

# **Data and Modeling for Environmental Credit Trading**

## **A Conservation Effects Assessment Bibliography**

**Special Reference Briefs Series no. SRB 2004-03**

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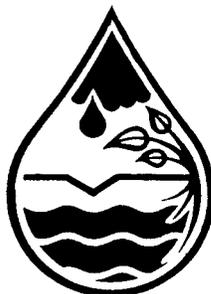
**Water Quality Information Center**

National Agricultural Library

Agricultural Research Service

U.S. Department of Agriculture

**105 citations**



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## **National Agricultural Library Cataloging Record:**

Sherman, Ted J.

Data and modeling for environmental credit trading : a conservation effects assessment bibliography.

(Special reference briefs ; NAL-SRB. 2004-03)

1. Environmental economics--United States--Bibliography.
2. Environmental auditing--United States--Bibliography.
3. Environmental impact charges--United States--Bibliography. I. Gagnon, Stuart R.  
II. Makuch, Joseph R. III. Water Quality Information Center (U.S.) IV. Title.  
aZ5071.N3 no. 2004-03

## Abstract

**Data and Modeling for Environmental Credit Trading**, Special Reference Brief 2004-03. U.S. Department of Agriculture, National Agricultural Library.

This bibliography is one in a multi-volume set developed by the Water Quality Information Center at the National Agricultural Library in support of the U.S. Department of Agriculture's Conservation Effects Assessment Project (CEAP). The bibliography is a guide to literature on the data and modeling requirements for environmental credit trading. It provides people interested in environmental credit trading and agriculture with information about the current state of data acquisition and use of simulation models in this emerging field.

Keywords: watershed management, pollution control, nonpoint source pollution, models, data collection, policy tools, environmental credit trading

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August 2004



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## Preface

This is one in a series of bibliographies developed by the Water Quality Information Center at the National Agricultural Library in support of the U.S. Department of Agriculture's Conservation Effects Assessment Project (CEAP).

The purpose of CEAP is to study the environmental effects of conservation practices implemented through various U.S. Department of Agriculture conservation programs. CEAP will evaluate conservation practices and management systems related to nutrient, manure, and pest management; buffer systems; tillage; irrigation and drainage practices; wetland protection and restoration; and wildlife habitat establishment. More information about CEAP is available at [www.nrcs.usda.gov/technical/nri/ceap/](http://www.nrcs.usda.gov/technical/nri/ceap/).

The current titles in this series are

- Environmental Effects of U.S. Department of Agriculture Conservation Programs  
Special Reference Brief 2004-01
- Implementing Agricultural Conservation Practices: Barriers and Incentives  
Special Reference Brief 2004-02
- Data and Modeling for Environmental Credit Trading  
Special Reference Brief 2004-03
- Agricultural Conservation Practices and Related Issues: Reviews of the State of the Art and Research Needs  
Special Reference Brief 2004-04

Each of the documents, as well as bibliographies on similar topics, is accessible online from the Water Quality Information Center at [www.nal.usda.gov/wqic/](http://www.nal.usda.gov/wqic/).

The center gratefully acknowledges the following organizations who granted permission to use their citations and/or abstracts in these bibliographies.

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- Thomson Zoological, LTD  
[www.biosis.com](http://www.biosis.com)

In addition, support from the Natural Resources Conservation Service for the development of these bibliographies is greatly appreciated.

Joseph R. Makuch, Ph.D.  
Coordinator  
Water Quality Information Center

## About This Bibliography

This bibliography is a guide to literature on the data and modeling requirements for environmental credit trading. Environmental credit trading is an approach to environmental protection that uses market-based mechanisms to efficiently allocate emission or pollutant reductions among sources with different marginal control costs. The purpose of this bibliography is to help people with an interest in environmental credit trading and agriculture become better informed about the current state of data acquisition and use of simulation models in this emerging field.

This bibliography has two sections. The first section contains citations to the limited literature currently available on this topic, including data and modeling related to wetland mitigation banking. Also included are citations where the subject is not agriculture, but the information in the document may have applicability to agriculture.

There are 40 citations with abstracts (when available) in the first section. Citations were found through literature searches of the AGRICOLA database, produced by the National Agricultural Library, and several commercial bibliographic databases. In addition, Water Quality Information Center staff created citations for documents that were located by various other means. Documents cited were published from 1993 through 2003.

The second section contains 65 citations with abstracts (when available) on the general topic of environmental credit trading and related economic incentives. All these citations are from the AGRICOLA database and cover documents published from 1981 through 2003. Water is the primary environmental focus of these citations.

URLs are provided for online documents that are freely available. The inclusion or omission of a particular citation does not imply endorsement or disapproval.

To locate information on a specific topic, use the subject index beginning on page 39. An author index is also available beginning on page 49.

To obtain a specific document, please contact your local library. Information on how to obtain documents from the National Agricultural Library can be found at [www.nal.usda.gov/dds/](http://www.nal.usda.gov/dds/).

# Data and Modeling for Environmental Credit Trading

## 1. Acid rain and environmental degradation: The economics of emission trading.

Klaassen, G.

Cheltenham, UK: Edward Elgar Publishing; 336 p. (1996)

ISBN: 1-85898-489-0

This citation is provided courtesy of CAB International/CABI Publishing.

## 2. An Analysis of Economic Incentives in Wetlands Policies Addressing Biodiversity.

Fernandez, L.

*Science of the Total Environment* (1-3): 107-122. (1999)

NAL Call #: RA565.S365; ISSN: 0048-9697.

Notes: Special issue: Managing for biodiversity for the protection of nature;

DOI: 10.1016/S0048-9697(99)00311-3

Descriptors: Wetlands / biodiversity/ Policies/ Restoration/ Environmental protection/ Economic analysis/ Environmental economics/ Legislation/ Biological diversity/ Habitat/ Nature conservation/ Environmental restoration/ Simulation/ Economics/ United States, California/ Environmental Policy/ Conservation/ Resources Management/ Habitats/ Policy Making/ Costs/ Economic Aspects/ United States, California/ Protective measures and control/ Environmental action/ Evaluation process

**Abstract:** This paper offers an economic analysis of economic incentives within the Habitat Conservation Plan and Wetlands Mitigation Bank policies. Both policies are relatively new policies for protection and restoration of ecosystems such as wetlands that support biodiversity. The components of the policies such as the measures of success, conversion of biological units into economic units, and timing of the actions by policymakers and landowners influence the incentives to carry out protection and restoration. A stochastic optimal control model is developed which incorporates ecological uncertainty of wetlands restoration. The model helps in examining the decisions of how much to invest in a wetlands mitigation bank or habitat conservation plan. The model is calibrated with data from California bioeconomic parameters. Numerical simulation of the model provides a sensitivity analysis of how model parameters of restoration costs, stochastic biological growth, discount rate, and the market value of credits affect the trajectory of investment and the optimal stopping state of wetlands quality when the investment ends. The analysis reveals that more restoration will occur when there is a reduction in restoration costs, an increase in biological uncertainty or an increase in the value of wetlands credits. Continued restoration is harder to justify at a higher discount rate and cost.

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### **3. Applying the Watershed Protection Approach to Estuaries and Wetlands.**

Mlay, M.

In: Changes in Fluxes in Estuaries: Implications From Science to Management/  
Dyer, K. R. and Orth, R. J.

Fredensborg, Denmark: Olsen and Olsen, 1994; pp. 407-410.

Notes: ISBN: 87-85215-22-8; Conference: ECSA22/ERF Symposium, Plymouth (UK),  
13-18 Sep 1992

*Descriptors:* USA/ wetlands/ estuaries/ resources management/ decision making/  
environmental protection/ watershed management/ ecosystems/ interagency  
cooperation/ U.S. Environmental Protection Agency (EPA)/ Estuaries/ Evaluation  
process/ Conservation, wildlife management and recreation/ Coastal Zone Resources  
and Management/ Brackish water

*Abstract:* In view of increasing environmental pressures on estuaries and wetlands, and with improved scientific understanding, the US Environmental Protection Agency (EPA) is working to broaden its traditional approach to the regulation of these complex ecosystems. Specifically, the Agency is changing its perspective on single-purpose regulatory approaches to include multi-agency, multi-media approaches, in recognition of the roles that air, land, and water play in the transport and fate of certain pollutants. The Agency is also promoting the use of natural, rather than political, boundaries, such as watersheds, as the management framework. This change in perspective is accompanied by the use of cooperative efforts and leveraging approaches, such as point-nonpoint source trading, in addition to 'command and control' regulatory approaches to achieve desired environmental effects. This paper provides several examples of this programmatic shift in EPA and discusses the role of science in applying environmental management approaches. The paper concludes by exploring the delicate relationship between science and regulatory decision-making. The author challenges researchers and decision-makers to work more closely together to communicate and understand the context of management decisions for which scientific data and information is needed and to translate this technical knowledge into information that can be applied in coastal management.

© Cambridge Scientific Abstracts (CSA)

### **4. The bioeconomics of regulating nitrates in groundwater from agricultural production through taxes, quantity restrictions, and pollution permits.**

Thomas, A. C. and Boisvert, R. N.

In: Research-Bulletin, No. 95-06; Ithaca, NY: Department of Agricultural, Resource, and Managerial Economics, Cornell University, 1995. 97 p.

This citation is provided courtesy of CAB International/CABI Publishing.

### **5. Cap-and-trade policy challenges: A tale of three markets.**

Colby BG

*Land Economics* 76 (4): 638-658. (2000)

NAL Call #: 282.8-J82.

Notes: 59 ref

This citation is provided courtesy of CAB International/CABI Publishing.

**6. Capturing benefits from water entitlement trade in salinity affected areas: A role for trading houses.**

Bell, R.

*Australian Journal of Agricultural and Resource Economics* 46 (3): 347-366.

(Sept. 2002)

NAL Call #: HD1401.A89; ISSN: 1364-985X

*Descriptors:* water resources/ water supply/ access/ salinity/ water use / externalities/ trade/ water allocation/ profits/ cost benefit analysis/ mathematical models

This citation is from AGRICOLA.

**7. Carbon Trading With Imperfectly Observable Emissions.**

Godal, O.; Ermoliev, Y.; Klaassen, G.; and Obersteiner, M.

*Environmental and Resource Economics* 25 (2): 151-169. (2003); ISSN: 0924-6460.

*Notes:* Publisher: Kluwer Academic Publ

*Descriptors:* Carbon/ Emissions Trading/ Monitoring/ Simulation/ Uncertainty/ Permits

*Abstract:* The Kyoto Protocol foresees emission trading but does not yet specify verification of (uncertain) emissions. This paper analyses a setting in which parties can meet their emission targets by reducing emissions, by investing in monitoring (reducing uncertainty of emissions) or by (bilaterally) trading permits. We derive the optimality conditions and carry out various numerical simulations. Our applications suggest that including uncertainty could increase compliance costs for the USA, Japan and the European Union. Central Europe and the Former Soviet Union might be able to gain from trading due to higher permit prices. Emissions trading could also lower aggregate uncertainty on emissions.

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**8. Compensating for wetland losses under the Clean Water Act.**

National Research Council (U.S.). Committee on Mitigating Wetland Losses.

Washington, D.C.: National Academy Press; xxiii, 322 p.: ill. (2001)

NAL Call #: KF5624-.C66-2001; ISBN: 0309074320

<http://books.nap.edu/books/0309074320/html/87.html>

*Descriptors:* Wetlands ---Law and legislation---United States/ Wetland conservation---Government policy---United States/ Wetland mitigation banking---United States

This citation is from AGRICOLA.

