SONORAN INSTITUTE *Shaping the Future of the West*

Literature Review: The Economic Value of Water and Watersheds on National Forest Lands in the United States

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Forest Service Water: A Natural Bounty

The federal government set aside the national forests more than 100 years ago, in part "for the purpose of securing favorable conditions of water flows." Today, the Forest Service manages 193 million acres, which hold waters providing essential products and services. National forests produce 87 trillion gallons of water per year (Brown and Froemke 2009), supplying more than 60 million people in over 3,000 towns and cities with drinking water (Ryan 2007, Dissmeyer 2000). Water on Forest Service lands offer a multitude of recreational opportunities for forest visitors, and provide habitat for abundant fish and aquatic species. Well-managed forests perform essential watershed services, preventing erosion, filtering sediment and contaminants, regulating water flows, and protecting water quality (Brown and Binkley 1994, Andreassian 2004, Ernst 2004, Brauman et al 2007).

Resources at Risk

Wildfire, climate change, and population growth pose threats to the amount and quality of water on Forest Service lands. Development encroaches upon private forests, demands for products and services from public forests will intensify (Barten 2006). Warmer temperatures and less precipitation have the potential to reduce available water from the nation's forests (Furniss et al 2010, Westerling et al 2006, IPCC 2007, Kimbell and Brown 2009, USDA Forest Service 2008). In turn, hotter and drier conditions make forests more susceptible to damage from wildfire, insects, and disease (Landsberg and Tiedemann 2000, Calkin et al 2007, IPCC 2007, GAO 2002, Brown and Froemke in press).

In many cases, it is more cost-effective to protect forest watersheds from threats like wildfire than to pay for restoration later. After fires in 1996 and 2002, erosion forced the city of Denver to shut down its

Cheesman Reservoir for several months. Costs for removing sediment and unclogging pipes totalled $31 million—much more than fire prevention treatments would have been prior to the fires (Derr 2009, Landsberg and Tiedemann 2000). Research in Portland, OR, Portland, ME, and Seattle, WA, found that every dollar invested in watershed protection can save anywhere from $7.50 to nearly $200 for new water treatment facilities (Emergon and Bos 2004). Forest Service scientists are developing several GIS-based tools that will help to guide management decisions to protect watershed values at risk (Ryan 2007, Ryan and Samuels 2010, Reynolds et al 2009).

Several cities have recognized the advantages of protecting watersheds to reduce water treatment costs. New York City spent $1.5 billion over ten years to protect 35 percent of the lands which feed the city's water supply (Smith et al 2006, Stanton et al 2010). In contrast, filtration facilities that would have been necessary without this protection would cost $6 to $8 billion to build and $300 million per year to operate (Smith et al 2006). The costs of protection—including purchase of development rights and payments to landowner for water-friendly management—were financed by a 9% tax increase on customers' water bills. The filtration facility would have doubled water bills (Smith et al 2006, Germain et al 2007, National Research Council 2000). In Santa Fe, the city has financed the protection of Forest Service lands that supply the city's water through a state grant and water user fees which will amount to an average of $6.50 per year per household. The cost for watershed protection through fuels reduction is approximately $200,000 per year, and the avoided costs for a 7,000 acre wildfire in the watershed are estimated at $22 million (Stanton et al 2010, Derr 2009).

Valuing Forest Service Water

There are many obstacles to accurate valuation of Forest Service water. To begin with, non-market values like fish habitat, scenic beauty, and flow regulation are difficult to price (Smith et al 2006, Emergon and Bos 2004, Scheffer et al 2000). Aquatic and riparian ecosystems are complex and, in some cases, poorly understood. The many inter-related values of water and watershed services make it difficult to determine total worth (Smith et al 2006, Brown 2000, Sedell et al 2000). Finally, each watershed is unique, so estimates may not be transferable across locations (Brauman et al 2007, Brown 2004). Because of these obstacles, water is often under-valued, and is sometimes overlooked in management decisions (Emergon and Bos 2004, Brauman et al 2007).

In spite of obstacles, there are many ways to estimate the value of Forest Service water (Emergon and Bos 2004, Brauman et al 2007). Market prices are available for consumptive uses, and there are established or developing markets for both water quality and water quantity in some locations (Stanton et al 2010, Smith et al 2006, Scarborough and Lund 2007), although market prices may not reflect total value (Glennon 2009). Cost based-approaches are particularly useful for valuing ecosystem services—these approaches look at replacement costs, mitigation costs, or damage costs avoided. They can incorporate some non-market water values, and data is relatively easy and inexpensive to collect and analyze (Emergon and Bos 2004, Brauman et al 2007). Other methods include production function approaches, travel costs or hedonic pricing, and stated preference or contingent valuation.

These types of techniques have produced several estimates. Sedell et al (2000) estimate the marginal value of water from all national forest lands to be $3.7 billion per year, noting that this does not include values from navigation, waste dilution, channel maintenance, ecological services, and non-use values. Another study noted that the USDA compensates farmers $50 per acre per year for "watershed services"—including soil conservation and protection, reduction of sedimentation, water quality control, and flow regulation (Smith et al 2006). This value could be a starting point in valuation of watershed services on forests. The same study found that in developed countries, the economic values for watershed services—including "water for people" and "water quality control"—ranges from approximately $18-$3,000 per acre per year.

Policy Recommendations

Policy reform is necessary in order to capture the immense value of water and watersheds on national forests. Federal agencies should first identify and prioritize areas of highest value (Brauman et al 2007, GAO 2003, GAO 2004, GAO 2007, McKinney et al 2010, Becker 2010).Then, the federal government can build upon successes in the United States—in cities like New York and Santa Fe—and around the world (Stanton et al 2010, Smith et al 2006, Perrot-Maitre and Davis 2001, Brauman et al 2007).

Policy makers can bolster and strengthen existing programs. Many programs exist in the United States for the protection of water quality (Stanton et al 2010, Brown 2000), but some are low-priority or underfunded (McKinney et al 2010). In order to better manage and evaluate water and watersheds, federal agencies need to build expertise in relevant fields including hydrology, economics, and ecosystem markets (Sedell et al 2000, USDA Forest Service 2008).

Reform should encourage or create market-based mechanisms for watershed protection (Smith 2009, Stanton et al 2010, Perrot-Maitre and Davis 2001, Brauman et al 2007, Kimbell and Brown 2009, McKinney et al 2010, USDA Forest Service 2008); for example, authorizing payments for watershed services and allowing federal agencies to trade in water quality and quantity (Sedell et al 2010). Most successful ecosystem markets are backed by regulation (Stanton et al 2010)--such as the Endangered Species Act and the Clean Water Act—new regulations should strengthen backing for markets for watershed services.

Finally, new policies should encourage or enable collaboration between agencies, states, local governments, private landowners, utilities, and businesses (Sedell et al 2000, USDA Forest Service 2010, McKinney et al 2010). Overall, regulations need to be flexible to our changing needs, climate, and economy (Stanton et al 2010, Brauman et al 2007, Kimbell and Brown 2009).

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