An Action Agenda for Great Lakes Basin Agriculture

Findings, Recommendations and
Conference Abstracts
From
The Great Lakes Basin Agriculture Summit

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- FINAL -

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PREFACE

The following "Action Agenda for Great Lakes Basin Agriculture" represents the final element of the project funded by the Great Lakes Protection Fund entitled *An Agricultural Profile of the Great Lakes Basin: Characteristics and Trends in Production, Land-Use and Environmental Impact.* The initial element, the Agricultural Profile report, and its complementary agri-environmental database currently housed at Michigan State University, were developed in order to provide background data and associated analyses regarding agriculture's impacts on the Great Lakes economy and environment. This information supported the development of this action agenda for Great Lakes agriculture research and policy needs at the April 22-23, 1996 Agriculture Summit in East Lansing, Michigan. The Great Lakes Commission is pleased to present the action agenda for consideration by the Great Lakes Protection Fund and other interested parties in the Great Lakes Basin.

The Great Lakes Commission's involvement in the Agriculture Profile project has been an outgrowth of the Commission's mandate "to promote the orderly, integrated and comprehensive development, use and conservation of the water resources of the Great Lakes Basin." Through its program areas, professional staff and many task forces, the Commission pursues its mandate via three principal functions: information sharing among the Great Lakes states; coordination of state policy positions on issues of regional concern; and advocacy of those positions on which the states agree. Project design and oversight for the Agricultural Profile Project was provided by Dr. Michael J. Donahue, Executive Director, Great Lakes Commission. Project Management was provided by Thomas Crane, Program Manager, Resource Management and Environmental Quality. Principal staff support and coordination of Agricultural Profile activities was provided by James J. Nicita, Program Specialist, Resource Management and Environmental Quality.

The Great Lakes Commission acknowledges the work of the Agricultural Profile Project Team: Michigan State University, Agriculture and Agri-Food Canada, World Wildlife Fund and the University of Guelph (see Appendix E for listing of Project Team members). The Commission also acknowledges the Radian Corporation for its work in the application of agricultural data to its client/server based "RAPIDS" system designed to store and manage data on air toxics emissions.

The Commission also gratefully acknowledges the members of the project Advisory Committee for their valuable contributions and advice throughout this initiative. Members of the Advisory Committee are also listed in Appendix E.

Finally, the Commission would like to thank the keynote speakers, panelists, moderators, and participants who participated at the Great Lakes Agriculture Summit. Their experience and ideas concerning research and policy needs has made this action agenda possible. Selected Summit keynote speeches and panel presentations are included in Appendix A. The final Agriculture Summit agenda, breakout session lists, and roster of attendees are included as Appendices B-D.

I. AN AGRICULTURAL PROFILE OF THE GREAT LAKES BASIN: PROJECT OVERVIEW

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The Great Lakes Basin is a prominent part of the agricultural heartland of North America. Agriculture is a leading industry in every Great Lakes state and province. In the U.S., the eight Great Lakes states account for 30% of all agricultural sales nationwide; a $45 billion a year industry that encompasses more than 170 million acres of land—more than half of the total land mass in the eight states. Twenty-two million of these acres lie within the Great Lakes Basin. The eight states account for more than 26% of the nation's total agricultural exports, and produce most of the nation's corn, soybeans and milk. Canadian figures are equally impressive; more than 13 million acres are in agricultural production in Ontario, and Basin farms account for 22% of total Canadian agricultural production. Basinwide, agriculture is the predominant land-use in the Lake Michigan and Erie Basins, and second only to forestry in the Superior, Huron and Ontario Basins.

The economic and environmental impacts of Great Lakes Basin agriculture are pronounced. Environmental concerns encompass issues such as soil erosion and soil quality; loss of nutrients and nutrient management; sedimentation; animal wastes and manure management; loss of wetlands, habitat and biodiversity; urban/rural interface and the use and management of pesticides. Economic issues include such matters as changes in land use and loss of farmland; crop diversity; farm income and commodity exports.