**9. Cost minimization of nutrient reduction in watershed management using linear programming.**

Schleich, J. and White, D.

*Journal of the American Water Resources Association* 33 (1): 135-142. (Feb. 1997)

NAL Call #: GB651.W315; ISSN: 1093-474X [JWRAF5]

*Descriptors:* watershed management/ water quality/ nutrients/ pollutants / phosphorus/ linear programming/ cost effectiveness analysis/ cost control / Wisconsin/ suspended solids

*Abstract:* Linear programming is applied to identify the least cost strategy for reaching politically specified phosphorus and total suspended solids reduction targets for the Fox-Wolf river basin in Northeast Wisconsin. The programming model uses data

collected on annualized unit reduction costs associated with five categories of sources of phosphorus and total suspended solids discharge in each of the 41 subwatersheds in the basin to determine the least cost management strategy. Results indicate that: (1) cost-effective nutrient reduction requires careful selection of geographic areas and source categories to address throughout the watershed; (2) agricultural sources are the most cost-effective to address in the basin; and (3) care should be exercised in setting nutrient reduction targets, given that there are likely to be significantly increasing marginal costs of nutrient reduction; the model predicts that lowering the most restrictive target by 33 percent would cut reduction expenditures by about 75 percent. Policy implications of the model include support for the investigation and potential development of institutional arrangements that enable cost-effective nutrient reduction activities to occur, such as the creation of an agency with authority over a given watershed, coordinated watershed management activities, or nutrient trading programs. This citation is from AGRICOLA.

#### **10. Documenting No-Till and Conventional Till Practices Using Landsat ETM+ Imagery and Logistic Regression.**

Brickley, R. S.; Lawrence, R. L.; and Miller, P. R.

*Journal of Soil and Water Conservation* 57 (5): 267-271. (2002)

NAL Call #: 56.8 J822; ISSN: 0022-4561

*Descriptors:* Cultivated Lands/ Agricultural Practices/ Tillage/ Data Acquisition/ Remote Sensing/ Satellite Technology/ Performance Evaluation/ Cost Analysis/ Carbon/ Global Warming/ Data acquisition

*Abstract:* The ability of agricultural lands to sequester carbon from the atmosphere and help mitigate global warming has the potential to add value to farmland through the development of carbon-credit trading. Crucial to the creation of a market-based carbon credit trading system is the monitoring and verification of agricultural practices that promote carbon storage. Using remotely sensed images for this purpose could prove more efficient and cost-effective than traditional land-based methods. Landsat Enhanced Thematic Mapper Plus (ETM+) imagery and logistic regression had >95% accuracy in verifying no-till fallow fields. Further research is needed to investigate the potential for this low-cost technology to assist in the monitoring and verification of practices that sequester carbon. Development of an accurate, low-cost, efficient means of monitoring and verifying carbon sequestering practices will further the development of cropland carbon credits, thus helping to mitigate global warming, and will add value to U.S. farmland.

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#### **11. Economic and environmental modelling for pollution control in an estuary.**

Hanley, N.; Faichney, R.; Munro, A.; and Shortle, J. S.

*Journal of Environmental Management* 52 (3): 211-225. (Mar. 1998)

NAL Call #: HC75.E5J6 ; ISSN: 0301-4797 [JEVMAW]

*Descriptors:* estuaries/ water pollution/ pollution control/ water quality/ permits/ oxygen requirement/ case studies/ uncertainty/ probabilistic models/ tradable pollution permits/ forth estuary/ Scotland/ emissions/ emissions permit system/ ambient permits system  
This citation is from AGRICOLA.

**12. The feasibility of tradeable permits for water abstraction in England and Wales.**

Morris, J; Weatherhead, EK; Dunderdale, JAL; Green, C; and Tunstall, S.  
In: Water: Economics, management and demand; International Commission on Irrigation & Drainage; Proceedings 18th European Regional Conference: Water -- An economic good. (Held September 1997 at Oxford, UK.) Kay, M.; Franks, T.; and Smith, L. (eds.); pp. 328-338; 1997.

Notes: 5 ref

This citation is provided courtesy of CAB International/CABI Publishing.

**13. Global CO<sub>2</sub> emissions trading: Early lessons from the U.S. acid rain program.**

Solomon BD

*Climatic Change* 30 (1): 75-96. (1995)

NAL Call #: QC980 .C55.

Notes: 71 ref

This citation is provided courtesy of CAB International/CABI Publishing.

**14. Greenhouse Gas Economics and Computable General Equilibrium.**

Gottinger, HW

*Journal of Policy Modeling* 20 (5): 537-580. (Oct. 1998); ISSN: 0161-8938.

Notes: Publisher: Elsevier Science Inc

*Descriptors:* Computable General Equilibrium/ Global Pollution/ Greenhouse Gases/ Environmental Policy

*Abstract:* This paper employs a new class of computable general-equilibrium (CGE) models, developed in the context of energy-economy-environmental models to simulate the impacts of the EU economy of internal and multilateral instruments for regulation of greenhouse gases (GHGs) emissions. Climate change due to emissions gases of greenhouse gases is a long-term global environmental problem. While specific impacts on different regions as well as their timing are yet uncertain, it is reasonable to suppose that unilateral voluntary action by individual countries to reduce their net emissions of GHGs is unlikely. This is because significant reduction of net GHGs emissions by a single major net emitter, say, for example the EU, is unlikely to substantially slow down the rate of increase in concentration in the atmosphere because the emissions of GHGs worldwide is increasing rapidly with spreading industrialization. On the other hand, unilateral changes in energy use patterns are widely perceived to have: adverse effects on a country's economic growth, consumer welfare and trade competitiveness. This perception is shared by both developing (DCs) and industrialized countries (INCs). Some major policy instruments have been assessed on the basis of experiments with the CGE model. The use of each of the policy instrument for direct GHGs regulation is promising. The results of the above experiments seem to show, that first, emission standards accomplish significant decreases in net GHGs emissions with negligible relative GDP and Welfare index changes and without major distributional impacts in the sense of relative changes in factor rewards. They seem to work through major reduction in coal and natural gas use and slight overall reduction in the use of petroleum. Second, auctioned tradeable permits also accomplish large decreases in net GHGs emissions, with, however a perceptible increase in the Welfare Index and significant distributional impacts in higher rewards to land owners and labor relative to capital owners. They

appear to work primarily by expansion to the forest sector and associated increases offsets generation. Third, the use of a GHGs tax on positive net emissions of GHGs by industries accomplishes large reductions in net GHGs emissions with significant increase in GDP and the Welfare Index. The relative changes in factor rewards are also important and favor land owners over labor and capital owners. This instrument too appears to work primarily through considerable expansion of the forest sector and consequent increases offsets generation. Each of these instruments show sufficient promise as effective policy tools for GHGs reduction, that it would be advisable to conduct further research in each case. The choice between standards on the one hand, and market-based domestic regulatory instruments on the other, is not straightforward. These results need verification through further analysis. (C) 1998 Society for Policy Modeling. Published by Elsevier Science Inc.  
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**15. Hydrodynamic modeling of wetlands for flood detention.**

Tsihrintzis, V. A.; John, D. L.; and Tremblay, P. J.

*Water Resources Management* 12 (4): 251-269. (Aug. 1998)

NAL Call #: TC401.W27; ISSN: 0920-4741 [WRMAEJ]

*Descriptors:* wetlands / flood control/ hydrodynamics/ drainage/ hydraulic structures/ simulation models/ mathematical models / structural design/ water flow/ Florida/ detention basins/ SWMM EXTRAN model

*Abstract:* The application of a link-node model in modeling hydrodynamics of wetland areas related to flood detention design is presented through the description of modeling and design efforts of an actual project, the first privately-owned wetland mitigation bank in Florida. The 142-ha project is located in the Chapel Trail Preserve of the City of Pembroke Pines, South Florida, where a degraded site is transformed into a healthy, self-sustaining wetland ecosystem. Creation of the wetlands, located adjacent to an existing development, required careful evaluation of drainage conditions. To properly design the wetland site, a hydrodynamic model was developed which allowed sizing of hydraulic structures and computation of maximum water surface elevations. The paper presents model description and calibration using field data, parameter sensitivity, general application in the project and use as a design tool. The model was found to be a valuable tool that can be applied in similar projects.

This citation is from AGRICOLA.

**16. Hydrologic Model for Design and Constructed Wetlands.**

Arnold, J. G.; Allen, P. M.; and Morgan, D. S.

*Wetlands* 21 (2): 167-178. (2001)

NAL Call #: QH75.A1W47; ISSN: 0277-5212

*Descriptors:* Flow Discharge/ Model Studies/ Hydrology/ Watersheds/ Topography/ Soil water plant Relationships/ Climatic Changes/ Land Use/ Artificial Wetlands/ Wetlands/ Mathematical models/ Water budget/ Stream flow/ Design/ Soils/ Topographic features/ Texas/ Trinity River/ United States

*Abstract:* The Trinity River Mitigation Bank was proposed to develop and use a mature, contiguous, diverse riparian corridor along the West Fork of the Trinity River near Dallas, Texas, USA. In the proposed wetland design, water would be diverted from Walker Creek as necessary to maintain wetland function. Therefore, assessment of the

magnitude and continuity of the flow from Walker Creek was paramount to successful wetland operation. The Soil and Water Assessment (SWAT) model was used to assess whether the sustained flow (storm flow and base flow) from the Walker Creek Basin could maintain the proposed bottomland wetland ecosystem. For this study, SWAT was modified to allow ponded water within the prescribed wetland to interact with the soil profile and the shallow aquifer. The water budget was prepared for the wetland based on a three-step process. First, data required to run the model on Walker Creek, including soils, topographic, land-use, and daily weather data were assembled. Next, data required to validate the model were obtained. Since stream flow was not available at the proposed site, flow from a nearby watershed with similar soils, land use and topography were used. In the final step, the model was run for 14 years and compared to the measured water balance at the nearby watershed. The model results indicate that the wetland should be at or above 85 percent capacity over 60 percent of the time. The wetland did not dry up during the entire simulated time period (14 years) and reached 40 percent capacity less than one percent of the time during the simulation period. The advantages of the continuous simulation approach used in this study include (1) validation of wetland function (hydroperiod, soil water storage, plant water uptake) over a range of climatic conditions and (2) the ability to assess the long-term impact of land-use and management changes.

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#### **17. Integrated economic-hydrologic water modeling at the basin scale: The Maipo River basin.**

Rosegrant, M. W.; Ringler, C.; McKinney, D. C.; Cai, X.; Keller, A.; and Donoso, G. *Agricultural Economics* 24 (1): 33-46. (Dec. 2000)

NAL Call #: HD1401.A47; ISSN: 0169-5150 [AGECE6].

Notes: Special issue: Management of water resource for agriculture / edited by U. Chakravorty and D. Zilberman; Includes references

Descriptors: water allocation/ farm inputs/ decision making/ productivity/ irrigation/ demand/ water use efficiency/ resource utilization/ models/ water policy/ cost benefit analysis/ equations/ Chile

Abstract: Increasing competition for water across sectors increases the importance of the river basin as the appropriate unit of analysis to address the challenges facing water resources management; and modeling at this scale can provide essential information for policymakers in their resource allocation decisions. This paper introduces an integrated economic-hydrologic modeling framework that accounts for the interactions between water allocation, farmer input choice, agricultural productivity, non-agricultural water demand, and resource degradation in order to estimate the social and economic gains from improvement in the allocation and efficiency of water use. The model is applied to the Maipo river basin in Chile. Economic benefits to water use are evaluated for different demand management instruments, including markets in tradable water rights, based on production and benefit functions with respect to water for the agricultural and urban-industrial sectors.

