United States Department of Agriculture
Natural Resources Conservation Service

Conservation Resource Brief

Water Quality

February 2006 Number 0603

Key Messages:

- The quality of water reflects what occurs on the land.
- Six million acres of buffers help protect the water quality in the United States.
- ERS research reports links between improved management and observable changes in water quality may take 10 years before long-term changes are distinguishable from short-term fluctuations.
- The application of conservation practices for water quality benefits often provides a greater benefit to society than the individual farmer.
- Erosion rates on cropland have dropped significantly in the last 20 years, and sediment continues to be the primary non-point source pollution concern.
- Research indicates erosion reductions on private lands over the period 1982 to 1992 produced benefits to water-based recreation of $373 million.
- Nutrients and pesticides from agriculture are an increasing concern.

Contact:

NRCS Web site at www.nrcs.usda.gov.

Helping People Help the Land

Description

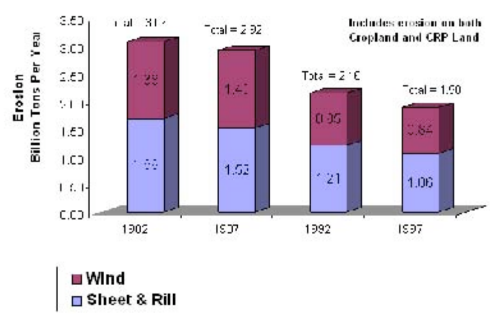
Water quality is a primary indicator of the health of our environment and the quality of water reflects what occurs on the land. NRCS helps farmers improve their land in an environmentally sound manner. The result is better water quality for drinking, recreation, wildlife, fisheries and industry.

Surveys of public opinion indicate a concern about the quality of water in this country. Public understanding of water quality is often focused on drinking water supplies. To adequately address water quality problems, we need to focus on water sources including lakes, rivers, streams, wetlands and estuaries, as well as ground water. The primary water quality issues from agriculture for these water resources are sediment, nutrients, pesticides, pathogens, and in some parts of the country, salinity.

Water quality concerns from agriculture are generally defined as non-point source (NPS) pollution. NPS is pollution that comes from diffuse sources such as runoff from the land after a rainstorm rather than out of a pipe from a factory. This can make identification of the source of a water quality problem difficult. Often a water quality problem from NPS is the result of actions by many landowners both rural and urban. Consequently, solutions to NPS water quality problems can be difficult to determine and contentious to implement.

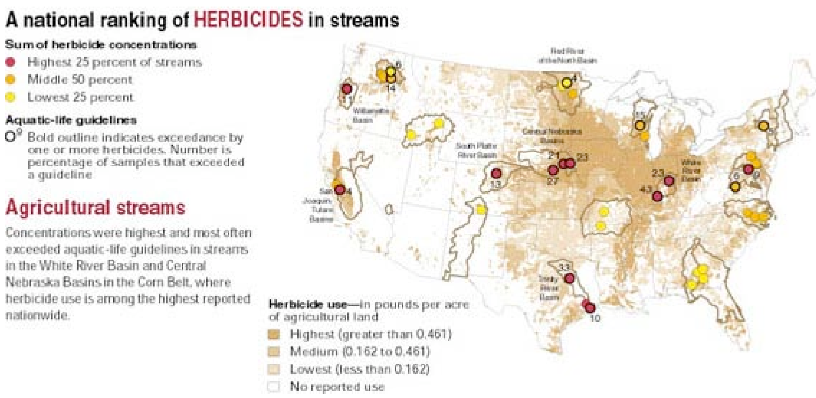
Current Conditions and Trends

The 2000 National Water Quality Inventory from EPA identified non-point source (NPS) pollution as the leading source of water quality impairment for all water bodies in this country. Agriculture is identified as the major contributor of NPS pollutants in the US. Agriculture's impact on



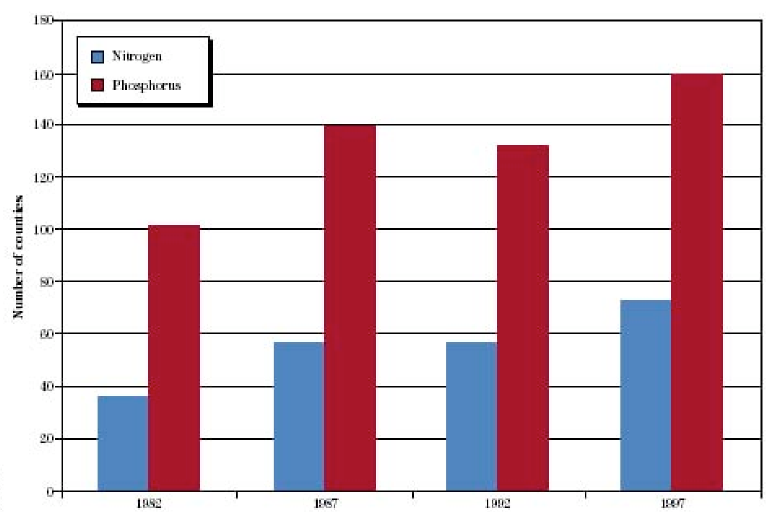
the environment should be considered in the context of the amount of land supporting agricultural activities. While other sources of NPS such as urban runoff are significant, agriculture's effect is magnified by the large percentage of land in agricultural use. About 41 percent of the land in the continental United States is devoted to farms or ranches.

Farmers in many parts of the country are implementing reduced tillage and other forms of residue management. NRI data shows that erosion from cropland has decreased over the last 20 years. Even with this significant reduction, sediment from all sources continues to be the primary NPS concern. Many persons believe the decrease in tillage and reductions in erosion have been accompanied by increased use of herbicides and pesticides in crop production. This has led to concern about low level concentrations of herbicides found in drinking water supplies in different parts of the country. However, ERS research indicates differences among tillage types and their chemical usage after the initial adoption phase.



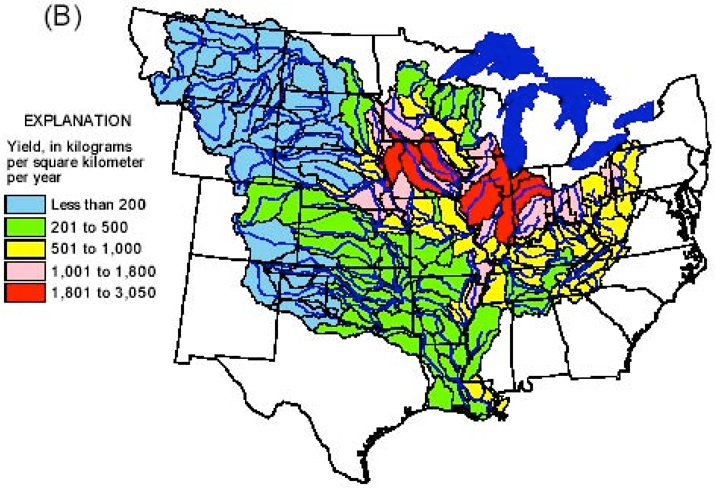
Other changes in agriculture, such as the increase of confined livestock operations, have increased concerns about nutrient and pathogen runoff from the land application of manure. This concentration of livestock has resulted in some areas of the country with potentially more manure produced than is needed. A USDA study produced in 2000, shows there are a number of counties where the potential nutrients from manure production exceed the available cropland in the county.

Figure 29 Number of counties with county-level excess nutrients



Decreases of dissolved oxygen in water can result from nutrient laden runoff entering surface waters and causing excessive growth of algae. An increase in available nitrogen has the potential to cause increases in algae in marine systems, while phosphorous is the limiting nutrient in freshwater systems. As an example, the map below shows the yield of nitrogen into the Gulf of Mexico. This has raised concerns about the hypoxic zone in the Gulf of Mexico and the amount of nitrogen used for crop production in the Midwest.

