The Social Costs of Nutrient Pollution in the United States

Tina Andarge[1], Christy Dolph[2], Jacques Finlay[2], Mainul Hoque[3], Yongjie Ji[4], David A. Keiser[1], Catherine L. Kling[3], Daniel J. Phaneuf[5], Yau-Huo Shr[6], Christian Vossler[7]

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[1]UMass Amherst, [2]U Minnesota, [3]Cornell, [4]Iowa State, [5]Wisconsin, [6]NTU, [7]U Tennessee

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Motivation: Air Pollution

TABLE 2—GROSS EXTERNAL DAMAGES AND GED/VA RATIO BY INDUSTRY

Industry	GED/VA	GED
Solid waste combustion and incineration	6.72	4.9
Petroleum-fired electric power generation	5.13	1.8
Sewage treatment facilities	4.69	2.1
Coal-fired electric power generation	2.20	53.4
Dimension stone mining and quarrying	1.89	0.5
Marinas	1.51	2.2
Other petroleum and coal product manufacturing	1.35	0.7
Steam and air conditioning supply	1.02	0.3
Water transportation	1.00	7.7
Sugarcane mills	0.70	0.3
Carbon black manufacturing	0.70	0.4
Livestock production	0.56	14.8
Highway, street, and bridge construction	0.37	13.0
Crop production	0.34	15.3
Food service contractors	0.34	4.2
Petroleum refineries	0.18	4.9
Truck transportation	0.10	9.2

Notes: GED in $ billion per year, 2000 prices. Industries included in Table 2 have either a GED/VA ratio above 45 percent or a GED above $4 billion/year.

Motivation: Air and Water Pollution

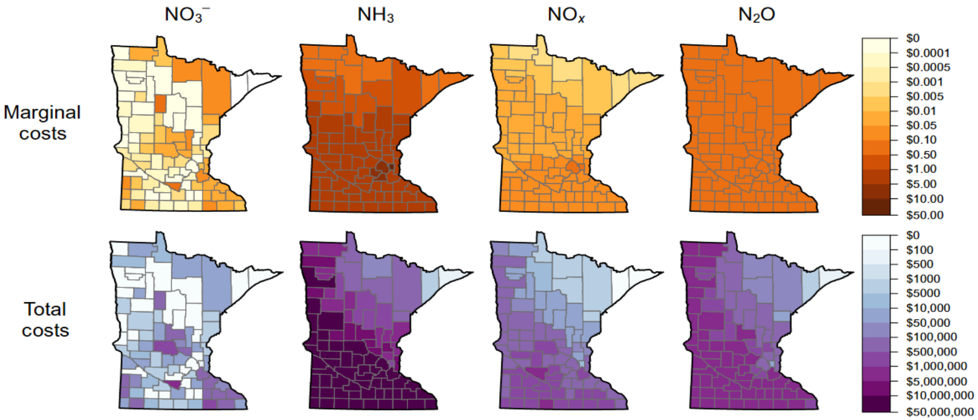

Fig. 1. The marginal and total social costs of N fertilizer applied in each county in Minnesota. Damages from NO_3^- represent the sum of costs in each county in Minnesota due to groundwater contamination of private domestic wells and public water suppliers. Damages from ammonia (NH_3) and N oxides (NO_x) are related to premature deaths from N fertilizer emissions that contribute to the formation and associated impacts of $PM_{2.5}$ and include regional damages within and beyond the borders of Minnesota. Damages from N_2O are estimates of the costs due to global climate change converted into CO_2 equivalents and valued using the SCC. Total costs are average annual values based on reported on-farm N fertilizer inputs assuming a 20-year time horizon and a 3% rate of discount (*59*). Marginal costs are estimated as dollars per kilogram of N fertilizer.