This citation is from AGRICOLA.

**18. Market Incentives to Reduce Nonpoint Source Agricultural Nutrient Pollution: A Theoretical and Implementational Discussion.**

Norman, M. E. and Keenan, J. D.

*Journal of Environmental Systems* 24 (2): 151-157. (1995); ISSN: 0047-2433

*Descriptors:* nonpoint pollution/ agricultural pollution/ nutrients/ animal wastes/ taxation/ compost/ permits/ government programs/ research programs/ water pollution control/ nonpoint pollution sources/ agricultural runoff/ composting/ Environmental action/

Sources and fate of pollution

*Abstract:* This article provides a theoretical and implementational discussion of several potential market-based mechanisms to reduce nonpoint source agricultural nutrient pollution, including an excess nutrient tax; off-site animal waste disposal subsidy; animal waste transport subsidy; compost subsidy; and nutrient permit trading system. Market incentives have theoretical appeal in that, if set at the proper level, they compel polluters to reduce pollution generation to the socially efficient level automatically. However, each market-based mechanism has associated implementational factors which must be overcome. The implementation discussion highlights the basic information, monitoring, enforcement, and political requirements concerning each of the policies. In addition, market inefficiencies may reduce the practical effectiveness of market-based incentives. In cases where informational and other inefficiencies are high, alternative approaches (such as market surveys and nutrient management education) aimed at reducing those inefficiencies may be required.

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**19. A Method to Improve the International Comparability of Emission Data From Industrial Installations.**

Saarinen, K.

*Environmental Science and Policy* 6 (4): 355-366. (2003)

NAL Call #: GE170.E58; ISSN: 1462-9011.

*Notes:* Publisher: Elsevier Sci Ltd

*Descriptors:* Industrial Emissions/ Comparability/ Monitoring/ Data Production Chain

*Abstract:* Emissions from industrial installations are regulated under several international conventions and directives to prevent harmful impacts on environment and human health. Stricter limitations often exist in national legislations, or due to regional and local conditions, than in the international conventions. The international comparability of emission data from industrial installations is currently poor. Comparability is an essential element when the environmental performance of different installations or techniques is studied, as well as in reviewing data presented in emission registers. The availability of reliable and comparable data is an important requirement for the emissions trading market. Comparable emission data ought to be used when reviewing compliance with the national emission reduction targets established under international conventions, as well as in reviewing the compliance of industrial installations with the requirements set in the environmental permit conditions. There are currently no internationally agreed principles or a comprehensive strategy for production of emission data at the level of an industrial installation. The data production chain principle presented in this paper provides a tool for identifying elements that are essential in comparing emission data correctly and that need to be taken into consideration to ensure emission data reliability. The method was originally developed

and applied in Finland for emission and impact monitoring of wastewaters from industrial installations and fisheries. Due to the implementation of the Integrated Pollution Prevention and Control (IPPC) directive the methodology was reconstructed for integrated emissions monitoring purposes. The data production principle was introduced for European use when preparing the BREF document on monitoring of emissions. It will also be relevant when the industrial installations report their emissions data to the Pollutant Release and Transfer Registers (PRTRs). (C) 2003 Elsevier Science Ltd. All rights reserved.

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## **20. Modeling for Point-Non-Point Source Effluent Trading: Perspective of Non-Point Sources Regulation in China.**

Zhang, W. and Wang, X. J.

*Science of the Total Environment* 292 (3): 167-176. (2002)

NAL Call #: RA565.S365; ISSN: 0048-9697.

Notes: Publisher: Elsevier Science Bv

*Descriptors:* Non Point Source Pollution/ Point Non Point Effluent Trading/ Watershed/ Uncertainty/ Pollution Abatement/ Water Quality/ Nonpoint/ Wetlands/ Cost

*Abstract:* In the past decades, little abatement efforts have been implemented on China's non-point source water pollution, and studies aiming at non-point sources regulation were also rare; Watershed abatement trading between point and non-point sources may serve as a cost-effective way to deal with the problem. The inherent uncertainty of non-point emissions, however, could affect the feasibility and outcome of point-non-point effluent trading. The purpose of this paper is to model the watershed point-non-point abatement trading incorporating the uncertainty of non-point source emissions, and to examine its impacts on trading equilibrium and trading ratio. The uncertainties of non-point emissions were taken into consideration by setting an acceptable probability by which the watershed emission constraints were achieved. Using the watershed optimization model, the optimal abatement allocation and trading ratio were explicitly illustrated. It was found that they were affected significantly by the variances of non-point emissions, the reliability requirement assigned to the non-point abatement, and the marginal abatement costs of point and non-point sources. Since the variances of non-point emissions may increase or decrease at the abatement level, the impacts of these factors were discussed in different circumstances. Based on the illumination of the trading model, future directions and implications of point-non-point trading in China were discussed. (C) 2002 Elsevier Science B.V. All rights reserved.

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## **21. Phosphorus Credit Trading in the Fox-Wolf Basin: Exploring Legal, Economic, and Technical Issues.**

Baumgart, P; Johnson, B. N.; and Pinkham, J. R.

Alexandria, VA: Water Environment Research Foundation; 97-IRM-5D, 2000. 110 p.

*Descriptors:* water pollution/ phosphorus/ Wisconsin/ water quality/ monitoring/ models/ total maximum daily load

*Abstract:* The report details the work of a nonprofit organization to implement a watershed based trading program for the Fox-Wolf basin in Wisconsin. It examines the

history of water quality problems and mitigation efforts in the area, as well as the current legal and economic environment for starting such a program. Modeling and monitoring activities the group is taking to support a trading program is also described.

## **22. Phosphorus Credit Trading in the Kalamazoo River Basin: Forging Nontraditional Partnerships.**

Kieser, M.

Alexandria, VA: Water Environment Research Foundation; 97-IRM-5C, 2000. 282 p.

*Descriptors:* water pollution/ phosphorus/ Michigan/ water quality/ monitoring/ environmental models/ nonpoint source pollution

*Abstract:* A voluntary water quality trading demonstration program intended to reduce phosphorus and sediment loading in parts of the Kalamazoo River in Michigan is described. The program achieves better water quality using trades between point and nonpoint sources than those achieved by point source controls alone. The environmental and economic benefits of the program are analyzed and technical issues such as setting baselines through calculations, monitoring and modeling are discussed.

## **23. PM10 Conformity Determinations: The Equivalent Emissions Method.**

Foresman, E. L.; Kleeman, M. J.; Kear, T. P.; and Niemeier, D. A.

*Transportation Research: Part D, Transport and Environment* 8 (2): 97-112. (2003);

*ISSN:* 1361-9209.

*Notes:* Publisher: Pergamon-Elsevier Science Ltd

*Descriptors:* Particulate Air Pollution/ Atmospheric Particles/ Southern California/ Infant Mortality/ Aerosol / Association/ Emergency/ Children/ Asthma/ Visits

*Abstract:* The US Clean Air Act Amendments require PM10 transportation conformity and attainment demonstrations. This study examines the policy implications and validity of a proposed PM10 transportation conformity method called equivalent emissions (EE) that uses a linear, non-chemical model to incorporate emissions trading into PM10 transportation conformity determinations. We evaluate the new method by comparing predictions from EE to predictions from a mechanistic air quality model that uses non-linear chemical mechanisms to calculate the formation of secondary PM10. Results indicate that the EE method over estimates reductions of secondary PM10 formation allowing the primary fraction to rise while secondary PM10 is not actually declining in the atmosphere. Thus, conformity could be established between air quality and transportation plans using EE, resulting in projects being funded that might prolong public exposure to unhealthy levels of PM10 depending on the specifics of the non-attainment area. (C) 2003 Published by Elsevier Science Ltd.

© Thomson ISI

## **24. Point/Nonpoint source trading of pollution abatement: Choosing the right trading ratio.**

Malik, A. S.; Letson, D.; and Crutchfield, S. R.

*American Journal of Agricultural Economics* 75 (4): 959-967. (Nov. 1993)

*NAL Call #:* 280.8-J822; *ISSN:* 0002-9092 [AJAEB]

*Descriptors:* pollution control/ law enforcement/ costs/ water quality/ trading/ uncertainty/ mathematical models/ ratios/ United States/ abatement costs

*Abstract:* In programs for trading pollution abatement between point and nonpoint

sources, the trading ratio specifies the rate at which nonpoint source abatement can be substituted for point source abatement. The appropriate value of this ratio is unclear because of qualitative differences between the two classes of sources. To identify the optimal trading ratio, we develop and analyze a model of point/nonpoint trading. We find the optimal trading ratio depends on the relative costs of enforcing point versus nonpoint reductions and on the uncertainty associated with nonpoint loadings. The uncertainty does not imply a lower bound for the optimal trading ratio. This citation is from AGRICOLA.

**25. Predicted change in soil carbon following afforestation or reforestation, and analysis of controlling factors by linking a C accounting model (CAMFor) to models of forest growth (3PG), litter decomposition (GENDEC) and soil C turnover (RothC).**

Paul, K. I.; Polglase, P. J.; and Richards, G. P.

*Forest Ecology and Management* 177 (1-3): 485-501. (2003)

NAL Call #: SD1.F73; ISSN: 0378-1127.

Notes: Publisher: Elsevier Science

Descriptors: Soil/ Carbon cycle/ Models/ Afforestation/ Reforestation/ Decomposition/ Pinus radiata/ Australia/ Monterey pine/ Soil

*Abstract:* A complete carbon (C) accounting model for forest systems, GRC3, links a C tracking model (CAMFor) with independently verified models of forest growth (3PG), litter decomposition (GENDEC) and soil C turnover (RothC). GRC3 was tested in seven regional case studies of eucalypt or Pinus radiata plantations in Australia to predict rates of change in soil C after afforestation and to determine controlling factors. The model was calibrated as far as possible to above-ground growth of plantations, litterfall, accumulation of litter and in some cases root biomass, and was then run to determine expected change in soil C. Between 0 and 10 years soil C was predicted to decrease by an average of 1.7% per year (0.79tCha super(-1) per year) and between 10 and 40 years it was predicted to increase by 0.82% per year (0.46tCha super(-1) per year). The mean rate of change after 40 years was 0.09% per year (0.06tCha super(-1) per year). These values and pattern of change were consistent with a recent review of the global literature of change in soil C after afforestation [For. Ecol. Manage. (2002a)]. Modelling analyses suggests the main reasons for this pattern are: (i) initially, there are limited inputs of C to soil as plantation net primary production (NPP) is small and goes to building biomass. Residues from the previous crop decompose leading to net loss of C unless a groundcover (intercrop or weeds) is maintained in the inter-rows, (ii) much of the plantation NPP is allocated to long-lived woody components (stems, branches, and coarse roots), which are temporarily or permanently (by harvesting) removed from the soil C cycle, and (iii) as the stand develops, inputs from the more lignified, resistant material increases. The amount of input may be less under plantation than pasture but the quality of residues is the over-riding factor and in the long-term soil C accumulates. Actual trends in soil C may vary according to site and management conditions, but the main controlling factors will be different between pasture and plantation in the amount and allocation of NPP, and the quantity and quality of residue inputs to soil. Sensitivity (Monte Carlo) analyses showed that model parameters and processes for which it will be important to have good estimates include the amount of NPP and its allocation to various plant components, rate constants for decomposition of litter and root residues,

the proportion of C lost to respiration during decomposition of litter and soil C, and rate constants for humification (the proportion of decomposing above-ground litter that is transferred to soil). Changes in soil C were small compared with other forest pools and fluxes-after 40 years of afforestation less than 3% of the cumulative NPP was predicted to accumulate in soil. It is debatable whether it will be feasible or cost-effective to directly measure change in soil C over short-time frames (such as 5 years) for the purpose of claiming C credits under an emissions trading scheme. Modelling provides a useful alternative and at the very least can be used to identify sites and time frames where investment in soil C measurement may be warranted.