(B)

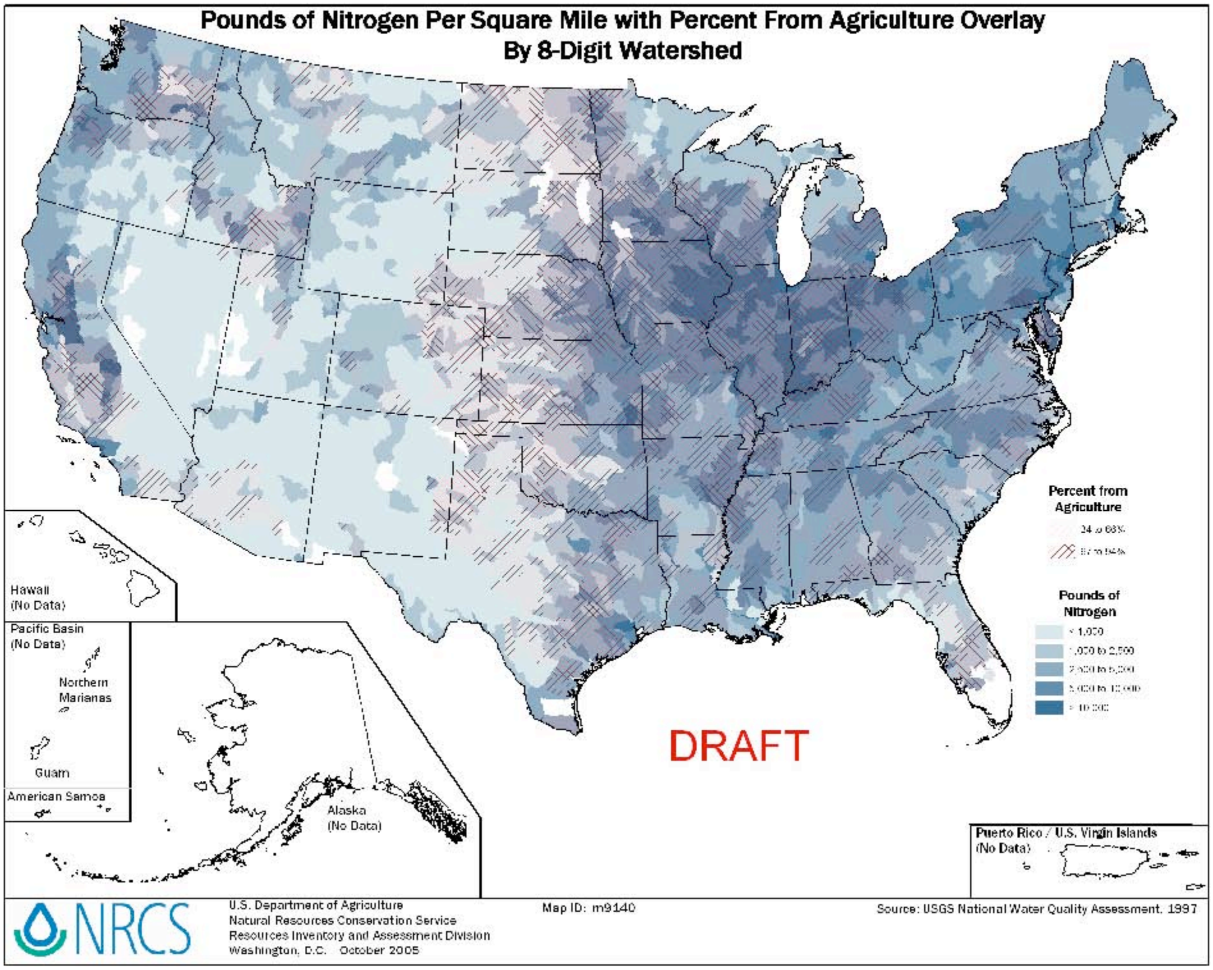


The installation of conservation buffers has been a major success for farmers and water quality. Properly designed buffers at the edge of a field can provide the final polishing of runoff before it enters a ditch, stream or lake. Efforts by USDA to encourage the installation of buffers began in the 1990s and continues today. This emphasis on conservation buffers has resulted in the installation of nearly six million acres of buffers protecting the water quality of the country.

Salinity as a water quality issue is primarily associated with irrigation in arid climates. As irrigation water is used and reused, salts accumulate in the soil and in drainage water from the irrigated fields. This problem is primarily addressed by irrigation water management to closely match irrigation water application to the plant needs.