Keeler *et al.*, *Sci. Adv.* 2016;**2**:e1600219 5 October 2016 **4 of 9**

Motivation: Water Pollution, National Models

Policy Analysis

Eutrophication of U.S. Freshwaters: Analysis of Potential Economic Damages

WALTER K. DODDS,* WES W. BOUSKA, JEFFREY L. EITZMANN, TYLER J. PILGER, KRISTEN L. PITTS, ALYSSA J. RILEY, JOSHUA T. SCHLOESSER, AND DARREN J. THORNBRUGH
Division of Biology, Kansas State University, Manhattan, Kansas 66506

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United States Department of Agriculture

Economic Research Service

Technical Bulletin Number 1922

September 2008

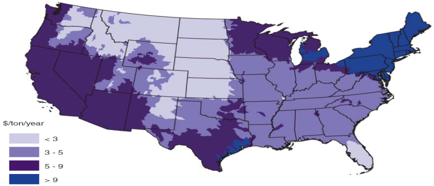
USDA

Economic Measures of Soil Conservation Benefits

Regional Values for Policy Assessment

LeRoy Hansen and Marc Ribaudo

Figure 3
Range and distribution of all water-erosion benefit values, by HUC



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Edwin H. Clark
Journal of Soil and Water Conservation January 1985, 40 (1) 19-22;

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An Integrated Assessment Model for Valuing Water Quality Changes in the U.S.

This Paper

Research Questions:

1. What are the marginal and total damages from nutrient pollution in the US?
2. How do these damages vary by location and socioeconomic characteristics?
3. How do these damages vary by industry?

Approach: Integrated Assessment Model using

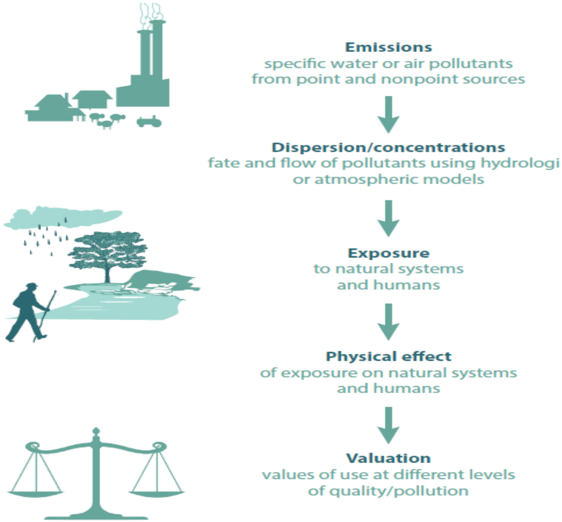
1. Data on nutrient pollution concentrations and sources
2. Economic valuation modules on housing, recreation, drinking water, climate, non-use

Preview of Preliminary Findings:

1. Damages higher on coasts and near water bodies
2. Disproportionate benefits based on income, race
3. Routing, Recreation are important
4. Lots of work still to be done

Framework, Data, and Valuation Approaches

IAM



Keiser and Muller (2017)

Data

Baseline Data

1. 73K Census Tracts (2010)
2. 9K Lakes from NHDPlus V2 - greater than 1 km^2
3. N and P data from Shen et al. (2020)
4. Routing from NHD (Keiser and Shapiro, 2019)
5. Community Water Systems with surface water sources

More to Come Soon:

1. Baseline concentrations and routing from National SWAT model
2. Module on climate change, biological condition gradient

Valuation

Hedonics

1. Meta-analysis of 11 published studies (1999-2007) with 87 observations
2. Link changes in N, P to changes in Secchi to value (National Lakes Assessment)
3. 500m buffer for lakes greater than 1 km^2

Recreation

1. Link changes in P to changes in recreation to changes in value
2. Based on Keiser (2019) and RUVD (2016)
3. Current average value of $70 per day
4. Assume 90 mile radius from center of Census Tract

Drinking Water

1. Link changes in N to changes in treatment costs
2. Based on Mosheim and Ribaudo (2017)
3. Vary assumption of systems that treat