Developing a Basin-specific profile of agricultural production, land use and environmental impacts and trends is a necessary foundation to the understanding of Great Lakes Basin agriculture and for the formulation of research, management and policy options at the state/provincial and regional levels. While extensive data on agriculture had been compiled prior to this project, the information and data to support initiatives related specifically to Great Lakes Basin agriculture had yet to be assembled on a binational Basinwide basis.

A special call for proposals issued by the Great Lakes Protection Fund in 1992 afforded an opportunity to address this problem. The Great Lakes Commission, in partnership with four other agencies/ organizations, subsequently received support for a project titled *An Agricultural Profile of the Great Lakes Basin: Characteristics and Trends in Production, Land Use and Environmental Impacts.* In 1994, the Project Team began work on this multi-year initiative to develop a detailed Agricultural Profile of the Great Lakes Basin; to generate the data and associated analyses required to identify implications for Great Lakes ecosystem health and to formulate an agenda for agriculture research and policy development. Late that same year, a 21 member binational Advisory Committee was assembled, comprised of representatives from federal, state and provincial agencies, research institutions, nongovernmental organizations and agri-business to provide project oversight and guide the development of the Agricultural Profile. The principal charges undertaken by the Advisory Committee in concert with the Project Team included the following:

1. **Development of a binational integrated agri-environmental database and associated data analysis.** This portion of the project was undertaken by Michigan State University, Institute for Water Research and Agriculture and Agriculture and Agri-Food Canada. This database was developed to support (1) the description and characterization of agriculture in the Great Lakes Basin and (2) the analysis of trends of agricultural activities which may have an impact on the Great Lakes ecosystem.

2. **An assessment of ecosystem and human health impacts of current use pesticides in the Great Lakes Basin.** This component of the project was conducted by the World Wildlife Fund for the purpose of identifying parameters and exploring sources of information about the exposure and hazards of pesticides currently used in the Great Lakes Basin.

3. **Developing a binational inventory of nonpoint source pollution related laws, policies and programs in the Great Lakes Basin.** This project element was provided by the University of Guelph and was designed to capture information related to statutes and regulations relevant to Great Lakes Basin agriculture; technical assistance programs and financial assistance programs.

4. **Developing a client-based inventory data system to provide data storage, integration and analysis capabilities.** The Radian Corporation, as an outgrowth of its previous work with the Great Lakes Commission to provide a database for the Regional Air Pollution Inventory Development System (RAPIDS), was contracted to provide a modified version of RAPIDS for the Agricultural Profile project.

5. **Preparation of the Agricultural Profile report.** The writing of this report was the responsibility of all of the project partners. Report preparation and production was coordinated by the Great Lakes Commission. This report was designed to provide background information and associated analyses regarding agriculture's implications for Great Lakes ecosystem health. The Profile report consists of five primary sections each of which gives background knowledge to the reader about key issues related to Great Lakes Basin agriculture. The report also contains numerous appendices designed to provide specific detailed information and additional support to the body of the profile report. The document should not be viewed as the "definitive analysis" on Great Lakes Basin agriculture, but rather it provides a look at the "big picture" of Great Lakes Basin agriculture through the development of a binational profile of agricultural statistics and information. This information will be used (in part) to develop a research and policy agenda for consideration by the Great Lakes Protection Fund (which supported this project) and other interested parties in the Great Lakes Basin.

6. **Convening of a Great Lakes Agriculture Summit.** The purpose of this two-day event was to bring agriculture and environmental professionals from throughout the Basin together to introduce them to the draft Agricultural Profile report and (through small group discussion) identify new directions in agriculture research, policy and management related to ecosystem effects.

The information that follows in this document addresses this sixth and final charge.

The Agricultural Profile report (described under item 5 above) was used as background information for participants attending the Great Lakes Agriculture Summit, held on April 23-24, 1996 at the Kellogg Center on the campus of Michigan State University in East Lansing.

