calculations, possibly the highest in the world.

Source: Gowdy, John M. and Carl N. McDaniel, 1999, The Physical Destruction of Nauru: An Example of Weak Sustainability, Land Economics:: 75-2

- The possibility of hitting tipping points in resource degradation and/or loss that are irreversible
- Loss aversion of degraded environment felt by individuals
- Some natural resources or ecosystems cannot be substituted for
- Our impact on the environment is approaching or has passed global carrying capacity [12]

There is a major disparity between the two definitions in just how we create things and where the material for those things we make actually comes from. The disparity can be explained simply that a weak sustainability approach assumes that natural resources are so abundant that any concern for their depletion can be ignored and that any natural resource that does become depleted can be substituted with human-made capital or facilities. This idea was challenged by Nicholas Georgescu-Roegen in 1975 when he wrote "One must have a very erroneous view of the economic process as a whole not to see that there are no material factors other than natural resources"[13] as can be seen from the sidebar example of the country of Nauru.

Strong sustainability is founded upon much the opposite, that natural resources are limited and there are natural processes that when degraded or damaged have no substitute equivalent human-made capital replacements. Under such a system, the answer to a request to degrade a highly-valued resource must sometimes be "no". Sometimes compromise is not sustainable.

Ecological Economics, which supports a strong sustainability society, believes that the economy lies within the environment and that all of man's economic development comes ultimately from the input of renewable and nonrenewable natural resources. The issue of resource substitutions is much more seriously considered, as well as the negative impacts of development upon the environment. Ecological Economics is much more holistic than standard or mainstream economics as explained by Michael Kosz:

> "It can be concluded that the weak sustainability rule has in principle a different world view regarding the "embeddedness" of the economy in a social and ecological context. While standard environmental economics assumes economy to be (a) black box where inputs and outputs are measurable and no physical limits to growth exist, ecological economics deals with the physical limits (especially thermodynamics) and the dynamic development of ecological systems."[14]

An informative comment on mainstream economists comes from one:

> "No discipline [except economics] attempts to make the world act as it thinks the world should act. But of course what Homo sapiens does and what Homo economicus should do are often quite different. That, however, does not make the basic model wrong, as it would in every other discipline. It just means that actions must be taken to bend Homo sapiens into conformity with Homo economicus. So, instead of adjusting theory to reality, reality is adjusted to theory."[15]
>
> -Lester Thorow

Moving to a strong sustainability economy will be challenging and would alter many things that society uses and consumes (cars, houses, food, etc.) and many

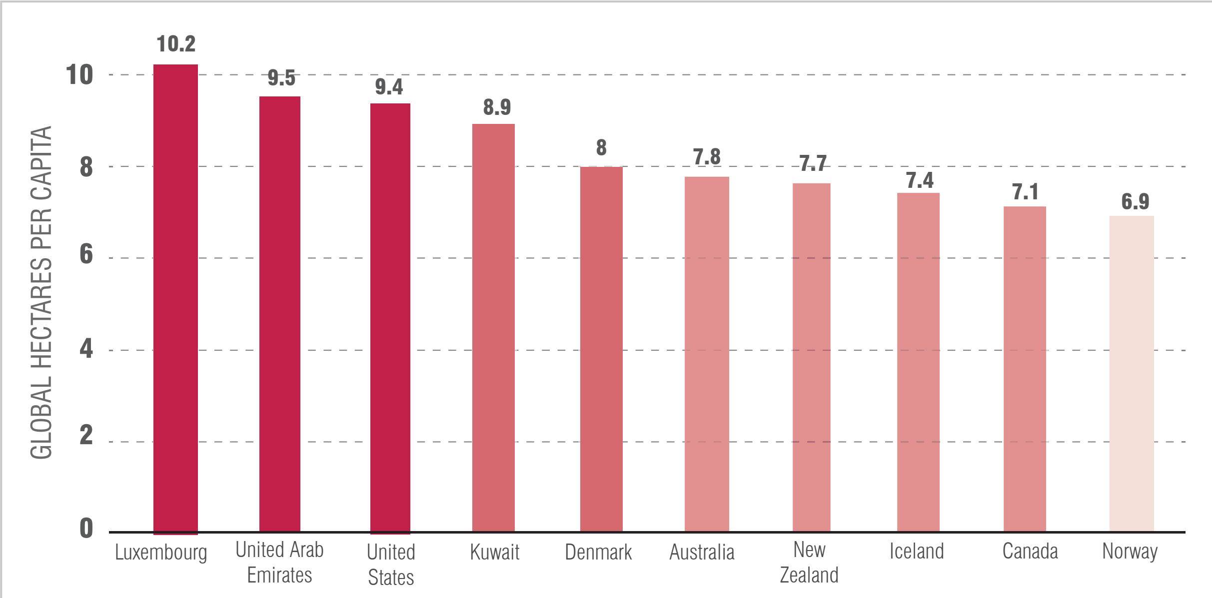



**Figure 4-3:** Top Ten Countries by Ecological Footprint

Source: Ranking America, http://rankingamerica.wordpress.com/2009/07/11/the-u-s-ranks-3rd-in-ecological-footprint/

activities that people do each day (commuting, working and relaxing). However, some experts believe it is achievable:

> "We hold that the realization of a strong sustainability strategy seems politically feasible. Strong sustainability is not wishful thinking but it seems to be more closely related to environmental policies as one might expect at a first look. There are many studies which rely on the costs of such a strategy. We entertain the hypothesis that the transition towards strong sustainability will be less expensive than many economists still believe. Things look even better if new visions of the quality of life and of patterns of sustainable consumption will be added to the overall picture."[16] Konrad Otto and Ralf Döring

Managing ourselves within the capacity of the UMR system means living within the limits of our natural resources. This report aims to describe a transition to strong sustainability that will significantly reduce our ecological footprint.

## Taming the People

The modern economy and life style over the last several decades has been driven by consumerism such that it has become patriotic to buy material goods and essentially waste resources – creating the quintessential modern American invention: a throw-away society. It is not sustainable in either a weak or strong scenario.

Through the 1940's the U.S. lead the world in oil exports [17], but by the 1970's we had begun to exhaust our oil resources and were importing nearly 25 percent of our consumed oil; by 2000 we were importing nearly 65 percent.[18] Concurrent with our dramatic movement to importing oil we abandoned nearly all passenger rail transportation and instead built the largest highway system on earth, one completely dependent upon a steadily growing supply of oil and raw materials to build the highway system and the cars and trucks running on it. We became a sprawling society, leaving our cities, and building upon vast acres of prime farmland to create inefficient suburbs, strip malls and parking lots.

Along with the energy and transportation sectors there has been a major transition in our manufacturing sector. About 50 years ago the United States was the world's leader in most manufacturing categories; yet today it is almost impossible to buy "Made in the USA" products even though Americans are urged to spend their income to save the economy. The majority of our consumer goods are now shipped from countries thousands of miles away.

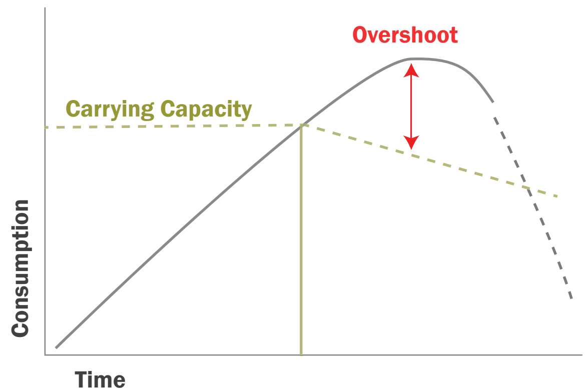
The result of these changes in our life style has been the creation of one of the largest ecological footprints[19], and associated carbon footprint, on the planet, as indicated in the Figure 4-3 above.

In 1996 Wackernagel and Reese estimated that if all other people on the planet lived the lifestyle of Americans we would need the resources of at least three planet Earths.[20] Our nation's path is a dangerous one because we have become so dependent upon other countries for essential products.

### Growing Natural Resilience

Agronomy essayist, Fred Kirschenmann believes "The best model we have available for managing systems for resilience is wild nature. During its long evolutionary journey, nature has demonstrated its capacity to adapt to shocks and disturbances. So how can we use nature's wild system, and the way it is organized, to help us design a new agriculture for sustainability? That is the challenge and opportunity which now confronts us."

Quote from essay "Sustainable Agriculture in the Upper Mississippi in the 22nd Century", found in Chapter 6 of this report




Source: Adapted from Our Ecological Footprint, Wackernagel & Rees, 1996.

**Figure 4-4:** Carrying Capacity Overshoot

## Understanding Biological Carrying Capacities

Carrying capacity is defined generally as "the maximum number of animals that a specific habitat or area can support without causing deterioration or degradation of that habitat."[21] Since humans live within habitats and require the natural resources produced by these habitats to survive and prosper, understanding an approximate carrying capacity for our habitats is essential for creating sustainable and healthy societies. In 2011, the world population grew beyond seven billion[22] humans sharing resources with all other species. The more resources that humans consume and habitats that we degrade, the lower will be the carrying capacity for other species as well.

Unfortunately we are exceeding the carrying capacity of our environment on an increasing scale – a situation called overshoot by biologists (see Figure 4-4). As of August 21, 2010, the Guardian (UK) reported that "the world as a whole went into 'ecological debt'". This indicates that we are now annually consuming resources and producing waste at a rate of about 36 percent faster than the forests, fields and fisheries of the world can replace and absorb them.[23, 24]

## Recognizing the Essential Need for Abundant Natural Resources

The recent book "The Story of Stuff" [25] and its associated web videos have provided an enlightening glimpse, in very stark terms, of our use of natural resources. The book connects the shopping habits of modern American consumers with the sources of the materials required to manufacture those goods, their methods of production and their fate when we are through with them. The book explains clearly why we need to rethink how we consume and dispose of resources.

The increasing disconnect between our general

### Surface Mining Operations

Jacob Ranch Mine Complex in Mining:
Coal extraction in an open pit surface mine.

Source: Doc Searls, http://www.flickr.com/photos/docsearls/3241210846

"Giant Trencher" in Transition Between Mines

The mining of ores requires the removal of vast amounts of overburden and ore material, creating toxic tailing ponds that pose risks to water quality and drinking water and leaving large areas of abandoned, empty and degraded landscape.

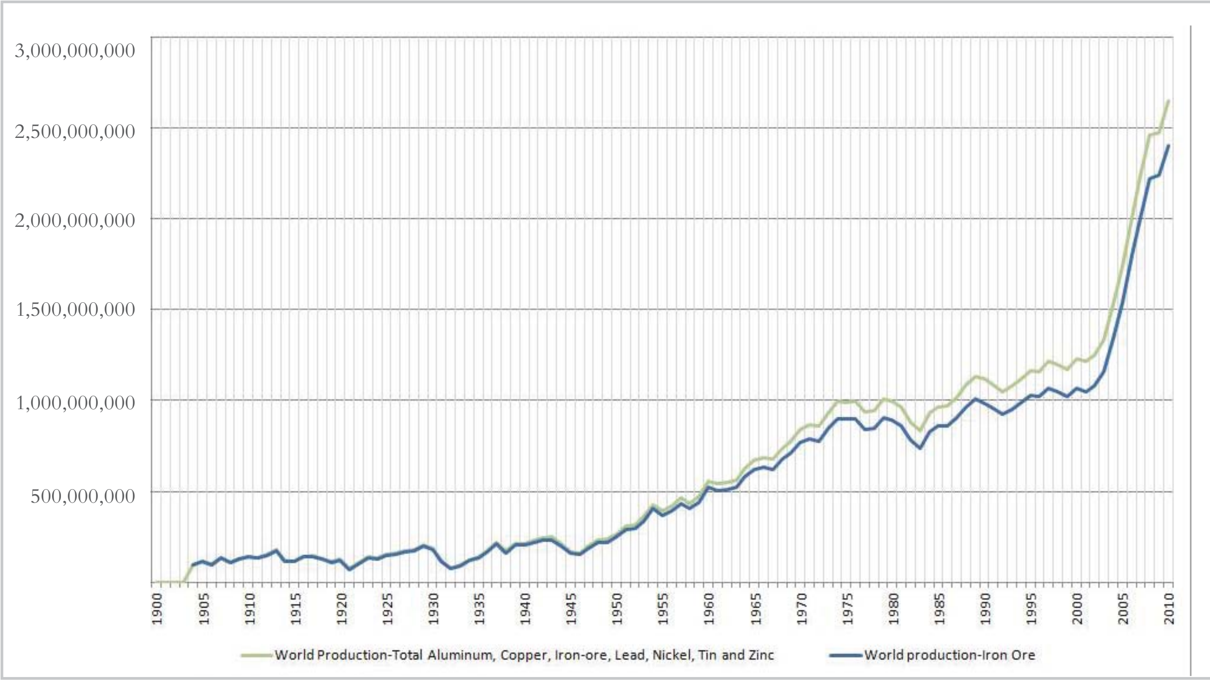



**Figure 4-5:** World Ore Production in Metric Tons

Source: USGS, http://minerals.usgs.gov/minerals/pubs/mcs

knowledge of where the things we eat and use come from is well documented. This phenomenon has allowed most economists to ignore the fact that every physical thing we make comes from natural resources or natural capital. The typical economist uses the term capital when referring to two things; money and the products of human manufacturing. The requirement to properly include land and natural resources has disappeared from their discipline.[26] A primary danger with this way of thinking is the misconception that we can create material things from nothing; resulting in a lack of concern for conserving valuable nonrenewable and renewable resources.

Despite being in the midst of the information age the infrastructure of an information society, much like an industrial society, can only exist through the extraction of natural resources. Mining is an important source of many of these resources.

Mining has been an important activity in the UMR states for many decades with the extensive removal of iron ore, lead, zinc, silicon, gravel, and coal. Figure 4-5 above shows the world's increasing extraction of several ores, essential materials for increasing and expanding most types of infrastructure and buildings and products we use every day. The near exponential growth trend in the early 2000's is a consistent with the expansion of the economies of Asia adopting more Western-type – and consumption intensive - life-styles.

In addition to ores mined for energy and infrastructure, modern communication technologies like the components in computer servers, cell phones and tablet computers depend on key elements known as rare earth metals that must be mined from the earth. We have been and will continue to be dependent upon large volumes of nonrenewable resources such as iron ore to support our current economic system.

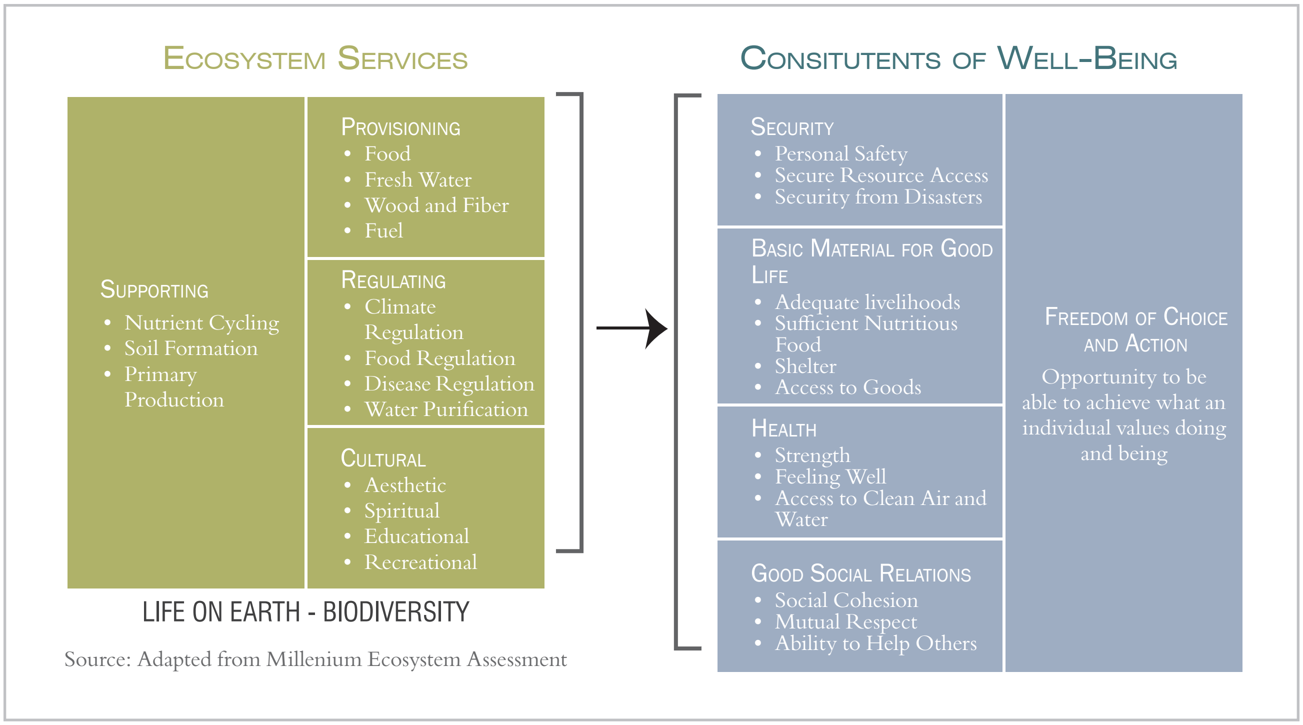
Two questions require consideration: how long can sufficient extractive volumes be maintained to satisfy the insatiable demand and are the negative environmental and social impacts worth the benefits?