© Cambridge Scientific Abstracts (CSA)

## **26. Restoring Wetlands Through Wetlands Mitigation Banks.**

Fernandez, L. and Karp, L.

*Environmental and Resource Economics* 12 (3): 323-344. (1998); ISSN: 0924-6460

*Descriptors:* Environmental economics/ Environmental restoration / Wetlands/ Development projects/ Mathematical models/ Government regulations/ Economic Aspects/ Rehabilitation/ Stochastic Process/ Model Studies/ Optimization/ Simulation / Sensitivity Analysis/ Calibrations/ Banks / Investment/ Habitat improvement (physical)/ Environmental protection/ Environmental legislation/ Policies/ wetlands mitigation banks/ Environmental action/ Evaluation process/ Protective measures and control/ Freshwater

*Abstract:* This paper offers the first economic analysis of wetlands mitigation banks. The banks are a new alternative for restoration of wetlands by developers before receiving regulatory approval for future development of wetlands in the same watershed. A stochastic optimal control model is developed which incorporates ecological uncertainty of wetlands restoration. The model helps in examining the decisions of how much to invest in a wetlands mitigation bank. The model is calibrated with data from California bioeconomic parameters. Numerical simulation of the model provides a sensitivity analysis of how model parameters of restoration costs, stochastic biological growth, interest rate, and the market value of credits affect the trajectory of investment and the optimal stopping state of wetlands quality when the investment ends. The analysis reveals that restoration of the whole site will occur when there is a reduction in restoration costs, an increase in biological uncertainty or an increase in the value of wetlands credits. Continued restoration is harder to justify with a higher interest rate.

© Cambridge Scientific Abstracts (CSA)

## **27. Sensitivity analysis of predicted change in soil carbon following afforestation.**

Paul, K. I.; Polglase, P. J.; and Richards, G. P.

*Ecological Modelling* 164 (2-3): 137-152. (2003)

NAL Call #: QH541.15.M3E25; ISSN: 0304-3800

*Descriptors:* Models/ Soil/ Carbon cycle/ Afforestation/ Plantations/ Australia/ Modeling/ mathematics/ computer applications/ Soil

*Abstract:* A credible and cost-effective methodology is needed to support the use of new tree plantations to offset greenhouse gas emissions, and ultimately to form part of an emissions trading scheme. A number of validated models of forest growth are available. However, there has been relatively little validation of models to predict

changes in pools of C in litter and soil, and thus suitable for C accounting. A modelling approach is needed to track changes in soil C because direct measurements are currently cost-prohibitive. Modelling approaches also allow for scenario analyses that can be useful for planning purposes. We used a complete C accounting model for forests, GRC3, to simulate patterns of change in soil C following afforestation under four test cases representing typical conditions in Australia. Soil C was predicted to initially decrease (usually during the first 10 years) before a gradual recovery and accumulation of soil C occurred. Sensitivity analyses were used to determine which parameters and inputs potentially cause the greatest uncertainty in calculated change in soil C using GRC3. Taking into account the uncertainties in the values of parameters and inputs, initial (0-10 years) decrease in soil C was predicted to be 0.96-2.35% per year (or 4.16-14.8 t C ha super(-1)) with a standard deviation between 0.10 and 0.43% per year among case studies, whereas the predicted increase in soil C (10-40 years) was predicted to be between 0.49 and 1.80% per year (or 7.57-24.4 t C ha super(-1)) with a standard deviation between 0.18 and 0.69% per year. Results indicated that uncertainty could be greatly reduced by calibration of the fraction of above-ground litter transferred to soil C (i.e. humification), fraction of C lost by respiration during decomposition of litter, dead roots and soil C, and decomposition rates of the soil C pools. It was also important to obtain accurate input data for initial soil C content (including inert soil C), climatic conditions and allocation of net primary production to various tree components.  
© Cambridge Scientific Abstracts (CSA)

## **28. The Structure and Practice of Water Quality Trading Markets.**

Woodward, R. T.; Kaiser, R. A.; and Wicks, A. M. B.

*Journal of the American Water Resources Association* 38 (4): 967-979. (2002)

NAL Call #: GB651.W315; ISSN: 1093-474X.

Notes: Publisher: Amer Water Resources Assoc

Descriptors: Transferable Discharge Permits/ Nonpoint Source Pollution/ Water Policy/ Regulation/ Decision Making/ Water Quality/ Pollution Control/ Permits/ Externality/ Costs

*Abstract:* The use of transferable discharge permits in water pollution, what we will call water quality trading (WQT), is rapidly growing in the U.S. This paper reviews the current status of WQT nationally and discusses the structures of the markets that have been formed. Four main structures are observed in such markets: exchanges, bilateral negotiations, clearinghouses, and sole source offsets. The goals of a WQT program are environmental quality and cost effectiveness. In designing a WQT market, policy makers are constrained by legal restrictions and the physical characteristics of the pollution problem. The choices that must be made include how trading will be authorized, monitored and enforced. How these questions are answered will help determine both the extent to which these goals are achieved, and the market structures that can arise. After discussing the characteristics of different market structures, we evaluate how this framework applies in the case of California's Grassland Drainage Area Tradable Loads Program.

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### **29. Team Approaches in Reducing Nonpoint Source Pollution.**

Romstad, E.

*Ecological Economics* 47 (1): 71-78. (2003)

NAL Call #: QH540.E26; ISSN: 0921-8009.

Notes: Publisher: Elsevier Science Bv

Descriptors: Nonpoint Source Pollution/ Game Theory/ Environmental Economics/ Incentives/ Enforcement and Monitoring

Abstract: It is technically difficult and costly to monitor nonpoint source pollution. Consequently, most economic instruments directed towards reducing this type of pollution have focused on circumventing the monitoring problem by focusing on readily observable factors. Such instruments include taxes or tradable permits on inputs or other incentives to induce changes in farming practices. One difficulty with such approaches is that the incentives may not be consistent with the primary objectives of the policies-to reduce nutrient runoffs. This paper seeks to identify under what conditions it would be beneficial to apply more direct incentives for reduced nutrient runoffs. Monitoring and enforcement are core issues in this connection. It is still difficult to monitor individual farm field runoffs. Hence, the incentive problems associated with multiple agents emitting to the same recipient need to be resolved. (C) 2003 Elsevier B.V All rights reserved.

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### **30. Three-Dimensional Eutrophication Model for Lake Biwa and Its Application to the Framework Design of Transferable Discharge Permits.**

Yamashiki, Y.; Matsumoto, M.; Tezuka, T.; Matsui, S.; and Kumagai, M.

*Hydrological Processes* 17 (14): 2957-2973. (2003)

NAL Call #: GB651.H93 ; ISSN: 0885-6087.

Notes: Publisher: John Wiley & Sons Ltd

Descriptors: VLES/ very large eddy simulation/ Eutrophication/ Lake Biwa/ Transferable Discharge Permits/ Equations/ Solver

Abstract: The main goal of this study is to evaluate the eutrophication status under different management approaches in a basin, by combining the Biwa3D model (three-dimensional eutrophication analysis model) with several nutrient-reduction cases to calculate their effects on the water quality in Lake Biwa, Japan, and by applying the model to evaluate the cost-effectiveness between different scenarios designed to control eutrophication. A non-hydrostatic hydrodynamic model featuring very large eddy simulation (VLES) concepts, combined with ecological components that consider three types of phytoplankton species, one zooplankton, and nutrient cycling in each grid, is developed as the basic component of the research. Nitrogen and phosphorus loads from 111 sub-basins that supply Lake Biwa are set as the boundary condition for the numerical simulation. The chlorophyll a concentration calculated near the water intake, weighted in proportion to the intake discharge, is set as the water quality index. Transferable discharge permits are introduced for estimating the total reduction cost for achieving the objective water quality. Two types of scenario are tested: one considers the difference in location of nutrient reduction in the north and south basins, and the other ignores this difference. Initially, the effect of nutrient loads on the water quality of Lake Biwa was calculated using the Biwa3D model, using estimated nitrogen and phosphorus loads from the basin as the boundary condition. Transferable discharge

permits were then designed according to the impact factor on each basin calculated by the model in order to compare the cost-effectiveness of the reduction scenarios. It is concluded that consideration of the characteristics of each basin and the distribution of effluent in designing transferable discharge permits reduces the total costs by around 4-25% of that required for achieving the target concentration of chlorophyll a. Copyright (C) 2003 John Wiley Sons, Ltd.  
© Thomson ISI

**31. The time path and implementation of carbon sequestration.**

Feng HL; Zhao JH; and Kling CL

*American Journal of Agricultural Economics* 84 (1): 134-149. (2002)

NAL Call #: 280.8 J822.

Notes: 24 ref

This citation is provided courtesy of CAB International/CABI Publishing.

**32. Tradable Discharge Permit System for Water Pollution: Case of the Upper Nanpan River of China.**

Tao, W.; Zhou, B.; Barron, W. F.; and Yang, W.

*Environmental and Resource Economics* 15 (1): 27-38. (2000); ISSN: 0924-6460

*Descriptors:* Wastewater discharges/ Chemical oxygen demand/ Water pollution control/ Environmental economics/ Permits/ Wastewater Disposal/ Water Pollution Sources/ Economic Aspects/ Receiving Waters/ Economics/ Costs/ Waste disposal/ Pollution control/ Waste water/ Yunnan Province/ China, People's Republic/ Nanpan River/ tradable permits/ Environmental action/ Sources and fate of pollution/ Prevention and control/ Water & Wastewater Treatment/ Freshwater

*Abstract:* A discharge permit system for water pollution of the upper Nanpan River has been tested since 1992. This paper proposed the shift of the current non-tradable permits to tradable permits to attain the same pollution reduction targets at a lower cost. It was found that this river appeared good for trading. A pilot trading program for point sources was then recommended to a smaller trading zone. There would be ten potential trades for chemical oxygen demand discharge, gaining an annual cost-saving of Chinese Yuan 2.4 million, or saving 18.4% of the total annual cost to attain the reduction target without trading. The marginal pollution reduction cost was estimated at Chinese Yuan 959 for one kilogram chemical oxygen demand per day. Meanwhile, 'without trading' and 'with trading' scenarios would bring about 900.9 kg/day and 51.5 kg/day of redundant reduction respectively. The net annual benefit arising from trading, about Chinese Yuan 1.6 million, would still be significant. At last, the study recommended that compliance monitoring and executing institution requirements be kept in mind while designing the program. An information system needs to be established to provide potential participants relevant information. The method of permit allocation and lifespan of permits should also be addressed later.

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**33. Trading poultry litter at the watershed level: A goal focusing application.**

Jones K and D' Souza G

*Agricultural and Resource Economics Review* 30 (1): 56-65. (2001)

NAL Call #: HD1773.A2N6.

Notes: 25 ref

This citation is provided courtesy of CAB International/CABI Publishing.

