

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.

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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.

© Thomson ISI

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 CO₂ 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.

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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.

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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.

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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.
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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.

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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.