## Short-term Economics Shortchanges Nature

> "Everyone in the world depends completely on Earth's ecosystems and the services they provide, such as food, water, disease management, climate regulation, spiritual fulfillment, and aesthetic enjoyment."[27]
>
> -Millenium Ecosystem Assessment, 2005

The Ecological Society of America (ESA) defines ecosystem services as "a wide range of conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfill human life." Further, according to ESA, ecosystem services provide us with biodiversity and goods that we depend upon including food, fiber, biomass and the systems required to support these goods. [28]

These are essential goods and services for which we do not pay and yet have taken for granted. Nature's pollinators offer a good example. Insects provide hundreds of billions of dollars[29] worth of pollination



Source: Adapted from Millenium Ecosystem Assessment

**Figure 4-6:** Ecosystem Services

services that cannot be reasonably and affordably duplicated by any man-made process and yet we fail to include this zero cost and enormous dollar benefit into our calculations. Dousing our crops with broad spectrum pesticides may cause the extinction of valuable and irreplaceable creatures. The worst case scenario is the failure of entire crops, which will provide economists with a clear dollar value to include in their figures. However, a more prudent approach would be to apply the precautionary principle because we believe that the price will be far too much and must be avoided.

"The way humanity manages or mismanages its nature-based assets, including pollinators, will in part define our collective future in the 21st century," said Achim Steiner, U.N. undersecretary general and UNEP executive director.[30]

Ecosystem services and functions must be accounted for within a 'strong sustainable' vision. In 1997, a group of scientists wrote an article that estimated the global value of ecosystem services and functions at over $33 trillion annually (in 1994 U.S. dollars).[31] The article further broke down this annual average value by ecosystem types and the value each provided to the public estimates per hectare[32] for healthy land and marine biomes. The authors were extremely careful in explaining that their research was a preliminary estimate and was considered likely an underestimate of the true value of the world's ecosystem services and natural capital. This is in part because economists cannot properly set the value of irreplaceable services, which are essentially of infinite value.

We have listed the estimated annual values from the 1997 Nature article for four of the land types found within the UMR Basin in order for readers to visualize the value of land we often think is useless or under-developed. We must reiterate that these were average preliminary and incomplete values. For comparison, the fifth item listed is the general value the authors placed on Cropland.

| Land Types | Annual Avg. Estimated Value (1994 Dollars) |
|---|---|
| Wetlands/Floodplains | $19,580 per hectare |
| Temperate Forests | $302 per hectare |
| Prairies | $232 per hectare |
| Natural River | $8,498 per hectare |
| Cropland | $92 per hectare |

When we make decisions that negatively impact ecosystems we are degrading the ecosystem services and functions which they freely provide us. Eventually, if enough of these ecosystems are damaged, our lifestyles will be negatively affected as well because costs of the losses will rise exponentially and the benefits will erode. In short, we will pay more and get less.

Historically, the Corps of Engineers and floodplain developers have overestimated the benefits and underestimated the costs of their projects. Over the past several decades, these miscalculations have begun to add up.

Wetlands provide a telling example. One acre of a healthy wetland can absorb and store a million gallons of floodwater- at no charge.[33] Whereas, constructing a storage facility to hold a million gallons of floodwater on a one-acre footprint would cost tens of thousands of dollars and require ongoing maintenance expenses. Most big floods are on a scale hundreds of times larger than a million gallons. Wetlands also provide benefits in terms of mitigating pollution, providing wildlife habitat, and supporting fisheries. These benefits contribute to industry, tourism and reducing infrastructure cost as well, which complicates the cost benefit analysis because man-made replacements offer few, if any, of these additional benefits. Unfortunately, when a shopping mall displaces wetlands in the floodplain, economists fail to account for the loss of natural ecosystem services.

It has been estimated that it would cost about $45 billion per year to restore the life-support systems for the planet[34] while producing a 100 to 1 Benefit-Cost Ratio to the public.[35] Nature simply can provide these services at dramatically less cost than anything humans can attempt to engineer- and the majority of these services have no man-made equivalent. Nor can ecosystem services and functions be replaced through efficiency and cost effectiveness or inventiveness.

## The Challenge of Planning for Climate Change

> "Humanity has never had to grapple with a problem that measures itself in centuries, threatens our very existence, and requires global cooperation to overcome. We are fairly beset by gaping uncertainties. We know it could get really bad, but we don't know exactly how bad it will get, or how fast, or where. We don't know how much it will cost to re-engineer the world along sustainable lines, or how quickly we can do it, or even whether we can do it at all.
>
> We are stumbling around in the dark, in an area where scientists tell us some very, very nasty beasties dwell. In that situation, it seems to me the overwhelming bias should be toward action -- getting lean, mean, and nimble enough to handle ourselves no matter what slouches our way."[36]
>
> -David Roberts

The impacts of climate change that will occur over the next century are not known but the vast majority of climate experts agree that significant changes will occur. These climate changes will have dramatic impacts upon all aspects of the way that we live.

Large segments of our population either voluntarily or as required by law purchase insurance for health, car, and property. By purchasing this insurance we attempt to cover risks with a typically very small chance of occurring but that would be devastating to us financially. Yet, despite the strong indications from climatologists for over 30 years that humans were emitting large volumes of green house gases (GHG) into the atmosphere that would have a major impact upon the climate, we have done little to alter our activities that produce these GHGs. Our own ignorance of ecosystem services and the interdependence and interrelatedness of the relationships in nature's economy complicate our understanding of climate change impacts. To our detriment, we tend to learn about these relationships after their collapse when the impacts, the cost, and the pain are amplified.

We have now likely passed a threshold where we and our children will live in a different world due to climate change; hotter temperatures, less stable and predictable precipitation levels and more severe storms.[37] Impacts from these changes will be felt profoundly in supplies of food, water, energy, social stability and geopolitical and personal security.

There is a nexus between climate change and the landscape and nowhere is it more profound than in the vast areas of land that have been converted to agriculture. The pinnacle of this conversion is lands planted in annual monocultures such as corn, soybeans, cotton, etc. These lands lose most of the ecosystem services they provide us because the habitats have been stripped from them. The crops planted each year, along with much of their residue is transported away leaving a barren, near lifeless environment. The resilience provided by these habitats is concurrently lost or severely degraded including the long-term sequestration of carbon increasing greenhouse gases, as well as the ability to hold water and breakdown pollutants.

## Reducing Excess Pollution in the UMR

> "The impact of human agriculture has been felt not only on the land but in the river itself. Increasingly, in the last half of the twentieth century, the agricultural soil-nutrient mix washed into the river carried with it a high-tech chemical stew of fertilizers, insecticides, and herbicides. Sediments and pollutants not irretrievably trapped

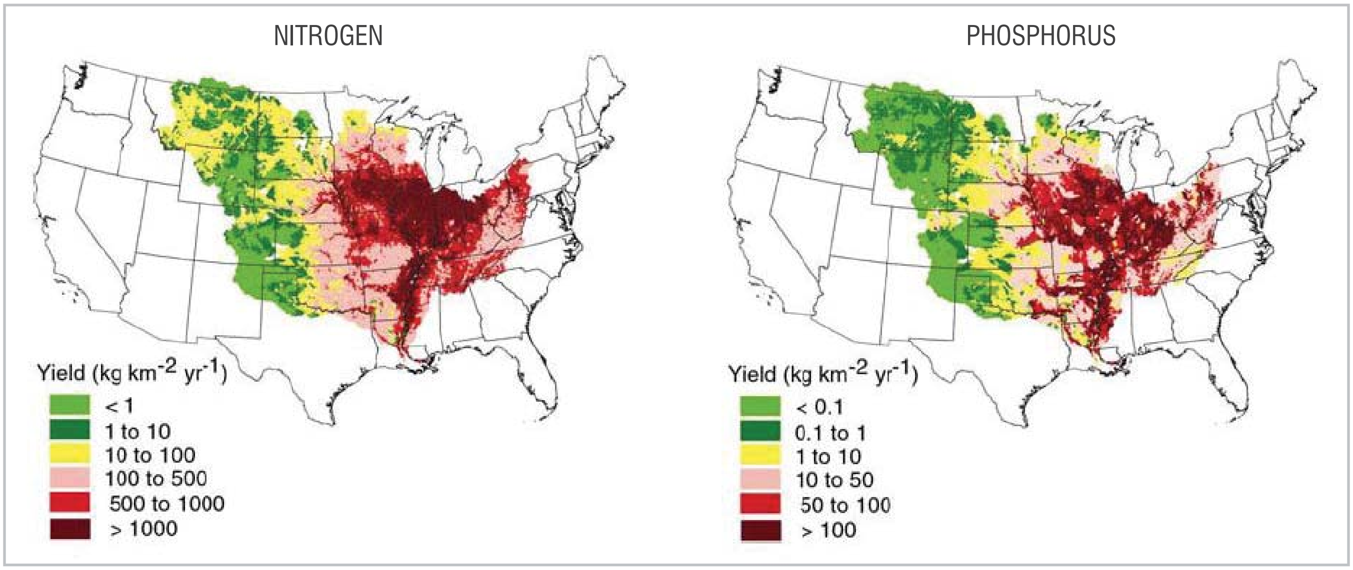



**Figure 4-7:** Total Nutrient Yields - Nitrogen and Phosphorus

Total Nutrient yield delivered to the Gulf of Mexico from sources in the incremental drainages of the MARB of (a) total nitrogen and (b) total phosphorus. *Source*: US Geological Survey, Nutrient Delivery to the Gulf of Mexico, Geographic Variations in Nutrient Delivery (Modeled findings). http://water.usgs.gov/nawqa/sparrow/gulf_findings/faq.html

> by the impoundments of the Nine-Foot Channel Project were sluiced through the armored, channelized Lower Mississippi into the Gulf of Mexico"[38]
>
> - Calvin Fremling, renowned UMR biologist and professor at Winona State University in Minnesota

According to the late Calvin Fremling, quoted above, eutrophication – the introduction of large amounts of nutrients, typically nitrates and phosphates, into a water body – is "rampant" within the dammed portion of the UMR and is reducing oxidation of organic material introduced into the river.[39] Nitrogen can be considered a proxy for excessive nutrients, pesticides and sediments from soil erosion because these sources of pollution generally originate from the same farm field location. Nutrients are the primary cause of eutrophication or 'dead zones' throughout the world and of particular concern to us, in the Gulf of Mexico. (Also see Figure 1-1 for the location of world dead zones.)

Figure 4-7 above clearly shows that the geographical source of nitrogen pollution within the UMR is the Corn Belt states. The large-scale industrialized monoculture agricultural system currently practiced in the UMR Basin is responsible for the excessive nutrient, chemical and soil runoff levels. It is much more efficient and effective to eliminate, or at least significantly reduce the pollutants and sedimentation before they enter the river system than to try and deal with them once they have entered the system. In fact, it is impracticable to address these pollutants once they have entered our rivers and the Gulf. Due to our unwillingness to regulate nonpoint pollution, the only current recourse then is to endure the fish kills and economic losses of 'dead zones' and wait for nature to attempt to heal itself. Since the 1980's, the Gulf Dead Zone has persisted and expanded which suggests nature's system is overwhelmed. The Gulf Dead Zone demonstrates the need for upstream prevention of the pollution.

## Acknowledging Technological Fixes Are Not the Primary Solution

Technology can be viewed to a certain extent as neutral since it is how and the extent to which we use it that creates most of the resulting positive or negative impacts. Undoubtedly many good technologies exist; however, many are questionable, if not outright detrimental. Too often it is a lack of experimentation and testing to determine unintended or unexpected after-the-fact consequences that can cause havoc in the environment. After the technology is established it is very difficult to remove, so another layer of untested technology becomes the proposed solution to the negative consequences.

Business and cultural influences in American society have led us to believe that new technologies are primarily beneficial. Because of this we tend to depend upon new or improved technology as the solution to our environmental problems, rather than to adjust how we live and consume resources.

Our belief in new or better technology is directly connected to our belief that economic growth always results in better human welfare, and by extension an improvement in our environment. The UMR and its residents suffer from the consequences of this unbridled faith in technology. The nearly complete transformation of the UMR prairies and wetlands to monoculture agriculture has resulted in significant pollution in our streams and rivers, along with the dramatic loss of ecosystem services, natural products and species. No technology has been able to adequately fix, substitute for or remedy these losses.

Peter North, an author and engineer,[40] explains in a 2004 article in Pacific Ecologist that there are three justifications for depending upon technology to continue economic growth indefinitely:

> "The technology explanation comes in three parts:
>
> 1. Technology improves the efficiency with which materials are used. Therefore, the use of resources will diminish.
> 2. When we run out of one resource, technology will find us a substitute.
> 3. Technology will find a solution to environmental problems."

As was discussed in the section above, Essential Need for Abundant Natural Resources, resource use is increasing, not decreasing. As shown by the size of our current mining equipment, (See Surface Mining Operations Sidebar on page 31) advances in technology not only improve extraction efficiency in actuality, but more importantly they increase our ability to extract resources at greater rates and across larger areas which means we do more damage at less 'economic' cost. This was also true when technological advances in home energy efficiencies were developed with the reaction being building larger homes, not accruing energy savings.[41] The result was that we became wasters at a larger scale.

We have also discussed the issue of resources substitution in the Myth 1: Unlimited Resources, specifically for fossil fuels. Developing technology for the extraction of oil is and has been for decades a sector of heavy investment. This is underscored by Nate Hagan of the Oil Drum blog.

> "It isn't that there's no technology. The question is, technology is in a race with depletion, and that's a whole different concept. And we think that we can show empirically that depletion is winning, because energy return on investment (EROI) keeps dropping for gas and oil."[42] (See Figure 3-2 on page 16 regarding EROI)

Although some resources can be sufficiently substituted, at least for the short-term, there are essential resources such as petroleum that we have not found adequate substitutes despite decades of searching. There is still oil to be extracted, but the costs and risks are rising rapidly. (See Tar Sands Sidebar on page 14)

And finally, the track record of technology fixing our environmental problems is poor. Difficult environmental problems such as air quality, water quality, soil fertility loss, hazardous and toxic waste, solid waste disposal, radioactive waste disposal, and climate change are all driven by economic growth, albeit growth that is inadequately measured with traditional means. The UMR region has numerous examples of the above listed problems that are not being adequately addressed. Although there have been small improvements in some of these areas, the improvements have largely been overwhelmed by increasing economic activity-or more accurately, 'uneconomic' activity- (The Gulf Dead Zone provides a sad example). The finger of technology has not been able to hold back the tidal wave of environmental problems. Technology is insufficient because it cannot comprehend, duplicate or mimic the complexity of natural systems and it cannot be deployed systemically on nature's scale.

## Rebuilding Resilience: Localizing Economies

The share of the manufactured goods we produce in this country has dramatically decreased over the last several decades. Sixty years ago manufacturing accounted for up to 28 percent of our economy. Today it is only about 10 percent of GDP.[43] A dramatic loss of manufacturing jobs followed that trend. Farming has also had a dramatic decrease in the number of farmers declining 65 percent since 1950 to less than 2 percent of the population.[44] In some respects a movement to local economies and local agriculture would be a reversal of about five decades of an unrestrained effort to eliminate all barriers to trade between countries, a philosophy promoted by neo-liberal economists for various reasons but ultimately supported by their belief in unlimited resources and unlimited substitution (weak sustainability). Global free trade is really only economical while petroleum to fuel the world's ships and planes is abundant and cheap. As we have already stated, many knowledgeable people believe that the days of cheap oil are over. Also, global trade is now based more upon competitive advantage (cheaper labor and/or limited regulation) as opposed to a true comparative advantage (superior technology and/or a better resource endowment),[45] which has contributed to U.S. job losses and global pollution.

A movement to local economies and local agriculture is a step forward for our social and economic development.

Global free trade as currently practiced could be assessed as merely a phase that has not provided its intended goal of raising the standard of living and associated welfare for all humans on the planet. World hunger continues to rise to higher levels according to the UN Food and Agriculture Organization, with 925 million people chronically hungry. During 2010 and 2011 food prices reached record highs. A recent study by the United Nations and World Bank stated that small-scale farmers in developing countries who primarily grow export crops have become vulnerable to the swings in the world food market and competition from subsidized famers in industrialized countries.[46]

If our current model of global free trade is in fact critically flawed, then an acceptable and workable alternative must be adopted. A return to the local manufacturing of all goods that we have the capability of efficiently producing, as well as a return to a more diverse and environmentally benign agricultural system that strives to sell its products locally would be much closer to a strong sustainability model and would address many of the negative impacts of global free trade including the loss of jobs and environmental damage:

> "As several authors have pointed out, free trade enables countries to export environmental damage to places outside their borders, and to export with it any awareness of, or responsibility for, the damages incurred (Berlik et al. 2002; Dekker-Robertson & Libby 1998; Mayer et al. 2005; Mayer et al. 2006; Muradian & Martinez-Alier 2001). Responsible consumption, then, may start with domestic production."[47]
>
> - Julianne Mills - Post-Doctoral Fellow of Environmental Demography/Geography, Davidson College Economics Department Davidson, North Carolina, USA

There are many successful examples of local economy initiatives than can be expanded or used as models. Many of these never fell out of favor in western European industrialized economies. These include:

1. Farmers markets that help bring locally grown or made food and crafts to nearby customers.
2. Small-scale farms that can be owned and operated by a greater proportion of the population and produce more revenue per acre than industrialized farms.
3. Cooperatives allow local people to combine their resources into a business they control and that benefits them and their community.
4. The Transition Towns Network helps towns plan for a prosperous fossil fuel-constrained future.
5. Reinventing and reinstituting Home Economics in our schools to teach young people about managing households, preparing healthy diets, and performing skills that save families money[48]
6. Local currency and micro credit can keep money in a community and help build small businesses.