The Agricultural Profile report consists of an executive summary and a report introduction, followed by two primary sections which provided background for participants at the Agriculture Summit to facilitate Summit dialogue and stimulate the development of agricultural research, management and policy recommendations to the Great Lakes Protection Fund. The first major section (Chapter III), titled *A Profile of Agriculture in the Great Lakes Basin,* summarizes the work of project team members (Agriculture and Agri-Food Canada and Michigan State University) involved in the development of the agri-environmental database and analytical framework. The second major section (Chapter IV) of the

Profile document contains discussion papers under six issue areas that were identified by the Project Team and Advisory Committee. Each discussion paper provides issue-specific background and is followed by one or more emerging issues and policy questions that were considered at the Summit. By design, these issue papers were intended to be thought provoking to stimulate discussion and debate at the Summit. Finally, the report includes extensive appendices, including a database report, a case study on agricultural phosphorus assessment, a discussion of the application of the modified RAPIDS data system to the Agricultural Profile project, the binational inventory of laws, policies, and programs, and the World Wildlife Fund report on health and ecological impacts of current use pesticides in the Great Lakes Basin.

The Agriculture Summit was the culmination of more than one year's planning and involved input and advice from the project team members as well as the Advisory Committee. More than 165 individuals from the US and Canada attended the Summit which included the participation of 15 speakers. On day one of the Summit, the Project Team presented the Agricultural Profile report and database. This presentation was followed by three panel sessions addressing Agriculture and the Great Lakes Economy, Agriculture and the Great Lakes Environment, and Sustainable Agriculture in the Great Lakes Basin. These presentations were designed to stimulate thought and set the stage for the small group (breakout) discussions the next day.

During day two, participants formed six breakout groups according to the above-mentioned issue areas in the Profile report. A modified nominal group process was used in the breakout sessions to ensure consistency in approach and maximize the opportunity for participant input. Summit participants were given background information and instructions on using the nominal group process and were asked the following three questions:

- *Focusing on your group's particular issue area, what are the principal research/data needs pertaining to Great Lakes Basin Agriculture?*

- *Focusing on your group's particular issue area, what are the principal policy/programmatic needs?*

- *What specific initiatives must be taken (and by whom) to add these issues to the agendas of appropriate public and nongovernmental agencies and organizations? What role can the Great Lakes Agri-Ecosystem Database (in either its present or expanded form) play in advancing these agendas once they are formed?*

Participants in the Environmental Programs, Policies, and Regulations Affecting Great Lakes Basin Agriculture breakout session, because of its slightly different nature, were asked the following two questions:

- *What are the principal strengths and weaknesses of the current legal, policy, and programmatic frameworks pertaining to Great Lakes Agriculture and its environmental impacts?*

- *What specific initiatives must be taken, and by whom, to revise these frameworks to better address Great Lakes Agriculture and its environmental impacts at the federal, state/provincial, regional, and local levels?*

Based on these questions, the breakout sessions generated literally hundreds of ideas for a research and policy agenda for agriculture and its impacts on the Great Lakes Basin ecosystem. The staff of the Great Lakes Commission, in consultation with Michigan State University and Agriculture and Agri-Food Canada, developed the following set of findings and recommendations from the ideas generated at the Agriculture Summit.

The findings and recommendations in this document are organized according to each breakout session at the Agriculture Summit: Economic and Production Dimensions of Great Lakes Agriculture; Natural Resources and Environmental Dimensions of Great Lakes Agriculture; Fish, Wildlife, and Ecological Dimensions of Great Lakes Agriculture; Health and Ecological Impacts of Current Use Pesticides; Environmental Programs, Policies, and Regulations Affecting Great Lakes Agriculture; and Technology Creation and Transfer. They are followed by an appendix which includes selected Agriculture Summit keynote speeches and panel presentations, breakout session lists, and a roster of Summit participants.

Implementation of the recommendations will be a shared responsibility of all of the individuals, agencies and organizations with an interest in or mandate pertaining to Great Lakes Basin agriculture. The Project Team urges all readers to identify one or more recommendations in which they can assume a leadership or support role. The Project Team's commitment to and interest in Great Lakes Basin agriculture will continue, and people are encouraged to share their progress in the implementation of the following recommendations.

II. FINDINGS AND RECOMMENDATIONS

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A. Economic and Production Dimensions of Great Lakes Agriculture

Findings

The economic and production dimensions of Great Lakes agriculture are vital factors in any strategy directed at achieving a state of sustainability. The challenge is a formidable one: how can the Great Lakes Basin community maintain the benefits of high agricultural productivity (i.e., human nourishment, employment, community development) without jeopardizing either the natural resource base on which it depends, or the health of those who make it productive? In addressing this challenge, Agriculture Summit participants focused on four critical policy issues as a subset of a larger array of issues. These included farmland conversion, transportation infrastructure, climate change and, more generally, agriculture policy.