**34. Transaction Costs and Sequential Bargaining in Transferable Discharge Permit Markets.**

Netusil, N. R. and Braden, J. B.

*Journal of Environmental Management* 61 (3): 253-262. (2001)

NAL Call #: HC75.E5J6; ISSN: 0301-4797.

Notes: Publisher: Academic Press Ltd

*Descriptors:* Marketable Permits/ Non Point Source Pollution/ Transaction Costs/ Source Pollution Abatement/ Nonpoint Pollution/ Efficiency/ Incentives/ River

*Abstract:* Market-type mechanisms have been introduced and are being explored for various environmental programs. Several existing programs, however, have not attained the cost savings that were initially projected. Modeling that acknowledges the role of transactions costs and the discrete, bilateral, and sequential manner in which trades are executed should provide a more realistic basis for calculating potential cost savings.

This paper presents empirical evidence on potential cost savings by examining a market for the abatement of sediment from farmland. Empirical results based on a market simulation model find no statistically significant change in mean abatement costs under several transaction cost levels when contracts are randomly executed. An alternative method of contract execution, gain-ranked, yields similar results. At the highest transaction cost level studied, trading reduces the total cost of compliance relative to a uniform standard that reflects current regulations. (C) 2001 Academic Press.

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**35. Use of multispectral Ikonos imagery for discriminating between conventional and conservation agricultural tillage practices.**

Vina A; Peters AJ; and Ji L

*PE and RS: Photogrammetric Engineering and Remote Sensing* 69 (5): 537-544. (2003)

NAL Call #: 325.28 P56.

Notes: 12 ref

This citation is provided courtesy of CAB International/CABI Publishing.

**36. Water markets and water quality.**

Weinberg, M.; Kling, C. L.; and Wilen, J. E.

*American Journal of Agricultural Economics* 75 (2): 278-291. (May 1993)

NAL Call #: 280.8-J822; ISSN: 0002-9092

*Descriptors:* water quality/ irrigation water/ markets/ water use efficiency/ water allocation/ farm management/ decision making/ drainage/ simulation models/ water policy/ United States

*Abstract:* In addition to improving the allocative efficiency of water use, water markets may reduce irrigation-related water quality problems. This potential benefit is examined with a nonlinear programming model developed to simulate agricultural decision-making

in a drainage problem area in California's San Joaquin Valley. Results indicate that a 30% drainage goal is achievable through improvements in irrigation practices and changes in cropping patterns induced by a water market. Although water markets will not generally achieve a least-cost solution, they may be a practical alternative to economically efficient, but informationally intensive, environmental policies such as Pigouvian taxes.

This citation is from AGRICOLA.

### **37. Watershed management and wetland mitigation: A framework for determining compensation ratios.**

King, Dennis M.; Bohlen, Curtis C.; and Adler, Kenneth J.

Solomons, Md.: Chesapeake Biological Laboratory; 17 p. : ill. (1993)

*Notes:* Cover title. "Review copy." "July 19, 1993." "University of Maryland System draft report #: UMCEES-CBL-93-098." Includes bibliographical references (p. 17).

*NAL Call #:* QH76.K562--1993

*Descriptors:* Wetland conservation---Mathematical models/ Wetland conservation---Government policy/ Watershed management/ Environmental policy---Mathematical models

This citation is from AGRICOLA.

### **38. Watershed nutrient trading under asymmetric information.**

Johansson RC

*Agricultural and Resource Economics Review* 31 (2): 221-232. (2002)

*NAL Call #:* HD1773.A2N6.

*Notes:* 45 ref

This citation is provided courtesy of CAB International/CABI Publishing.

### **39. Watershed Risk Analysis Model for TVA's Holston River Basin.**

Chen, C. W.; Herr, J.; Goldstein, R. A.; Sagona, F. J.; Rylant, K. E.; and Hauser, G. E.

*Water, Air and Soil Pollution* 90 (1-2): 65-70. (July 1996)

*NAL Call #:* TD172.W36 ; *ISSN:* 0049-6979.

*Notes:* Conference: Int. Clean Water Conf.: Clean Water: Factors That Influence Its Availability, Quality and Its Use, La Jolla, CA (USA), 28-30 Nov 1995

*Descriptors:* Water authorities/ water resources/ waste water/ hydrology/ pollution control/ water quality/ watersheds/ River basins/ Hydroelectric power plants/ Holston Basin/ risk/ water pollution control/ decision making/ United States/ Holston River/ modelling/ risks/ General papers on resources/ Prevention and control/ General/ Sources and fate of pollution/ Freshwater pollution/ Environment

*Abstract:* The Electric Power Research Institute has launched a research project to develop a conceptual risk analysis framework for watershed management of point and nonpoint source pollution. The research leads to the design of an engineering model to 1) process and translate water quality data (coliform, BOD, DO, suspended solids, temperature, sediment, etc.) into decision variables (suitability for water contact sports and swimming, fish spawning, fish survival, human consumption of fish, and freedom from algal nuisance, etc.) and 2) predict water quality improvements from proposed management alternatives. Actual development of the model is being carried out with the Tennessee Valley Authority (TVA) for the Holston River watershed. The effort includes

model construction by importation of GIS map files, stringing together existing watershed and reservoir models, calibration of the model, and selection of decision variables and water quality check points. The model calculates hydrology, waste load, water quality and suitability of fish habitats at headwaters. The base case results and improvements after best management alternatives will be compared to the data observed by TVA's River Action Team. The final product will be a user friendly tool that stakeholders can use to find a cost effective method of improving water quality, including market-based pollution trading.

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**40. Wetlands mitigation banks: A developer's investment problem.**

Fernandez, L. and Karp, L.; Berkeley, Calif.: University of California Berkeley, Department of Agric. Resour. Econ (Series: Working Paper Series 713), 1994. 35 p.  
*Notes:* ISSN: 1068-7483; Co-published by: California Agricultural Experiment Station and Giannini Foundation of Agricultural Economics

*NAL Call #:* S1.W6

*Descriptors:* wetlands / land development/ investment/ reclamation/ federal programs/ land policy/ stochastic models/ restoration

This citation is from AGRICOLA.

## Water Quality Trading and Related Issues

**41. Agricultural nonpoint source pollution and economic incentive policies: Issues in the reauthorization of the Clean Water Act --- Water quality.**

Malik, Arun S.; Larson, Bruce A.; Ribaldo, Marc. ; and United States. Dept. of Agriculture. Economic Research Service. Resources and Technology Division. Washington, DC: U.S. Dept. of Agriculture, Economic Research Service, Resources and Technology Division; iv, 14 p. (1992)

*Notes:* Cover title. "November 1992"--P. iii. Includes bibliographical references (p. 12-14).

*NAL Call #:* aTD428.A37M34-1992

*Descriptors:* Agricultural pollution---Government policy---United States/ Water Pollution ---Government policy---United States

This citation is from AGRICOLA.

**42. Albemarle-Pamlico: Case study in pollutant trading -- Most of the nutrients came from nonpoint sources.**

Hall, J. and Howett, C.

*EPA Journal* 20 (1/2): 27-29. (1994)

*NAL Call #:* TD171.U5; *ISSN:* 0145-1189

*Descriptors:* estuaries/ water quality/ pollutants/ nutrients/ nitrogen/ point sources/ nutrient sources/ environmental degradation/ watershed management/ pollution control/ North Carolina/ nonpoint sources

This citation is from AGRICOLA.

**43. At the Crossroads of Control.**

Willey, Z.

*Agricultural Engineering* 72 (3): 12-15. (1991).

*Notes:* 2 fig, 1 tab.

*Descriptors:* Agricultural management/ Economic analysis/ Nonpoint pollution sources/ Water pollution/ Water quality/ Environmental fate

This citation is from AGRICOLA.

**44. Building markets for tradable pollution rights: Ohio River Valley Water Sanitation Commission (ORANSCO), Federal Water Pollution Control Act of 1972.**

Maloney, M. T. and Yandle, B.

In: *Water rights: Scarce resource allocation, bureaucracy, and the environment/* Anderson, T. L.; San Francisco, Calif.: Pacific Institute for Public Policy Research, 1983. pp. 283-320.

*Notes:* ISBN: 0884103897

*NAL Call #:* KF5569.A2W37

This citation is from AGRICOLA.

**45. Can a watershed be managed?**

Johnson, C. R.; Kaunelis, V. P.; and Cave, K. A.

*Water Environment and Technology* 12 (6): 31-33. (2000)

NAL Call #: TD419.W37; ISSN: 1044-9493

*Descriptors:* Catchment hydrology/ Nonpoint source pollution/ Watersheds/ Michigan

This citation is from AGRICOLA.

**46. Charting a new course: Pollutant trading can play a key role in improving water quality.**

Podar, Mahesh and Kashmanian, Richard M.

*Forum for Applied Research and Public Policy* 13: 40-44. (Fall 1998); ISSN: 0887-8218

*Descriptors:* Environmental policy/ Economics/ Water pollution/ Pollution control/

Water quality/ United States

This citation is from AGRICOLA.

**47. Chesapeake nutrient trading needs CWA funding.**

*Water Environment and Technology* 7 (5): 30-34. (1995)

NAL Call #: TD419.W37; ISSN: 1044-9493

*Descriptors:* Environmental programs/ Clean Water Act/ Chesapeake Bay/

Water quality

This citation is from AGRICOLA.

**48. A classroom experiment about tradable permits.**

Kilkenny, M.

*Review of Agricultural Economics* 22 (2): 586-606. (Fall 2000-Winter 2000)

NAL Call #: HD1773.A3N6; ISSN: 1058-7195.

*Notes:* Includes references.

*Descriptors:* rural communities/ permits/ experiments/ teaching methods/ externalities/

costs/ college students/ markets

This citation is from AGRICOLA.

**49. Controlled trading of pollution permits.**

Russell, C. S.

*Environmental Science and Technology* 15 (1): 24-28. (1981)

NAL Call #: TD420.A1E5; ISSN: 0013-936X

This citation is from AGRICOLA.

**50. Cost-effective point-nonpoint trading: An application to the Susquehanna River Basin.**

Horan, R. D.; Abler, D. G.; Shortle, J. S.; and Carmichael, J.

*Journal of the American Water Resources Association* 38 (2): 467. (2002)

NAL Call #: GB651.W315; ISSN: 1093-474X

*Descriptors:* Nonpoint source pollution/ Water quality/ Environmental programs/

Cost benefit analysis/ Watersheds/ Pennsylvania

This citation is from AGRICOLA.

**51. Design and Legality of an Innovative Approach to Nonpoint Source Control.**

Dudek, D. and Wendel, H.

In: Contributed papers and abstracts for the conference on water, laws and management. (Held 17 Sep 1989-22 Sep 1989 at Tampa, Florida.)

Middleburg, Va.: American Water Resources Association; 1989.

*Notes:* AWRA special publication No.89-4.

*NAL Call #:* TD223.A1C66

*Descriptors:* Nonpoint source pollution/ Water pollution/ Water quality/ Environmental programs/ Colorado

This citation is from AGRICOLA.

**52. Differences in social and public risk perceptions and conflicting impacts on point/nonpoint trading ratios.**

Horan, R. D.

*American Journal of Agricultural Economics* 83 (4): 934-941. (Nov. 2001)

*NAL Call #:* 280.8-J822; *ISSN:* 0002-9092 [AJAEB].

*Notes:* Includes references.