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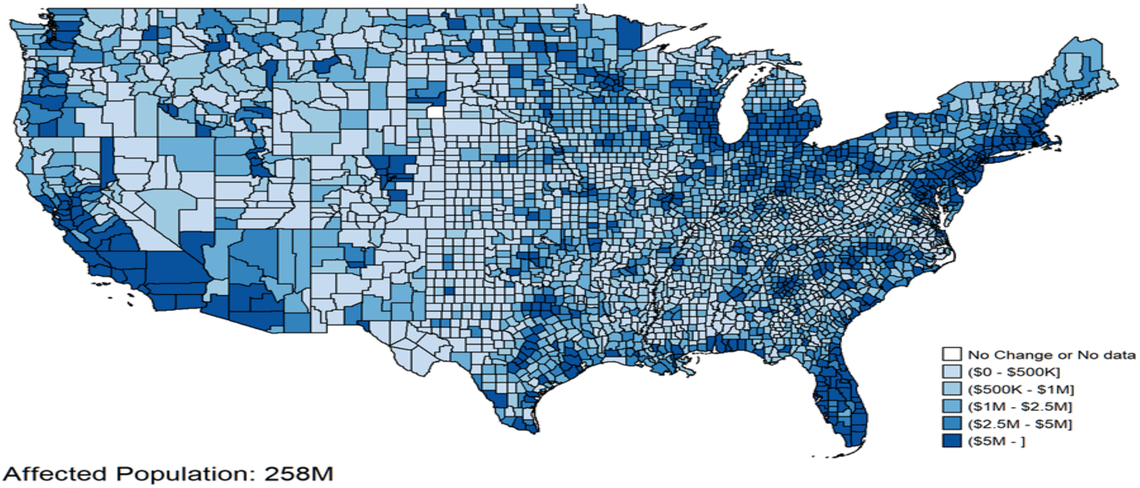
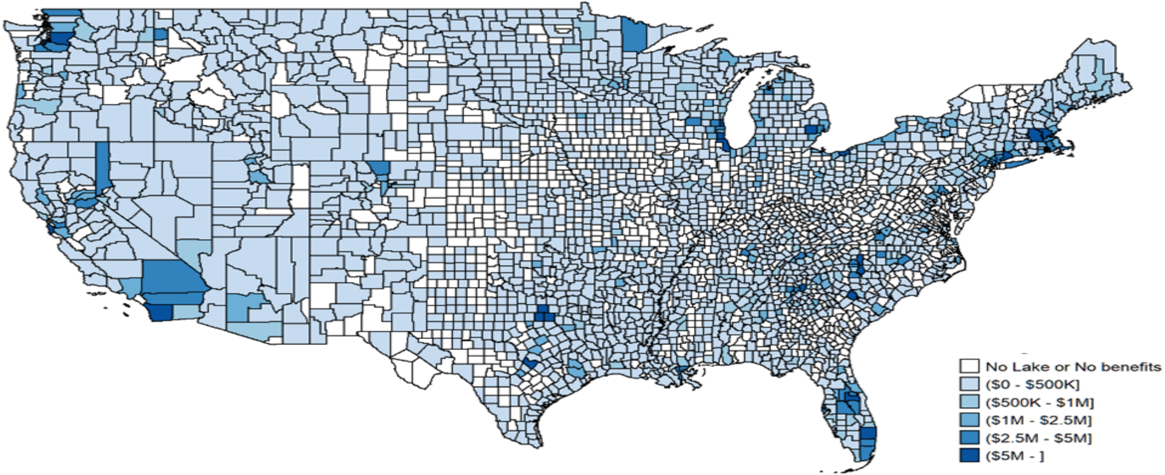
Preliminary Results - 20% Reductions in N, P

Preliminary Results: Recreation Benefits ($12.7B)