These types of initiatives are usually bottom-up creations. In order to flourish and multiply they require an economic and policy environment on all government levels that empower them. These examples do not reflect a goal of isolationism because trade is important to all levels of economies. Local economies provide us with self-sufficiency and security so that essential goods and services are always sourced and available to us. Surplus, luxury and specialty goods can then be traded.

A vision of a transition to a strong sustainability society should not leave any change or modification, either physical or policy, off of the table. For example, in discussions with the Corps regarding the UMR the idea of eventually removing most, if not all, of the navigation infrastructure is not one they will honestly consider. Even though there is a requirement to consider such an option in the large-scale navigation project development process, the idea to remove any dam is automatically rejected because of their aforementioned economic development mandate and the laws written in the 1930's establishing navigation as the primary use of the inland waterways system. The likely benefits that would result from a dam removal such as increased natural production, flood protection requiring no construction or maintenance, tourism and others are not seriously considered or included in calculations of benefits, Neither we nor the American public should be restricted by what are essentially artificial constraints that have strictly a limited economic basis without consideration for true sustainability.

---

1 Aldo Leopold, 1949, Sand County Almanac: A Taste for Country, page 189

2 Prescott, Allen R., 2002 Wellbeing of Nations. Island Press, New York, page 2

3 USACE, June 2010, America's Inner Coast Summit, St. Louis, MO

4 National Research Council-Committee on U.S. Army Corps of Engineers Water Resources Science, Engineering, and Planning; , 2011, National Water Resources Challenges Facing the U.S. Army Corps of Engineers, National Academies Press, ISBN: 0-309-21133-6, page 23

5 Principle: a basic generalization that is accepted as true and that can be used as a basis for reasoning or conduct

6 United Nations, 1987, Brundtland Commission Report, 1987, "Sustainable development is development that meets the needs of the present without compromising the needs of future generations to meet their own needs."

7 Herman E. Daly, 1977, Steady-State Economics

8 Costanza, Robert, et al, 1997, The value of the world's ecosystem services and natural capital, Nature, 387:255

9 Turner, R. Kerry, 1992, Speculations on Weak and Strong Sustainability, Cserge Working Paper GEC 92-26: page 8

10 The Case for Strong Sustainability, Konrad Ott: in: Ott, K. & P. Thapa (eds.) (2003).Greifswald's Environmental Ethics. Greifswald: Steinbecker Verlag Ulrich Rose. ISBN 3931483320. Retrieved on: 2009-02-16, page 62

11 Ibid

12 Turner, R. Kerry, 1992, Speculations on Weak and Strong Sustainability, Cserge Working Paper GEC 92-26: page 14

13 Georgescu-Roegen, Nicholas, 1975, "Energy and Economic Myths", Southern Economic Journal: No. 3

14 Kosz , Michael, 1998, Weak and Strong Sustainability Indicators, and Regional Environmental Resources

15 Thurow, Lester C., 1983, Dangerous Currents: The State of Economics, Random House: page 21

16 Ott, Konrad and Ralf Döring, Strong Sustainability and Environmental Policy in Germany: The position of the German Council of Environmental Advisers on strong sustainability and its implementation in practical policy, page 9

17 Fanning, Leonard M., 1945, Our Oil Resources, McGraw-Hill Book Company, Inc., NY

18 Energy Information Administration (EIA), 2004a, Table 5.1 Petroleum Overview, 1949-2003

19 Ecological Footprint: a measure of the land area necessary to sustain the current levels of resource consumption and waste discharge by that population [Source: Wackernagel, Mathis and William Rees, 1996, Our Ecological Footprint]

20 Ibid, page: 15

21 Wildlife Terms, Stewardship Forest, N.C. Cooperative Extension Service: No.13

22 Kunzig, Robert, 1-2011, 7 Billion, National Geographic Magazine, http://ngm.nationalgeographic.com/2011/01/seven-billion/kunzig-text

23 Simms, Andrew (the new economics foundation), 8-23-2010, We've Gone Into the Ecological Red, The Guardian, http://www.commondreams.org/view/2010/08/23-1

24 New Economics Foundation, 2010, World enters ecological debt on Saturday 21 August 2010, http://www.neweconomics.org/press-releases/world-enters-ecological-debt-on-saturday-21-august-2010

25 Leonard, Annie, 2010, The Story of Stuff : How Our Obsession with Stuff Is Trashing the Planet, Our Communities, and Our Health-and a Vision for Change, Free Press, New York

26 Czech, Brian, 2000, Shoveling Fuel for a Runaway Train, University of California Press

27 Millennium Ecosystem Assessment, 2005, Ecosystems and Human Well-being: Synthesis, page 1

28 Daily, Gretchen C., et al, Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems, Ecological Society of America, http://www.ecology.org/biod/value/EcosystemServices.html

29 Science Daily, 2008, Economic Value Of Insect Pollination Worldwide Estimated At U.S. $217 Billion, http://www.sciencedaily.com/releases/2008/09/080915122725.htm

30 McCarthy , Michael, March 10, 3011, "Decline of honey bees now a global phenomenon, says United Nations", London Independent, http://www.independent.co.uk/environment/nature/decline-of-honey-bees-now-a-global-phenomenon-says-united-nations-2237541.html#

31 Costanza, Robert, et al, 1997, The value of the world's ecosystem services and natural capital, Nature, 387:253-260

32 1 hectare = 2.47 acres

33 England, Laura, 2008, Save and expand wetlands to help state with flood control , Milwaukee-Wisconsin Journal Sentinel, http://www.jsonline.com/news/opinion/29530179.html

34 Porrit, J., 200 7, Capitalism as if the world matters, London, page 360

35 Balmford, A. et all, 2002, Economic reasons for conserving wild nature, Science 297: 950-953

36 Roberts, David, 2011, "Smackdown: climate science vs. climate economics" – Grist, http://www.grist.org/climate-policy/2011-02-09-smackdown-climate-science-vs-climate-economics

37 U.S. Environmental Protection Agency, 2010, Climate Change Indicators in the United States

38 Fremling, Calvin R., 2005, Immortal River: The Upper Mississippi in Ancient and Modern Times, University of Wisconsin Press, page 371

39 IBID, page 373

40 North, Peter, 2004, Can Economic Growth Save the Environment, Pacific Ecologist, Issue 9, http://pacificecologist.org/archive/growthenvi.html

41 Nelson, Michael and John Vucetich, 2010, True Sustainability Needs an Ethical Revolution, The Ecologist

42 Gronewold, Nathanial, 2009, New school of thought brings energy to the 'dismal science', Greenwire, http://www.eenews.net/Greenwire/print/2009/10/23/12

43 Hartmann, Thom, 2010, Globalization is Killing the Globe: Return to Local Economies, http://www.commondreams.org/view/2010/02/08-5

44 International Society for Ecology & Culture, ISEC's Local Food Toolkit – Factsheet, http://www.localfutures.org/local-food-resources

45 Gupta, Satya Dev , Comparative Advantage and Competitive Advantage: An Economics Perspective and a Synthesis

46 White, Anna, 2010, Rebuilding local economies: a shift in priorities, Share The World's Resources

47 Mills, Julianne H. , 2009, Economic Prosperity, Strong Sustainability, and Global Biodiversity Conservation: Testing the Environmental Kuznets Curve Hypothesis (Dissertation - Ohio State University): page 58

48 Litchtenstein, Alice H and David S. Ludwig, 2010, Bring Back Home Economics Education, Journal of the American Medical Association, http://www.foodpolitics.com/wp-content/uploads/Home-Ec.pdf

## A Once and Future River - Robert E. Criss

The Upper Mississippi, our Great River, has attracted plenty of attention lately. As favored interests clamor for billions of taxpayer dollars for lock expansion projects, the federal budget is causing economic and political crisis while the Asian carp, exploiting the artificial connection of the Illinois Waterway, threatens to enter invade the Great Lakes. Damaging floods are now commonplace and may return this year, just three years after the devastating Flood of 2008 that destroyed levees, one after another like dominoes, from central Iowa to St. Louis. Could it be that human shortsightedness and selfishness have finally caught up with us, and that we are suffering the consequences of poorly considered actions? Numerous thoughtful people believe so, including some who predicted many of these sad outcomes.

It was not always so. The Great River, once a beautiful braided stream, flowed free and unfettered, nurturing everything that lived nearby. Floodplain soils were periodically replenished, so farms were fertile, and fish and fowl were so abundant as to stagger modern imagination. It was all free, costing nothing to "maintain".

The story of how the Great River was engineered to realize certain benefits, along with a tragic set of unforeseen consequences, has been well told by others. In a transformation that required two centuries to effect, the river was leveed, constricted by rocks and concrete, dredged, overfished, and polluted with chemicals and sewage. The flowing river was converted into a continuous "stairway" of flat-water lakes, its now deeper waters stifling benthic life, drowning the bars, and changing the natural cycle of flow. The colossal locks and dams impede not only fish, but all small vessels. Each construction project deepened the river channel, yet floods became more frequent and more severe (Figure). The huge flocks and productive fisheries disappeared. All this was sacrificed for the monstrous barges that the system was designed to serve

Recent studies by the GAO establish that barge transport is not only highly subsidized, but contrary to longstanding assertions, is less fuel efficient than the railroad for moving goods from place to place. Never discussed is that this system is a job killer, simply because very few workers are needed on the huge towboats. Instead of real jobs, we got multiple layers of regulation and inefficient government bureaucracy.

*For Criss' complete essay, please see Chapter 6, Expert Contributor Essays*

# Chapter 5: Conclusions and Recommendations

The historical and largely unchallenged belief in the management of our natural landscape has been that resources are unlimited. One result of this is that it is difficult today to find a place that humans have not significantly altered. Few more dramatically altered landscapes can be found in the U.S. than the Upper Mississippi River Basin. The UMR has 29 dams on it transforming this floodplain river into a series of slack water pools. About 60 percent of the diverse pre-settlement prairies, wetlands, forests and savannahs have been transformed into monoculture agricultural systems. Both of these unsustainable transformations were accomplished through political influence by special interests for narrow short-term benefits. Further, these transformations continue through huge subsidies and a growing public "landscape amnesia" for what has been lost. We believe that our movement along this unsustainable path must end.

The authors of "Natural Capitalism" close their book asking several questions. One of them, "How is it we have created an economic system that tells us it is cheaper to destroy the earth and exhaust its people than to nurture them both?" is especially compelling to us.[1]

A long-term sustainable vision must be holistic in its view. It must properly consider the people currently living, future generations, and the environment upon which we all depend. Thus far our country has not adequately considered any of these three items. Within a region such as the UMR Basin a long-term vision must consider all three items within the region's specific context and resource limitations. This is a difficult task and involves assessing our values and future goals in relationship to the realities of natural laws.

We have for too long emphasized short-term economic growth over preserving natural resources and properly managing renewable resources without a serious in-depth analysis of the environmental impacts of this growth or the likelihood of natural resource sustainability. We have built myths with unsupported promises of benefits to all, which have actually proliferated the exploitation of natural resources for the economic gain of a minority. We have treated our environment as if it was either unlimited in its vastness and resilience or its protection is considered a luxury that can only be accomplished through ever increasing economic growth – both assumptions are wrong. A strong indicator of this is that humans consume or extract about 40 percent of the world's net primary production[2] of the planet just to support our growing population and lifestyles, and this share is growing each year.[3] That leaves a decreasing share for all other species.

According to ecological economist Herman Daly there are three conditions of resource use that a sustainable economy must meet:[4]

1. The regeneration of renewable resources must exceed their rates of use.
2. Our pollution cannot exceed the capacity of the environment to absorb our pollution.
3. The use of nonrenewable resources must be less than the rate of the development of sustainable renewable substitutes.

> *"How is it we have created an economic system that tells us it is cheaper to destroy the earth and exhaust its people than to nurture them both?"*

These are the rules of the natural economy. We are carelessly disregarding them. We are currently consuming renewable resources and producing waste at a rate of about 36% higher than the forests, fields and fisheries of the world can replace and absorb them respectively.[5] As we have discussed, our use of petroleum is approaching, if not already beyond, its peak and no sustainable renewable substitute has been found.

The push to increase exports of grain down the UMR is equivalent to exporting our valuable topsoil and fossil fuels abroad. This is not the path of a strong, sustainably developed economy. Instead it is more an indicator of a developing country exporting its raw materials rather than finished products. Our economy has been captured by transnational corporations selling us foreign-produced finish goods. Our country has a huge untapped market for our own goods if we have the will to reinvent our manufacturing base and sell them to ourselves. A movement to local economies and local agriculture will help accomplish this and move us towards a strong sustainable model where non-renewable resources are conserved.

We must face these important facts within the UMR and beyond:

- We are completely dependent upon properly functioning natural resources and systems for our livelihood
- Our population and per capita use of resources have grown beyond the renewable capability of our natural systems
- The estimated value of ecosystem services/functions are immense
- We heavily subsidize many activities that severely impact natural systems

MCE is not advocating a return to the past, as some might say. We are suggesting that if what we are doing is unsustainable and inequitable we should look to solutions everywhere including the past. To dismiss or ignore traditional knowledge or past experience is discounting potentially valuable solutions to our problems. When and where appropriate we can modify and combine traditional knowledge with new knowledge.

In many respects, we are revisiting the efforts of a previous generation attempting to change our resource exploitive trajectory. During the middle 1930's to late 1940's grass-root organizations proposed that a Missouri Valley Authority (MVA) be created to manage the Missouri River. Their goal was to "(seek) to balance development with the needs of the natural environment" prompted in part by an understanding of the costs to the public that the destruction of the environment brings. Their effort was focused upon stopping the "consequences of leaving environmental decision making in the hands of private interests and government bureaucrats."[6]

Although they failed in the creation of the MVA they left us with information we should remember and apply:

> "Too long our American forests, rivers, minerals have been exploited for private profit. Too long our soils have been neglected and abused ….Our life becomes constantly more urban and more mechanical. We are losing our contact with nature, with the outdoors and with the leisurely pace of living which characterized America in its rural epoch. …. (We must choose) long-range goals with care. … In the field of resource development and conservation, it means an emphasis on the so-called renewable or living resources: forests, soil, waters, wildlife, recreation, and scenery. In regional planning, it means the dispersion of industries and cities and the encouragement of our smaller communities. This is not to disparage our engineering works …. But it is to say that men do not live by consumers' goods alone."[7]

The above quote, if anything, is more appropriate today since we have largely followed the path they were trying to avoid. In many ways the topics discussed within this report paint a bleak picture for the future if we do not make significant changes in how we live. To help to move us along a new path based upon strong sustainability we have outlined actions we can begin to take.

## Recommendations

> *"The 'key log' which must be moved to release the evolutionary process for an ethic is simply this: quit thinking about decent land-use as solely an economic problem. Examine each question in terms of what is ethically and esthetically right, as well as what is economically expedient. A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise……. The fallacy the economic determinists have tied around our collective neck, and which we now need to cast off, is the belief that economics determines all land use."*[8]
>
> -Aldo Leopold

How then can we start moving the "key log" Aldo Leopold spoke of with respect to the long term future of the UMR Basin? First we propose the following as fundamental principles to direct management of the UMR ecosystem:

1. Formally acknowledge as a society that we are completely dependent upon a healthy environment, adequate available natural resources, and functioning ecosystem services for our survival and prosperity. This will set the resource baseline that cannot be compromised away.
2. All of us, including decision-makers, need to learn to live within our means, financially, and more importantly, within the means of our own national natural resource limits. We must commit to ending ecological indebtedness.
3. Set reasonable but thoughtful priorities for the future that are long-term and fairly consider the livelihood of future generations.
4. Minimize or completely eliminate the impacts of the activities that most heavily affect important and irreplaceable natural systems – especially those activities that are significantly subsidized.
5. Utilize the Precautionary Principle in a reasonable manner in guiding our decisions and actions, especially when dealing with essential or irreplaceable ecosystem services and functions:

   > "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof. The process of applying the Precautionary Principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action."[9]

Using these principles, MCE advocates we begin to manage ourselves within the capacities of the UMR system by developing policies to support the following:

1. The navigation industry should pay the majority cost of the inland waterways system, and at least 80 percent of the construction, operation, maintenance, and ecosystem restoration caused by the system within five years.
2. The 9-foot navigation channel on the Missouri River should be abandoned and the river restored to a more natural state.
3. The use of out-of-scale barges on the UMR should be phased out and replaced with shallow draft barges that do not require an artificially constructed channel created by dams and locks. This would allow locks and dams to be systematically and logically removed, eventually returning a more natural hydrology to the river.
4. The impact of navigation-related structures upon the level of floods needs to be assessed using sound scientific, not political, criteria. If found to have significant impacts upon flood stages these structures should be removed or altered so that their impact is minimized.
5. Large portions of the floodplains need to be reconnected to the river through removal, lowering, or moving levees away from the river or installing gates in levees to allow flood waters to naturally and benignly spread over the floodplain.
6. Large areas of wetlands within the basin need to be restored to provide water storage, water filtration and other ecosystem services.
7. Federal and state regulations, including flood insurance, should be reformed to strongly inhibit floodplain development and end the cycle of rebuilding flood damaged properties within floodplains.
8. The Clean Water Act's current exemption of agriculture from the Act's requirements for nonpoint source dischargers needs to be eliminated thereby requiring the agriculture industry to meet standards for clean water.
9. The industrialized, monoculture agricultural system needs to be phased out, with a concerted effort to move to a modernized, diverse, sustainable, local agricultural system. The new system would be more in tune with nature including more appropriate crop rotations, a transition from annual to perennial crops and the use of integrated pest management systems. It delivers increased food security and ecological resilience against disasters and market failures.
10. We should strive to lower our GHG emissions and incorporate the impacts of climate change in our planning. This would include the

following:

i. Developing less energy intensive transportation systems; to include consideration of the fuel for the vehicle, the person-miles per energy unit used, and the resources needed to construct and maintain the system's infrastructure.

ii. Using less fossil fuel derived energy and sustainable levels of renewable energy in all activities

iii. Creating climate consistent and resilient landscapes both in rural and urban areas to adjust for predicted: [10, 11]

    1. Longer growing seasons
    2. Higher air and soil temperatures
    3. Precipitation uncertainty
    4. Stress upon water availability
    5. Different pest vectors

iv. Preparing for potentially larger average water flows and more frequent flooding in the UMR Basin.[12]

It would be naïve and disingenuous to end without mentioning what may be the most difficult obstacle and challenge for change in this country. As mentioned in the Introduction, the influence of corporations, lobbyists, wealth and the almost unprecedented wealth disparity in the country must be addressed. We were warned of this by two of our revered icons:

> "I hope that we shall crush in its birth the aristocracy of our monied corporations, which dare already to challenge our government to a trial of strength, and bid defiance to the laws of our country."[13]
>
> -Thomas Jefferson

> "I see in the near future a crisis approaching that unnerves me and causes me to tremble for the safety of my country. ... corporations have been enthroned and an era of corruption in high places will follow, and the money power of the country will endeavor to prolong its reign by working upon the prejudices of the people until all wealth is aggregated in a few hands and the Republic is destroyed."[14]
>
> -Abraham Lincoln

Unfortunately, we have seen how difficult it is to reign in the influence of money in our government; nothing has worked thus far and in the past few years the influence of money in politics seems to have worsened.[15, 16, 17] Many people working in the political realm have observed that passing system-wide legislative reforms has become increasingly difficult and that the policy that is adopted has generally been "retail policy" primarily drafted to satisfy a small group of constituents or "clients", not to adequately address needed system-wide change that would benefit the country as a whole.[18] An equally alarming trend is the growing need for nongovernmental initiated lawsuits directed not at the polluters or resource exploiters but at the government agencies failing to adequately enforce environmental protection laws.  A Constitutional Amendment may be required to remove the influence of money and corporations in our political system. This would restore power to the American people (and exclude corporations) as it was intended by the U.S. Constitution[19] in order to provide us with a better chance for our movement to a strong sustainable society. Whatever it takes, a more just and equitable economic system is essential for sustainability within the Basin and beyond it.

In closing, major positive transformations have occurred in societies both within our country and others. A place that we might look for sustainable solutions is Curitiba, Brazil[20, 21] where over a 20-year period the city of two million people was transformed despite having a low per capita income to one of the most livable and sustainable cities in the world. It has not been done through huge projects promoted by federal politicians nor built by transnational corporations. Instead it was built with community participation, initiative, spirit and innovative leadership. The mayor of Curitiba, Jaime Lerner, developed the motivation and atmosphere for change in the early 1970's. The ideas and qualities of Curitiba are replicable at many levels because its foundation is based upon a philosophy of respecting people, acknowledging that citizens are the owners of all public assets and services, and solving problems holistically through experimentation. Lerner believed that when all people have respect they will work together to solve problems.[22]

Our recommendations cover long-term changes that will require a major shift in the values of the American public. Long-term changes must begin with a vision before steps can be taken to achieve it. We envision vast changes in the physical landscape and the health of our environment resulting from these recommendations, along with improvements in the overall general welfare of generations of Americans and residents of the UMR Basin in particular. Further, we envision sustainable prosperity as we tame ourselves and embrace our River.

> "Now there's laws that we must live by
> and they're not the laws of man

Can't you see the shadow that moves
across this land
The future is upon us and there's so
much we must do
And you know I can't ignore it and my
friend neither can you"
-Dan Fogelberg from "Blind to the
Truth"

---

Photos from Title:

Zafar, Salman, November 2, 2009, 'Recycling in Curitiba.' http://www.flickr.com/photos/cleantechsolutions/6706673877/

"The Linha Verde (Green Line), Curitiba - Brazil." Travel to Parana. http://traveltoparana.wordpress.com/2010/01/15/curitiba-is-the-first-brazilian-city-to-win-the-sustainable-transport-award/

"Barigui Park." Travel to Parana. http://traveltoparana.wordpress.com/2009/12/18/a-green-city-parks-in-curitiba-brazil/

1 Hawken, Paul, Amory Lovins and L. Hunter Lovins, 1999, Natural Capitalism. Little, Brown

2 Net Primary Production definition: The rate at which an ecosystem accumulates energy or biomass, excluding the energy it uses for the process of respiration. This typically corresponds to the rate of photosynthesis, minus respiration by the photosynthesizers, http://www.biology-online.org/dictionary/Net_primary_productivity

3 Harper, Charles H., 2004, Environment and Society, Pearson Prentice Hall

4 Daly, Herman, 1991, "Institutions for a Steady-State Economy", Steady State Economics, Island Press

5 Simms, Andrew, 2010, "We've Gone Into the Ecological Red", The Guardian

6 Hurley, Andrew (editor), 1997, Common Fields: an environmental history of St. Louis, Missouri Historical Society Press, St. Louis, pages 221-222

7 CIO committee on Regional Development and Conservation, folder 821, James Davis Papers

8 Leopold, Aldo , 1948, "The Land Ethic"

9 Wingspread Statement on the Precautionary Principle, 1998, Racine, WI, available at http://www.gdrc.org/u-gov/precaution-3.html

10 U.S. Environmental Protection Agency, 2010, Climate Change Indicators in the United States

11 George W. Kling et al - Union of Concerned Scientists, 2003, Confronting Climate Change in the Great Lakes Region - Impacts on Illinois Communities and Ecosystems, http://www.ucsusa.org/greatlakes/glregionill.html

12 Jha, Manoj, Jeffrey G. Arnold, Philip W. Gassman, Filippo Giorgi, and Roy R. Gu2, 2006, Climate Change Sensitivity Assessment on Upper Mississippi River Basin Streamflows Using SWAT, Journal of the American Water Resources Association

13 Thomas Jefferson, 1816, quoted in Lawrence Goodwyn, The Populist Moment

14 President Abraham Lincoln, Nov. 21, 1864, letter to Col. William F. Elkins, in The Lincoln Encyclopedia, by Archer H. Shaw

15 Legal Information Institute, Cornell University, http://www.law.cornell.edu/supct/html/08-205.ZS.html

16 Citizens United v. Federal Election Commission, 2010, US Supreme Court Ruling, http://en.wikipedia.org/wiki/Citizens_United_v._Federal_Election_Commission

17 Mann, Thomas E. - Senior Fellow, Governance Studies, 2010, Citizens United vs. Federal Election Commission is an Egregious Exercise of Judicial Activism Campaign Finance, U.S. Supreme Court, U.S. Congress, Corporate Social Responsibility, Brookings Institution, http://www.brookings.edu/opinions/2010/0126_judicial_activism_mann.aspx

18 Harper, Charles, 2004, Environment and Society, Pearson Prentice Hall

19 Hartmann, Thom, 2002, Unequal Protection, Rodale Inc.

20 See http://www.citiesforpeople.net/cities/curitiba.html

21 See http://www.heureka.clara.net/gaia/curitiba.htm

22 Hawken., Paul, Amory Lovins and L. Hunter Lovins, 1999, Natural Capitalism. Little, Brown

## *The Human Economy and the UMR Basin* - Donna M. Anderson

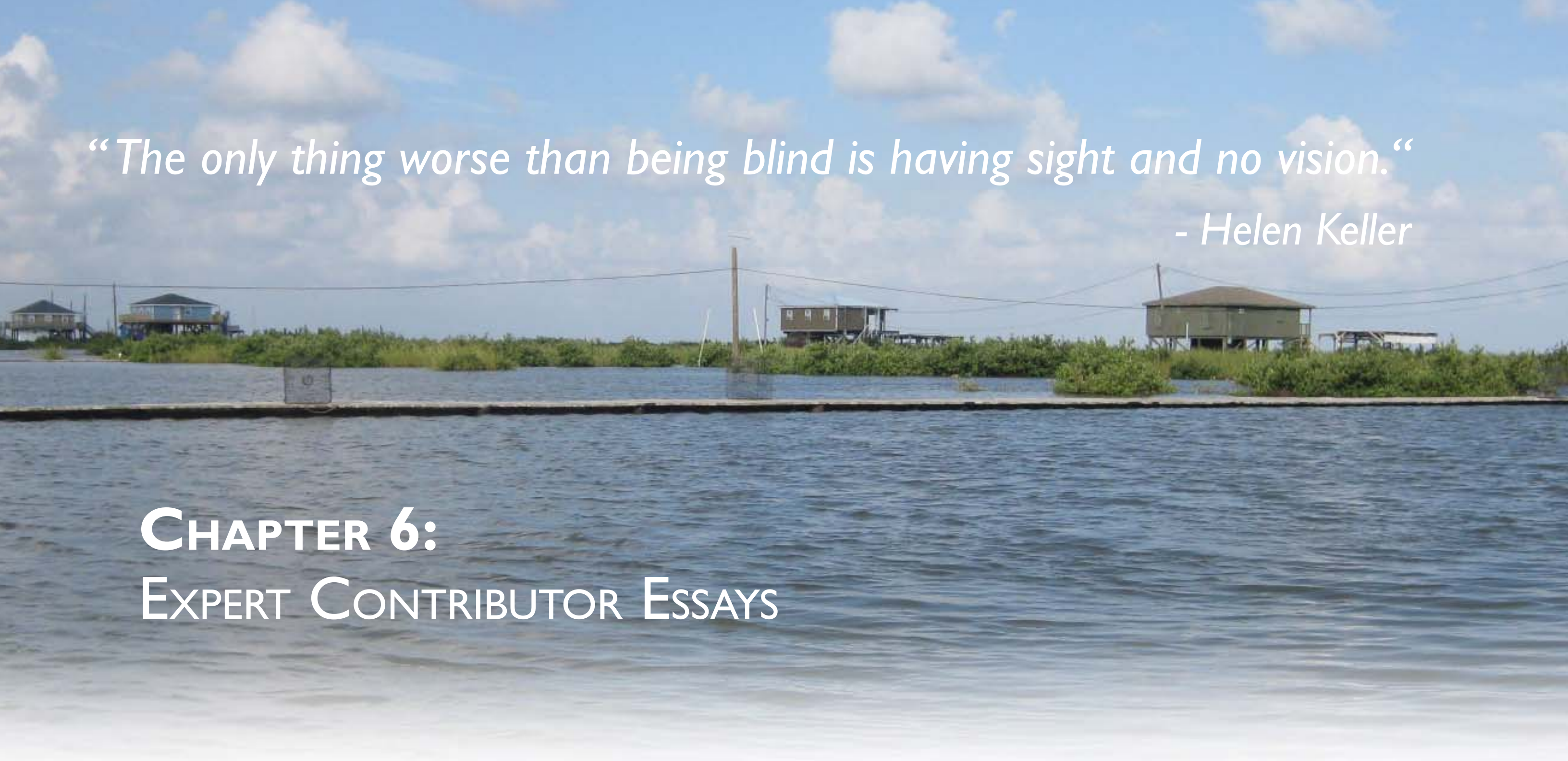
"We can't solve problems by using the same kind of thinking we used when we created them."
-Albert Einstein

In 1966, ecological economist Kenneth Boulding introduced the idea of the earth as a 'closed economy …in which [it] has become a single spaceship, without unlimited reservoirs of anything, either for extraction or for pollution, and in which, therefore, man must find his place in a cyclical ecological system …' Twenty-five years later, we would do well to embrace the spaceship allusion as we consider our relationship with the Upper Mississippi River basin, the impact of human-related economic activities on this area now and in the future, and implications this reality has for the region's economic stakeholders: consumers, producers, and governments.

Most significantly, the spaceship view of the human economy means that it is a relatively small part of the larger natural ecosystem. Although humans and their economies are important elements of the natural world, they nonetheless are not the dominant or even controlling factor. This human economy-natural ecosystem spaceship relationship is shown in Figure 1, which contrasts starkly with the human-centric traditional economic paradigm portrayed in Figure 2 that has dominated economic behavior and policy. The natural ecosystem, long considered a subset of the human economy in traditional economic theory, is viewed merely as an extractive and waste disposal sector, a tool to be managed, or manipulated, to augment short-term human welfare as measured by consumption of man-made goods. Boulding referred to the traditional economic paradigm as the "cowboy economy," not only because the 19th century American cowboy faced a seemingly limitless supply of empty land, rich soil, vast forests, and abundant fish, but also because of the association with reckless and exploitative behavior.

The implications of the ecological economic versus the traditional economic paradigms on consumption and production are profoundly different. In the cowboy economy, these human activities are of utmost importance because of the critical assumption that human well-being is improved by a quantitative increase in economic output. Further, since resources are assumed to be either limitless or easily substitutable with man-made innovations, increasing resource use and human economy growth is not a problem.

*For Anderson's complete essay, please see Chapter 6, Expert Contributor Essays*




# Chapter 6: Expert Contributor Essays

During the drafting of this report we contacted experts in the fields of ecology, hydrology, agriculture and ecological economics. Five scholars agreed to provide us with their thoughts on a truly sustainable future for the Upper Mississippi River Basin within the context of their field. We have the great pleasure of printing each of their essays in this chapter and hope that you appreciate them as much as we have, and especially that you learn from them as we have.

# Taming the People

*- K. S. Lubinski*

Last year I participated in a science exchange in Kolkata, India, with colleagues from the Upper Mississippi and Ganges rivers. A hydrologist from the Indian Statistical Institute, Professor Sengupta, at least 85 years old and weighing no more than 100 pounds, had to be helped onto the stage by a graduate student. Nevertheless, he finished his presentation with a simple but formidable admonition to the engineers in the room. He filled his lungs, pointed directly at the engineers (most of whom had spent their entire careers designing flood control structures) and said "Don't tame the river. Tame the people!" This from a man whose densely populated and generally poor country has suffered from countless great floods.

I can't think of a more appropriate subtitle to the Missouri Coalition for the Environment's vision. Sooner or later, humans, as individuals, communities or entire civilizations, either accept that there is a limit to how far their natural resources can be stretched, or suffer horrible consequences. Ironically, many of us in the agriculturally-rich heartland seem to have forgotten (or have never been taught?) the concept of carrying capacity. Perhaps our bounties of sunshine, soil, grain and water have lulled us into taking nature for granted. Or maybe our high tech life style promotes the unsupported belief that there is no end to squeezing ever more golden eggs out of our goose.

I've witnessed some instances of increased ecological awareness during my life, but they have been few, and fewer still during the last couple of decades. Most recently I listened to local fishermen and hunters berate plans to protect the river's fish and wildlife by reducing the human footprint within the Upper Mississippi National Wildlife and Fish Refuge. Why? Because they've always been able to fish, hunt and otherwise do what they want at such and such a spot, and it is <u>their right</u> to do so. Nature of course couldn't care less about such self-proclaimed rights. Further back in time, during one of the mussel booms on the river, I often shared experiences with commercial clammers. At one time these men had a reputation for policing their own activities and thus promoting sustainable harvests. But profits were peaking and in response to my suggestion that they consider additional voluntary harvest limits, I was promptly labeled as a communist. "Socialist" might be the more popular tag today.

So from my perspective, far too many people still look upon the river as an infinite resource to be ignored or improved and domesticated[1] for either profit or pleasure. Something worth considering - when <u>individuals</u> lose contact with and appreciation for the unpredictable and untidy "naturalness" of the river, can we realistically expect the big players, like agri-business or transportation, to do otherwise?

The whole river system, including its social, economic, and ecological components, needs to be sustained, rather than just a single sector. We know that these sectors, at critical thresholds, compete with each other, and it seems irresponsible to continue to subsidize one without considering the effects of that action on the others. We can't have it all.

I think of the whole system as the river community. To sustain the community, changing our behavior is more important than finding technical fixes that focus on single sector goals, or that treat symptoms instead of the disease. Visioning is vital[2], but to make the kinds of major changes suggested by the Missouri Coalition for the Environment, river stakeholders (all of us that care) would have to:

- Accept the responsibility of sustaining the community (even the pieces we don't especially value),
- Distinguish between the <u>needs</u> of the community (What level of clean water? Which native species? How many barges?) and the <u>wants</u> of the individual sectors, and
- Objectively evaluate current and potential future trade-offs to meet common needs first.

Too often disregarded, one of our needs is for the river ecosystem to be healthy[3], as evidenced by the species it supports and by its resilience to disturbance. A healthy river provides the ecosystem services[4] (such as waste assimilation, flow regulation, transportation and recreation) we depend on. This need is fundamental, and it will be even more important to future generations as it becomes harder to find "nature". Fortunately, large river ecosystems tend to be especially resilient to disturbance[5], and the Upper Mississippi is no exception.

1 Karieva, P., S. Watts, R. McDonald, and T. Boucher, 2007, Domesticated Nature: shaping landscapes and ecosystems for human welfare, Science, 316: 1866-1869.

2 Costanza, R, 2003, A vision of the future of science: reintegrating the study of humans and the rest of nature, Futures, 35: 651-671.

3 Lubinski, K. S, 2010, The concept of river ecosystem health and its relationship to management, Workshop Proceedings: Sedimentation, Erosion, Flooding, and Ecological Health of River,. Indian Statistical Institute, Kolkata, India, 78-87

4 Lubinski, K, R. Clevenstine, M. Davis, S. Brewer, N. McVay, and P. West, 2007, Upper Mississippi River System Navigation and Ecosystem Sustainability Program, Environmental Science Panel Report 4: Ecosystem Services: FY 2006 Workshop, U. S. Army Corps of Engineers, Rock Island, St. Louis, and St. Paul Districts, 46 pp, + appendices.

5 Church, M., J. Gardiner, K. S. Lubinski, G. Petts, R. E. Sparks, J. V. Ward, and R. Welcomme, 1995, Ecology of large floodplain rivers and its relationship to management, *In:* Sustaining the Ecological

The concept of ecosystem health[6],[7], which has gained support over the last three decades, doesn't require a river to be pristine or unchanged from the condition it was in centuries ago. However, a healthy, self-sustaining river does need to retain most of its natural features and processes (If it walks like a duck and quacks like a duck …). The concept of ecosystem health grew out of the notion that humans could learn to use natural resources only up to the point where they started dipping into the "principle", to use an economic analogy. An acceptable level of taking from an ecosystem is like living off the interest generated by a bank account. The concept recognizes that there is a range on the scale of river condition that is below ideal but still good (i.e. healthy). Ecosystem losses incurred while dropping down the scale should be conscious decisions by society, part of the price we're willing to pay to have channels deep enough to carry barges, and levees that provide partial or temporary flood protection.

Is the river healthy today? It has been altered in many ways, by pollution, levees, dams, and invasive species, but that doesn't by itself mean the river isn't healthy. A colleague at the National Mississippi River Museum and Aquarium refers to the current condition of the river as its "second nature". Still, its resilience, productivity, and diversity make it arguably one of world's highest quality "working" rivers. The many different answers you hear in response to the health question are primarily dependent on the person answering the question and which reach of river he or she represents. Upriver people tend to focus on its visitor use-days (more than Yellowstone National Park!), its value as a bird migratory corridor, or its pleasure-boat friendly beaches. Most people near or below St. Louis on the other hand take a dimmer view of the river, preferring that it be kept on the other side of the levee. It would be extremely valuable to be able to answer the question about the health of the different reaches of the river objectively and consistently over time.

Quantifying the river's health requires a merging of science and human values. The science must combine knowledge of how large rivers behave with specific data from the Upper Mississippi. Our knowledge about the needs of river ecosystems has grown rapidly over the last 40 years. We now know that to support its native species and their habitats and food webs, a floodplain river requires certain flow rates[8], water quality, room to expand and contract every year, and the ability to reset important ecological processes by reshaping the floodplain during rare "channel forming" high flow events. Some scientists have referred to measures of these attributes as a river's vital signs.

Do we have the necessary data for the Upper Mississippi River or the ability to get them in the near future? Yes. For the last twenty years the Upper Mississippi has supported what is probably the most extensive river monitoring program in the world[9], [10]. In addition to a major federal science center with six State field stations, and a world-class museum and aquarium, there are at least five university-supported field stations on the river. Together these facilities have the capacity to address many information needs, including the creation of regular ecological report cards for the river.

However, with the exception of two admirable but narrowly focused efforts[11],[12] , Upper Mississippi managers have struggled with health indicators and standards. A management system based on regular, scientifically credible assessments of the condition of the ecosystem and stakeholder-supported standards still seems far in the future. Individual habitat restoration projects are planned in engineering detail, but with little ecological context. Early in 2011, a new program intended to show how restoration projects contribute to the condition of the whole ecosystem was shelved due to lack of funding. Without a well-conceived and scientifically defendable report card process, it's hard to imagine how the needs of the ecosystem can be objectively weighed against the needs of the economy.

This example points out one of the major short-comings of the river's current management system. Individuals (including myself at times) from many agencies weave in and out of an informal decision making process composed of marginally functioning

Integrity of Large Floodplain Rivers: Application of Ecological Knowledge to River Management, Conference and Workshop Summary, National Biological Service. Environmental Management Technical Center, Onalaska, WI, pp. 3 – 7.

6 Rapport, D. J, 1989, What constitutes ecosystem health? Perspectives in Biology and Medicine **33**: 120-132

7 Karr, J. R., 1999, Defining and measuring river health, Freshwater Biology **41**: 221

8 U. S. Geological Survey, 1999, Ecological status and trends of the Upper Mississippi River System 1998: A report of the Long Term Resource Monitoring Program, U. S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, LTRMP 99-T001, 236 pp.

9 Johnson, B. L., and K. H. Hagerty, eds., 2008, Status and trends of selected resources of the Upper Mississippi River System, U. S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, Technical Report LTRMP 2008-T002, 102 pp + Appendices A-B

10 Richter, B. D., Baumgartner, J. V., Wigington, R., and Braun, D. P, 199, How much water does a river need? Freshwater Biology 37: 231-249

11 The Mississippi River Makeover Project, http://www.dakotaswcd.org/wshd_missmak.html

12 Sullivan, J. F., 2008, The use of Metaphyton to Evaluate Nutrient Impairment and Proposed Nutrient Criteria for the Wetlands and Backwaters in the Upper Mississippi River, Wisconsin DNR, La Crosse, WI.

and overlapping committees. The process seems more tailored to helping the Corps of Engineers improve its "spending performance" and reputation for partnering than to helping the ecosystem. Further, the management system seems especially weak when it comes to using the great amount of information at its disposal to achieve long-term goals. The system has become entrenched and intent on maintaining the *status quo*. Success is measured primarily by maintaining the flow of federal funds into river programs (a want?), not by measures of improved ecosystem or community condition.

The *status quo* includes the continuation of the Environmental Management Program which directs most of the habitat restoration activities on the river. Many people associated with this program believe that the river ecosystem will never be self-sustaining again. (It continues to fill with sediment, more slowly now than immediately after it was dammed, but still at rates that threaten its future diversity.) As a consequence, the belief is that the river will always need artificial support. I'm a taxpayer as well as an ecologist, and I'd like to know there is a light at the end of the habitat restoration tunnel. Reaching a point where the river ecosystem can take care of itself is a community need. If the only way that the river ecosystem can be sustained is through artificial means, it might be more accurate to categorize it as a park or a zoo.

One last observation about ecosystems and their management is worth mentioning here. Some scientists today seriously wonder if we (managers, scientists, politicians, and publics) have as much control over the world's remaining natural resources as we think we do. They point to the unpredictability of altered ecosystems, and external factors like climate change, subsidies, and the global economy. In this environment, they suggest that rather than setting static future goals for the river we'd be better off taking a more adaptive approach, one that simply gets our ecosystems moving on more desirable trajectories. Then by regularly checking on progress, we could better estimate how far we are from success and make course corrections to get there more effectively. Relative to the Upper Mississippi, the adaptive approach has the advantage of placing a high value on formal, progressive learning and its role in river management. It would also give us a greater opportunity to test some of the assumptions we take for granted. Both approaches however, start with the belief that our community's future depends on the future of the ecosystem.

Because the social, economic and ecosystem sectors of the river community depend on each other, realizing the Missouri Coalition for the Environment's vision will require stakeholders to make sacrifices and help meet the needs of others. Accepting that, are we ready, willing and able to tame ourselves? The answer depends on whether we can agree that the multi-faceted prize is worth the effort. Can we accept the idea of establishing some minimal controls on commercial traffic to meet the needs of a self-sustaining river? The law currently forbids this, and changing the law would not be easy. Will we be capable of limiting our land-use "wants" so that many of the ecosystem services that floodplains provide can be restored? That would require greater awareness and acceptance of common values. The river ecosystem has always been magnanimous in helping humans meet their needs. It will be a huge challenge for us to work as a community to help the ecosystem continue to meet its own needs, and to sustain its ability to serve our grandchildren as it is serving us now.

*[This essay reflects my personal and individual ideas and beliefs. Nothing here should be attributed to any of the institutions that have supported my scientific endeavors.]*

# Sustainable Agriculture in the Upper Mississippi in the 22nd Century

*- Frederick Kirschenmann*

In recent years everyone involved in agriculture has indicated a desire to be---and claims to be---"sustainable." Whether farmer, food processor, retailer, or input supplier, claiming to be "sustainable" is now an important market-driven initiative.

The problem with such claims is that none of our modern food system is *designed* to be sustainable. The singular goal of our modern food system is *maximum, efficient production for short-term economic return*. All of modern agriculture---whether conventional, organic, or local---is under pressure to subscribe to this goal if it is to survive in today's market. By contrast, a truly *sustainable* agriculture, while being productive, must *also* subscribe to the goal of *maintaining* productivity. In other words, to truly conform to the requirements of a sustainable agriculture, such an agriculture must---in addition to being productive---be designed for *resilience* in the face of changing circumstances. To date, none of our food system has been designed to meet that goal.

The best model we have available for managing systems for resilience is wild nature. During its long evolutionary journey, nature has demonstrated its capacity to adapt to shocks and disturbances. So how can we use nature's wild system, and the way it is organized, to help us design a new agriculture for sustainability? That is the challenge and opportunity which now confronts us.

The emerging challenges as we enter the 21st century are becoming obvious. Our modern industrial food system---like so much of the rest of our industrial economy---is dependent on two major gifts of nature:

1. the natural resources that fuel our food system---notably cheap fossil energy, fossil water reserves, fertilizers, land, seafood and a rich storehouse of biodiversity and genetic diversity; and
2. the natural sinks which absorb the wastes of our human activities.

Herman Daly already warned us 30 years ago, that we are rapidly depleting these two essential resources which support our human economy and that we must now redesign our human economies---including our food and agriculture system---to function as a subsystem of the eco-system and to operate within those limits. Unfortunately, driven by the singular goal of maximum, efficient production for short term economic return, we have failed to heed Daly's advice. Consequently we have now reached a point where these resources, so essential to our industrial production system, are in a state of depletion, and we have not, as yet, designed the necessary alternative systems.

The era of cheap, stored, concentrated energy---especially oil, coal and natural gas---has now ended. And our current food system is almost entirely dependent on that cheap energy. Petroleum is the key ingredient in our synthetic fertilizer system which provides the majority of the nutrients to sustain our productivity. Petroleum manufactures and operates our farm equipment as well as all of the equipment and operations used to process, package, and transport all of our food. Most of our pesticides used to control the pests in our specialized cropping systems are made from petroleum. According to some reports 25 percent of our food costs today can be attributed to the Haber-Bosch process which produces the anhydrous ammonia which supplies the vast majority of the nitrogen which produces our crops for food, feed and fiber.

Seventy percent of the fresh water on the planet is now used for agriculture irrigation. Having relied on synthetic inputs to supply crop nutrients we have invested no effort to maintain the biological health of our soil. Consequently our soil only absorbs and retains a sixth of the rainfall of which it is capable, thus requiring almost constant irrigation.

We have also been drawing down our rock phosphate and potassium reserves---the principle source of our phosphorus and potash fertilizers. Rock phosphate is now only available in 4 countries and, similarly, only 4 countries still have potassium reserves. The United States has already mined almost all of its reserves.

Due to our system of specialization we have dramatically reduced our genetic and biodiversity resources. According to the UN Food and Agriculture Organization, we have lost about three-fourths of our crop varieties and one-fifth of our animal breeds in the last century. Our populations of essential pollinators, like bees, have also been seriously declining.

The sinks on which we relied to absorb the wastes of our industrial agriculture system are becoming saturated. One indicator is, of course, the dramatic increase in the number of dead zones on the planet. The fact that the atmosphere is now becoming so saturated with green house gasses, which threatens to seriously destabilize the climate of the planet, is a second indicator. Stable climates are especially essential to maintaining productivity in highly specialized monoculture production systems.

What can wild nature teach us to help us redesign our food and agriculture system to make it more resilient and sustainable in the face of these many challenges?

Several things come to mind.

First, nature functions on the basis of perennials, not annuals. Perennials have a demonstrated history of performing rather well under drought and flood conditions. Consequently they will be much more resilient in our future unstable climate conditions. Much less energy is required for perennials. Furthermore, more efficient root management by perennials would require less nitrogen input, and the improved soil health due to dramatically reduced soil erosion and more vibrant root systems would significantly reduce overall fertilizer inputs. Perennials are also much more effective in protecting themselves against pests thereby reducing the need for pesticides. Given all of these wild nature benefits we should devote much more of our research to the kind of perennial plant breeding that has been championed by The Land Institute in Salina, Kansas and a few of our Land Grant Universities, along with research in other countries. Consequently, by shifting a modest amount of our agricultural research resources to such perennialization we could replace a majority of our annual crop cereal production throughout the world within the next fifty years.

Second, Sir Albert Howard reminded us that "there shall be no waste" in farming systems modeled after "mother earth." This principle is essential to restoring the biological health of our soils, which, in turn, is essential to farming systems designed for sustainability. As Howard reminded us, the living biotic community in the soil feeds on humus and we need to return all waste---preferably as compost---to supply the food (humus) for that living community in order to sustain soil health.

Third, studies like those cited by Ivette Perfecto et. al. in *Nature's Matrix: Linking Agriculture, Conservation and Food Sovereignty*, 2010, suggest that a global system of small farmer networks would be much more sustainable than huge concentrations in a few mega farms. Natural adaptive cycles demonstrate that extinctions are a natural part of any biological system, so when we have "too big to fail" farms go extinct, a huge food security problem confronts us. By contrast, when a small farm in a network goes extinct, it will be relatively easy for the farmer to move into another network and start over.

Fourth, animal agriculture should be reintegrated into crop agriculture. Again, as Howard and many other 20th century luminaries reminded us "mother earth never farms without livestock." And animals should be allowed to exercise their normal ecological functions. Ruminants are designed to eat grass and forages. Pigs evolved principally in woodlands. This is a transition that will probably, in any case, be necessitated as energy costs increase, but we should begin the transition now. All of this also means that we would produce and eat less meat, which health care professionals tell us would be good for human health and likely reduce health care costs over time. Additionally, such a transformation would also provide the landscape with the ecological benefits of having an appropriate amount of animals dispersed throughout the landscape. Naturally some ecologies would sustain a proportionately larger number of animals than others. Regional systems should be designed to maximize land health. Food systems should then be developed in such healthy ecologies that enable us to eat well from those redesigned landscapes in the regions in which we live.

Fifth, our future agriculture systems should practice poly cultures where ever possible and ecologically appropriate. This will be especially important on our horticulture farms. Complex rotations of horticulture crops, produced on healthy soils, can dramatically reduce pest and weed pressure and produce more nutrient-dense, great-tasting vegetables.

Sixth, we should immediately increase our efforts to restore genetic and biological diversity in each ecological region, or "food shed." History clearly reveals that regions which developed and preserved biodiversity were much better equipped to sustain themselves in the face of famines or other food threatening events. Reinvigorating the development of seed diversity and animal breed diversity in each food shed will be a vital aspect of future food sustainability.

Finally, we should begin transforming our uniform, globalized food system into regional networks of food sheds which invite communities of individuals to become "food citizens" and become actively engaged in designing food systems that are appropriate to their region. Such active citizenship would transfer authority of regional food systems to the citizens that live in those communities, rather than retaining it in the hands of distant corporations who understandably design food system that meet their private profit goals. Food sheds and the concept of "food sovereignty" are gaining interest in many parts of the world, including urban centers in the United States, and our new food system designs should honor and encourage such citizen involvement.

# Upper Mississippi River History and Hydrology

*- Nicholas Pinter*

## Setting

This essay will briefly review the history of human modifications of the Upper Mississippi River (UMR) and the impacts of these modifications upon the hydrology and future resilience of the river system. The focus of this review is the Mississippi River and its floodplain upstream of the river's confluence with the Ohio River at Cairo, IL. We refer to the reach from the Ohio up to the Missouri River confluence as the Middle Mississippi River (MMR) and the reach upstream of the Missouri River as the impounded reach. The junction with the Missouri River is a major boundary on the Mississippi in terms of its hydrology, geomorphology, and engineering history. The Missouri River is the main source of sediment as well as water to the river downstream of the confluence[13], and its 530,000 $mi^2$ basin is climatically and geomorphically distinct from the basin of the UMR. The MMR runs a distance of 195 miles (314 km) from the Ohio confluence to just north of St. Louis. Major tributaries entering the MMR include the Big Muddy, the Kaskaskia, and the Meramec Rivers. The MMR is sometime called the "open river" reach of the river, where minimum navigation depths are maintained using what engineers call "river training structures" (wing dikes, bendway weirs, etc.; see below), bank revetment, and dredging.[14] The UMR extends 1171 river miles (1884 km) from Missouri confluence upstream to Lake Itasca, MN. The impounded reach has been made navigable by 29 locks-and-dams that have turned much of the river into a series of slackwater pools.

## Early History of the UMR

The impacts of the historical river-system modifications outlined above have been extensively researched, and those full results are beyond the scope of the short review here. My research group has focused on historical changes in flooding and the mechanisms that have driven these changes. Such research starts with a single question – Are floods on the Mississippi River system getting worse and more frequent over time? This assertion has been repeated, in both the scientific literature and in the popular press, during recent years, and not without reason. The 2008 flood crest on the UMR was the 2nd ~500-year flood in 15 years and the 3rd or 4th 100-year flood in ~35 years at several locations. At St. Louis, the precise record of stages (flood levels) stretches back 150 years, and the 10 highest crests have all occurred within the past <70 years. The chance of this flood history being a random distribution is less than the chance of flipping a coin 10 times in a row and having them all come up "heads." In fact, the assertion that flood dynamics on the UMR have changed dramatically can be tested statistically. And once verified (see below), the mechanisms driving those changes can be precisely determined.

Any review of "human influences" on any American river should at least note that this history does not entirely begin with the arrival of Europeans[15], but Native American influences are seen mainly on smaller streams, and the impacts seem to be orders of magnitude less profound than modern modifications. The UMR was first seen by Europeans in 1673, when the expedition led by Louis Jolliet and Pere Jacques Marquette made its way down the Wisconsin River from the Great Lakes. The first permanent settlement west of the Mississippi was Ste. Genevieve (now Ste. Genevieve, Missouri), founded in 1735. St. Louis followed in 1764. The Lewis and Clark expedition made some of the first hydrologic measurements of the Mississippi River during its first winter encampment in 1803-04 at Camp Dubois, near the Mississippi-Missouri confluence north of modern day St. Louis. Compared to its modern hydrology, the early 19th century Mississippi system had less variability in its flow and more regular seasonal timing, consistent with the impacts of basin development, channelization, and dam construction.[16]

The Mississippi and other rivers were the focus of early exploration because they provided avenues of transportation across the continental interior. Pere Marquette traveled by canoe. The subsequent trappers and traders traveled by canoe or using flat bottomed "bateaux".[17] Lewis and Clark utilized canoes, shallow pirogues, and a keelboat, the last larger but still with the shallow drafts required by the river at this time. Westward expansion and settlement on the heels of

13 Meade, R.H., 1995, Setting: geology, hydrology, sediments, and engineering on the Mississippi River, p. 13-30, in Meade, R.H., ed., Contaminants in the Mississippi River, 1987-92: Reston, Virginia, U.S. Geological Survey Circular 1133, 140 p.

14 Pinter, N., K. Miller, J.H. Wlosinski, and R.R. van der Ploeg, 2004. Recurrent shoaling and dredging on the Middle and Upper Mississippi River, USA. Journal of Hydrology, 290: 275-296

15 Stinchcomb, G.E., T.C. Messner, S.G. Direse, L.C. Nordt, and R.M. Stewart, 2011. Pre-colonial (A.D. 1100-1600) sedimentation related to prehistoric maize agriculture and climate change in eastern North America. Geology, 39: 363-366

16 Ehlmann, B.L., and R.E. Criss, 2006. Enhanced stage and stage variability on the lower Missouri River benchmarked by Lewis and Clark. Geology, 34: 977-980

17 Branyan, R.L., 1974, Taming the Mighty Missouri: A History of the Kansas City District Corps of Engineers 1907-1971, Kansas City, MO: U.S. Army Corps of Engineers, Kansas City District, 128 pp.

Lewis and Clark saw trade and river navigation continue to utilize the Mississippi and other rivers. Transport was by canoe or, for larger cargos, by keelboat, the latter vessels requiring as little as 3-4 ft of draft.[18] Over the course of the 19th century, increased populations along the Mississippi led to demands for larger capacity. Beginning about 1820, keelboats gradually were supplanted by stern- and side-wheeled paddleboats of the steamboat era. During the 20th century, steamboats were in turn supplanted by the diesel-driven multi-barge towboats that are the dominant vessel of river navigation today. This evolution in navigation technology drove demands for increasing the depth of the river and progressively more intensive regulation of the Mississippi River, which has been a driver (THE major driver, many would argue) of the extensive river modifications of the 20th and 21st centuries outlined in the section below.

## "Industrialization" of the UMR

The Mississippi River has been extensively modified during the past 100-200 years, primarily: (1) to facilitate river navigation, and (2) for flood control. In addition, its contributing basin has also changed extensively in ways that strongly affect the hydrology of the river. The first systematic U.S. Government activity on the Mississippi River began in 1824 with removal of "snags" (trees and other large debris in the channel) in order to facilitate navigation.[19] In an ill-fated attempt to eliminate snags at their source, a program of riverbank clearing was undertaken beginning in 1835, which triggered a wave of channel widening as the river pushed against the now unanchored, treeless banks.[20] Increased bank erosion and more silt in the river was the unintended consequence of removing the trees along the river banks. Now the river's channel grew shallower as eroded soil filled its channel.

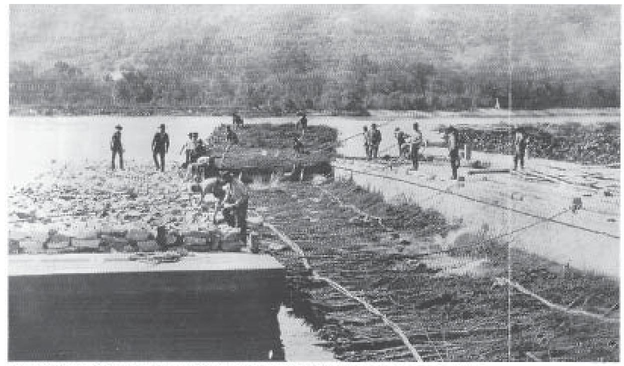
In 1881, Congress authorized a comprehensive channel improvement project to deepen the channel and reduce the impacts of siltation, in part to rectify the earlier bank clearing; by 1900, there were ~300 wing dams in the MMR with a cumulative length of roughly 285,000 ft.[21] Wing dams help prevent silt from entering the main channel and speed the current in the main channel to help it maintain depth. The 1927 Rivers and Harbors Act authorized a 9 ft deep navigation channel up to St.

18 Vestal, S., 1945 (reprinted 1996). The Missouri. University of Nebraska Press: Lincoln, 368 pp.

19 Dobney, F.J., 1978. River Engineers on the Middle Mississippi: A history of the St. Louis District, U.S. Army Corps of Engineers. Washington: U.S. Government Printing Office

20 Ibid

21 Westphal, J.A., and Clemence, S.P., 1976, SLD Potamology Study (S-7): Rolla, University of Missouri, The Institute of River Studies, 59 p.



*Throwing Rock on Brush Mats. Photograph by Henry Bosse, 1891*
Source: U.S. Army Corps of Engineers

**Figure 6-1:** Wing Dam Construction - 1890s

Louis[22], and almost $19 million was spent on 768 new wing dams and new revetments between 1930 and 1945. Numerous wing dams also were built on the UMR, but this strategy was later recognized as ineffective on the upper river. The 1930 Rivers and Harbors Act extended the 9 ft channel upstream to Minneapolis, to be achieved by constructing 24 locks-and-dams[23], an effort completed by 1940.[24] The pooled reaches of the UMR today consist of a series of slackwater pools at low flows, with minimum navigation depths maintained by those dams.

Through the 19th and especially during the 20th centuries, settlement and progressive development led to a profound transformation of the floodplains of the MMR and impounded reach. Maps and vegetation surveys by the General Land Office (GLO) made through the early 19th century showed that much of the floodplain was dominated by grassland prairie, with riparian floodplain concentrated on islands, valley slopes, and ravines.[25] This widespread grassland likely was maintained by periodic flooding and frequent broadcast burning. Within the UMR basin, a major timber boom began around 1875, with at least 200 sawmills along the UMR and its tributaries and

22 Chen, Y.H., and Simons, D.B., 1986, Hydrology, hydraulics, and geomorphology of the Upper Mississippi River System: Hydrobiologia, v. 136, p. 5-20

23 Wiener, J.G., C.R. Fremling, C.E. Korschgen, K.P. Kenow, E.M. Kirsch, S.J. Rogers, Y. Yin, and J.S. Sauer. 1998. Mississippi River. In Mac, M.J., P.A. Opler, C.E. Puckett Haecker, and P.D. Doran, eds., Status and trends of the nation's biological resources. Reston, Virginia: U.S. Department of the Interior, U.S. Geological Survey. 1: 351–384.

24 Chen, Y.H., and Simons, D.B., 1986, Hydrology, hydraulics, and geomorphology of the Upper Mississippi River System: Hydrobiologia, v. 136, p. 5-20

25 Fremling C, B Drazkowski 2000 Ecological, institutional, and economic history of the Upper Mississippi River. Resource Study Center, St. Mary's University of Minnesota, Winona.Hall, B.R., 1991. Impact of agricultural levees on flood hazards. U.S. Army Engineer Waterways Experiment Station Technical Report, HL-91-21, 36 pages.

employing more than 100,000 lumberjacks at its peak.[26] Clearance of land and floodplain modification for agriculture varied broadly by region, but became regionally important through the late 19th and 20th centuries.

Hydrologically, conversion of native land to agriculture locally caused up to six-fold increases in flood flows[27] as well as significant soil erosion and downstream flux of sediment. These impacts were later moderated after adoption of soil-conservation practices in the 1930s.[28] Agriculture on floodplain land was also facilitated by the widespread emplacement of tile drainage, which likely had significant effects on storm runoff, but these effects are difficult to quantify because the extent and timing of tile-drain construction are poorly documented. Finally, late 20th century urbanization significantly worsened flooding in small urban catchments[29], [30] but had relatively small impacts on rivers as large as the Mississippi and its major tributaries.[31]

Agricultural development as well as the growth of towns and cities has led to the progressive growth of levees on the MMR and impounded reach floodplains. Originally, large floods on the Mississippi extended from bluff to bluff, a distance spanning several miles along most of the river (floods "miles wide and a foot deep"). Initial levee construction protected local population centers; at St. Louis for example, a natural floodplain 7 to 12 miles wide was already constricted down to just 2000 feet wide by 1903.[32] The Illinois State Drainage and Levee Act of 1879 made state funds available to organize levee districts and protect and develop agricultural floodplain land.[33] Early agricultural levees generally were no higher than about 6-10 feet above flood stage.[34] In the 20th century, Federal funds were made available for much more ambitious levee projects. Along the MMR for example, nine Federal levee projects, generally protecting to the 100- to 500-year (0.2% to 1% probability) level were complete by 1960, and five others were under construction.[35] Along the MMR and UMR, at least 8,000 miles of levees have been constructed, including 2,249 miles built by the U.S. Army Corps of Engineers.[36]

## Effects Of River-System Modification

The impacts of the historical river-system modifications outlined above have been extensively researched, and those full results are beyond the scope of the short review here. My research group has focused on historical changes in flooding and the mechanisms that have driven these changes. Such research starts with a single question – *Are floods on the Mississippi River system getting worse and more frequent over time?* This assertion has been repeated, in both the scientific literature and in the popular press, during recent years, and not without reason. The 2008 flood crest on the UMR was the 2nd ~500-year flood in 15 years and the 3rd or 4th 100-year flood in ~35 years at several locations. At St. Louis, the precise record of stages (flood levels) stretches back 150 years, and the 10 highest crests have all occurred within the past <70 years. The chance of this flood history being a random distribution is less than the chance of flipping a coin 10 times in a row and having them all come up "heads." In fact, the assertion that flood dynamics on the MMR and UMR have changed dramatically can be tested statistically. And once verified (see below), the mechanisms driving those changes can be precisely determined.

Any discussion of flood trends must distinguish between the **volume** of river or flood flow (its "discharge") from the **height** of that flow (river "stage"). Several

26 Ibid

27 Knox, J.C., 1999. Long-term episodic changes in magnitudes and frequencies of floods in the Upper Mississippi river valley. In: A.G. Browne, T.A. Quine (Eds.), Fluvial Processes and Environmental Change, John Wiley & Sons: London, pp. 255-282

28 Potter, K.W., 1991. Hydrological impacts of changing land management practices in a moderate-sized agricultural catchment, Water Resources Res. 27, 845-855

29 Van Sickel, D.R., 1979, Effects of urbanization on streams. In Water Problems of Urbanizing Areas. Proceedings of the Research Conference, New England College, Henniker, New Hampshire July 16-21, 1978. The American Society of Civil Engineers, New York, p 259-270.

30 Changnon, S.A., and Demissie, M., 1996. Detection of changes in streamflow and floods resulting from climate fluctuations and land use-drainage changes, Climatic Change 32, 411-421

31 American Society of Civil Engineers, 1996. Handbook of Hydrology, 2nd ed., ASCE Manuals and Reports on Engineering Practice 28, American Society of Civil Engineers: New York

32 Stevens, G.T., 1979. SLD Potamology Study (S-3). St. Louis Division, U.S. Army Corps of Engineers, Contract #DACW-43-76-C-0157. 43 pages

33 Chen, Y.H., and Simons, D.B., 1986, Hydrology, hydraulics, and geomorphology of the Upper Mississippi River System: Hydrobiologia, v. 136, p. 5-20

34 Dyhouse, G.R., 1985. Levees at St. Louis--More harm than good? in W.R. Waldrop (ed.), Hydraulics and Hydrology in the Small Computer Age: Proceedings of the Specialty Conference. American Society of Civil Engineers Hydraulics Division, p. 390-395

35 Dobney, F.J., 1978. River Engineers on the Middle Mississippi: A history of the St. Louis District, U.S. Army Corps of Engineers. Washington: U.S. Government Printing Office

36 Tobin, G.A., 1995. The levee love affair: A stormy relationship? Water Resources Bulletin, 31: 359-367

studies have tested whether flood flows on the Upper Mississippi and other rivers have systematically increased over time. Analyses of both river discharges and flood-producing precipitation have identified statistically significant increases at many locations across the eastern two-thirds of the country during the 20th century.[37], [38], [39], [40] In contrast, Lins and Slack[41] saw trends in moderate floods but no discernable trends in the largest events. Such differences are expected when different statistical techniques are applied to noisy data sets like flood volumes, where long-term trends can be masked by year-to-year variability. Trends in flood flows over time emerge decisively and unequivocally where the changes are truly extreme, such as in northern Europe, where climate change has driven flood volumes up to 30% higher over the past ~century.[42]

Any systematic change in flood flows (discharges) at a given location represents the sum total of all runoff controls in the basin, including climate change, land-use shifts, as well as flood reductions from dams constructed upstream. Looking again at discharges over time, and thus the cumulative effects of all of the above effects, Pinter et al.[43] tested for trends in both discharge time series at 68 stations on the Mississippi and Lower Missouri Rivers. We identified 11 significant trends in flood discharges, all of them positive and all on the Upper Mississippi (11 of 21 total sites). No other site anywhere on the Mississippi-Missouri system showed any other statistically significant change in flood flows, consistent with the findings of Pinter et al.[44] that construction of the large mainstem dams on the Missouri River (Fort Randall, Garrison, Gavins Point , Oahe, and Big Bend Dam) have counterbalanced discharge increases over time due to climate and/or land-use change over the past ~100 years.

And now stages. The stage, or height, or a river in flood reflects both the volume of discharge passing a given location, plus local conditions (width, depth, roughness, flow velocity, and local engineering and other structures) in that river reach. As the eminent engineer of the 19th century, Charles Ellet put it, "*The water is supplied by nature, but its height is increased by man.*" Pinter et al.[45] statistically tested flood stages at the same 68 stations and for the same spans of time as described in the previous paragraph. Many additional stations had significant rising trends in peak stages, with the increases up to 10 times greater than could be explained by changes in discharge alone. Thus climate- or land-use-driven discharge changes are detectable (e.g., on the UMR), but local engineering of the Missouri and Mississippi River on whole has been the predominant influence at many locations on these rivers.

The results above have been echoed by local hydrologic analyses of flood levels, including studies that date back 35 years and longer. Belt[46], Stevens et al.[47], Pinter et al.[48], Criss and Shock[49], Wasklewicz et al.[50], Jemberie et al.[51], and others have pointed out that flood stages have risen significantly over the past ~century at

---

37 Changnon, S.A., K.E. Kunkel, and K. Andsager, 2001. Causes for record high flood losses in the central United States. Water International, 26: 223-230

38 Groisman, P.Y., R.W. Knight, and T.R. Karl, 2001, Heavy precipitation and high streamflow in the contiguous United States: Trends in the twentieth centur,. Bulletin of the American Meteorological Society, 82: 219-246

39 Milly, P.C.D., R.T. Wetherald, K.A. Dunne, and T.L. Delworth, 2002. Increasing risk of great floods in a changing climate. Nature, 415: 514-517

40 Ya, P., R. T. Knight, T. R. Karl, D. R. Easterling, B. Sun, and J. H. Lawrimore (2004), Contemporary changes of the hydrological cycle over the contiguous United States, J. Hydrometeorology, 5, 64-85

41 Lins, H.F., and J.R. Slack, 2005. Seasonal and regional characteristics of U.S. streamflow trends in the United States from 1940 to 1999. Physical Geography, 26: 489-501

42 Pinter, N., R.R. van der Ploeg, P. Schweigert, and G. Hoefer, 2006. Flood Magnification on the River Rhine. Hydrological Processes, 20: 147-164

43 Pinter, N., A.A. Jemberie, J.W.F. Remo, R.A. Heine, and B.S. Ickes, 2008. Flood trends and river engineering on the Mississippi River system, Geophysical Research Letters, 35, L23404, doi:10.1029/2008GL035987

44 Pinter, N., R. Thomas, and J.H. Wlosinski, 2002. Reply to U.S. Army Corps of Engineers Comment on "Assessing flood hazard on dynamic rivers." Eos: Transactions of the American Geophysical Union, 83(36): 397-398.

45 See Footnote 29

46 Belt, C.B. Jr., 1975. The 1973 flood and man's constriction of the Mississippi River. Science, 189: 681-684

47 Stevens, G.T., 1979. SLD Potamology Study (S-3). St. Louis Division, U.S. Army Corps of Engineers, Contract #DACW-43-76-C-0157. 43 pages

48 Pinter and Thomas, 2003. "Engineering modifications and changes in flood Behavior of the Middle Mississippi River," in At the Confluence: Rivers, Floods and water Quality in St. Louis, Robert E. Criss and David A. Wilson, Editors, Missouri Botanical garden Press, pp. 96-109.

49 Criss, R.E., and E.L. Shock, 2001. Flood enhancement through flood control. Geology, 29: 875-878

50 Wasklewicz, T.A., J. Grubaugh, and S. Franklin, 2004. 20th century stage trends along the Mississippi River. Physical Geography, 25: 208-224

51 Jemberie, A.A., N. Pinter, and J.W.F. Remo, 2008. Hydrologic history of the Mississippi and Lower Missouri Rivers based upon a refined specific-gage approach. Hydrologic Processes, 22: 7736-4447, doi:10.1002/hyp.7046

measurement stations along the MMR and the Lower Missouri River. Recently, some workers with the St. Louis District of the Corps of Engineers have suggested that all of these analyses are invalid because early measurements of flow were biased[52] but this assertion was tested and found to be erroneous.[53, 54] The flood-level increases are most dramatic along the MMR, reaching up to 17 feet over the past 100 years at the worst spot.

The question in this research has been to pinpoint precisely which river changes have driven flood stages (but not discharges) upward over time. Pinter et al.[55] and Pinter et al.[56] assembled a database every major engineering structure on over 4000 km of the Mississippi River system over the past 100-150 years (many thousands of structures). We then constructed a statistical model to test the correlation between the timing and location of each type of structure and the documented stage increases. These studies found that when and where navigational training structures – wing dikes and bendway weirs – were constructed, stages increased the most. Navigation training structures have been shown to raise flood levels by constricting the channel, blocking flow, and reducing flow velocities during flooding.[57, 58] The second most important mechanisms were levees. Levees are understood to increase flood stages by reducing or eliminating overbank storage of flood waters and/or reducing conveyance of overbank flow.[59] Remo et al.[60] did detailed hydraulic modeling in order to test and further quantify the statistical results above. That study found that on the MMR, vegetation changes over the past 100 years added roughness that raised stages slightly (0-1 ft), levees increased flood levels by 2-4 feet, and the navigation training structures did indeed drive most of the observed flood-level increases – about 15 ft of the total 17 ft at the most heavily impacted location on the MMR.

The large database and statistical study of the UMR[61] quantified the levels of human impacts on flood levels for each specific river reach, including the impounded reach in particular. Many impounded reach sites contained numerous wing dikes constructed in the early 20th century, prior to abandonment of this engineering strategy in favor of lock-and-dam construction. Flood stages increased – about ~6 feet averaged along the impounded reach – during wing-dike construction, followed by little or no change (in flood levels) after completion of the locks-and-dams. The navigational dams are associated with small increases in stages relative to pre-dam conditions, but these structures operate full-open during floods, with no flood-retention capacity planned or possible. These lock-and-dam structures have certainly impacted the geomorphology and biology of the impounded reach, but their impact upon flood hydrology appears to be small. In fact, by inundating the former floodplains within the pooled reaches of the UMR before major 20th century development could encroach, this engineering strategy has essentially averted flood damages that likely would have occurred if people had been free to populate the floodplain as they did along other rivers nationwide.

52 Dieckmann, R.J., and G.R. Dyhouse, 1998. Changing history at St. Louis—Adjusting historic flows for frequency analysis. pp. 4.31-4.36. First Federal Inter-Agency Hydrologic Modeling Conference, April 20-22, 1998, Las Vegas, NV

53 Stevens, G.T., 1979. SLD Potamology Study (S-3). St. Louis Division, U.S. Army Corps of Engineers, Contract #DACW-43-76-C-0157. 43 pages

54 Pinter, N., 2010. Historical discharge measurements on the Middle Mississippi River, USA: No basis for "changing history." Hydrological Processes, 24: 1088-1093

55 See footnote 29

56 Pinter, N., A.A. Jemberie, J.W.F. Remo, R.A. Heine, and B.A. Ickes, 2010. Empirical modeling of hydrologic response to river engineering, Mississippi and Lower Missouri Rivers. River Research and Applications, 26: 546-571

57 See footnote 34

58 Pinter, N., and R.A. Heine, 2005. Hydrodynamic and morphodynamic response to river engineering documented by fixed-discharge analysis, Lower Missouri River, USA. Journal of Hydrology, 302: 70-91

59 Hall, B.R., 1991, Impact of agricultural levees on flood hazards, final report: U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Miss.

60 Remo, J.W.F., N. Pinter, and R.A. Heine, 2009. The use of retro- and scenario- modeling to assess effects of 100+ years river engineering and land cover change on Middle and Lower Mississippi River flood stages. Journal of Hydrology, 376: 403–416

61 See footnote 42

# A Once and Future River

*- Robert E. Criss*

The Upper Mississippi, our Great River, attracted plenty of attention in 2011. As favored interests clamor for billions of taxpayer dollars for lock expansion projects, the federal budget is causing economic and political crisis while the Asian carp, exploiting the artificial connection of the Illinois Waterway, threatens to invade the Great Lakes. Damaging floods are now commonplace and returned in spring, just three years after the devastating Flood of 2008 that destroyed levees, one after another like dominoes, from central Iowa to St. Louis. Could it be that human shortsightedness and selfishness have finally caught up with us, and that we are suffering the consequences of poorly considered actions? Numerous thoughtful people believe so, including some who predicted many of these sad outcomes.

It was not always so. The Great River, once a beautiful braided stream, flowed free and unfettered, nurturing everything that lived nearby. Floodplain soils were periodically replenished, so farms were fertile, and fish and fowl were so abundant as to stagger modern imagination. It was all free, costing nothing to "maintain".

The story of how the Great River was engineered to realize certain benefits, along with a tragic set of unforeseen consequences, has been well told by others. In a transformation that required two centuries to effect, the river was leveed, constricted by rocks and concrete, dredged, overfished, and polluted with chemicals and sewage. The flowing river was converted into a continuous "stairway" of flat-water lakes, its now deeper waters stifling benthic life, drowning spawning and nesting sites, and altering the natural cycle of flow. The colossal locks and dams impede not only fish, but all small vessels. Each construction project deepened the river channel, yet floods became more frequent and more severe (Figure 6-2). The huge flocks and productive fisheries disappeared. All this was sacrificed for the monstrous barges that the system was designed to serve

A recent report by the Nicollet Island Coalition establishes that barge transport is not only highly subsidized, but contrary to longstanding assertions, is less fuel efficient than the railroad for moving goods from place to place.[62] Never discussed is that this system is a job killer, simply because very few workers are needed on the huge towboats.

It is not difficult to envision a more auspicious future. It is surely folly to invest additional billions in lock expansion projects. Why subsidize an expensive,

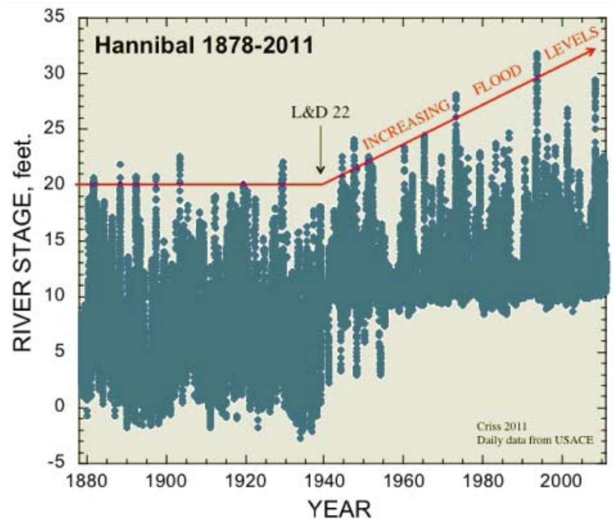



**Figure 6-2:** River Levels at Hannibal, Missouri 1878 - Present

Daily river levels at Hannibal. Missouri since 1878. Eight miles downstream, Lock and Dam #22 at Saverton began operation in 1939, eliminating low water conditions at Hannibal and increasing the water depth. Afterward, the largest floods have become increasingly destructive.

inefficient, environmentally destructive, anachronistic mode of transport? Instead, we have several good options, and can implement some inexpensive, immediate steps that will steer us toward a more sustainable future.

First, barge traffic needs to pay its own way. Few people understand that the fee the huge tows pay to transit through each lock is precisely zero. Barge interests, ever clamoring for special treatment, don't even pay for the electricity needed to operate the locks, nor for channel and lock maintenance, dredging operations, nor the huge bureaucracy exclusively dedicated for their benefit. The argument that towboats pay a fuel tax is specious- those meager receipts clearly do not cover the aforementioned costs, and besides, all modes of commercial transportation utilize fuels on which taxes are paid. Contrast barge traffic with freight rail that pays fuel tax plus all the associated costs of operating and maintaining their right-of-way. Instead of perpetrating this unfair system, lock fees, fuel and corporate taxes can easily be restructured to recover ancillary expenditures, while favoring smaller tows having shallower draft. This administrative change would eliminate the need for lock expansion and reduce the need for destructive dredging, even while creating desperately needed jobs.

Second, a simple modification would greatly improve the network of river levees. The current system encourages districts to build levees ever higher, and to stack sandbags on top when floods threaten, and to continue that exhausting activity until flood waters recede or the levee breaks. This expensive practice fosters endless competition among levee districts, pitting farmers against farmers against municipalities. The

62 Nicollet Island Coalition, 2010, Big Price – Little Benefit

## Some Suggestions for an Improved River

1. Use protective zoning to foster appropriate floodplain use
2. Make a realistic assessment of flood risk
3. Transfer river management authority to agencies with modern approaches
4. De-authorize the Lower Missouri River navigation channel
5. Use smaller boats on the Upper Mississippi River; barges should pay the costs of the system they use
6. Construct gated levees; compensate farmers for floodwater storage
7. Promote natural management strategies to reduce flood risk
8. Recognize the intrinsic and future value of foodplains as aglands, parklands, aquifers, and habitat
9. Accept that good environmental policy is good economic policy

ultimate result is catastrophic failures that destroy levees, destroy roads and property, and cause destructive scour and sand deposition on the fields. A far better system would be to install a system of gates into the levees that could be slowly opened whenever failure is imminent. Such a system would not only save both levees and fields from harm, but would rejuvenate soils while removing peak floodwater from the raging river, much to the benefit of other threatened properties. A system where inundated farms are compensated for floodwater storage that prevents the flooding of others would be ideal.

By implementing these and other measures, the Great River could begin a slow transformation back to a sustainable, more natural condition. Towboats would become smaller and their drafts shallower. Real jobs would be generated, and the need for dredging and other channel maintenance would be reduced. There would be no need for costly lock expansion. Lift requirements at individual locks would be reduced, so the river could flow more freely, fostering natural processes that would regenerate shallow and sandbar habitat. Flood levels would ameliorate as the river responds to these changes and to floodwater storage on the floodplains. In the fullness of time, perhaps the need for the locks and dams would disappear altogether. Slowly the river would recover, and the flocks and schools would regain an abundance that currently survives only in human imagination.

# The Human Economy and the UMR Basin

*- Donna M. Anderson*

> "We can't solve problems by using the same kind of thinking we used when we created them." -Albert Einstein

In 1966, ecological economist Kenneth Boulding[63] introduced the idea of the earth as a 'closed economy …in which [it] has become a single spaceship, without unlimited reservoirs of anything, either for extraction or for pollution, and in which, therefore, man must find his place in a cyclical ecological system …' Twenty-five years later, we would do well to embrace the spaceship allusion as we consider our relationship with the Upper Mississippi River basin, the impact of human-related economic activities on this area now and in the future, and implications this reality has for the region's economic stakeholders: consumers, producers, and governments.

Most significantly, the spaceship view of the human economy means that it is a relatively small part of the larger natural ecosystem. Although humans and their economies are important elements of the natural world, they nonetheless are not the dominant or even controlling factor. This human economy-natural ecosystem spaceship relationship is shown in Figure 6-3, which contrasts starkly with the human-centric traditional economic paradigm portrayed in Figure 6-4 that has dominated economic behavior and policy. The natural ecosystem, long considered a subset of the human economy in traditional economic theory, is viewed merely as an extractive and waste disposal sector, a tool to be managed, or manipulated, to augment short-term human welfare as measured by consumption of man-made goods. Boulding referred to the traditional economic paradigm as the "cowboy economy," not only because the 19th century American cowboy faced a seemingly limitless supply of empty land, rich soil, vast forests, and abundant fish, but also because of the association with reckless and exploitative behavior.

The implications of the ecological economic versus the traditional economic paradigms on consumption and production are profoundly different. In the cowboy economy, these human activities are of utmost importance because of the critical assumption that human well-being is improved by a quantitative increase in economic output. Further, since resources are assumed to be either limitless or easily substitutable with man-made innovations, increasing resource use and human economy growth is not a problem.

However, experiences in the UMR basin and elsewhere provide evidence that first, resources are not limitless and easily substitutable with man-made goods, and second, that quality of life involves more than consumption of man-made goods and services. In the spaceship economy, recognition of the inextricable link between the health and welfare of the human economy and the health and welfare of the natural ecosystem means that the preservation of the natural ecosystem will lead to economic progress. According to Boulding, "the essential measure of the success of the economy is not production and consumption at all, but the nature,

63 Kenneth Boulding, 1966, "The Economics of the Coming Spaceship Earth", http://www.colorado.edu/econ/Kenneth.Boulding/spaceship-earth.html

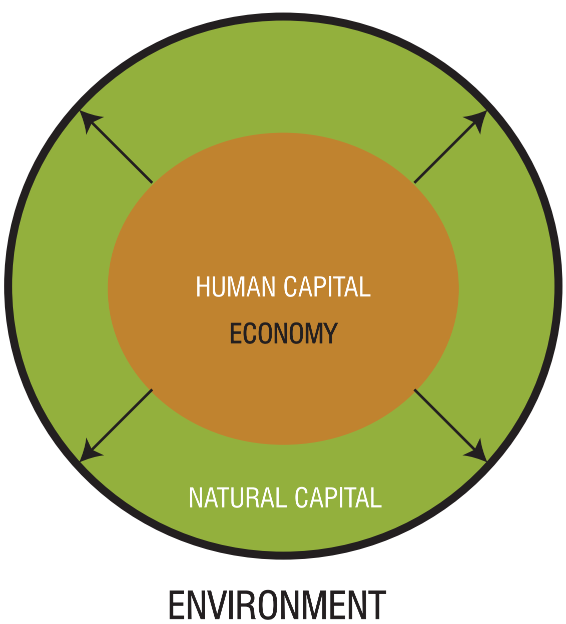



**Figure 6-3:** Human Economy - Natural Ecosystem

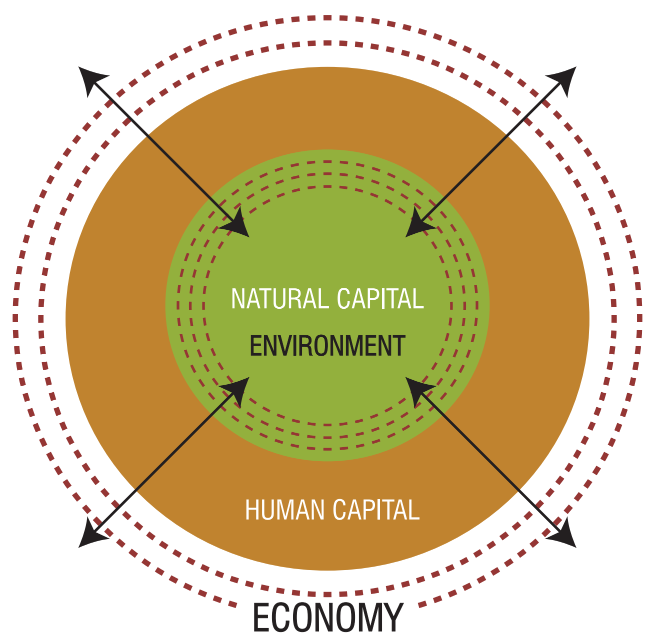



**Figure 6-4:** Human-Centric Traditional Economic Paradigm

extent, quality, and complexity of the total capital stock." Note that the capital to which Boulding refers is not what immediately comes to mind – machinery or equipment - but natural capital, defined as a stock of natural resources that yield a flow of valuable ecosystem goods or services into the future. The natural capital found in the UMR basin provides the following goods and services, not all of which are recognized and priced in the market system.

- **Provisioning services:** provides resources used in the production of goods for human consumption, such as timber for homes, fish for food, land and rich topsoil for crops, and water for irrigation and energy production.
- **Regulating services:** regulates ecosystem processes such as waste decomposition, cleansing of the air, pest control, natural fertilization, flood storage, and soil erosion prevention.
- **Cultural services:** provides spiritual, aesthetic, recreational or psychological services, such as boating, fishing, swimming, hunting and camping.
- **Supporting services**: regulates processes necessary for all the other ecosystem services, such as topsoil formation, nutrient cycling, and bio-diverse habitats for a wide array of plants and animals.

While recognizing that the use of natural capital for the production of essential goods and services needed for our survival and well being is inevitable, such as using UMR basin land for crop production or water for energy production, the failure to acknowledge the value of natural capital's other services has led to its misuse. In the UMR basin, certain goods and services, such as corn, soybeans, and electricity have a market price, although the other services provided by the land and river mentioned above such as flood storage or provision of a bio-diverse habitat do not. Consequently, most stakeholder behavior and policy focuses on the use of land for crop production or water for energy production, resulting in the overuse and contamination of both resources. For example, a national and international market for corn and soybeans has led to an inefficient allocation of UMR basin land and water to agriculture production, since our market pricing system does not adequately take into account the negative externalities associated with monoculture agriculture, including fertilizer run-off, soil nutrient depletion, and the high use of fossil fuels to produce and transport agriculture products beyond the local economy. Because natural capital is excluded from traditional economic theory and practice, the vital, life supporting sources of natural income essential for sustainability, are considered to have no market value and are therefore ignored.

As shown in Figure 6-3, growth of the human economy crowds out natural capital, negatively affecting the flow of natural services and resources available now as well as in the future. (In comparison, in the traditional economics paradigm pictured in Figure 6-4, there is no opportunity cost associated with economic growth.) One challenge, then, is to determine the quantity and quality of natural capital that needs to be preserved so that the value of the resulting goods and services does not decline. This means determining ecosystem functions or services that are critical, i.e., that have no natural or man made substitute, whose loss would be irrevocable, or whose loss would constitute a considerable risk to human wellbeing. Certainly, the UMR basin services mentioned throughout this document, and specifically on in chapter **??** meet the definition of "critical

Destruction of critical natural capital is a prescription for uneconomic growth which occurs when increases in production come at an expense in resources and well-being that exceeds the value of the items made. From the premises of strong sustainability, it follows that economic stakeholders have a responsibility to the greater ecological world, and that sustainable development must therefore take a different approach to valuing natural resources and ecological functions. Sustainable scale is exceeded for an ecosystem service when the rate of resource depletion reduces the capacity of natural capital to provide in the future the natural income it yielded in the past. Thinking about sustainable scale forces us to focus at least as much on ecosystem services, and the natural income they provide, as on resources.

Kenneth Boulding's spaceship metaphor begs the question: how can we expect infinite growth on a finite planet? The answer, of course, is that we cannot. Strong sustainability means operating an economy within the ecological constraints of earth's natural resources: a "steady state" economy in which waste outputs are within the natural absorptive capacities of the environment; harvest rates do not exceed regeneration rates for renewable resources; and the rate of depletion does not exceed the rate at which renewable substitutes can be developed for nonrenewable resources. As with financial capital, if the rate of withdrawal exceeds the rate of replacement, the amount available will eventually shrink to zero and sustainability is destroyed. We must ask ourselves: Is this what we want?

# Expert Bios

## Donna Anderson

Professor of Economics, University of Wisconsin-La Crosse.

Prior to receiving her Ph.D. from Michigan State University, she worked in accounting and finance for the General Electric Company in Erie, PA and Schenectady, NY, and as the Director of Policy Analysis for the Institute for Public Policy and Social Research in East Lansing, MI. Her fields of expertise include ecological economics, state and local government finance, and economic analysis of public and private work/family policies.

## Robert Criss

Professor of Earth and Planetary Sciences at Washington University in St. Louis

Dr. Robert Criss received both his MS and PhD from the California Institute of Technology. Following his dissertation studies he was a geologist with the United States Geological Survey then Professor of Geology at UC Davis. He is author of Principles of Stable Isotope Distribution (Oxford University Press, 1999) and co-editor of several books including At the Confluence: Rivers, Floods, and Water Quality in the St. Louis Region (MBG Press, 2003). His published papers and commentary encompass many disciplines and have appeared in 35 scientific journals, numerous books and several newspapers. He advocates thoughtful land use and realistic risk assessment as being essential to a bright economic and environmental future.

## Fred Kirschenmann

Distinguished Fellow

Professor of Religion and Philosophy, Iowa State University
President, Stone Barns Center for Food and Agriculture

Frederick Kirschenmann serves as a distinguished fellow at the Leopold Center for Sustainable Agriculture at Iowa State University and the President of the Board at the Stone Barns Center for Food and Agriculture in Picontico Hills, New York. He also manages his family's organic grain and livestock farm in North Dakota. He is the author of Cultivating an Ecological Conscience: Essays from a Farmer Philosopher.

## Ken Lubinski

Dr. Ken Lubinski, a river ecologist, has studied the Illinois and Mississippi rivers since the early 1970's. He was the lead scientist during the design and early implementation of the Long Term Resource Monitoring Program for the Upper Mississippi River system. He has been invited to participate on river science exchanges by colleagues working on the Mekong, Paraguay/Parana, Yangtze, and Ganges rivers. He currently serves on the Board of Directors of the International Society of River Science. He lives in Brownsville, MN. This essay is a reflection of his personal beliefs, and should not be attributed to any organization with which he is currently affiliated.

## Nicholas Pinter

Professor in the Department of Geology and Environmental Resources and Policy program, Southern Illinois University
Director and lead investigator of SIU's Watershed Science and Policy program

Prof. Pinter's research is in earth-surface processes and surface-water hydrology applied to a broad range of problems. His research focuses on river system dynamics and flooding, in particular quantifying mechanisms by which flooding can increase due to human modifications of river systems. An additional focus is mitigation of flood risk and the risk of other natural hazards.

The methodological focus of Pinter's river research is "empirical hydrology," meaning using direct quantitative measurements and other real-world data to independently test assumptions in hydraulic models, floodplain management assessments, and other river-system and watershed issues. Pinter's research group completed a large project to assemble a Terabyte-scale GIS database of 100-150 years of channel hydrography, floodplain topography and land cover, and engineering construction and infrastructure on >4000 km of the Mississippi and Missouri Rivers. This enormous database, and others including a database of >8 million hydrologic data, allow the research group to empirically test the causal connections between (1) climate, land use, channel modifications, floodplain management, etc. and (2) flood response. Pinter has also worked on similar problems on several European rivers, including the Rhine, Danube, and their tributaries and others.

The work above and other research has been funded by the National Science Foundation, FEMA, the U.S. Geological Survey, NASA, and other sources. Pinter has held fellowships from the Alexander von Humboldt Foundation (Bessel Prize), from the European Union (Marie Curie Fellowship), and a research and writing award from the John D. and Catherine T. Macarthur Foundation.

# APPENDIX A: UMR BARGE TRAFFIC AND ITS EFFICIENCY

The dams have transformed the UMR from St. Louis to the Twin Cities in Minnesota into a series of slack water pools to maintain the 9-foot channel for navigation as shown in Figure A-1 below.

From 1953 through 2010 about 3.38 billion tons of commodities have been shipped through Locks 27[1] (see Figure A-2 below) on the UMR navigation system representing the volume going through the impounded or dammed reaches of the UMR. Over the last three decades about 2.26 billion tons were shipped through this section of the river, or about 75.2 million tons per year. The average over the last decade has decreased to about 70.1 million tons per year with the last four years being significantly below the decade average.

The associated benefit of the 9-foot channel is the perceived cost savings for using the inland waterways system versus using the competing (and non-subsidized) rail system. Over the last three decades, the taxpayers have provided an estimated $3.5 billion to the project for construction, operation and maintenance with only about $500 million coming from the barge industry. Beginning in 1986 the inland waterways navigation industry has been obligated to pay 50 percent of the new construction and rehabilitation costs of navigation structures only; prior to 1986 the navigation industry contributed nothing to the cost of the system. The costs of the original constructing and annually operating and maintaining the system, along with restoring environmental damage, have been

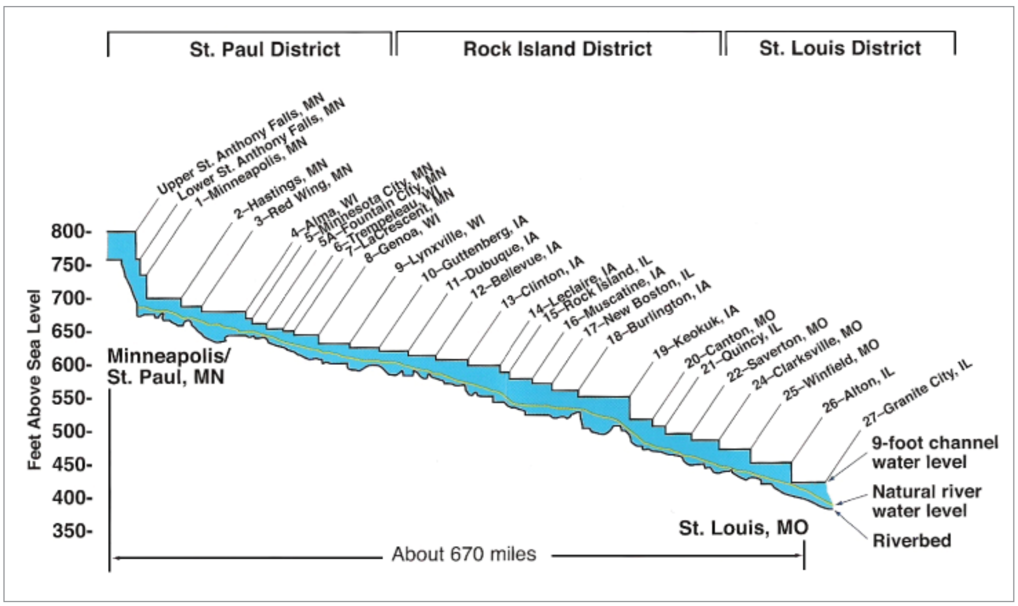



**Figure A-1:** Locks from Minneapolis/St. Paul to St. Louis

Source: US Army Corps of Engineers

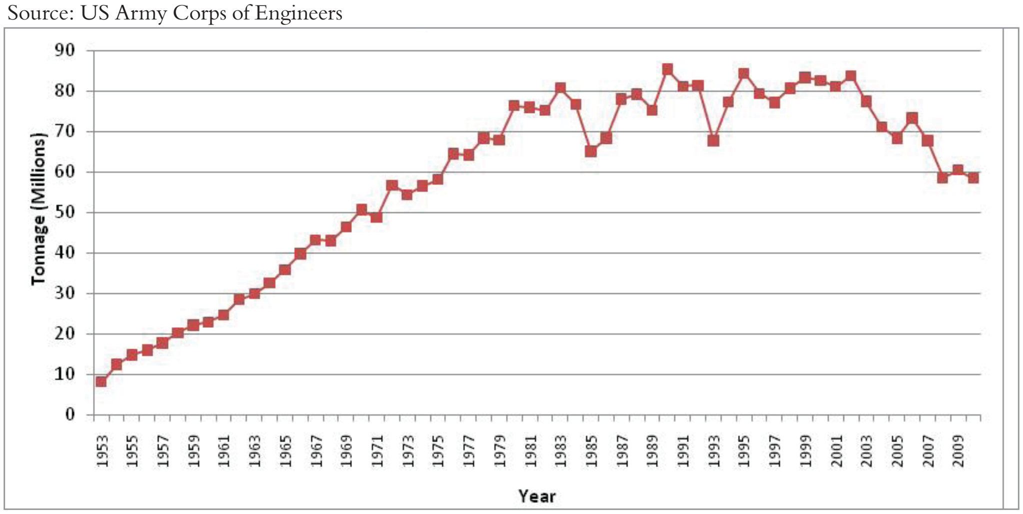



**Figure A-2:** Shipping Volume at Lock 27, 1953 - 2010 externalized and thus not included in the cost users pay to ship on the UMR.

The inland waterways navigation industry touts itself as the most cost efficient and "environmentally sound"[2] form of commercial transportation in the country. The problem with this assertion is that it is not accurate. As is the case with most things, the devil is in the details and the details do not support the navigation industry's claims.

## Cost Efficiency

The navigation industry bases its cost efficiency upon an assertion that their customers save money by using barges over trucks or rail to ship their goods - typically bulk commodities such as grain and coal hauled long distances.[3] On the face, this seems reasonable but further investigation leads one to realize that there is a major problem with this conclusion. A large portion of the costs to ship on the country's rivers have been removed from the price a customer pays to ship their goods. In essence, every time they use the barge system they are getting a significant discount, but that discount is paid by the U.S. taxpayers, not by the navigation industry.

The taxpayer subsidized costs not included in the barge shipping price include:

1. 100 percent of all operation costs of the inland waterways system, including the Corps' staff working at each of the locks and dams.
2. 100 percent of all maintenance costs of the inland waterways system, including the cost of making repairs to the locks, dams and numerous other navigation structures. This also includes the annual dredging of hundreds of miles of channels.
3. At least 50 percent of the construction costs for rehabilitating existing navigation infrastructure and building new navigation structures.
4. 100 percent of the environmental restoration costs resulting from the long-term impacts of the inland waterways system.

These costs are not minor adding up to well over 500 million dollars each year for the entire inland waterways system and over 200 million dollars each year on the UMR, excluding environmental restoration and degradation costs. The major competitor for the commodities shipped on the rivers is the rail industry.[4] Unlike passenger rail, commercial rail today receives virtually no subsidy from the taxpayers so their customers are paying the full cost of shipping.[5] It is important to note that barge traffic has declined significantly on the UMR over the last 20 years, even with these immense subsidies to the industry.

Clearly, if the navigation industry customers had to pay the full cost of shipping on our rivers, it is questionable that barges would be their preferred choice.

## Environmental Efficiency

The industry's conclusion that barges are more environmentally sound than rail is based upon an improper assessment of data, which was pointed out in the 2010 NIC report "Big Price – Little Benefit".[6] The industry assertion is that barges are able to move a ton of commodities further per gallon of fuel than rail. This assertion continues that because of this alleged "higher" fuel efficiency barges then also emit fewer harmful pollutants. The simplistic and misleading data and assumptions used ignored three important facts:

1. A barge on the inland waterways system typically travels between 20 and 35 percent further than a train to take their goods from the same starting point to the same destination. This is because rivers do not run in straight lines but have numerous bends and turns. The mileage number navigation industry uses ignores this geographic fact.
2. Most barge tows are carrying bulk commodities to a single long-distant destination. Yet the navigation industry compares these barges to trains carrying many different products and commodities to many different destinations requiring numerous stops and starts and loading and unloadings. When barges are compared to a similar rail hauling situation – unit trains, which haul a single commodity a long distance, rail is significantly more fuel efficient than are barges.

The inland waterways system has caused immense damage to the environment, of which almost none has been repaired. The restoration efforts on our rivers will take decades and billions of dollars to complete.

---

1 USACE OMNI Reporting System, http://www2.mvr.usace.army.mil/omni/webrpts/menu.html

2 Levitz, Jennifer and Cameron McWhirter, 2011, Olds Locks Jam River Traffic, Wall Street Journal,

3 Wikipedia, Inland waterways of the United States, http://en.wikipedia.org/wiki/Inland_waterways_of_the_United_States

4 The trucking industry receives about a 20 percent subsidy

5 Erera, Alan, Rail Freight Transportation, Georgia Institute of Technology

6 Nicollet Island Coalition, 2009, Big Price – Little Benefit: Proposed Locks on the Upper Mississippi and Illinois Rivers Are Not Economically Viable, Section 4: Superior Barge Fuel efficiency Claims Are Questionable

## Endorsments

Institute for Agriculture and Trade Policy

Piasa Palisades Group - Illinois Sierra Club

Prairie Rivers Network

National Wildlife Federation
(Report Recommendations)

Iowa Environmental Council

Missouri Coalition for the Environment
Effective Citizen Action Since 1969