*Descriptors:* water quality/ pollution control/ risk/ social costs/ ratios/ stochastic processes/ federal programs/ equations/ United States

*Abstract:* If stochastic nonpoint pollution loads create socially costly risk, then an economically optimal point/nonpoint trading ratio-the rate point source controls trade for nonpoint controls-is adjusted downward (a risk reward for nonpoint controls), encouraging more nonpoint controls. However, in actual trading programs, ratios are adjusted upward in response to nonpoint uncertainties (a risk premium for nonpoint controls). This contradiction is explained using a public choice model in which regulators focus on encouraging abatement instead of reducing damages. The result is a divergence of public and social risk perceptions, and a trading market that encourages economically suboptimal nonpoint controls.

This citation is from AGRICOLA.

**53. Draft framework for watershed-based trading.**

Environmental Protection Agency, Office of Water

Washington, D.C.: U.S. Environmental Protection Agency. (1996)

*Notes:* EPA/800-R-96-001.

<http://www.epa.gov/owow/watershed/framwork.html>

*Descriptors:* Watersheds/ Water quality/ Environmental programs/ Clean Water Act

This citation is from AGRICOLA.

**54. Economic incentives for agricultural nonpoint source pollution control.**

Malik, A. S.; Larson, B. A.; and Ribaud, M.

*Water Resources Bulletin* 30 (3): 471-480. (May 1994-June 1994)

*NAL Call #:* 292.9-Am34; *ISSN:* 0043-1370 [WARBAQ].

*Notes:* Includes references.

*Descriptors:* water pollution/ pollution control/ environmental legislation/ incentives/ economic policy/ Clean Water Act

*Abstract:* The limited success of command-and-control policies for reducing nonpoint source (NPS) water pollution mandated under the Federal Water Pollution Control Act

(FWPCA) has prompted increased interest in economic incentive policies as an alternative control mechanism. A variety of measures have been proposed ranging from fairly minor modifications of existing policies to substantial revisions including watershed-wide polices that rely on economic incentives. While greater use of economic incentive policies, such as environmental bonds and point/nonpoint source trading is being advocated in the reauthorization of the CWA, the expected effects of individual proposals will be modest. The characteristics of NPS pollution, namely uncertainty and asymmetrical information, underscores that there is no single, ideal policy instrument for controlling the many types of agricultural NPS water pollution. Some of the usual incentive-based policies, such as effluent taxes, are not well suited to the task. Individual incentive policies proposed for the reauthorized CWA, such as pollution trading or deposit/refund systems, are not broadly applicable for heterogeneous pollution situations. Economic incentive policies may be appropriate in some cases, and command-and-control policies will be preferable in others and may in fact complement incentive policies.

This citation is from AGRICOLA.

#### **55. Efficiency of U.S. conservation-compliance program.**

Govindasamy, R. and Huffman, W.

*Agricultural Economics* 8 (2): 173-185. (Feb. 1993)

NAL Call #: HD1401.A47; ISSN: 0169-5150 [AGECE6].

Notes: Includes references.

Descriptors: erosion/ control/ erosion control/ soil conservation/ federal programs/ opportunity costs/ losses from soil/ equations/ production costs/ profits/ soil types/ mathematical models/ efficiency/ United States/ Iowa/ cost functions

Abstract: Under the conservation-compliance program, most of the individual producers are forced to cut their soil erosion to 7 t per acre annually irrespective of the marginal cost of controlling soil erosion. In a system where coupons to a ton of soil loss were issued to producers and traded, the marginal cost of controlling soil loss within each soil type and across different soil types would be equalized. An instrumental variable procedure was used to determine the effect of soil erosion on net profits. The results for Iowa show that there is considerable difference in the marginal opportunity cost of controlling soil erosion between soil types. By assigning one ton of erosion to Iowa soil type Downs (5-10% slope) instead of Clarion (2-5% slope), there is a savings of \$5.00 per acre for the society as a whole. The tradable coupon system is not only efficient, but will also bring in more land under soil conservation.

This citation is from AGRICOLA.

#### **56. Estuarine Management from a Global Economic Perspective.**

Bundy, M. M.

*Water Science and Technology* 26 (12): 2735-2739. (1992)

NAL Call #: TD420.A1P7

Descriptors: Estuaries/ Water quality/ Environmental programs/ Watersheds/ Chesapeake Bay

This citation is from AGRICOLA.

**57. Feasibility of point-nonpoint source trading for managing agricultural pollutant loadings to coastal waters.**

Crutchfield, S. R.; Letson, D.; and Malik, A. S.

*Water Resources Research* 30 (10): 2825-2836. (Oct. 1994)

NAL Call #: 292.8-W295; ISSN: 0043-1397 [WRERAQ].

Notes: Includes references.

*Descriptors:* pollutants/ agriculture/ water pollution/ point sources/ pollution control/ water quality/ watersheds/ coastal areas/ feasibility/ United States/ nonpoint source pollution / point source pollution

*Abstract:* A recent focus of water quality policy discussions has been the trading of pollution abatement between point and nonpoint sources. Point-nonpoint trading would allow point sources to sponsor nonpoint source controls rather than install further controls of their own. If nonpoint source loadings are significant and the marginal costs of their control are lower than for additional point source controls, water quality goals could be met at lower cost with trading. We isolate difficulties particular to incentive policies such as point-nonpoint trading and then screen coastal watersheds for those satisfying conditions that play a major role in determining whether trading can improve water quality. We follow the recent Coastal Zone Act Reauthorization Amendments in emphasizing agriculture, the single largest cause of nonpoint source pollution. Our screening analysis provides an initial, empirical assessment of the feasibility of trading for managing agricultural land use to protect coastal water quality. We also illustrate the additional analysis required to quantify the potential for successful trading in those watersheds which meet our screening criteria.

This citation is from AGRICOLA.

**58. Fertile ground: Nutrient trading's potential to cost-effectively improve water quality.**

Faeth, Paul.

Washington, DC: World Resources Institute; viii, 50 p.: ill., map. (2000)

Notes: Includes bibliographical references (p. 47-50).

NAL Call #: TD427.N87-F33-2000; ISBN: 1569731977

<http://www.wri.org/water/nutrient.html>

*Descriptors:* Nutrient pollution of water---United States/ Water quality management---United States

This citation is from AGRICOLA.

**59. Furthering 'beyond-compliance' programs.**

Linett, B.; Hartig, J. H.; Wise, P. L.; Mehan, G. T.; Tosine, H. M.; and Gulezian, G.

*Water Environment and Technology* 10 (11): 63-68. (1998)

NAL Call #: TD419.W37; ISSN: 1044-9493

*Descriptors:* Environmental programs/ Water quality/ Water pollution/ Pollution prevention/ Great Lakes

This citation is from AGRICOLA.

**60. Green evolution: Are economic incentives the next step in nonpoint source pollution control?**

Young, T. F. and Karkoski, J.

*Water Policy* 2 (3): 151-173. (2000); ISSN: 1366-7017

*Descriptors:* Agricultural pollution/ Government policies/ Water pollution control/ Economics/ Environmental incentives/ United States, California/ Water Quality Control/ Nonpoint Pollution Sources/ Agricultural Runoff/ Best Management Practices/ Pricing/ Costs/ Pollution control / Environmental protection/ Selenium/ Pollution legislation/ Pollution (Nonpoint sources)/ Runoff (Agricultural)/ Charges/ Costs/ United States, California/ incentives/ Environmental action/ Water quality control/ Protective measures and control/ Water Quality

*Abstract:* Pollution from agriculture remains one of the United States' most vexing water pollution problems. Conventional wisdom asserts that agricultural pollution control is best accomplished using voluntary 'Best Management Practices', and that quantitative discharge limits and economic incentives are impractical. Recent experience in California demonstrates otherwise. Here, quantitative limits on selenium discharges have been imposed on a regional consortium of farm districts. The consortium has developed a relatively streamlined institutional system that uses tradable discharge permits to enforce the limits. Individual districts use tiered water pricing and other mechanisms to control discharges. Agricultural pollution from the region has decreased.  
© Cambridge Scientific Abstracts (CSA)

**61. Green payments for nonpoint pollution control.**

Horan, R. D.; Shortle, J. S.; and Abler, D. G.

*American Journal of Agricultural Economics* 81 (5): 1210-1215. (1999)

*NAL Call #:* 280.8-J822; ISSN: 0002-9092 [AJAEB].

*Notes:* Paper presented at the annual meeting of the American Agricultural Economics Association, August 8-11, 1999, Nashville, Tennessee. Includes references.

*Descriptors:* pollution control/ incentives/ federal programs/ support measures/ environmental protection/ water quality/ United States/ Clean Water Action Plan  
This citation is from AGRICOLA.

**62. Has the time come to regulate farmers: We already do, but how do we decide what is enough, how clean is clean.**

Allee, D. J. and Dworsky, L. B.

*Water Resources Update* (88): 21-22. (1992)

*NAL Call #:* TD201.U61.

*Notes:* Special issue on the Clean Water Act.

*Descriptors:* Agricultural management/ Environmental Policy/ Clean Water Act/ Pollution control/ Nonpoint source pollution/ Water quality  
This citation is from AGRICOLA.

**63. Implementing domestic tradable permits for environmental protection.**

Organisation for Economic Co-operation and Development.  
Paris, France : Organisation for Economic Co-operation and Development.  
252 p. : col. ill. (1999)

*Notes:* Includes bibliographical references.; ISBN: 9264170227

*Descriptors:* Emissions trading/ Environmental policy/ Economic aspects/  
OECD countries/ Environmental Protection

This citation is from AGRICOLA.

**64. Incentive based conservation policy and the changing role of government.**

Sohngen, Brent  
DeKalb, Illinois.: American Farmland Trust Center for Agriculture in the Environment.  
(1998)

*Notes:* Center for Agriculture in the Environment Working Paper Series: CAE/WP98-6.

NAL Call #: HD256-.W67-no.-98-6

<http://www.aftresearch.org/researchresource/wp/wp98-6.html>

*Descriptors:* Environmental policy/ Water quality/ Economics/ United States

This citation is from AGRICOLA.

**65. Increasing regulators' confidence in point-nonpoint pollutant trading schemes.**

Taff, S. J. and Senjem, N.

*Water Resources Bulletin* 32 (6): 1187-1193. (Dec. 1996)

NAL Call #: 292.9-Am34; ISSN: 0043-1370 [WARBAQ].

*Notes:* Includes references.

*Descriptors:* water pollution/ point sources/ pollutants/ pollution control/ watershed management/ water quality/ costs/ regulation/ uncertainty/ Oregon/ nonpoint sources/ water quality uncertainty/ practice uncertainty/ enforcement uncertainty/ price uncertainty

*Abstract:* One of the principal stumbling blocks to regulatory agencies' adopting pollutant trading schemes is the complex of uncertainties surrounding any change in institutions. This is especially true if nonpoint pollution sources are to be involved along with point sources. Regulators are understandably reluctant to switch from tried-and-true point source permit systems, even if trading schemes can be shown (on paper, at least) to result in lower public expenditures. We propose a set of practical criteria for point- nonpoint pollutant trading systems that promise to increase regulators' confidence that the new system will be equally effective in controlling pollution and at the same time more likely to capture efficiencies in pollution reduction practices.

This citation is from AGRICOLA.

**66. Innovative Water Quality-Based Permitting: A Policy Perspective.**

Downing, D. and Sessions, S.

*Journal of the Water Pollution Control Federation* 57 (5): 358-365. (1985)

NAL Call #: TD419.R47

*Descriptors:* Water quality/ Pollution control/ Water pollution/ Nonpoint source pollution/  
Environmental programs

This citation is from AGRICOLA.