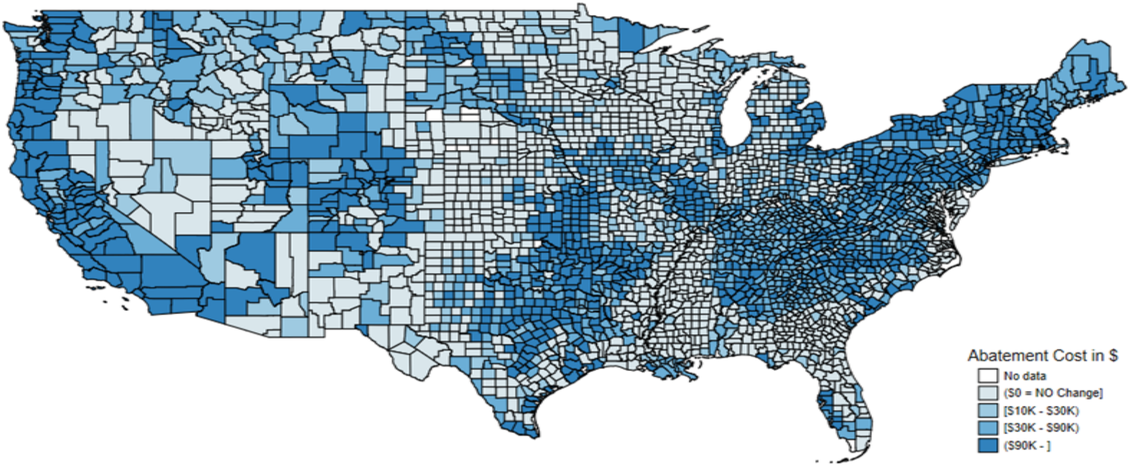


Preliminary Results: Hedonic Benefits ($853M)



Affected houses: 3M units

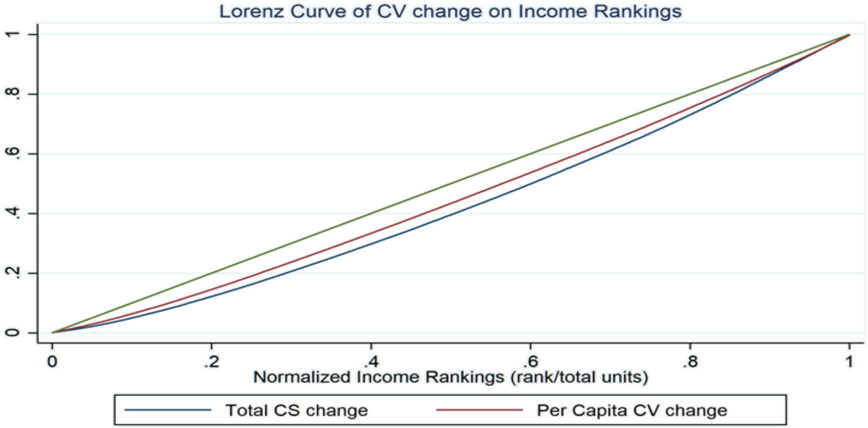
Preliminary Results: Drinking Water Treatment ($225M)



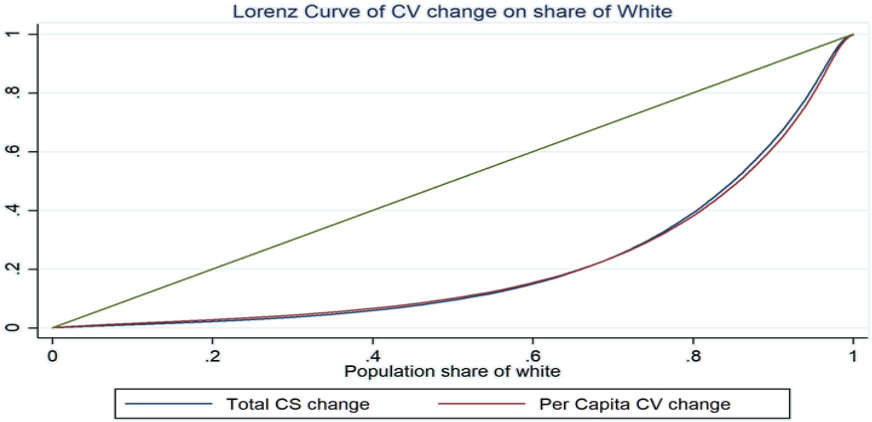
Affected Unit: 217.6 ML Populaiton

Preliminary Results - Distribution of Benefits

Distribution of Recreation Benefits: Income

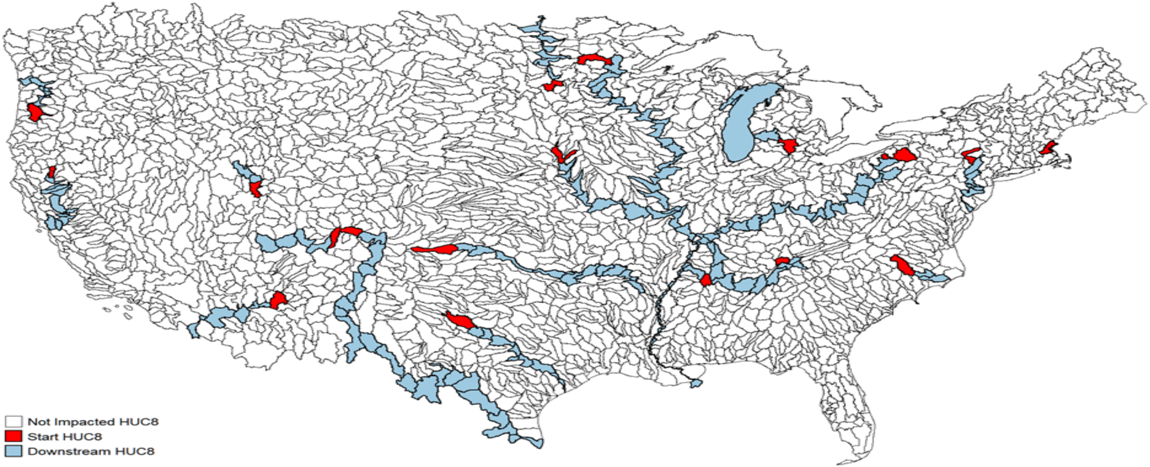


Distribution of Recreation Benefits: Race



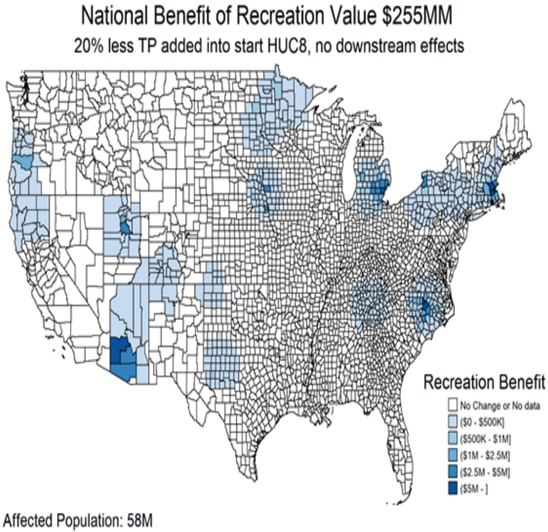
Preliminary Results - Routing

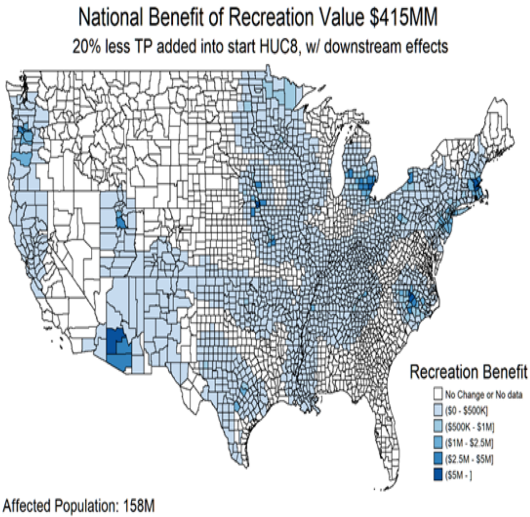
Routing and Decay Model (NHD)



N & P concentration decreases in 127 downstream HUC8s following the change in concentration in 18 headwater HUC8

Routing and Decay Model (NHD)





More to come soon. Thanks!