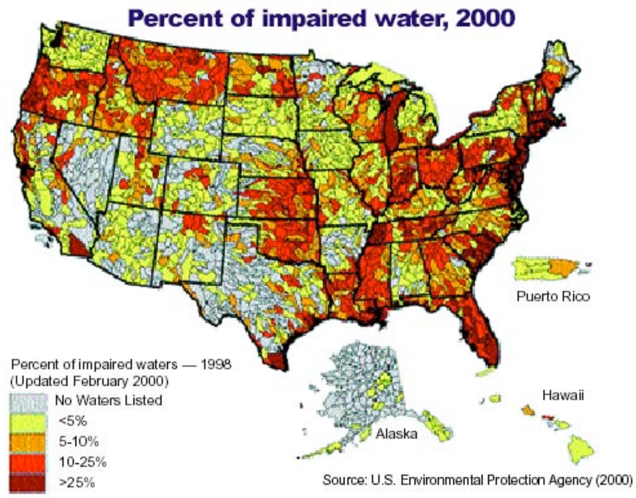
Major Opportunities and Barriers

Water quality is a reflection of what occurs on the land. However, water quality is measured in streams or in the groundwater after pollutants have left the land and entered the water. This makes it difficult to tie individual actions on the land to results in the water. Not all water quality issues are related to agriculture. Some areas of the country have concerns due to development and point sources. While we have a good arsenal of practices to treat the land, research data is lacking to show a direct cause and effect relationship between a practice installed on the land and an improvement in water quality. With impaired waters affecting many parts of the country, we need a better way to document the relationship between improvements in water quality and treatment of the land.

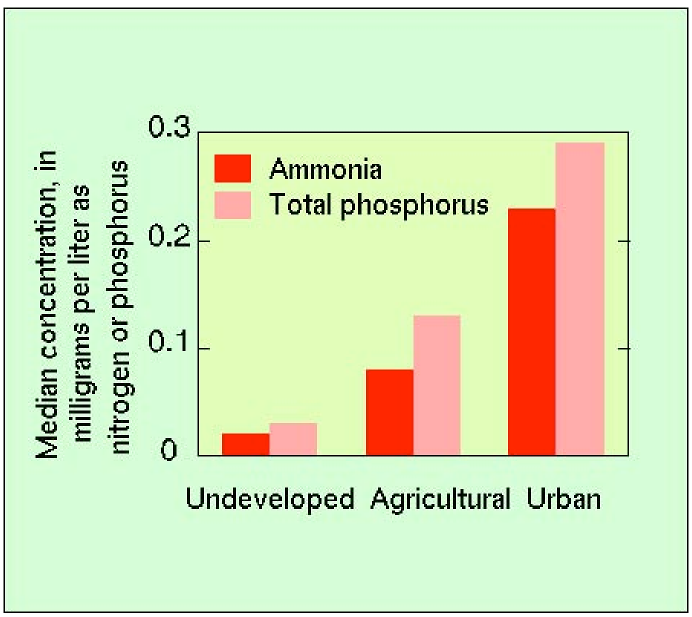


The best conservation farmer is also a businessman whose farm must be economically viable. Some conservation practices, while beneficial in the long run, may cause a short-term loss in income or benefit society more than the individual farmer. This is particularly true for nutrient loss. The impacts are often seen in water bodies and estuaries far from the crop fields where the nutrients were applied. Trade offs between environmental and societal benefits and the hard realities of farm economics need to be considered as new technologies are developed and new programs are implemented.

Changes in agriculture make addressing these problems challenging. On the one hand, agriculture has gotten bigger and uses the latest technology to compete in the global marketplace. This forces us to adapt conservation technology to the customer that uses the largest equipment and the latest techniques such as precision agriculture. On the other hand, there are still many farmers who approach farming in a much less technological and capital intensive manner. Conservation assistance and technology still needs to be available to these farmers as well.



State water quality agencies assess water quality throughout the country and EPA uses the results to develop a map of impaired waters. Total Maximum Daily Load (TMDL) allocations are then mandated by water quality regulators in the impaired watersheds. Agriculture, as a major land use in most watersheds, can be heavily impacted by TMDLs. The TMDL can target very specific resource concerns that may require a farmer to invest in conservation practices to meet the TMDL allocation that are different from his individual goals.



Although agriculture is a major contributor to non-point source polltion, developed land has a higher impact on a per acre basis. The chart shows urban or developed land to contribute more than two times the amount of nitrogen and phosphorus to runoff than agriculture. The graphic below illustrates the relative impact of agricultural sources to pollution in urbanized and rural watersheds.

Science and Technology Status

The Conservation Effects Assessment Project (CEAP) is cooperative effort between NRCS and ARS to determine the specific impacts of conservation practices on the environment. CEAP will estimate conservation benefits at a national scale using the National Resources Inventory (NRI) as the sampling base. CEAP will also conduct watershed studies to provide a framework for evaluating and improving the performance of national assessment models and allow for additional research on the effects of conservation practices on a watershed scale.

In addition to CEAP, there are other studies underway funded by the Cooperative State Research Education and Extension Service (CSREES) related to sediment transport and attached nutrients and the efficacy of conservation systems. Results from these studies should lead to the design of better conservation systems to address nutrient loss. CSREES is also funding a number of other studies on the fate of phosphorous and nitrogen in agricultural watersheds. Understanding how nutrients move in the agricultural environment will help to identify strategies to limit negative impacts on the environment.

Nitrate loss in drainage water from agricultural land is a significant source of nitrates in the surface water. Controlling and managing the outflow of drainage systems holds much promise in reducing this nitrate source. NRCS participates with industry, the Agricultural Research Service and university researchers to install demonstrations of these practices around the country to communicate the results.

The Conservation Innovation Grants (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies. This program is currently demonstrating many new and innovative technologies to address water quality issues.

Resource Investment

Significant investments in water quality are being made throughout the country by Federal and State governments and universities. Some examples are:

CEAP – NRCS $1 million per year for 5 years, ARS $15 million in refocused research

CSREES – Over the last 5 years $56 million invested in water quality research

CIG - $9.8 million in 2004 for water quality related projects

In addition to these research programs, other programs are making significant investments in water quality through the installation of conservation practices. Programs such as the Environmental Quality Incentives Program, the Conservation Reserve Program, the Wetlands Reserve Program, Section 319 Grants and numerous state sponsored programs currently invest more than $1 billion dollars per year in conservation practices installed on farms. Total investment directly toward water quality by NRCS is outlined below.

Conservation Connection

While new research will help to quantify the effect of conservation practices, some general statements can be made about conservation practices and water quality. Conservation practices and management techniques need to be used in a system to reduce erosion, improve soil quality, increase infiltration of water into the soil and filter runoff as it leaves the field. In addition, the use of nutrients and pesticides need to be managed by the rate, timing and method of application.

Practices such as residue management, cover crops and reduced tillage will reduce erosion, improve soil quality and increase infiltration of water into the soil. The establishment of grassed waterways and grade stabilization structures will reduce gully erosion. Filter strips and buffer areas will filter runoff and provide a buffer between farming activities and environmentally sensitive areas. Installation of these practices needs to be in a system to work together with proper management techniques to control the inputs of nutrient and pesticides.

The key to conservation remains helping the farmer make good conservation decisions through conservation planning. There are many tools that help make the planning process better suited to the farmer's needs. Digitized soil surveys and digital ortho photography used in geographic information systems help the conservationist analyze data and present it in formats that are useful. Computer models such as RUSLE2 help the conservation planner quickly determine soil loss. Conservation system guides (CSG) that identify commonly used resource management systems for a geographic area help to speed up the planning process and allow farmers to review common resource systems that might be used on their farm.

NRCS Program Funding, Water Quality 2002 – 2005

Program	Financial Assistance Funding 2002-2005	Technical Assistance Funding 2002-2005	% of FA	% of TA
Conservation Technical Assistance (CTA)	$0	$542,700,000		63%
Environmental Quality Incentives Program (EQIP)	$781,399,017	$172,044,907	69%	20%
Ground & Surface Water Conservation (GSWC)	$11,327,682	$2,611,033	1%	0%
Conservation Innovation Grants (CIG)	$16,023,741	$80,118	1%	0%
Conservation Security Program (CSP)	$66,767,511	$10,015,127	6%	1%
Wetlands Reserve Program (WRP)	$199,222,890	$11,688,629	18%	1%
Resource Conservation & Development_ (RC&D)	$0	$24,227,002		3%
Wildlife Habitat Incentives Program (WHIP)	$5,695,101	$1,052,662	1%	0%
Agricultural Management Assistance (AMA)	$11,146,305	$2,601,718	1%	0%
Watershed Protection and Flood Prevention Program (WP&FPP)	$18,905,700	$6,495,300	2%	1%
Conservation Reserve Program_ (CRP)	FSA Provides FA	$83,548,969		10%
Grassland Reserve Program (GRP)	$20,096,674	$5,203,534	2%	1%
Total	$1,130,584,621	$862,268,999	100%	100%

The RC&D program provides benefits for a multiple number of resource issues. Dollar amounts given reflect a percentage of total program funding for RC&D for FY 2002-2004. This figure is pro-rated based on data analysis conducted for the national program evaluation conducted in FY2004 & FY 2005. The same dollar amounts are under water management and water quality which are captured under the water management element in the RC&D statute.

For a General CRP Sign Up, used 1/3, 1/3, and 1/3 for cost: for Continuous CRP used 2/3 water quality and 1/3 wildlife (wetland restoration).

Research Connection

The table below is from an ERS report detailing studies of water quality impairments and benefits from control measures.

Table 2.3.3 – National estimates of the damages from water pollution or benefits of water pollution control		
Estimate of:	Study/Year	Description:
Selected estimates of damages		
Water quality damages from soil erosion	Clark and others (1985)	Damages to all uses: $3.2-$13 billion, “best guess” of $6.1 billion (1980 dollars). Croplands share of damages: $2-$8 billion.
Water quality damages from soil erosion	Ribaudo (1989)	Damages to all uses: $5.1-$17.6 billion, “best guess” of $8.8 billion. Agriculture’s share of damages: $2-$8 billion.
Adjustments to net farm income considering effects of soil erosion	Hrubovcak, LeBlac and Eakin (1995)	Reduction in net farm income account of about $4 billion due to soil erosion effects.
Infrastructure needs to protect drinking water from poor source water quality	Environmental Protection Agency (1997a)	$20 billion in current and future (20-year) need under Safe Drinking Water Act requirements for microbial treatment; $0.2 billion for nitrates; and $0.5 billion for other synthetic chemicals, including pesticides.
Health costs from water-borne disease outbreaks	Environmental Protection Agency (1997b)	Damages from *Giardia* outbreaks: $1.2-$1.5 billion in health costs.
Recreational damages of water pollution	Freeman (1982)	Total recreational damages from all forms of water pollution: $1.8-$8.7 billion; “best guess” of $4.6 billion (1978 dollars/year)
Selected estimates of benefits from water pollution control		
Water quality benefits of reduced soil erosion from conservation practices	Ribaudo (1986)	Erosion reduction from practices adopted under the 1983 soil conservation programs were estimated to produce $340 million in offsite benefits over the lives of the practices.
Water quality benefits of reduced soil erosion from Conservation Reserve Prog.	Ribaudo (1989)	Reducing erosion via retirement of 40-45 million acres of highly erodible cropland would generate $3.5-$4.5 billion in surface-water quality benefits over program life.
Recreational fishing benefits from controlling water pollution	Russell and Vaughan (1982)	Total benefits of $300-$966 million, depending on the quality of fishery achieved.
Recreational benefits of surface-water pollution control	Carson and Mitchell (1993)	Annual household willingness to pay for improved recreational uses of $205-$279 per household per year, or about $29 billion.
Recreational benefits of soil erosion reductions	Feather and Hellerstein (1997)	Total of $611 million in benefits from erosion reduction on agricultural lands since 1982, based on recreation survey data.
Drinking water benefits in four regions from reduced nitrates	Crutchfield, Cooper, and Hellerstein (1997)	Monthly household willingness to pay for drinking water meeting EPA nitrate standards of $45-$60 per month.
Freshwater-based recreation benefits from reduced soil erosion from the CRP	Feather, Hellerstein, and Hansen (1999)	Annual increased consumer surplus $35.3 million from improved quality of recreation at rivers and lakes.