**67. International trading arrangements, the intensity of resource use, and environmental quality.**

Young, M. D.

In: Agriculture and water quality: International perspectives/ Braden, J. B. and Lovejoy, S. B.

L. Rienner: Boulder, Colo., 1989; pp. 197-215.

*Notes:* Includes references.

*NAL Call #:* HC79.W32A37

*Descriptors:* international trade/ environmental policy

This citation is from AGRICOLA.

**68. Lessons learned about the performance of USDA agricultural nonpoint source pollution programs.**

Ribaudo, M. O.

*Journal of Soil and Water Conservation* 53 (1): 4-10. (1998)

*NAL Call #:* 56.8-J822; *ISSN:* 0022-4561 [JSWCA3].

*Notes:* Includes references.

*Descriptors:* water quality/ water pollution/ pollution control/ environmental protection/ federal programs / USDA/ program evaluation/ United States

This citation is from AGRICOLA.

**69. Managing the Water Environment: Prospects for Change.**

Zabel, T. and Rees, Y.

*Water Law* 9 (5-6): 195-203. (1999); *ISSN:* 0959-9754

*Descriptors:* Effluents/ Economics/ Environmental programs/ Water pollution/ United Kingdom

This citation is from AGRICOLA.

**70. A new tool for water quality: Making watershed-based trading work for you.**

National Wildlife Federation.

Montpelier, Vt.: National Wildlife Federation. (1999)

*Notes:* Title from title page of source code document. "June 1999"

Includes bibliographical references.

*NAL Call #:* TD365-.N48-1999

<http://www.nwf.org/watersheds/pdf%5Fdocuments/newtool.pdf>

*Descriptors:* Water quality management/ Watershed management

This citation is from AGRICOLA.

**71. Nonpoint pollution policies and politics: The role of economic incentives.**

Braden, J. B.

*American Water Resources Association Technical Publication Series (TPS)* (88-4): 57-65. (Nov. 1988)

*NAL Call #:* TC401.A5; *ISSN:* 0066-1171.

*Notes:* In the series analytic: Nonpoint pollution: 1988--policy, economy, management, and appropriate technology / edited by V. Novotny. Includes references.

*Descriptors:* pollution by agriculture/ water pollution/ environmental pollution/ control/ programs/ environmental policy/ incentives/ subsidies/ abatement subsidies/ transferable discharge permits  
This citation is from AGRICOLA.

#### **72. Nonpoint sources.**

Line, D. E.; McLaughlin, R. A.; Osmond, D. L.; Jennings, G. D.; Harman, W. A.; Lombardo, L. A. ; and Spooner, J.

*Water Environment Research* 70 (4): 895-912. (June 1998)

*NAL Call #:* TD419.R47; *ISSN:* 1061-4303 [WAERED].

*Notes:* Includes references.

*Descriptors:* water pollution/ groundwater pollution/ pollutants/ pesticide residues/ leaching/ runoff/ pollution control/ low input agriculture/ best management practices/ nonpoint source pollution

*Abstract:* Annual literature review covers multiple aspects of nonpoint source pollution and includes references to articles on pollution trading.

This citation is from AGRICOLA.

#### **73. Nonpoint sources.**

Line, D. E.; Jennings, G. D.; McLaughlin, R. A.; Osmond, D. L.; Harman, W. A.; Lombardo, L. A. ; Tweedy, K. L.; and Spooner, J.

*Water Environment Research* 71 (5): 1054-1069. (Aug. 1999)

*NAL Call #:* TD419.R47; *ISSN:* 1061-4303 [WAERED].

*Notes:* Includes references.

*Descriptors:* water pollution/ groundwater pollution/ groundwater/ surface water/ water quality/ pollutants/ runoff/ leaching/ agricultural land/ agricultural chemicals/ pollution control/ literature reviews/ nonpoint source pollution/ best management practices

*Abstract:* Annual literature review covers multiple aspects of nonpoint source pollution and includes references to articles on pollution trading.

This citation is from AGRICOLA.

#### **74. Optimizing point/nonpoint source tradeoff in the Holston River near Kingsport, Tennessee.**

Podar, M. K.; Jaksch, J. A.; Sessions, S. L.; Crossman, J. C.; Ruane, R. J.; Hauser, G.; and Burmaster, D. E.

In: Perspectives on nonpoint source pollution: Proceedings of a national conference. (Held 19 May 1985-22 May 1985 at Kansas City, Missouri.)

Washington, D.C.: U.S. Environmental Protection Agency, Office of Water Regul and Standards; pp. 417-424 ; 1985.

*Notes:* Includes references.

*NAL Call #:* TD223.P39

*Descriptors:* river water/ water pollution/ point source/ pollution by agriculture/ waste disposal/ biological oxygen demand/ waste water treatment/ simulation models/ Tennessee

This citation is from AGRICOLA.

**75. Options for agricultural nonpoint-source pollution control.**

Ribaudo, M. O.

*Journal of Soil and Water Conservation* 47 (1): 42-46. (Jan. 1992-Feb. 1992)

NAL Call #: 56.8-J822; ISSN: 0022-4561 [JSWCA3].

Notes: Includes references.

Descriptors: pollution/ control/ pollution control/ water pollution/ drainage/ leaching/ runoff/ pesticides/ sediment/ soil conservation/ land policy/ USDA/ land banks/ federal programs/ United States

This citation is from AGRICOLA.

**76. Point-nonpoint effluent trading in watersheds: A review and critique.**

Jarvie, M. and Solomon, B.

*Environmental Impact Assessment Review* 18 (2): 135-157. (1998)

NAL Call #: TD194.6.E56; ISSN: 0195-9255

Descriptors: Watersheds/ Water pollution/ Environmental policies/ Economics/ Nonpoint source pollution

This citation is from AGRICOLA.

**77. Point-nonpoint nutrient trading in the Susquehanna River basin.**

Horan, R. D.; Shortle, J. S.; and Abler, D. G.

*Water Resources Research* 38 (5): 8-1-8/13. (2002)

NAL Call #: 292.8-W295; ISSN: 0043-1397

Descriptors: Water quality/ Nonpoint source pollution/ Pollution load/ Environmental programs/ Market development/ Economics

This citation is from AGRICOLA.

**78. Point/nonpoint source pollution reduction trading: An interpretive survey.**

Letson, D.

*Natural Resources Journal* 32 (2): 219-232. (Spring 1992)

NAL Call #: HC79.E5N3; ISSN: 0028-0739 [NRJOA].

Notes: Includes references.

Descriptors: water pollution/ cost control/ literature reviews/ United States

This citation is from AGRICOLA.

**79. Point-nonpoint source trading for managing agricultural pollutant loadings: Prospects for coastal watersheds.**

Letson, David.; Crutchfield, Stephen R.; Malik, Arun S.; and United States. Dept. of Agriculture. Economic Research Service.

Washington, DC: U.S. Dept. of Agriculture, Economic Research Service; vii, 14 p. : ill., map. (1993)

Notes: Cover title. "September 1993"--P. [iii]. "Water quality."

Includes bibliographical references (p. 13-14).

NAL Call #: A281.9-Ag8A-no.674

Descriptors: Water quality management---United States/ Agricultural pollution---United States/ Nonpoint source pollution---United States

This citation is from AGRICOLA.

**80. Point-Nonpoint Source Trading: Looking beyond Potential Cost Savings.**

Bartfeld, E.

*Environmental Law* 23 (1): 43-106. (1993)

*Descriptors:* Environmental policy/ Laws and regulations/ Water quality/  
Water pollution/ Nonpoint source pollution/ Pollution prevention/ Economics

This citation is from AGRICOLA.

**81. Point/nonpoint source trading program for Dillon Reservoir and planned extensions for other areas.**

Elmore, T.; Jaksch, J.; and Downing, D.

In: Perspectives on nonpoint source pollution: Proceedings of a national conference. (Held 19 May 1985-22 May 1985 at Kansas City, Missouri.)

Washington, D.C.: U.S. Environmental Protection Agency, Office of Water Regulations and Standards; pp. 413-416.; 1985.

*Notes:* Includes references.

*NAL Call #:* TD223.P39

*Descriptors:* water reservoirs/ water pollution/ point source/ pollution by agriculture/  
control/ programs/ water composition and quality/ monitoring/ Colorado

This citation is from AGRICOLA.

**82. Point Sources-Nonpoint Sources Trading in the Lake Dillon Watershed: A final report.**

Northwest Colorado Council of Governments

Frisco, Colo.: Northwest Colorado Council of Governments. (1984)

*Notes:* Final Report 1984. 45 p.

*Descriptors:* Nonpoint source pollution/ Wastewater treatment/ Water pollution/  
Phosphorus/ Eutrophication/ Water quality trading

This citation is from AGRICOLA.

**83. Policy objectives and economic incentives for controlling agricultural sources of nonpoint pollution.**

Horan, R. D. and Ribaud, M. O.

*Journal of the American Water Resources Association* 35 (5): 1023-1035. (Oct. 1999)

*NAL Call #:* GB651.W315; *ISSN:* 1093-474X [JWRAF5]

*Descriptors:* agriculture/ water pollution/ pollution control/ water quality/ economics/  
incentives/ policy/ costs/ USDA/ United States

*Abstract:* In this paper, we review the physical characteristics of agricultural nonpoint pollution and discuss the implications for setting appropriate pollution control objectives and designing incentive-based pollution control policies. First, we discuss that policy objectives must be designed carefully to ensure positive economic net benefits can be expected from pollution control. Next, we review several classes of incentives and recommend the use of design-based incentives (i.e., incentives based on variable input use, management practices, and land use) for controlling nonpoint pollution. Cost-effectiveness requires that incentives elicit three types of responses from farmers: (1) use variable inputs at appropriate levels, (2) adopt appropriate management practices, and (3) make appropriate land use decisions at the extensive margin of production. If a set of incentives fails to induce the correct responses, the resulting runoff levels and

hence ambient pollution levels and damages will be too large relative to policy goals. A review of existing programs suggests that greater program coordination and improved targeting of incentives are needed for further water quality improvements. Alternatively, properly designed market-based systems may be effective alternatives. These systems would reduce overall pollution control costs by allowing markets to allocate point source and nonpoint source control costs more efficiently.

This citation is from AGRICOLA.

**84. Pollution Permits and Markets for Water Quality.**

O'Neill, W. B.

Madison, Wisc.: University of Wisconsin, 1980.

*Notes:* PhD Thesis

*Descriptors:* Water pollution/ Water quality/ Models/ Program planning/ Economics

This citation is from AGRICOLA.

**85. Pronsolino v. Marcus.**

Shosteck, D.

*Ecology Law Quarterly* 28 (2): 327-354. (2001); ISSN: 0046-1121

*Descriptors:* Water pollution/ Nonpoint source pollution/ Water quality/ Clean Water Act/ Pollution load/ Laws and regulations/ Environmental protection/ Environmental policy/ total maximum daily load

This citation is from AGRICOLA.

**86. The regulation of water pollution permit trading under conditions of varying streamflow and temperature Wisconsin permit market system, Transferable Discharge Permits.**

O'Neil, W. B.

*Land Economics* 6: 219-231. (1983)

*NAL Call #:* HD1401.L3; *ISSN:* 0075-7837.

*Notes:* Includes references.

*Descriptors:* Wisconsin

This citation is from AGRICOLA.

**87. The role of education in nonpoint source pollution control policy.**

Ribaudo, M. O. and Horan, R. D.