Farmland in the Great Lakes Basin, which includes cropland, woodland and permanent pasture, is rapidly declining. The decade beginning in 1981 saw 4.5 million acres (1.8 million hectares) converted to nonagricultural use. Much of this land conversion has taken place near the metropolitan population centers in the Basin, but is also documented in more remote rural areas where residential, commercial, industrial and transportation development pressures also exist. Land conversion prompted by population pressures has caused sprawling development. This has been a dominant and continuing post WWII trend, and the economic and ecological implications have become increasingly evident. In Michigan, for example, 70% of the state's total converted agricultural land (from 1982-1992) was located in just three urbanized areas. This 850,000 acre (343,995 hectare) decline included approximately 300,000 acres (121, 410 hectares) of cropland, much of which was considered prime agricultural land. A governor's task force estimated that this impact represented a potential loss of $60 to$120 million annually in gross farm sales.

Significant loss of prime agricultural farmland shifts the burden of continued productivity to lesser and often more marginally productive acreage. Increases in fertilizer and pesticide usage are often a consequence; and habitat and environmental quality can also be sacrificed when the intensity of farming on such land increases. Also, farmland conversion on the urban/suburban fringe exacerbates urban sprawl and has been shown to deter or otherwise hamper effective brownfields redevelopment initiatives.

Maintaining an adequate transportation infrastructure in the Great Lakes Basin is also vital to the future growth and sustainability of Great Lakes agriculture. The movement of commodities off-farm to intermediate distribution points or other destinations is a key cost and marketing factor. The supply of inputs to the farming process, such as equipment and fertilizer, is the other half of the two-way routing system.

The Great Lakes Basin benefits from a highly developed multi-modal transportation system that features a dense road system historically developed to ensure adequate farm to market access. This system, however, has continuing need for repair and replacement; it is estimated that one-third of the region's bridges are deficient. Freeze-thaw cycles wreak havoc on road and bridge structures, and damage to vehicles and weight restrictions on aging bridges add up to significant costs in terms of alternate routing and commodity movement delays. Adequate investment in, and maintenance of the road system is therefore a fundamental requirement for Great Lakes Basin agriculture.

Climate change implications for the economic and production dimensions of Great Lakes agriculture of are increasing concern as well. Scientific evidence suggests that, over the last century, the average surface temperature in the Northern Hemisphere has increased one degree Fahrenheit. Even the more conservative Global Circulation Models indicate that this trend will continue and accelerate. An average increase of another degree or two is anticipated to have pronounced impacts on agricultural productivity. Under such a scenario, interior continental areas could experience longer, more persistent droughts, a change in rainfall patterns and, on a more positive note, an increase in the length of the growing season. In the Great Lakes Basin, however, the benefits of the latter would likely be offset by instability in precipitation patterns and, hence, planting and harvesting dates. Climate change impact studies are underway in the Great Lakes Basin, and an added emphasis on implications for agriculture production and attendant economic factors is advisable.

Beyond these various issue-specific determinants of economics and productivity is the broader area of public policy and its attendant impacts. Agricultural production has historically been subject to a strong and pervasive governmental influence (largely federal government), whether it be through regulations, subsidies, price supports, voluntary programs or other initiatives. Such programs have met with mixed success; they can sometimes boost productivity and sustainable practices, for example, while at other times they can interfere with basic market signals.

An ambitious agenda of applied research is warranted to ensure that public policies provide a favorable climate within which the farming community can pursue an economically profitable and environmentally sustainable future. For example, a better understanding is needed of the social, economic, environmental and quality of life implications of farmland conversion. The opportunity costs of such activity need to be understood, as well as the array of options (and associated implications) for slowing such conversion. Adequacy of the transportation infrastructure for efficient farm to market operations needs to be assessed, and necessary multi-modal linkages maintained. Adaptive strategies need to be developed over both the short and long term to contend with the anticipated implications of climate change. