Appendix 2

Literature

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Literature Review

Sustainability

1. Harrington, Larry. **Sustainability in Perspective: Strengths and Limitations of Farming Systems Research in Contributing to a Sustainable Agriculture**. Journal of Sustainable Agriculture. Volume 5, Number 1-02, pp. 41-59

Abstract: This paper describes issues that face practitioners of farming systems research-extension (FSRE) as they address issues of the sustainability of agriculture. First, several major interpretations of "sustainable agriculture" are discussed; then categories of sustainability problems are presented. Causes of unsustainability are then discussed, with a focus on the interacting roles of population pressure on resources, population growth, poverty, policy, and institutional concerns. Finally, four potential contributions of FSRE towards the sustainability of agriculture are defined and described: "direct," "adaptive", "policy-oriented", and "preventive" and contributions. FSRE has focused on "direct" farm - or community-level interventions, but the "preventive" contributions of new agricultural technologies developed outside of FSRE have been more powerful in the past, and are likely to remain so in the future. New technology "prevents" resource degradation when it: helps alleviate poverty, generates additional off-farm employment and facilitates expanded food production on smaller harvested areas, thus reducing pressures on fragile lands and forest margins. Reasons are presented why FSRE is likely, at best, to make only a limited contribution to agricultural sustainability.

2. Agunga, Robert A. **What Ohio Extension Agents Say About Sustainable Agriculture**. Journal of Sustainable Agriculture. Volume 5, Number 3; 1995, pp169-187

Abstract: Virtually all scientists agree that the ecosystem represents a web of life. Changes in the plant, animal or human sphere are likely to trigger changes in one or more of the spheres and in the ecological system as a whole. Understanding this interconnectedness of life is basic for everyone. Education on the ecological aspects of agriculture is only now being promoted under the rubric of agricultural sustainability. In general, sustainable agriculture enjoins farmers to reduce their usage of petrochemicals on the land. While a few part-time and small-scale farmers are quick to catch on to the new practice, commercial farmers and megafarm operators are still examining the risks involved. Extension agents could play a key role in helping these commercial farmers in their decision-making processes regarding the environment. The question is whether Extension agents understand environmental concepts themselves. This study found that Extension workers in Ohio who responded to the survey lack a firm understanding of sustainable agriculture. While research findings necessary to convince these agents about the scientific basis of agroecology abound, these may not be available to Extension agents. Extension agents have expressed a need for training in sustainable agriculture. It is recommended that The Ohio State University Extension Service organize regular in-service training programs to prepare these agents adequately so that they, in turn, can educate their farmers. In the long run, the study urges agricultural education departments in land-grant universities to include sustainable agricultural education as a part of the curriculum for extension graduates. Finally, the Researcher found that there exists a communication gap between members of the sustainable

agriculture movement and extension agents. This gap must be narrowed through open discussions and increased flow of information in both directions.

3. Francis, Charles, Clive Edwards, John Gerber, Richard Harwood, Dennis Keeney, William Liebhardt, Matt Liebman. **Impact of Sustainable Agriculture Programs on U.S. Landgrant Universities.** Journal of Sustainable Agriculture. Volume 5, Number 4; 1995, pp19-33

Abstract: Emerging societal concerns about resource use, environmental impact, food safety, government support programs and economic equity in agriculture have prompted U.S. landgrant universities to reevaluate priorities and led to some new initiatives in sustainable agriculture. Activities include modifications in classroom curricula and extension program topics, as well as new research directions. The importance of these programs in landgrant universities was evaluated with a mail survey to all states. From over 150 responses to the survey about teaching, research and extension, we found that the perceived impact was greatest on extension and least on classroom teaching. In a comparison of geographic regions of the U.S., the impact (as suggested by ratings) was highest in the Northeast and lowest in the South. We describe in detail 7 university programs the at authors' institutions. Specific activities in these universities include sustainable agriculture centers, competitive grant programs, workshops and classes, new extension and inservice training opportunities, experimental and demonstration farms, revised teaching materials, a new book series and close working relationships with farmer organizations. From these examples, a "model program" is constructed that includes the most successful components from different universities. Given funding and personnel limitations in landgrant universities, we propose future collaboration to maximize cooperation and minimize duplication across state programs. Finally, a list of potential future directions for sustainable agriculture programs in the landgrant universities is proposed. We conclude that impact on landgrant programs has been substantial, but variable among universities in the last few years. There is great potential for cooperative ventures among universities to address both the sustainability of agriculture and the concerns of society.

4. Conner, David, and Jane Kolodinsky. **Can You Teach an Old Dog New Tricks? An Evaluation of Extension Training in Sustainable Agriculture.** Journal of Sustainable Agriculture. Volume 10 Number 4, 1997, page 5-20.

Abstract: This paper examines the results of an evaluation of a training conference in sustainable agriculture for New England extension agents. The results of a survey of participants revealed a polarization among agents in their attitudes and knowledge about sustainable agriculture and participatory learning. These differences in attitudes and knowledge, in turn, had a large effect upon the usefulness and impact of the training. The results indicate that agents with differing attitudes and knowledge have different training needs and that the approach using a single training format for all agents needs to be reconsidered. It concludes with recommendations to planners of future conferences and suggestions of further research.

5. Lyson, Thomas A. **Environmental, Economic and Social Aspects of Sustainable Agriculture in American Land Grant Universities**. Journal of Sustainable Agriculture. Volume 12 Number 2/3, 1998, page 119-130.

Abstract: Agricultural sustainability is challenging 'conventional' or 'mainstream' agriculture as the dominant organizing paradigm for teaching research, and outreach in American land grant universities. However, not all faculty members subscribe to the tenets of sustainable agriculture. This paper examines how a sample of faculty members from all land grant universities in the U.S. view sustainable agriculture. Results show that, in the minds of agricultural academics, agricultural sustainability is closely aligned with enhancing environmental quality. It is less closely tied, for the, to increasing profitability for farmers or with improving the quality of life in rural areas. Results vary be academic discipline and be personal background characteristics.

6. Hanson, James C., Charles S Kauffman, and Anne Schauer. **Attitudes and Practices of Sustainable Farmers, with Applications to Designing a Sustainable Agriculture Extension Program**. Journal of Sustainable Agriculture. Volume 5, Number 4; 1995, pp. 135-156.

Abstract: This report summarizes the attitudes of cultural practices of 398 self-described sustainable farmers from 17 states in 1991 and 1992. A large majority of the surveyed grain farmers and vegetable farmers have reduced their use of inorganic fertilizers and herbices or do not use these chemicals. Many of the producers state that their long term farm goals include the complete elimination of inorganic fertilizers and herbicides. After the transition to sustainable agriculture, a majority of grain farmers thought their yields had increased or remained the same. Principles and approaches consistent with an effective extension program to specifically meet the needs of these sustainable farmers are identified.

Policy and Sustainable Development

6. Schuh, G. Edward And Sandra Archibald. November 1996. "**An Operational Model Of Sustainable Development: Some Thoughts On Getting The Incentives For Public Policy Right**." Proceedings of the Fifth Joint Conference on Agriculture, Food, and the Environment, June 17-18, 1996, Padova, Italy. University of Minnesota, Center for International Food and Agricultural Policy, 1994 Buford Avenue, St. Paul, MN 55108 geschuh@hhh.umn.edu, sarch@hhh.umn.edu

Abstract: As background for addressing agricultural policy and sustainable development issues, we address in this paper some general issues we believe it important to consider in developing a broad and consistent conceptual framework for the analysis of sustainability. The objective of this paper is to propose a comprehensive conceptual framework for bringing sustainability issues into practical public policy formulation. A "people first" view is proposed: one that assumes that the ultimate purpose of natural resources and the economic system is first the well-being of mankind.

Policy and Conservation

7. Bhattarai, Madhusudan And Michael D. Hammig. 1998. "**Environmental Policy Analysis And Instruments For Biodiversity Conservation: A Review Of Recent Economic**

Literature." Clemson University, Department of Agricultural and Applied Economics, Clemson, SC 29634-0355. Mhammig@clemson.edu

Abstract: This paper provides a synthesis of recent literature dealing with the institutional environment, policy framework, and economic instruments used in policy analysis related to the conservation and sustainable use of biodiversity resources. The paper analyzes the economic consequences of alternative policy options and summarizes the application of these economic issues in the formulation of biodiversity protection policy. The paper also concludes that the proper understanding of underlying institutions and, if needed, institutional reforming procedures are also required to provide appropriate incentive structures for conservation and sustainable use of biodiversity resources. Illustrations of these principles and examples are taken from published accounts of biodiversity policy debates and policy implications.

Agricultural Research Design and Policy

8. Rutten, H. 1997. "**Coping With Turbulence; Strategies For Agricultural Research Institutes**." National Council for Agricultural Research/ P.O. Box 20401, 2500 EK The Hague, The Netherlands.

Abstract:
1. Today, after having focused on Research, Extension and Education (the so-called 'REE-triptych') for over a century, the agricultural knowledge system is in a phase of transition. New roads should be taken to establish agricultural knowledge policies that will think ahead - both in the 'theory' and the 'practice' of knowledge processes.

2. Modeling innovation processes along linear perspectives is increasingly less productive; both knowledge-driven models (such as the classical REE concept) and market-driven perceptions are insufficient to implement a fresh and adequate policy of agricultural innovation.

3. Generating knowledge, developing technologies and skills, and innovating are three fundamentally different activities. Agricultural knowledge policies should be designed to create the most favorable conditions for the production of knowledge, the development of technologies and skills, and innovation - both separately and combined.

4. In order for innovation policies to be successful it should be recognized that knowledge is only one of the essential ingredients of successful innovation and that research is only one way of amassing knowledge.

5. Several skills that are essential for researchers to be adequate partners in innovation processes have been given insufficient attention in research training and education. More specifically they include skills in making research designs, alternately applying 'microscopic' and 'wide-angle' perspectives (mixed scanning), and transcending disciplinary boundaries (transdisciplinarity).

6. In 21st century society Dutch agriculture will have the best prospects if it is decided to develop a multiform type of agriculture.

7. In order to develop sustainable agriculture and to improve the vitality of the countryside while at the same time realizing the required system innovations, government activities should not be confined to a policy of creating essential preconditions and supporting social initiative. Rather, the government should also play the role of an innovative entrepreneur - in close cooperation with private enterprise, social organizations and knowledge institutes. In addition, new strategic alliances between private enterprise, social organizations, knowledge institutes, and government bodies will be necessary to shape system innovations.

9. Vickery, John And Luanne Lohr. 1997. **"Sustainability Assessment In Agriculture: Annotated Bibliography And Resource List Of Methods."** University of Georgia, Department of Agricultural and Applied Economics, Athens, GA 30602. jvickery@iapt.org, llohr@agecon.uga.edu

Abstract: Sustainability assessment is fundamental to improving the long-term viability of agricultural systems. A variety of assessment tools have been developed for the practitioner to evaluate sustainability at multiple levels, from field to farm. This report is a compilation of annotated references on assessment methods from published and unpublished sources. Each section contains a methodological description, a list of published sources, and a list of relevant programs and contacts. While not exhaustive, the report presents a range of tools and applications that are currently in use or are in testing for future use.

10. Burt, W.(Ed.) 1993. **"Evaluating Agricultural Research and Productivity in an Era of Resource Scarcity: Symposium sponsored by NC-208**, Impact Analysis and Decision Strategies for Agricultural Research" held at Orlando, Florida, March 4, 1993, Proceedings edited by W. Sundquist.

Policy and Water Quality

11. **Ribaudo, Marc O.** Economics of Water Quality Protection from Nonpoint Sources: Theory and Practice. (mribaudo@ers.usda.gov 202-694-5488). Richard D. Horan, and Mark E.Smith, Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 782 (AER-782).

Abstract: Water quality is a major environmental issue. Pollution from nonpoint sources is the single largest remaining source of water quality impairments in the United States. Agriculture is a major source of several nonpoint-source pollutants, including nutrients, sediment, pesticides,and salts. Agricultural nonpoint pollution reduction policies can be designed to induce producers to change their production practices in ways that improve the environmental and related economic consequences of production. The information necessary to design economically efficient pollution control policies is almost always lacking. Instead, policies can be designed to achieve specific environmental or other similarly related goals at least cost, given transaction costs and any other political, legal, or informational constraints that may exist. This report outlines the economic characteristics of five instruments that can be used to reduce agricultural nonpoint source pollution (economic incentives, standards, education, liability, and research) and discusses empirical research related to the use of these instruments. Keywords: water quality, nonpoint-source pollution, economic incentives, standards, education, liability, research

12. Simpson, T. W. 1998. **A Citizen's Guide to Maryland's Water Quality Improvement Act.** Univ. of MD Coop. Extension, College Park, MD.

13. Smith, V. Kerry ; Schwabe, Kurt A. ; Mansfield, Carol **"Does Nature Limit Environmental Federalism?"** Resources for the Future Discussion Paper: 97/30. 1997

Abstract: This research considers whether the principles developed to analyze the optimal jurisdiction for reproducing public goods can be applied in cases where regulations of private activities provide the primary means to deliver different amounts of public and quasi-public goods. The analysis evaluates how devolution affects the development of benefit cost analyses for regulations and the role of economic versus environmental factors in defining the extent of the regulatory market. Using a study of nutrient control for the Neuse River in North Carolina, the analysis develops area specific measures of the benefits and costs of regulations and illustrates how changes in the composition of the areas allowed to "count" for policy design can affect decisions about the levels of control judged to meet the net benefit test.

14. Lovejoy, Stephen B. ; Hyde, Jeffrey. **"Nonpoint-source pollution defies U.S. water policy."** Forum for Applied Research and Public Policy v. 12 (Winter '97) p. 98-101

Abstract: Runoff from agricultural operations, including fertilizers, pesticides, sedimentation, and animal waste, represents the greatest source of water pollution in the United States. And because nonpoint-source pollution is so difficult to monitor, it will remain the biggest challenge to regulators in charge of cleaning up our waters. In response, the United States Department of Agriculture launched the 1989 Water Quality Initiative to provide the know-how for farmers to meet water-quality goals set by individual states. "These technologies include reduced tillage, integrated pest management, and nutrient and manure testing," say Stephen B. Lovejoy, a professor of agricultural and environmental policy, and Jeffrey Hyde, a graduate research assistant in the Department of Agricultural Economics at Purdue University. And though the 1996 Farm Bill authorizes more than $2.2 billion for conservation, including nonpoint-source pollution programs, the campaign for clean water still faces significant challenges. For one, those who bear the costs of cleanup--farmers--are not the ones who reap economic gains from cleaner water. "Those who benefit the most are the fishermen, swimmers, boaters, and others who are presently not using the water because of nonpoint-source pollution," the authors say.

15. Brooks, K. N., Peter F. Ffolliott, Hans M. Gregersen, K. William Easter. 1994. **"Policies For Sustainable Development: The Role Of Watershed Management.**" The Environmental and Natural Resources Policy Training Project, University of Wisconsin, Madison, WI, USA 53705. Policy Brief 6. kbrooks@mercury.forestry.umn.edu, weaster@dept.agecon.umn.edu

Findings: The basic points made in this policy brief are that:

- Watershed management and upland conservation provide a means to achieve sustainable land and water resource management.
- Poor management of natural resources on watersheds is a major cause of land and water degradation and rural poverty in the world today.

- The main cause of such mismanagement is lack of appropriate policies that encourage application of known watershed management principles and practices, including both structural and vegetation management options.
- Because watershed boundaries seldom coincide with political boundaries, the environmental point of view that favors watershed boundaries often conflicts with the political point of view that logically favors political boundaries.
- The main policy challenge is to move toward greater integration of the two points of view.
- This involves establishing and implementing policies so that people become responsible for the impacts of their actions on others outside their normal decision-making context (internalize the externalities, as economists say).

Policy and History

16. Vande Kamp, Philip And C. Ford Runge. 1994. **"Trends And Developments In United States Agricultural Policy: 1993-1995"**. University of Minnesota, Center for International Food and Agricultural Policy, Dept. of Applied Economics, St. Paul, MN 55108 frunge@dept.agecon.umn.edu

Abstract: A number of factors including budget pressures, emphasis on environmentally sensitive agriculture, emphasis on finding agricultural export markets, and anti-agricultural program sentiment have fueled a climate for change in United States agricultural policy. Whether significant changes will occur depends on the political strength of agricultural interest groups and on the compromises which can be reached between them. Several notable achievements have been accomplished in recent domestic agricultural policy legislation. The 1995 farm bill will define the commodity and conservation programs for the next five years. In addition to domestic developments, there have been history-setting accomplishments in reducing barriers to international agricultural trade. The tri-partite North American Free Trade Agreement became effective January 1, 1994. The Uruguay Round Agreement of the General Agreement on Tariffs and Trade was completed in late 1994 and will become effective in 1995.

17. Tweeten, Luther. 1998. **"Overview Of U.S. Agricultural Policy."** The Ohio State University, Department of Agricultural Economics, tweeten.1@osu.edu

Abstract: Agriculture progresses through four stages of policy: traditional, developing, maturing, and modern. The third or maturing stage of sizeable transfers from taxpayers and consumers to farmers is described at length an 10 implications drawn for the United States and other countries. Among the lessons learned are that government commodity programs once initiated contain much momentum for continuation; that benefits of programs accrue disproportionately to the least disadvantaged among those eligible; that markets work for farm commodities because goods are rival, exclusionary, and transparent; that agricultural market forces are difficult to circumvent; that the least competitive traditional farm commodities are most likely to seek and receive government help; that multilateral trade reform has not been very effective in liberalizing farm trade; that American farm policy has been heavily influenced by populist myths; that economic analysis matters; and that direct payments targeted solely to small farms are essential but politically infeasible to save small farms.

Agricultural Policy

18. Batie, Sandra S. **Green Payments As Foreshadowed By EQIP**. Michigan State University, Dept. Of Agricultural Economics, East Lansing, MI 48824. **Batie@Msu.Edu.** Staff Paper 99-45. July 1998 (Submitted August 1999), 22 Pages; Adobe Acrobat Pdf 92k Bytes.

Abstract: This paper addresses the potential of the Environmental Quality Incentives Program to become the first true green payment program, one which is not directly linked to farm income goals as all conservation programs have been in the past, even in contrast to the Conservation Reserve Program and the now obsolete Agricultural Conservation Program. EQIP is thus discussed as a new generation of conservation programs which are General Agreement on Tariffs and Trade-legal (no payments to farmers which may influence trade) and more targeted to actual agro-environmental problems than the traditional conservation programs. In the next sections, the paper raises two important questions: First, to what extent should green payments substitute for traditional commodity payments, as they are being phased out? If taking water quality problems into account, EQIP does not reach the geographic areas of the highest commodity program payments, although substitution was never intended and has inherent problems. The paper then looks at EQIP as a green payment program, discussing to what extent EQIP reflects the desired characteristics of a GATT-legal green payment program. Three such characteristics are discussed as hurdles for a successful EQIP implementation: a program has to be targeted, tailored and transparent. Additionally, rent-seeking by various private interests, lack of science-based data, agency and farmer inertia and the complexity of the program are all challenges which must be faced. The study concludes with a discussion of the future of green payments.

19. Batie, Sandra S.; Mary A. Schulz; David B. Schweikhardt. **The Environmental Quality Incentives Program: Locally Managing Natural Resources.** Michigan State University, Dept. Of Agricultural Economics, East Lansing, Mi 48824. **Batie@Pilot.Msu.Edu, Schweikh@Pilot.Msu.Edu.** Staff Paper 98-03. March 1998, 15 Pages; Adobe Acrobat Pdf 105k Bytes

20. Batie, Sandra S.; Mary A. Schulz; David B. Schweikhardt. **A Continuation Of Environmental Conservation Policy: The Conservation Reserve Program**. Michigan State University, Dept. of Agricultural Economics. Staff Paper 97-16, March 1997.

21. Runge, C. Ford. **U.S. Farm Policy: Can FAIR Be Fixed?** University of Minnesota, Dept. of Applied Economics, 1994 Buford Avenue, St. Paul, MN 55108. Staff Paper P98-10.

Abstract: In the scheme of things, the 1996 Federal Agricultural Improvement and Reform Act (FAIR) contained important breaks with a tradition of crop-by-crop subsidies dating back to the Agricultural Adjustment Act of 1933. It freed many producers of "program commodities" (maize, grain sorghum, wheat, barley, oats, cotton and rice) from a system of crop-specific base acre accounting, merged these accounts into a single "whole farm base," and allowed production of any but a few crops on these lands. Overall, the freedom to produce in direct response to market forces, rather than on the basis of crop-by-crop subsidies, as well as the budget discipline of predetermined payments, were important steps in the direction of decoupled lump-sum compensation. Yet from the point of view of advocates of policy reform, FAIR represents an

unfinished agenda. A variety of problems and issues remain. First, the coverage of "freedom to farm" is only partial, with numerous commodities left out of the decoupling program. Second, those critical of the distributive impacts of the commodity programs find little to cheer about in the new contracts, and consider the acronym FAIR ironic. Supply responses induced by price levels in the first two years of FAIR have led to substantially lower prices and marketing receipts in 1998. A call has now gone up to resuscitate some form of safety net, such as a return to deficiency payments or an extension and increase in contract payments under the 1996 Act. It is appropriate to move now to finish the unfinished agenda of the 1996 Act by implementing a long term safety net based on some form of revenue assurance (á la Cochrane and Runge, 1992).

22. Babcock, Bruce A.; Terrance M. Hurley; Junjie Wu; Paul D. Mitchell. **The Environmental Effects Of Freedom To Farm.** American Agricultural Economics Association Annual Meeting, August 2-5, 1998, Salt Lake City, Utah. **Dmhurley@Iastate.Edu.** Selected Paper. 1998, 18 pages.

Abstract: The Federal Agriculture Improvement and Reform Act (FAIR) of 1996 ended commodity specific subsidies and resulted in a significant shift in corn and soybean production in 1997. While conservation compliance improved the environmental health of the Central U.S., changes in production due to the FAIR act have tempered these improvements.

Best Management Practices (BMP)

23. Houston, Jack E. ; Sun, Henglun. **"Cost-Share Incentives and Best Management Practices in a Pilot Water Quality Program."** Journal of Agricultural and Resource Economics v24, n1 (July 1999): 239-52

Abstract: This study integrates three biophysical simulators to predict crop yields, water-soil pollution emissions, and farmers' net returns under uncertain weather and market conditions. Multiple-objective programming incorporates farmer attitudes toward voluntary participation under alternate rates of government cost-share subsidies to search for efficient pollution abatement solutions as best management practices (BMPs). Net returns decline an estimated 9.6% when farmers adopt a cost-share program with a $2.50/acre subsidy, while reducing N leaching by 2.7%. For a $10/acre subsidy, N leaching can be reduced by almost 6%, but farmer net returns decline by 15%.

24. DeVuyst, Eric A., Ipe, Viju C. **"A Group Incentive Contract to Promote Adoption of Best Management Practices."** Journal of Agricultural and Resource Economics v24, n2 (December 1999): 367-82

Abstract: The control of agricultural nonpoint source pollution is emerging as a priority of state and national pollution control programs. Best management practices (BMPs) are often proposed as a method of control. Many BMPs are perceived by farmers as having economic disadvantages when compared to conventional management systems. In the absence of tougher environmental restrictions on farmer behavior and complete observability of individual farmer actions, it may be necessary to provide economic incentives to encourage farmer adoption of BMPs within environmentally sensitive watersheds. This study investigates the use of a group incentive

contract to encourage adoption of BMPs. The idea behind the group incentive contract is to compensate farmers for actual damages due to adoption of BMPs while avoiding moral hazard problems and exploiting the correlated risks that farmers in a watershed face. Simulation results indicate that the majority of the nitrate pollution generated by central Illinois corn growers could be eliminated at little or no cost.

25. Weaver, R. D. And Taeho Kim. 1999. **"Targeting Environmental Protection In Agriculture: IPM And BMPs As Environmental Performance Indicators."** American Agricultural Economics Association Annual Meeting, August 8-11, 1999, Nashville, Tennessee. r2w@psu.edu.

Abstract: Nonparametric technical efficiency estimates of potentially polluting input use in soybean and wheat indicate substantial heterogeneity across farms. This implies large costs would be associated with uniform standards or incentives to regulate these inputs. While technical efficiency is not observable, indicators of environmentally beneficial practices are found useful predictors.

26. Govindasamy, Ramu ; Cochran, Mark J. **"The Conservation Compliance Program and Best Management Practices: An Integrated Approach for Economic Analysis."** Review of Agricultural Economics v17, n3 (September 1995): 369-81

27. Yadav, Satya N. ; Wall, David B. **Benefit-Cost Analysis of Best Management Practices Implemented to Control Nitrate Contamination of Groundwater**. Water Resources Research v34, n3 (March 1998): 497-504

28. Ipe, Viju C. **A Group Incentive Program for Farmer Adoption of Best Management Practices**. 1998. University of Illinois

29. Anonymous. **"Best Management Practices for Irrigation."** Publication Number 442-901, posted February 2000. http://www.ext.vt.edu/pubs/farmasyst/442-901a/442-901a.html

Abstract: Increased concern for the deteriorating quality of our nation's waters, such as the Chesapeake Bay, has led each state to adopt and promote nonpoint-source (NPS) pollution control measures. NPS pollution results from runoff, snow melt, or groundwater seepage from industrial, municipal, and agricultural sites. NPS pollution often goes unnoticed; however, it is extremely widespread and makes a significant contribution to our overall water pollution problem.

Virginia's approach to the problem of NPS pollution is primarily through voluntary programs and education of its citizens. Agricultural producers are encouraged to adopt Best Management Practices, called BMPs. BMPs, which include management, structural, and agronomic measures, are sound, common-sense conservation practices that will result in water quality improvements.

While irrigators encounter the same NPS pollution problems that all crop producers face, they can take positive measures to prevent irrigation from contributing to pollution. In addition to

creating problems due to sedimentation, nutrient enrichment, and chemical poisoning, irrigation runoff and excessive leaching represent wasted water and energy.

The links address:
- Design BMPs
- Management BMPs
- Fertigation /Chemigation BMPs

Pollution Control Costs

30. McSweeny, William T. ; Shortle, James S. **"Probabilistic Cost Effectiveness in Agricultural Nonpoint Pollution Control."** PA State U; PA State U. Southern Journal of Agricultural Economics v22, n1 (July 1990): 95-104

Abstract: Conceptual weaknesses in the use of costs of average abatement as a measure of the cost effectiveness of agricultural nonpoint pollution control are examined. A probabilistic alternative is developed. The focus is on methods for evaluating whole-farm pollution control plans rather than individual practices. As a consequence, the analysis is presented in a chance-constrained activity analysis framework because activity analysis procedures are a practical and well developed device for screening farm plans. Reliability of control is shown to be as important as reduction targets in designing farm plans for pollution control. Furthermore, broad-axe prescriptions of technology in the form of Best Management Practices may perform poorly with respect to cost effectiveness.

Policy and Risk

31. Horan, Richard D., Roger Claassen; Joseph Cooper. **"Environmental Risk And Agri-Environmental Policy Design".** American Agricultural Economics Association Annual Meeting, July 30- August 2, 2000, Tampa, Florida.horan@msu.edu, claassen@econ.ag.gov, jcooper@econ.ag.gov, 29 pages; Adobe Acrobat PDF 152K bytes.

Abstract: Agricultural nonpoint pollution is inherently stochastic (e.g., due to weather). In theory, this randomness has implications for the choice and design of policy instruments. However, very few empirical studies have modeled natural variability. This paper investigates the importance of stochastic processes for the choice and design of alternative nonpoint instruments. The findings suggest that not explicitly considering the stochastic processes in the analysis can produce significantly biased results.

Forestry

32. Flamm, Barry R. **Sustainable Forests: It's About Time (Montana).** Journal of Sustainable Forestry. Volume 4 Number 3/4, 1997, page 139-147

Abstract: Forest health should be determined by ecological criteria as opposed to the more limited tree production approach. We must recognize the vital relationships between conserving biological diversity and sustaining forest ecosystems. World-wide forest management practices have too often ignored ecological principles, thereby jeopardizing forest health in the lone-term. Much warranted attention has been given to rain forest problems. Temperate, mountain forests are also threatened, presenting unique sustainability problems. The forests of western Montana are a case in point. Sustainability is, of course, about time, and it is about time that forest management is changed to assure healthy forests for the future.

33. Salleh, M. N. Sustainability: **The Panacea for Our Forestry Ills?** Journal of Sustainable Forestry. Volume 4 Number 3/4, 1997, page 33-43.

Abstract: Fewer than one tenth of tropical forests are being managed on a sustainable basis. Sustainable forest management means managing the forest in such a way as to not irreversibly reduce the potential of that forest to produce all products in subsequent harvests. The United Nations Conference on Environment and Development in Rio resulted in several decisions that are relevant to the future of forestry. The Conference also focused world attention on questions of the environment. One outcome of this increased awareness has been the growing support for eco-labelling, which may provide an opportunity for those countries able to prove their forest products are harvested sustainably. Other economic opportunities present themselves in the utilization for cellulose of tree crops such as rubberwood and oil palm trunks and fronds. Non-wood resources such as rattan also hold promise if we are able to grow them in conjunction with existing tree crops. The roles of tropical forests as carbon sinks require more in-depth study as does the question of what constitutes critical levels of biodiversity. Aesthetic values such as recreational use increasingly require that sufficient buffer zones of unique features be preserved. These challenges demand that the forestry profession becomes more proactive and support major policy changes to address the need for sustainable forest management.

34. James T. Walters, former Extension Associate, Department of Forestry, College of Natural Resources, Virginia Tech and James E. Johnson, Associate Dean of Outreach, College of Natural Resources, Virginia Tech. **"Moving Toward Sustainable Forestry: Strategies for Forest Landowners."** Publication Number: 420-144, posted March 2000. http://www.ext.vt.edu/pubs/forestry/420-144/420-144.html

35. Kays, Jonathan S., Robert Tjaden, **Developing A Forest Management Plan: The Key To Forest Stewardship.** Fact Sheet 625. http://www.agnr.umd.edu/ces/pubs/html/fs625/fs625.html

Abstract: The Elements of a Successful Forest Management Plan: A forest management plan is a working guide to good forest stewardship that allows the landowner to maximize the wildlife,

timber, recreation, aesthetic value, and other benefits of owning woodland. A good plan combines the natural and physiographic characteristics of the woodlot with the interests and objectives of the owner to produce a set of forest management recommendations. This plan, if followed, should transform the forest into one that is enjoyable and productive for the owner and for future generations.

A forest management plan does not need to be a long, complicated document filled with statistics and confusing jargon; the best plans are brief and to the point. Although formats vary, a sound and useful plan contains these essential elements:

1. landowner objectives for the woodlot;
2. individual maps denoting the property's location, boundaries, forest stands, and soil types;
3. forest inventory data;
4. descriptions and recommendations for each forest stand; and
5. a chronology of recommendations.

Plans are typically written for a 10-to 15-year period but should be updated about every 5 years. We will follow a sample forest management plan for the Becker farm to illustrate the steps in developing a plan.

36. Dylan H. Jenkins, Extension Associate, Department of Forestry, Virginia Tech; James E. Johnson, Professor, Department of Forestry, Virginia Tech. **"Sustainable Forestry: A Guide For Virginia Forest Landowners."** Publication Number 420-139, posted September, 1999. http://www.ext.vt.edu/pubs/forestry/420-139/420-139.html

Abstract: The purpose of this publication is to provide private landowners with some basic information about forest management and specifics on how timber harvesting should be conducted to ensure the sustainability of forest resources. This guide is designed to help make informed, knowledgeable decisions about managing forests. It will also help to understand the importance of management planning and how to work with professional foresters and natural resource management agencies.

The links address the following:

- What is Sustainable Forestry?
- Wildlife and Other Special Resources
- Pine or Hardwood?
- Environmental Regulations
- Forest Health
- Tax Considerations
- Planning Your Timber Harvest
- Financial Assistance
- Best Management Practices
- Management Assistance
- Economics of Reforestation
- Education Opportunities

37. James E. Johnson, Associate Dean - Outreach, College of Natural Resources, Virginia Tech; Barry W. Fox, Extension Specialist - Environmental Education, Virginia State University; Gregory K. Evanylo, Extension Specialist – Soil Science, College of Agriculture and Life Sciences, Virginia Tech; Carl E. Zipper, Assistant Professor - Crop and Soil Environmental Sciences, College of Agriculture and Life Sciences, Virginia Tech. **"Natural Resources and Environmental Management A Program Focus of Virginia Cooperative Extension."** Publication Number 420-001, posted September, 1999. http://www.ext.vt.edu/pubs/forestry/420-001/420-001.html.

Abstract: The bulletin describes a few of the pressing natural resource and environmental issues common in Virginia, and how Virginia Cooperative Extension is addressing them through education.

The links address:
- Forestry and Wildlife
- Water Quality Protection and Improvement
- Waste Management and Environmental Quality
- 4-H Natural Resources and Environmental Education
- Mined Land Restoration and Development

38. James E. Johnson, Associate Professor Forestry, Virginia Tech; Greg A. Scheerer, Former Extension Associate, Virginia Tech; George M. Hopper, Professor of Forestry, University of Tennessee; James A. Parkhurst, Assistant Professor of Wildlife, Virginia Tech; Mike King, Associate Professor of Wildlife, University of Tennessee; John C. Bliss, Extension Specialist, Forestry, Auburn University; Kathryn M. Flynn, Extension Specialist, Forestry, Auburn University. **"Managed Forests for Healthy Ecosystems."** This publication is available on-line through the University of Tennessee, and can be accessed at http://www.utextension.utk.edu/pbfiles/pb1574.pdf

39. Brooks, K. N., Hans M. Gregersen; P. F. Ffolliott. 1995. **"Agroforestry Policies Contribute To Sustainable Land Use."** The Environmental and Natural Resources Policy Training Project, University of Wisconsin. Policy Brief 13. Kbrooks@mercury.forestry.umn.edu, hgregers@mercury.forestry.umn.edu

Water Quality and Nutrient Management

40. DeSena, Mary. **"Water quality: Maryland act pioneers comprehensive nutrient management."** Water Environment & Technology v. 11 no5 (May 1999) p. 20-3

Abstract: What has been described as the most comprehensive farm nutrient control legislation in the U.S. was recently enacted by the Maryland General Assembly. Under the state's 1998 Water Quality Improvement Act, just under 15,000 farms are now required to develop and implement a nitrogen and phosphorus-based nutrient management plan.

Nutrient Management

41. Vatn, Arild, et al. **"ECECMOD: An Interdisciplinary Modelling System for Analyzing Nutrient and Soil Losses from Agriculture."** Ecological Economics v30, n2 (August 1999): 189-205

Abstract: This article discusses a set of principles for policy analysis of environmental problems. The main focus is on integrating economic and ecological analyses through a mathematical modelling framework. The paper starts by developing a general model for the study of environmental issues. Principles for operationalizing the model are discussed, and ECECMOD (a new modelling system constructed to analyze pollution from agricultural systems on the basis of these principles) is introduced. Some of the results obtained by ECECMOD are presented to facilitate a discussion about the gains to be obtained by this kind of analysis. The study shows that it is of great importance to combine economic and ecological analyses at a fairly high level of resolution when studying environmental effects of complex systems.

42. Mozaffari, P.M., and J.T. Sims. 1996. **"Phosphorus transformations in poultry-litter amended soils of the Atlantic Coastal Plain."** J. Environ. Qual. 25:1357-1365.

Abstract: Eutrophication is threatening water quality in Delaware's Inland Bays watershed, one of the largest aquatic ecosystems in the Eastern U.S. and also the site of a highly concentrated poultry industry. Since many (>85%) soils in this watershed are now high or excessive in P, better understanding of P transformations in poultry manure amended soils is needed. Our objectives were to determine the influence of poultry manure on P release from three soils from this watershed, on the amount and chemical forms of soil P, and on soil P sorption capacity. Phosphorus release from manure-amended soils was determined in a 110 day leached incubation study using three soils and two manure rates (18 and 36 Mg/ha). Phosphorus was separated into non-occluded (NOC-P), occluded P (OC-P), and calcium bound P (Ca-P) by sequential fractionation. Changes in P sorption capacity were quantified by a P sorption index. Net soluble P (NSP) released from the manured soils ranged from 1.1 to 15.0 mg/kg and was <4% of the total manure P added. Most NSP was in the initial leachate. Soil test P (STP) was increased by an average of 167 and 279 mg/kg at the 18 and 36 Mg/ha rates (6.2 " 0.2 mg STP/Mg manure). Most of the P in the manured soils (63-90%) was in the NOC-P and OC-P fractions. Phosphorus sorption index values decreased by 3-19% and 12-24% at the 18 and 36 Mg/ha rates. Further investigation of the long-term fate of the P in these chemical fractions and of the effect of manuring on the degree of P saturation of soils in this watershed is needed to determine if animal waste management in this watershed should be based on P rather than N.

Contact: jtsims@udel.edu

43. Sims, J.T. 1997. **Agricultural and environmental issues in the management of poultry wastes: Recent innovations and long-term challenges**. P. 72-90. In J. Rechcigl and H.C. MacKinnon (eds.) Uses of by-products and wastes in agriculture. Am. Chem. Soc., Washington, D.C.

Abstract: Modern poultry production systems face a number of complex environmental challenges. Most poultry operations are agricultural in nature, combining animal and crop production. Unfortunately, the inputs of feed and fertilizer required by concentrated animal operations are greater than the outputs in animal products and harvested crops. This often results in large excesses of nutrients on individual farms and in regions where poultry-based agriculture predominates. Many studies have shown that this can result in losses of nitrogen to groundwaters and phosphorus to surface waters, negatively affecting water quality. Other environmental concerns include the fate of trace elements, hormones, antibiotics, and pesticides added to poultry feed. This paper summarizes recent information on the environmental impact of poultry wastes in the U. S., with a particular emphasis on water quality. It also addresses some recent advances in poultry waste management and existing or proposed measures designed to minimize the environmental impacts of poultry based agriculture.

Contact: jtsims@udel.edu

44. Sims, J.T., and A.N. Sharpley. 1999. **Nutrient management for environmental protection: Challenges and changes in the U.S.** Presented at the 1999 Annual Meeting of the Northeast Branch of the American Society of Agronomy and Soil Science Society of America, University of Guelph, Guelph, Ontario, Canada, July 12, 1999.

Abstract: Nutrient management has always been a key component of agricultural planning. Decades of research have developed and refined efficient, economic means to optimize plant nutrition and thus increase crop yields. Government advisory agencies (e.g., Cooperative Extension, USDA Natural Resources Conservation Service) and private agricultural consultants have been able to transfer much of the nutrient management research into best management practices (BMPs) that are well-accepted by farmers today. Concepts such as realistic yield goals, soil testing and plant analysis as predictive and diagnostic tools, selection of the best nutrient sources, nutrient application methods and timings for different crop rotations, and monitoring the success of a nutrient management plan are widely regarded as sensible, cost-effective practices by most farmers. Unfortunately, despite the long-term efforts in research and technology transfer to improve the efficiency of nutrient management, federal and state analyses of ground and surface water pollution consistently identify agriculture as a major nonpoint source of nutrients. These reports, in combination with a series of local or regional events, such as fish kills, nuisance algal blooms, accidental discharges of manures from lagoons into streams and rivers, high nitrate concentrations in aquifers and rivers used as drinking waters, and soil test summaries showing large and increasing percentages of soils rated as "excessive" in P, have heightened public awareness about agriculture's role in nonpoint source pollution. Questions are now arising about the effectiveness of voluntary BMPs in protecting the environment. Close upon these questions has come debate about the need for regulatory programs to ensure that the impacts of agricultural nutrients on water, air, and soil quality are reduced to environmentally acceptable levels. We summarize in this paper some recent changes in the U.S. with regard to nutrient management and the challenges agriculture faces in implementing these changes.

National Efforts to Improve Nutrient Management: Historically, nutrient management planning at the national level has had two major thrusts. First, federal support of research at land grant universities and government research agencies (USDA Agricultural Research Service, US

Geological Survey) has been expected to produce the science-based solutions needed to maximize agricultural productivity while minimizing environmental impacts on air, soils, and waters. Second, advisory agencies, primarily Cooperative Extension and USDA-NRCS have been expected to review the research, extract and modify the most practical and useful options, and transfer this technology to the farm. More recently, due to reductions in the size and the changing mission of government advisory agencies, a greater reliance has been placed on private industry to provide advice on which new BMPs will be most useful to farmers. Advisory agencies continue to play a role, but are clearly moving more in the direction of broader scale nutrient management education and away from individual planning. Further, researchers are ever more reliant upon private industry for funding, which affects not only the direction of their research programs, but the duration. Consequently, it is increasingly difficult to sustain the long-term experiments that are vital to the evaluation of nutrient management BMPs, particularly those that seek to examine innovative practices that may not be practical or profitable in the short-term. Similar changes in the mission of research and advisory agencies have occurred in other countries, such as Canada, the Netherlands, and the U.K.

National legislation and policies to reduce agricultural nonpoint source pollution have also been proposed recently. Most of this legislation has been focused on animal agriculture, which is perceived to be of greatest immediate national concern for water and air pollution (Sharpley et al., 1998). However, it also has ramifications for other nutrient users and producers. Three examples of proposed legislation are: (i) the Animal Agriculture Reform Act (Senator Harkin, Iowa); (ii) the Farm Sustainability and Animal Feedlot Enforcement Act (Representative Miller, California), and (iii) the Poultry Electric Energy Power (PEEP) Act (Senator Roth, Delaware). A central theme is all this legislation has been the desire to address, at a national level, the water quality problems caused by the geographic intensification of animal production. One legislative goal has been to create a "level playing field", through national policies and regulations, that would prevent large animal operations from moving from their current location, often where environmental problems currently exist, to areas with less restrictive local environmental standards. Other goals have been to include more large animal operations, particularly poultry and swine, in permitted, regulatory programs; to assign responsibility for animal waste management to the large integrating companies, as well as to the farmer/contract grower; and to provide alternatives to land application of animal wastes, such as use for energy production (e.g., the PEEP Bill). To date, national legislation addressing nutrient management by animal agriculture, or any other major sources of nutrients (e.g., commercial fertilizers, municipal biosolids and composts) has not passed in the U.S.

National policy initiatives are also underway, again primarily addressing animal agriculture. By far the most significant is the USEPA-USDA Unified National Strategy for Animal Feeding Operations (AFOs), adopted in March of 1999 after lengthy discussion and public review. The nine "guiding principles" in this joint effort between the nation's lead regulatory agency (USEPA) and its lead technical agency for agriculture (USDA) reflect the changing national attitude towards agriculture and nonpoint source pollution:

More Literature on Nutrient Management

45. Beegle, D. 1997. **Nutrient management legislation in Pennsylvania: Who will be affected?** Agron. Facts 40. Pennsylvania State Univ., University Park, PA.

46. Lemunyon, J.L., and R.G. Gilbert. 1993. **Concept and need for a phosphorus assessment tool**. J. Prod. Agric. 6:483-486.

47. Moore, Jr., P. A. 1998. **Best management practices for poultry manure utilization that enhance agricultural productivity and reduce pollution**. P. 89-124. In J. Hatfield and B. A. Stewart (eds.) Animal waste utilization: Effective use of manure as a soil resource. Ann Arbor Press, Chelsea, MI.

48. Sharpley, A.N. 1995. **Identifying sites vulnerable to phosphorus loss on agricultural runoff**. J. Environ. Qual. 24:947-951.

49. Sharpley, A. N., J. J. Meisinger, A. Breeuswma, J. T. Sims, T. C. Daniel, and J. S. Schepers. 1998. **Impacts of animal manure management on ground and surface water quality**. P.173-242. In J. Hatfield and B. A. Stewart (eds.) Animal waste utilization: Effective use of manure as a soil resource. Ann Arbor Press, Chelsea, MI.

50. Sibbesen, E., and A. N. Sharpley. 1997. **Setting and justifying upper critical limits for phosphorus in soils**. P. 151-176. In H. Tunney et al., (eds.). Phosphorus Loss from Soil to Water. CAB International, London.

51. Sims, J. T. 1998. **Phosphorus soil testing: Innovations for water quality protection**. Commun. Soil Sci. Plant Anal. 29:1471-1489.

52. Sims, J. T. 1996. **The Phosphorus Index: A Phosphorus Management Strategy for Delaware's Agricultural Soils**. Fact Sheet ST-05. College of Agricultural Sciences and Cooperative Extension. University of Delaware, Newark, DE.

53. Sims, J. T., B. L. Vasilas, K. L. Gartley, B. Milliken, and V. Green. 1995. **Evaluation of soil and plant nitrogen tests for maize on manured soils of the Atlantic Coastal Plain**. Agron. J. 87:213-222.

54. Sims. J. T. and P. A. Moore, Jr. 1998. **Nutrient management planning: Phosphorus or nitrogen based?** P. 84-93. Proc. Natl. Poultry Waste Mgt. Symp., October 19-21, Springdale, AR. Contact: jtsims@udel.edu

Wetlands Management

55. David Broomhall, Extension Associate, and Waldon R. Kerns, Virginia Tech. "**The Status of Wetlands Management.**" Publication Number 448-106, Posted November 1997. http://www.ext.vt.edu/pubs/waterquality/448-106/448-106.html

Abstract: In recent years America's wetlands have received increasing attention. In 1988 George Bush made the protection of wetlands a campaign issue with his pledged support for a federal wetlands policy of "no net loss" of wetlands.' Increased attention to wetlands protection has caused the public to become more appreciative of the functions that wetlands provide, and has forced a reevaluation of the definition of "wetlands" and what is meant by "no net loss." The federal government has taken the lead role in developing policies to protect wetlands, but the states have quickly followed their lead, and, in many cases, developed policies which have more teeth than federal policies and which provide better protection of wetlands.

The purpose of this paper is three-fold. The first part discusses the functions that wetlands perform and the causes of wetlands changes. The second portion provides an historical synopsis of the evolution of wetlands policy in the United States, including a discussion of the debate over the definition of "wetlands" and the implications for wetlands policy, followed by a discussion of the current state of wetlands policy in Virginia. The paper closes with a discussion of the ways in which economic incentives could be used to strike a balance between responsible development and preservation of wetlands.

Links include:
- Role of Wetlands
- Cause of Wetlands Changes
- Evolution of Wetland Policy
- The Definition of a Wetland
- Virginia's Wetlands Management Programs
- Some Economic Perspectives on Wetlands Management

Note: Chesapeake Bay Information from STAC: "The Scientific and Technical Advisory Committee (STAC) provides scientific and technical guidance to the Chesapeake Bay Program on measures to restore and protect the Chesapeake Bay. As an advisory committee, STAC reports quarterly to the Implementation Committee and annually to the Executive Council. STAC members come primarily from universities, research institutions, and federal agencies. Members are selected on the basis of their disciplines, perspectives, and information resource needed by the Program." http://www.chesapeake.org/home.html

56. Thomas J. Miller, Edward D. Houde and Elizabeth J. Watkins. **Chesapeake Biological Laboratory Perspectives on Chesapeake Bay Chesapeake Bay Fisheries: Prospects for multispecies management and sustainability.** October 1996

Abstract: Fishery resources In the Chesapeake Bay are currently managed as individual species. In this framework the potential effect of the harvest of a species on the ecosystem generally is ignored. However, the Chesapeake Bay supports a multispecies fishery that annually lands finfish and shellfish worth in excess of $100 Million. Over the past 25 years the average annual commercial landing has been approximately 250,000 metric tonnes. Although menhaden and blue crabs represent ninety-five percent, by weight, of the commercial catch in the Bay, statistics show that 59 other species are also caught. The recreational sector also accounts for a large and diverse catch. Furthermore, there have been significant changes in the nature of the fishery. Over

the last one hundred years landings of oysters have diminished greatly, and in their place, landings of blue crab have risen dramatically. Over the same time period landings of anadromous fishes, such as American shad have declined. In contrast, landings of menhaden have risen so that its fishery now accounts for over 80%, by weight, of the total catch.

The multispecies nature of the combined fisheries arises for both technical and biological reasons. Technical interactions, which arise when a fishery targets on one species but catches other species incidently as bycatch, are present in the Chesapeake Bay. For example, 45 species are taken in poundnet fisheries and 53 species are taken in gillnet fisheries. Technical interactions are important considerations in fisheries management as they may limit the ability to regulate overall rates of fishing mortality. Biological interactions, which arise when a targeted species is an important link in a food web, also occur in the Chesapeake Bay. For example the removal of top predators (striped bass, bluefish and weakfish) may have significant impacts on the dynamics of the planktivore species, and thus the plankton community itself. Additionally, harvests of blue crab, spot and croaker have the potential to influence energy and nutrient exchanges between the benthic and pelagic food webs. To address these multispecies interactions several new approaches to fisheries management have been developed. These approaches implicitly account for intra-specific interactions. Ultimately, these approaches may be more compatible philosophically with the ecosystem-level management of the Chesapeake Bay's other natural resources.

We explored the need for and potential of multispecies approaches to the management of fisheries resources in the bay. The evidence suggests that adopting a multispecies approach would be advantageous. Many of the forces that lead to the adoption of multispecies management in other ecosystems are present in the Chesapeake, including concerns over extensive bycatches, and the presence of coupled population dynamics for several components of the ecosystem.

We reviewed multispecies approaches employed elsewhere in the U.S. and worldwide. We identified several broad classes of approach. The most direct approaches were descriptive involving graphical or multivariate statistical approaches such as principal components analysis and state-space time series analysis. These approaches are suitable to identify the extent and importance of the multispecies character of a fishery, but may have limited utility for management. Other approaches are more mechanistic. Examples include closed-form, and simulation models of interacting species, and more holistic models of the entire system. We suggest that multispecies models addressing technical interactions, and those involving descriptive rather than mechanistic approaches are most likely to be successful in the near-term.

However, several approaches such as simulation modeling and multispecies virtual population analysis seem unsuitable management tools for the Chesapeake Bay due to their high demand for data that is not currently available. New research, data collection and database development to correct these shortcomings are strongly recommended.

Our review indicates that several factors currently preclude adopting a multispecies approach in the Chesapeake Bay. Specific areas that must be addressed, which would improve current single-species management and develop the capability to explore the application of multispecies approaches include the need for:

- systematic information on catch and effort for exploited stocks,

- fishery-independent estimates of abundance for principal species in the bay,
- basic life history information,
- detailed knowledge of species interactions (especially predator - prey relationships),
- effects of habitat alteration,
- detailed understanding of multispecies models.

Adopting multispecies approaches to management would be a major shift away from traditional single species management and a major step toward fulfilling the ecosystem management goal of the Bay Program. We are not ready for this step today, but addressing the identified deficiencies will prepare us for multispecies management in the future.

57. Kurt Stephenson, Waldon Kerns, and Len Shabman. **Market-based Strategies for Chesapeake Bay Policy and Management: A Literature Synthesis**. Virginia Tech Hutcheson Hall Blacksburg, VA 24060

Each single species, each bed of Bay grasses, and each individual tributary in the Chesapeake Bay watershed are connected together as parts of a complex web of interactions that make up the Chesapeake Bay ecosystem. Likewise, human activity that makes up social and economic systems and this Bay ecosystem are intertwined. People are dependent on the water and land systems for economic activity, for recreational opportunities, for life support services, and for personal enrichment. In turn, the Bay is affected by human activity in the watershed, sometimes with adverse consequences.

In the past 20 years great strides have been made in the environmental restoration and protection of resources in the Chesapeake Bay. Despite these gains, there is still a widely recognized need for further environmental improvements. Rapid development pressure and population growth throughout the Bay region have placed new demands and more stress on Bay resources. While there is a recognizable need to make further progress in improving the environmental health of the Bay, it is also recognized that further efforts to improve environmental quality will become incrementally more costly to the public and private sectors. This growing concern with the incrementally increasing costs of environmental protection has coincided with common complaints that many existing environmental regulations are too inflexible and too insensitive to individual circumstances and choices. One of the great challenges we face is to better use strategies and mechanisms associated with everyday individual decisions to maintain the balance between the inevitable growth and development of the watershed and the health of the Bay.

Improved environmental quality can be accomplished in a more cost-effective fashion by allowing for more individual discretion in making choices related to the environment, while at the same time increasing and improving environmental protection. A set of policy tools that can be used to better achieve environmental objectives has been termed "market-based" environmental policies. The increased development and use of these policies can assist in bridging the gap between the proponents of environmental protection, economic growth, and individual choice. Potentially, these policies will allow environmental goals to be reached at the least cost to society.

58. Steven Nelson and Paul Elliot. **"Perspectives on Chesapeake Bay. 1994. Advances in Estuarine Sciences."** Chesapeake Research Consortium, Inc.

Abstract: *Perpectives on Chesapeake Bay, 1994* is the fourth in a series of literature syntheses being published by the Chesapeake Bay Program's Scientific and Technical Advisory Committee (STAC). The purpose of the series is to p rovide managers, scientists, legislators, and others with informative summaries on research findings and other issues that bear on the Chesapeake Bay Program's efforts to restore the nation's largest estuary.

This volume consists of four papers. Ranging literally over land, sea, and air, they not only reflect the diversity of scientific inquiry that is shaping the restoration effort but they also reveal the pervasiveness of two common themes. One is that the anthropogenic factor looms large in any scientific inquiry into the workings of the Chesapeake Bay ecosystem, with each paper providing a scientific perspective on the direct and indirect effects of human activity on estuarine structure and function.

59. Thomas R. Fisher and Arthur J. Butt. "**The Role of Nitrogen and Phosphorus in Chesapeake Bay Anoxia.**" Available at: http://www.chesapeake.org/pubs/litsyns/persp94/persp94.html#INT

Abstract: The Scientific and Technical Advisory Committee (STAC) communicates recent scientific work to managers, scientists, and citizens through the Perspectives on the Chesapeake Bay series. These STAC documents summarize scientific work on specific topics germane to Chesapeake Bay restoration. The STAC Education and Communications Workgroup coordinates the selection of topics and suggests authors and reviewers for each project. STAC members, Bay Program technical subcommittees, EPA Chesapeake Bay Program staff, and the general public suggest topics for STAC literature synthesis publications.
http://www.chesapeake.org/stacpubs.html

60. Chimka, C.T., J.N. Galloway, and B.J. Cosby. **Ammonia and the Chesapeake Bay Airshed.** STAC Publication No. 97-1

The 1995 Perspectives series includes individual documents on:

61. Miller, T. J., E. D.Houde and E. J. Watkins. **Chesapeake Bay Fisheries: Prospects for multi-species management and sustainability**(CRC No. 155)
62. Stephenson, K., W. Kerns, and L. Shabman **Market-based Strategies for Chesapeake Bay Policy and Management**(CRC No. 152).
63. Gardner, R.H., M.S. Castro, R.P. Morgan, and S.W. Seagle. **Nitrogen Dynamics in Forested Lands of the Chesapeake Basin** (CRC No. 151).
64. Nelson, S. and P. Elliott (Eds). The 1994 edition of the Perspectives series **Advances in Estuarine Sciences** (CRC No. 147)Dec. 1994. This document includes chapters on:
    - The Role of Nitrogen and Phosphorus in Chesapeake Bay Anoxia. *T.R. Fisher and A.J. Butt*
    - Atmospheric Deposition of Nitrogen and Contaminants to Chesapeake Bay and Its Watershed. *R.A. Valuigura, J.E. Baker, J. Scudlark, and L.L. McConnell*

- Mineralization and Availability of Nitrogen in Organic Waste-Amended Mid-Atlantic Soils. *G.K. Evanylo*
- The Occurrence and Distribution of Pesticides in Chesapeake Bay. *E. Johnson, J.R. Plimmer, R.B. Kroll, and A.S. Pait*

65. The 1992 edition of the Perspectives series **Advances in Estuarine Sciences.** (CRC No. 143) S.J. Nelson, C. McManus, P. Elliott, B. Farquhar, Eds. August 1992. This document includes chapters on:
    - *Hershner, C.* Ecological Functions and Values of Nontidal Wetlands.
    - Groundwater Discharge in Coastal Systems: Implications for Chesapeake Bay. *W.R. Reay and G.M. Simmons, Jr.*
    - Low-Level Effects of Toxic Chemicals on Chesapeake Bay Organisms. *D.A. Wright, J.D. Savitz, and S.I. Hartwell*
    - Fisheries Assessment and Management Synthesis: Lessons for Chesapeake Bay. *W.A. Richkus, S.J. Nelson, and H.M. Austin*

66. The 1990 edition of the Perspectives series **Advances in Estuarine Sciences.** (CRC No. 136) M. Haire and E. Krome, Eds. This document includes chapters on:

    - Coastal Ecosystem Models and the Chesapeake Bay Program: Philosophy, Background, and Status. *R.L. Wetzel and C.S. Hopkinson, Jr.*
    - The Functional Role of Estuarine Benthos. *R.J. Diaz and L.C. Schaffner*
    - Role of Best Management Practices in Restoring the Health of the Chesapeake Bay: Assessments and Effectiveness. *T.A. Dillaha*
    - Developing and Ecological Risk Assessment Strategy for the Chesapeake Bay. *J.Cairns, Jr. and D.R. Orvos*

67. The 1987 edition of the Perspectives series **Advances in Estuarine Sciences**(CRC No. 127) M. Lynch and E. Krome, Eds. December 1987.

Workshop Reports

To provide the Chesapeake Bay Program with expertise in specific areas, STAC organizes and sponsors technical workshops and publishes relevant findings. Past STAC-sponsored workshops have focused on living resources and their habitats, increasing the access of minority institutions to Bay restoration activities, atmospheric loadings to coastal areas, nutrient research evaluation, ecological modeling, wetlands, toxicology, and risk assessment.

68. Sharpley, Andrew (Editor). **Agricultural Phosphorus in the Chesapeake Bay Watershed: Current Status and Future Trends.** April 1998. (hard copies of this document are available from STAC)

69. Houde, E.D., M.J. Fogarty, T.J. Miller.**Prospects for Multispecies Fisheries Management in Chesapeake Bay: A Workshop.** (STAC Publication 98-002) August 1998.

70. Castro, M. S., K.M Eshleman, R. P. Morgan II, S. W. Seagle, R.H. Gardner, and L.F. Pitelka.**Nitrogen Dynamics in Forested Watersheds of the Chesapeake Bay.**(STAC Publication 97-3). June 17-19, 1997.

71. Bachman, L. Joseph, Scott Phillips, Thomas Cronin, Don Boesch, Richard Weismiller.**Watershed Response to Changes in Nutrient Loads: The Best Uses of Monitoring and Modeling.** (STAC Publication 98-1). May 1997.

72. Anonymous. **Integrated Analysis of Chesapeake Bay Monitoring Data.** (STAC Publication 97-002) November 1996.

73. Anonymous. **Habitat and Living Resources Monitoring Data Workshop.** (CRC No. 153) September 1995.

74. Anonymous. **Nutrient Subcommittee-sponsored Research on Nonpoint Sources of Nutrients: 1992-1996.** (CRC No. 154)

75. Hill, Paula, Richard Jachowski, and Harriette Phelps (eds). **Increasing the Access of Minority Institutions to Chesapeake Bay Restoration Activities. Proceedings of a Workshop 7-8 April 1995.** (CRC No. 150c *out of print, available on-line only*)..

76. Hill, Paula, Steve Nelson, and Pam Mason (eds.). **Chesapeake Bay Wetlands Research Recommendations and Program Descriptions, March 1993** (CRC No. 150b).

77. Hicks, Bruce, Elizabeth Watkins, and Paula Hill (Eds.). **Atmospheric Loadings to Coastal Areas: Resolving Existing Uncertainties.** (CRC No. 148). Feb. 1995.

78. Mihursky, Joseph A., and Ann Chaney (Eds.). **Current Approaches for Modeling Estuarine Ecosystem Processes. Proceedings of a Workshop.** (CRC No. 144). June 1991

79. Nelson, Steve, Mike Kemp, and Walter Boynton (Eds.). **New Perspectives in the Chesapeake System: A Research and Management Partnership**(CRC No. 137).

Chesapeake Research Conference Proceedings

80. Hill, Paula, and Steve Nelson (Eds.). **Toward a Sustainable Coastal Watershed: The Chesapeake Experiment.** Proceedings of a Conference 1-3 June 1994. (CRC No. 149).

Chesapeake Research Recommendations

81. Nelson, S., C. Corlett, (Eds.). **Research Recommendations for the Chesapeake Bay Program.**(CRC No. 138). July 1991.

Chesapeake Bay Research Reports

82. Modeling of the Chesapeake Bay: Non-Technical Version. (CRC No. 131b). Chesapeake Bay Program and Scientific and Technical Advisory Committee. February 1990.

83. Modeling of the Chesapeake Bay: Technical Version. (CRC No. 131a). Chesapeake Bay Program and Scientific and Technical Advisory Committee. February 1990.

Chesapeake Bay Directories

- Chesapeake Bay Researchers Directory. Version 3.0 July 1995.
- Directory of Chesapeake Bay Economists (CRC No. 150a) STAC Economics Workgroup 1994.
- Savitz, J., K. Hitchcock, (Eds.). **Chesapeake Basin Research Directory. Who's Who in Chesapeake Bay Research**. Version 2.0. January 1992. (CRC No. 141).

Chesapeake Bay and Chesapeake Bay Water Quality

84. Parker, Henry S.; Wright, Robert J. **"Agriculture and marine environments."** Agricultural Research, Jan 1999, p2, 1p

Abstract: Discusses the concern of the United States Agricultural Service (ARS) scientists about the potential effects of nutrients from agriculture and other sources on the water quality of coastal estuaries such as the Chesapeake Bay. Effects of excessive growth of algae and aquatic plants in the Gulf of Mexico; Highlights of the research related to agriculture and coastal environments by the ARS; Information on ARS' aquaculture program.

85. Comis, Don. **"Protecting the Chesapeake Bay."** Agricultural Research, Jan99, p4, 5p, 6c

Abstract: Focuses on the effort of the United States (US) Agricultural Research Service (ARS) to document the amount of agricultural compounds that reach the Chesapeake Bay. Information on airshed; Investigation on the effects of mixing alum residue from a drinking water treatment plant into chicken litter before applying it to cornfields; Results of a study on how a wetland can filter chemicals from farm runoff before the pollutants reach a bay tributary.

86. Costanza, Robert ; Greer, Jack Affiliation: U MD, 1997 **The Chesapeake Bay and Its Watershed: A Model for Sustainable Ecosystem Management? Frontiers in ecological economics: Transdisciplinary essays by Robert Costanza.** Cheltenham, U.K. and Lyme, N.H.: Elgar; distributed by American International Distribution Corporation, Williston, Vt.

87. Dunn, James W. ; Shortle, James S., PA State U; PA State U **"Agricultural Nonpoint Source Pollution Control in Theory and Practice"** Marine Resource Economics v5, n3 (1988): 259-70

Abstract: The theory of efficient policy instruments for agricultural pollution control has been evolving. Some new developments suggest that policies using financial incentives to encourage desirable farming practices are superior to those focusing on runoff directly or restrictions on farming practices. However, the theoretical models used to derive such results make assumptions about conditions that may not hold. As a result, implementation of the findings of such models is not necessarily routine. This article attempts to summarize these studies and interpret their implications for agricultural nonpoint source pollution control for the Chesapeake Bay.

The Chesapeake Bay and Environmental Policies from *Economic Viewpoint*, 1996
http://www.arec.umd.edu/areces/ev.htm

88. Lichtenberg, Erik. **Conservation Practices to Reduce Bay Nutrients: How Has Agriculture Done?**

Introduction: Agriculture and Nutrient Pollution in the Chesapeake Bay The Chesapeake Bay Agreements of 1983, 1987, and 1992 commit the state of Maryland to restoring the Bay to its former health and productivity by (1) reducing controllable loadings of major pollutants into the Bay and each of its major tributaries to 40 percent below 1985 baseline levels by the year 2000 and (2) capping controllable loadings at 40 percent of the 1985 baseline thereafter. Agriculture plays an important role in current plans for meeting the nitrogen and phosphorous commitments. At present, agricultural sources account for about one- third of total nitrogen loadings and two-fifths of total phosphorus loadings into the Bay (for details, see the Technical Appendix for Maryland's Tributary Strategies, Maryland Department of Natural Resources, March 12, 1996). Agriculture is the biggest non-point source of both nutrients, accounting for over half of nonpoint source nitrogen loadings, and almost two- thirds of nonpoint source phosphorus loadings. In 1995, the State adopted a set of strategies for meeting its nutrient reduction commitments. Those strategies emphasize reductions in point source emissions; they call for upgrades in sewage treatment plants that will limit nitrogen emissions to a little over one-third of the 1985 baseline and phosphorus emissions to only one- tenth of the 1985 baseline. Cutting agricultural emissions is also an important part of the strategies, as Figure 1 indicates. Overall, the Tributary Strategies call for cuts in agricultural emissions of nitrogen and phosphorus of 24 percent and 21 percent relative to estimated 1992 levels. The Tributary Strategies assume that the agricultural emissions cuts can be achieved by persuading larger numbers of farmers to:

- use conservation tillage to reduce erosion and preserve soil moisture, thereby reducing nitrogen runoff;
- plant cover crops to absorb excess nitrogen after crop harvest and to prevent erosion during the winter months;
- implement nutrient management plans such as testing for soil nitrogen that will result in lower fertilizer application rates; and
- implement soil conservation and water quality plans that use a variety of site- specific practices to reduce runoff and erosion on steeply- sloped land.

Farmers will not be required to implement any of these measures. Instead, the strategies rely on voluntary compliance with State and Federal agencies providing technical and financial assistance. How has Maryland fared in reducing nutrient pollution in the Bay? Progress has been made, particularly in curbing point source emissions. By 1994, point source emissions of phosphorus had been cut by 56 percent from the 1985 baseline, while point source emissions of nitrogen had been cut by 35 percent. Some improvement has been observed in Bay water quality as well: total phosphorus in the mainstream Bay appears to have fallen 19 percent by 1990. Unfortunately, nitrogen was estimated to have increased by 2 percent over the same period; and analysis of stream quality monitoring data for the period 1978-1993 conducted by the Maryland Department of Environment suggests upward trends in nitrate and nitrite concentrations in the Susquehanna, Potomac, and Choptank Rivers. The effects of implementing nutrient emissions

reduction measures in agriculture may not become evident for some time, particularly for nitrogen which, transported in shallow groundwater can take as little as a few days, or as much as several decades to travel into the Bay and its tributaries. Thus, it would be helpful to have other ways of gauging progress in implementing the measures called for in the Tributary Strategies. A set of surveys from the University of Maryland's Department of AREC allows estimation of trends in farmers' use of many of these runoff reduction practices over the past decade.

89. Lipton, Doug. **How Valuable Is The Chesapeake Bay?** University Of Maryland At College Park. University Of Maryland Eastern Shore Cooperative Extension Service University. Maryland Eastern Shore. University Maryland College Park

Introduction: In 1989, the Maryland Department of Economic and Employment Development (DEED, now the Department of Business and Economic Development or DBED) roughly estimated the Bay was worth $678 billion. Bay users and lovers may ask what the importance of this number is. After all, estimating the value of the Bay is not a very useful exercise unless we are planning to eliminate it or sell it to foreign investors. In a real-life scenario, the relevant way to use information about the Bay's value is to deter-mine how the value changes with certain environmental management and policy actions. This year, AREC faculty will begin research projects that will look into these issues. If we, as Maryland citizens, are going to spend $200 million each year in federal, state, local, and private monies to restore water quality in the Chesapeake Bay, and an additional $60 million a year to meet the nutrient reduction goal of 40% by 2000, it is important to know the economic benefits we will receive in return. To determine what these benefits are, we must first determine what it is we value about the Bay that will change due to water quality improvements. Most of these items relate to our use of the Bay, including commercial and recreational fishing, boating, swimming, beach use, sightseeing, and waterfront or water-view living. In addition, people who do not use the Bay in any way mentioned above, are still willing to pay something to restore its water quality; this non-use value is known as existence value. Meanwhile, one activity not included in determining the Bay's value is port activity because it does not depend on improved water quality to generate economic benefits.

90. Gardner, Bruce L. **Farm Bill Prospects and Implications.** University Of Maryland At College Park. University Of Maryland Eastern Shore Cooperative Extension Service University. Maryland Eastern Shore. University Maryland College Park.

Introduction: Just about everyone associated with farm policy geared up for the 1995 Farm Bill debate. With Federal support programs for major U.S. commodities expiring this year, Congress, the Clinton Administration and interest groups began to ready their platforms as early as 1993. Environmental interests hoped to build upon the gains they made in the 1985 and 1990 Farm Bills, while the Clinton Administration planned to further a rural development and investment agenda. In the meantime, dairy interests wished to settle unresolved policy issues from 1990, particularly the issue of supply management.

91. Hanson, James C. and Wesley N. Musser. **Federal Farm Commodity Programs and Sustainable Production Systems.** University Of Maryland At College Park. University Of

Maryland Eastern Shore Cooperative Extension Service University. Maryland Eastern Shore. University Maryland College Park.

Introduction: In the past, Federal farm commodity programs have deterred farmers from using sustainable production practices. Research demonstrates that farm programs before 1990 favored conventional rotations that use pesticides and fertilizers over sustainable or more diversified cropping rotations that minimize these inputs. The 1990 Farm Bill had provisions that potentially made sustainable participation easier. The cross compliance provision was eliminated, and a flex-acreage provision was instituted that allowed farmers to plant crops other than the program crop (i.e., corn) and still maintain that program crop's base acres. What would happen under Congressman Pat Roberts' Freedom to Farm proposal? Let's examine the potential impact on farm income and base acres for conventional and sustainable farmers under several scenarios — not participating in government programs, the existing 1990 Farm Program with and without flex acreage, and the Freedom to Farm proposal.

General Ecology

92. Bittermann, Wolfgang ; Haberl, Helmut. **"Landscape-Relevant Indicators for Pressures on the Environment."** Innovation 1998, 11, 1, Mar, 87-106.

Abstract: The operationalization of sustainable development requires indicators that can serve as information tools for the appraisal of the environmental consequences of socioeconomic development. These indicators should cover three main areas: (1) pressures of the socioeconomic system on the environment; (2) the state of the environment; & (3) socioeconomic responses, ie, activities to alleviate environmental problems. The indicators are discussed in light of two approaches for the description of the interaction between socioeconomic systems & their natural environment: (A) socioeconomic metabolism, ie, the mode in which societies organize their exchange of matter & energy with their natural environment; & (B) the colonization of nature, defined as the conundrum involving strategies employed to transform parts of the environment to render them more useful for societal needs. Four examples for indicators of sustainable development are presented for the case of Austria nutrient balances, manure management, energy consumption of crop farming, & appropriation of net primary production. These & similar indicators can be the basis for the development of spatially disaggregated sectoral ecobalances, which are necessary for an integrated economic & ecological assessment of the economic branches with the highest relevance for the sustainable development of cultural landscapes.

Economics and Ecology

93. Weersink, Alfons et al. **"Economic Instruments and Environmental Policy in Agriculture."** Canadian Public Policy v24, n3 (September 1998): 309-27

Abstract: Economic instruments can achieve environmental goals at least cost and provide incentives for further improvements. There are limited opportunities for the use of such instruments in agriculture where the pollution problems can be traced as in the case of intensive livestock operations. However, most environmental problems in agriculture involve a large number of diffuse pollution sources whose abatement practices are unobservable rendering it

difficult to achieve cost-effective pollution control with any single instrument. Rather than relying on first-best solutions through economic instruments, the most effective way of dealing with diffuse source pollution problems in agriculture may be technological developments and business-led initiatives.

94. Simpson, R. David ; Christensen, Norman L., Jr., eds. **Ecosystem function and human activities: Reconciling economics and ecology.** New York; London and Toronto: International Thomson, Chapman and Hall.

Abstract: Twelve papers, resulting from a workshop held by the Renewable Natural Resources Foundation in October 1995, present views of economists, ecologists, and other social and natural scientists on the Chesapeake Bay ecosystem evaluating tradeoffs between economic growth and ecological health. Norman L. Christensen Jr. and Jerry F. Franklin consider ecosystem function and ecosystem management. Michael A. Toman provides an overview of the issues and uncertainties of ecosystem valuation. Steven M. Bartell discusses ecological risk assessment and ecosystem valuation. Walter R. Boynton examines estuarine ecosystem issues on the Chesapeake Bay. Curtis C. Bohlen and Rupert Friday provide a landscape management perspective on riparian and terrestrial issues in the Chesapeake. Grace S. Brush focuses on the history and impact of human activities on the Chesapeake Bay. Jacqueline Geoghegan and Nancy Bockstael consider issues of human behavior and ecosystem valuation in an application to the Patuxent watershed of the Chesapeake Bay. Henry M. Peskin focuses on "green" accounting for the Chesapeake Bay. Timothy M. Hennessey discusses the institutional design for the management of estuarine ecosystems, focusing on the Chesapeake Bay Program. Dennis F. Whigham contrasts ecosystem functions or processes and ecosystem values. A. Myrick Freeman III offers some thoughts on valuing the services and functions of ecosystems. Michael K. Orbach explores the role of the social sciences in incorporating human values into the process of decision making in public policy. Simpson is Fellow at Resources for the Future in Washington, D.C. Christensen is Dean and a professor in the Nicholas School of the Environment at Duke University

Water Quality Management

95. Schwabe, Kurt A. **"Modeling State-Level Water Quality Management: The Case of the Neuse River Basin."** Resource and Energy Economics v22, n1 (January 2000): 37-62

Abstract: This research considers how the perceived costs of achieving water quality objectives are sensitive to three issues surrounding model structure and policy design. These issues include: (i) the extent of the regulated market, (ii) the responsibility of the regulated market for background pollution, and (iii) the use of alternative policy instruments. A large-scale process model is used to evaluate and compare the costs of nutrient reduction in the Neuse River Basin in North Carolina under various instruments, including a plan currently being considered by state regulators. The results emphasize the importance of flexibility in both model structure and policy design.

Farmer Behavior

96. Cooper, Joseph C. **"Combining Actual and Contingent Behavior Data to Model Farmer Adoption of Water Quality Protection Practices."** Journal of Agricultural and Resource Economics v22, n1 (July 1997): 30-43.

Abstract: Using farmer responses to contingent valuation method (CVM) survey data in combination with actual market data from four watershed regions in the United States, this study estimates the minimum incentive payments a farmer would accept in order to adopt more environmentally friendly "best management practices (BMPs). Combining actual market data with the CVM data adds information to the analysis, there-by most likely increasing the reliability of the results compared to analyzing the contingent behavior survey response data only. Given the decision to adopt, the article also presents a pooled model for the number of acres enrolled in the BMPs as a function of the incentive payments. Adoption rates predicted with the combined data model are significantly higher over a wide range of offers than those predicted using the traditional discrete choice analysis with the hypothetical data only. Hence, using the traditional CVM analysis results to determine payments to attain a given level of adoption may result in over-payment.

97. Amacher, Gregory S. ; Feather, Peter M. **"Testing Producer Perceptions of Jointly Beneficial Best Management Practices for Improved Water Quality."** Applied Economics v29, n2 (February 1997): 153-59

98. Traore, Namatie ; Landry, Rejean ; Amara, Nabil. **"On-farm Adoption of Conservation Practices: The Role of Farm and Farmer Characteristics, Perceptions, and Health Hazards."** Land Economics v74, n1 (February 1998): 114-27

Abstract: The research reported in this paper concerns (1) Quebec potato farmers and the factors that compose their concern for environmental degradation and (2) the adoption of conservation practices using a two-stage decision-making process. The surveyed farmers are concerned mainly with the problem of pest infestation. Their awareness of environmental problems is raised by the level of educational attainment, membership in producers' organizations, and participation in government sponsored farm programs. The actual adoption of conservation practices by farmers is influenced by the extent to which they perceive environmental degradation to be a problem, their educational level, the expected crop loss to pests and weeds, the perceived health effects of farm chemicals application, and the availability of adequate information on the best management practices.

99. McCann, Laura M. J. ; Easter, K. William. **"Differences between Farmer and Agency Attitudes Regarding Policies to Reduce Phosphorus Pollution in the Minnesota River Basin."** Review of Agricultural Economics v21, n1 (Spring-Summer 1999): 189-207

Abstract: Farmers and agency staff were surveyed regarding their opinions on alternative policies to reduce agricultural nonpoint source pollution in the Minnesota River. Farmers were also asked about their land and nutrient management practices. The information was used to

examine determinants of policy preferences. For agency staff, farmer resistance and administrative or transaction costs were more important than farmer costs. Both agency staff and farmers indicated that their preferred policy was a requirement for conservation tillage on highly erodible land. Changes in how soil test results are reported may have potential to reduce phosphorous applications, as would improved manure management.

Pfiesteria

Papers Available at http://www.agnr.umd.edu/pfiesteria/agpros.htm

100. Anonymous. **Agriculture and Its Relationship to Toxic Dinoflagellates in the Chesapeake Bay.** November 27, 1997. College of Agriculture and Natural Resources. University of Maryland.

(A group of 10 scientists, chaired by Dean Fretz, met on October 7, 1997, to review relevant issues and to develop a format for completing the assignment. Review and writing teams were established and charged with drafting this document by October 13, 1997. The Scientific Advisory Committee met twice more to review progress and discuss possible recommendations. This document forms the basis of much of Dean Fretz's verbal testimony.)

Although the evidence is circumstantial and inconclusive at this point, it has been suggested that nutrients lost from agricultural operations through runoff and leaching may be partially responsible for the recent outbreaks of Pfiesteria-like organisms in the lower Pocomoke River and several other rivers on the lower Eastern Shore. Nutrients enter water from many sources. Nutrients added to land, however, may represent a significant source of aquatic nutrients. Sewage sludge, septic tank effluent, organic manufacturing waste, and animal manures contain high concentrations of nitrogen and phosphorus. Most of this material is recycled onto land for disposal.

In response to a request by Commission Chair and former Governor Harry Hughes, Thomas A. Fretz, Dean of the College of Agriculture and Natural Resources, brought together a panel of regional experts in nutrient and animal management not only to examine the most current information related to nutrient losses, but to develop a strategy for reducing those losses. While the relationship between the outbreak of Pfiesteria and nutrient loading into aquatic systems remains unclear, the agricultural community recognizes the need to take action. Thus, a primary goal of this document is to review current practices and recommend methods for controlling losses of nutrients, especially phosphorus, from agricultural land.

This document contains scientific background information for the comments presented to former Governor Harry Hughes and the Blue Ribbon Commission. To the extent possible, we have attempted to discuss the level of uncertainty and the potential for recommended practices to contribute to reducing nutrient losses--especially soluble phosphorus--from land. In addition, we also discuss the length of time (immediate, short term, long term) required for implementing practices.

101. Fretz, T. A. **Notes for Dean Thomas A. Fretz's Presentation Before the Commission on Pfiesteria in the Chesapeake Bay.** October 17, 1997. College of Agriculture and Natural Resources. University of Maryland.

102. Fretz, T. A. **Slides from Dean Fretz's Presentation** - October 17, 1997. College of Agriculture and Natural Resources. University of Maryland.

103. Musser, Wesley N. and Edward T. Mallinson. **Economic Impact of Potential Avian Influenza Outbreak in the Delmarva Region.** Department Of Agricultural And Resource Economics. Fall 1996. Vol. 1 No. 2. University Of Maryland At College Park. University Of Maryland Eastern Shore Cooperative Extension Service.

Introduction: The broiler industry is one of the most important in the Delmarva Region, which includes Delaware, the Eastern Shore of Maryland, and the Eastern Shore of Virginia. Avian influenza (AI) is a persistent threat to this industry because of the large number of migrating waterfowl and shore birds, the AI contaminated Northeastern livebird auction markets, and the extraordinary density of poultry on the Delmarva. Previous outbreaks in Pennsylvania and other states and the current epidemic in Mexico demonstrate the loss of birds and production that accompanies AI. Information on the economic consequences of a Delmarva outbreak is important for industry and public decision- makers to evaluate disease prevention practices and establish operational and financial priorities. This paper presents estimates of the economic costs from an AI outbreak. Using production losses in Pennsylvania, the potential effects of an AI outbreak in Delmarva are estimated in terms of regional economic output, aggregate income, and employment. While it is recognized that other economic and social impacts are important, the estimates presented here are useful benchmarks for further discussion and analysis on this issue.

104. Maryland Department of Natural Resources. **Special Report of the Technical Advisory Committee on Harmful Algal Outbreaks in Maryland: Causes and Significance of Menhaden Lesions.** February 12, 1999.
http://www.dnr.state.md.us/bay/pfiesteria/98_lesion.html

Executive Summary: Members of Maryland's independent technical advisory committee on harmful algal outbreaks met together with regional experts in fish pathology and ecology to assess existing information regarding the causes of lesions found on menhaden and other fish, thought to be related to toxic outbreaks of Pfiesteria piscicida. In 1997 and 1998, lesions were found on only a small fraction of the young-of-the-year menhaden, particularly in smaller tidal rivers and creeks along the Eastern Shore and the Rappahannock and Great Wicomico Rivers in the Chesapeake Bay. The larger and deeper lesions found are ulcers developed as a result of fungal and bacterial infections and the defensive responses of the fish's cells. Fungal infections were not found on the smallest lesions and few fish collected from kills in which Pfiesteria was implicated have been examined for fungal infections. Consequently, Pfiesteria toxins, which have been demonstrated to erode the skin (epidermis) of fish in laboratory experiments, cannot be ruled in or out as initiators of fresh lesions or deep ulcers. The development of lesions is not required for Pfiesteria toxins to kill fish, consequently the uncertainty surrounding the causes of lesions does not call into question the linkages among fish kills, human health risks and toxic Pfiesteria outbreaks. This uncertainty does, however, mean that the prevalence of fish lesions

alone should not be considered a reliable indicator of toxic Pfiesteria outbreaks. Development of molecular methods offers the promise of a more timely and reliable detector of Pfiesteria and its toxins for protection of public health. In addition, experimental research on the modes of fungal infection and progression of ulcer formation would help resolve the existing uncertainties regarding their relationships to Pfiesteria and improve our limited understanding of the effects of these maladies on fish populations.

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The Chesapeake Bay and Environmental Policies: Economic Viewpoint, 1996
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167. Lipton, Doug. **How Valuable Is The Chesapeake Bay?** University Of Maryland At College Park. University Of Maryland Eastern Shore Cooperative Extension Service University. Maryland Eastern Shore. University Maryland College Park

Introduction: In 1989, the Maryland Department of Economic and Employment Development (DEED, now the Department of Business and Economic Development or DBED) roughly estimated the Bay was worth $678 billion. Bay users and lovers may ask what the importance of this number is. After all, estimating the value of the Bay is not a very useful exercise unless we are planning to eliminate it or sell it to foreign investors. In a real-life scenario, the relevant way to use information about the Bay's value is to deter-mine how the value changes with certain environmental management and policy actions. This year, AREC faculty will begin research projects that will look into these issues. If we, as Maryland citizens, are going to spend $200 million each year in federal, state, local, and private monies to restore water quality in the Chesapeake Bay, and an additional $60 million a year to meet the nutrient reduction goal of 40% by 2000, it is important to know the economic benefits we will receive in return. To determine what these benefits are, we must first determine what it is we value about the Bay that will change due to water quality improvements. Most of these items relate to our use of the Bay, including commercial and recreational fishing, boating, swimming, beach use, sightseeing, and waterfront or water-view living. In addition, people who do not use the Bay in any way mentioned above, are still willing to pay something to restore its water quality; this non-use value is known as existence value. Meanwhile, one activity not included in determining the Bay's value is port activity because it does not depend on improved water quality to generate economic benefits.

168. Gardner, Bruce L. **Farm Bill Prospects and Implications.** University Of Maryland At College Park. University Of Maryland Eastern Shore Cooperative Extension Service University. Maryland Eastern Shore. University Maryland College Park.

Introduction: Just about everyone associated with farm policy geared up for the 1995 Farm Bill debate. With Federal support programs for major U.S. commodities expiring this year, Congress, the Clinton Administration and interest groups began to ready their platforms as early as 1993. Environmental interests hoped to build upon the gains they made in the 1985 and 1990 Farm Bills, while the Clinton Administration planned to further a rural development and investment agenda. In the meantime, dairy interests wished to settle unresolved policy issues from 1990, particularly the issue of supply management.

169. Hanson, James C. and Wesley N. Musser. **Federal Farm Commodity Programs and Sustainable Production Systems.** University Of Maryland At College Park. University Of Maryland Eastern Shore Cooperative Extension Service University. Maryland Eastern Shore. University Maryland College Park.

Introduction: In the past, Federal farm commodity programs have deterred farmers from using sustainable production practices. Research demonstrates that farm programs before 1990 favored conventional rotations that use pesticides and fertilizers over sustainable or more diversified cropping rotations that minimize these inputs. The 1990 Farm Bill had provisions that potentially made sustainable participation easier. The cross compliance provision was eliminated, and a flex-acreage provision was instituted that allowed farmers to plant crops other than the program crop (i.e., corn) and still maintain that program crop's base acres. What would happen under Congressman Pat Roberts' Freedom to Farm proposal? Let's examine the potential impact on farm income and base acres for conventional and sustainable farmers under several scenarios — not participating in government programs, the existing 1990 Farm Program with and without flex acreage, and the Freedom to Farm proposal.

Books – Agricultural Research

170. Firstenberg, Paul B. **The twenty-first century nonprofit: Remaking the organization in the post-government era**. New York: Foundation Center, 1996

Abstract: Presents management concepts and practices applicable to the nonprofit organizations, which have been adapted from the "best practices" of business and nonprofits. Discusses the role of nonprofits in a changing America, where the government's ability to provide effective social, educational, cultural, and welfare programs is under challenge and where there have been sharp reductions in government funding for many nonprofits. Argues that to achieve a more effective, more efficient level of performance, in many cases, will require remaking the organization. Discusses the productivity imperative; approaches to restructuring; how to carve out a strategic niche; systems redesign; downsizing; the merger option; performance management; and the components of an internal reporting system for depicting performance and financial condition to management and the board. Describes how tax exempt organizations can expand their present revenue base by using a marketing approach to fundraising and by finding ways to generate earned income. Also addresses the conversion of a nonprofit corporation to a for-profit business enterprise. Discusses the management of human resources; the foundations of effective governance; and models of effective leadership. Firstenberg is a partner in the investment banking and advisory firm Zuckerman, Firstenberg and Associates.

Books – Agricultural Policy

171. Just, Richard E. ; Bockstael, Nancy, eds. **"Commodity and resource policies in agricultural systems."** Agricultural Management and Economics series New York; Berlin; London and Tokyo: Springer, 1991

Abstract: Nineteen papers examine commodity and resource policies in agricultural systems. Contributions focus on the problems confronting the joint formulation of commercial agricultural

and resource policies; the evolution and coordination of U.S. commodity and resource policies; state regulations for agricultural chemical use; policy failures arising from multiple jurisdictions; the effects of commodity program structure on resource use and the environment; the redistribution of income through commodity and resource policy; sequential coordination of agricultural and resource policy; information issues in the coordination of agricultural and resource policy; joint management of buffer stocks for water and commodities; economy and climate; the effects of the feedgrain and wheat programs on irrigation and groundwater depletion in Nebraska; water policy effects on crop production; tradeoffs between agricultural and chemical policies; the effects of commodity programs on resource use; best management practices versus socially optimal practices; agriculture and fisheries; agricultural policies and health regulation; air pollution and agriculture; and the significance of the interaction of agricultural and resource policy. Contributors are mainly economists. Contributors are mainly economists. Just and Bockstael are at the University of Maryland. Author and subject indexes.

Books – BMP

172. Leathers, Howard D. Affiliation: U MD. Just, Richard E.; Bockstael, Nancy, eds. **"Best Management Practices versus Socially Optimal Practices."** Commodity and resource policies in agricultural systems. Agricultural Management and Economics series New York; Berlin; London and Tokyo: Springer. 1991.