*Review of Agricultural Economics* 21 (2): 331-343. (Fall 1999-Winter 1999)

*NAL Call #:* HD1773.A3N6; *ISSN:* 1058-7195.

*Notes:* Includes references.

*Descriptors:* water quality/ water pollution/ pollution control/ educational programs/ program evaluation/ profitability/ environmental policy/ United States

*Abstract:* Education is often used to provide producers with information on how to operate more efficiently with current technologies or on profitable new technologies that generate less pollution. While such "win-win" solutions to water quality problems are attractive, we use a simple economic framework to show that education cannot be considered a strong tool for water quality protection. Its success depends on a number

of factors related to profitability and altruism, and "win-win" solutions are not always guaranteed, even when they appear to exist. Evidence suggests that net returns are the chief concern of producers when they adopt alternative management practices. This citation is from AGRICOLA.

**88. Search for the Northwest Passage: The assignment of NSP (non-point source pollution) rights in nutrient trading programs.**

Collentine, D.

*Water Science and Technology* 45 (9): 227-234. (2002)

NAL Call #: TD420.A1P7; ISSN: 0273-1223.

Notes: Special issue on Diffuse/Non-point Pollution and Watershed Management.

Descriptors: Nonpoint source pollution/ Water Pollution/ Water quality standards/ Environmental policy/ Pollution load/ Law and legislation/ Water Quality

This citation is from AGRICOLA.

**89. Simulation of a two-pollutant, two-season pollution offset system for the Colorado River of Texas below Austin.**

Letson, D.

*Water Resources Research* 28 (5): 1311-1318. (May 1992)

NAL Call #: 292.8-W295; ISSN: 0043-1397 [WRERA0].

Notes: Includes references.

Descriptors: river water/ water pollution/ pollutants/ water quality/ environmental impact/ seasonal variation/ simulation models/ mathematical models/ Texas/ pollution control

Abstract: A pollution offset system is a discharge permit system in which transfers are made subject to a restriction that no violations of water quality standards occur at any location. Simulation of a pollution offset system with seasonal variation and multiple pollutants allows for comparison of the savings possible from these design features. A simulation model (Qual-TX) developed by the Texas Water Commission is applied to a case study region near Austin, Texas, yielding impact coefficients for an economic optimization model without investment whose least cost solution represents the theoretical equilibrium of a pollution offset system. The optimization model finds short-run savings of 17.5% for a pollution offset system, as compared to a command and control policy that would also achieve the dissolved oxygen standard. Seasonal variation in permit design produces minimal effects; virtually all savings come from allowing pollution offsets for the two different pollutants.

This citation is from AGRICOLA.

**90. Theory and Practice of Pollution Credit Trading in Water Quality Management.**

Hoag, Dana L. and Hughes-Popp, Jennie S.

*Review of Agricultural Economics* 19 (2): 252-262. (1997)

NAL Call #: HD1773.A3N6; ISSN: 1058-7195

Descriptors: Economics/ Water quality/ Pollution control/ Environmental policy

This citation is from AGRICOLA.

**91. Trading between point and nonpoint sources: A cost effective method for improving water quality --- The case of Dillon Reservoir.**

Elmore, Tom and United States. Environmental Protection Agency. Office of Policy, Planning and Evaluation

Washington, D.C.: U.S. Environmental Protection Agency; 20 leaves: maps. (1984)

*Notes:* Presented at 57th WPCF Conference (New Orleans, La.); Cover title. "The work for this study was funded by a grant." Includes bibliographical references (leaf 20).

*NAL Call #:* TD224.C6T72

*Descriptors:* Water quality management---Colorado---Dillon Reservoir/  
Dillon Reservoir---Colorado

This citation is from AGRICOLA.

**92. Trading in the Tar-Pamlico.**

Hall, J. C. and Howett, C. M.

*Water Environment and Technology* 6 (7): 58-61. (1994)

*NAL Call #:* TD419.W37; *ISSN:* 1044-9493

*Descriptors:* Watershed management/ Water quality/ Nonpoint source pollution/  
Economics/ Laws and regulations

This citation is from AGRICOLA.

**93. Trading on water: Trading can be a cheaper answer to water quality problems, creating a win-win solution for all.**

Greenhalgh, Suzie and Faeth, Paul

*Forum for Applied Research and Public Policy* 16 (1): 71-77. (2001); *ISSN:* 0887-8218

*Descriptors:* Water quality/ Economics/ Environmental policy/ Water pollution/  
Pollution control/ United States

This citation is from AGRICOLA.

**94. Transferable Discharge Permit Trading under Varying Stream Conditions: A Simulation of Multiperiod Permit Market Performance on the Fox River, Wisconsin.**

O'Neil, W. B.

*Water Resources Research* 19 (3): 608-612. (1983)

*NAL Call #:* 292.8-W295

*Descriptors:* Water quality/ Water pollution/ Market development/ Economics/ Planning/  
Environmental programs

This citation is from AGRICOLA.

**95. Transferable Discharge Permits and Economic Efficiency: The Fox River.**

O'Neill, W.; David, M.; Moore, C.; and Joeres, E.

*Journal of Environmental Economics and Management* 10: 346-355. (1983)

*NAL Call #:* HC79.P55J6

*Descriptors:* Water quality/ Economics/ Simulation models/ Water pollution/  
Pollution control

This citation is from AGRICOLA.

**96. The U.S. environmental policy experience: A critique with suggestions for the European community.**

Howe, C. W.

*Environmental and Resource Economics* 3 (4): 359-379. (1993); ISSN: 0924-6460

*Descriptors:* Environmental policy/ United States/ Water quality/ Economics

This citation is from AGRICOLA.

**97. Using historical biological data to evaluate status and trends in the Big Darby Creek Watershed (Ohio, USA).**

Schubauer Berigan, M. K.; Smith, M.; Hopkins, J.; and Cormier, S. M.

*Environmental Toxicology and Chemistry* 19 (4,pt.2): 1097-1105. (2000)

*NAL Call #:* QH545.A1E58; *ISSN:* 0730-7268 [ETOC DK].

*Notes:* In the Special Issue: Ecosystem Vulnerability. Paper presented at the American Society for Testing and Materials-U.S. Environmental Protection Agency-Society of Environmental Toxicology and Chemistry Symposium, August 17-20, 1998, Seattle, Washington. Includes references.

*Descriptors:* watersheds/ watershed management/ biological indicators/ trends/ Ohio

*Abstract:* Assessment of watershed ecological status and trends is challenging for managers who lack randomly or consistently sampled data, or monitoring programs developed from a watershed perspective. This study investigated analytical approaches for assessment of status and trends using data collected by the Ohio Environmental Protection Agency as part of state requirements for reporting stream quality and managing discharge permits. Fish and benthic macroinvertebrate metrics collected during three time periods (1979-1981, 1986-1989, 1990-1993) were analyzed for the mainstem of Big Darby Creek, a high-quality warm-water stream in central Ohio, USA. Analysis of variance of transformed metrics showed significant differences among time periods for six fish metrics. In addition, significant positive linear trends were observed for four metrics plus the index of biotic integrity score, and negative linear trends for two fish metrics. An analysis of a subset of sites paired by location and sampled over the three periods reflected findings using all available data for the mainstem. In particular, mean estimates were very similar between the reduced and full data sets, whereas standard error estimates were much greater in the reduced subset. Analysis of serial autocorrelation patterns among the fish metrics over the three time periods suggests changes in the nature of stressors over time. A comparison within the most recent time period showed significantly better condition for Big Darby mainstem than for Hellbranch Run (the easternmost subwatershed), after adjusting for watershed size. The consistency of paired and nonrandomized results suggested that either type of data might be judiciously used for this watershed assessment. Results indicated that overall biological condition of the mainstem of the Big Darby Creek watershed has significantly improved since the early 1980s.

This citation is from AGRICOLA.

**98. Using Market Incentives to Protect Water Quality in America.**

Willey, Z.

*Water Resources Update* (88): 43-51. (1992)

NAL Call #: TD201.U61.

Notes: Special issue on the Clean Water Act.

Descriptors: Water quality/ Economics/ Pollution control/ Nonpoint source pollution/  
Water quality standards/ Environmental fate

This citation is from AGRICOLA.

**99. Water pollution: Pollutant trading could reduce compliance costs if uncertainties are resolved --- Report to the Chairman, Committee on Public Works and Transportation, House of Representatives.**

United States. General Accounting Office and United States. Congress. House. Committee on Public Works and Transportation.

Washington, D.C.: U.S. General Accounting Office; 15 p. (1992)

Notes: Cover title. "June 1992." "GAO/RCED-92-153." "B-247972.2"--P. 1.

Includes bibliographical references. SUDOCS: GA 1.13:RCED-92-153.

NAL Call #: TD420.U542-1992

Descriptors: United States Environmental Protection Agency---Auditing/  
Water Pollution---United States---Prevention---Cost control/ Water Pollution---  
Government policy---United States

This citation is from AGRICOLA.

**100. Water quality impacts of biochemical oxygen demand under transferable discharge permit programs [Delaware River estuary and Willamette River].**

Brill, E. D. Jr.; Eheart, J. W.; Kshirsagar, S. R.; and Lence, B. J.

*Water Resources Research* 20 (4): 445-455. (Apr. 1984)

NAL Call #: 292.8-W295; ISSN: 0043-1397 [WRERA].

Notes: Includes references.

Descriptors: water composition and quality/ waste water disposal/ transfers/  
regulations/ environmental assessment/ water management/ United States/ rivers/  
Delaware

This citation is from AGRICOLA.

**101. Water Quality Management Simulation Game.**

Chiang, Shin An.

Stillwater, Okla.: Oklahoma State University; 158 p. (1986)

Notes: Thesis (Ph. D.); Includes bibliographic references.

Descriptors: Water quality/ Water quality standards/ Pollution load/ Simulation models/  
Cost analysis

This citation is from AGRICOLA.

**102. Watershed-Based Effluent Trading: The Nonpoint Source Challenge.**

Stephenson, Kurt; Norris, Patricia; and Shabman, Leonard.

*Contemporary Economic Policy* 16 (4): 412-421. (1998)

NAL Call #: HD72.C6; ISSN: 1074-3529

*Descriptors:* Economics/ Water quality/ Pollution control/ Environmental policy

This citation is from AGRICOLA.

**103. Watershed-based permitting: Wave of the future of water quality management.**

Galya, D.; Mitchell, D.; and Gerath, M.

*Environmental Regulation and Permitting* 7 (4): 61-66. (1998); ISSN: 1083-6624

*Descriptors:* Watersheds/ Economics/ Water quality/ Pollution control/

Environmental policy

This citation is from AGRICOLA.

**104. Watershed-based Pollution trading Development and Current Trading Programs.**

McGinnis, S. L.

*Environmental Engineering and Policy* 2 (3): 161-170. (2001); ISSN: 1433-6618

*Descriptors:* Watersheds/ Water quality/ Water Pollution/ Environmental policy/

Water quality standards/ Watershed management

This citation is from AGRICOLA.

**105. The welfare sensitivity of agri-environmental instruments.**

Horan, R. D.; Claassen, R.; and Howe, L.

*Journal of Agricultural and Resource Economics* 26 (2): 368-386. (Dec. 2001)

NAL Call #: HD1750.W4; ISSN: 1068-5502.

*Notes:* Includes references.

*Descriptors:* pollution control/ environmental policy/ emission/ simulation/ welfare economics/ mathematical models/ uncertainty/ comparisons/ efficiency/ social benefits/ fertilizers/ runoff/ statistical analysis

This citation is from AGRICOLA.



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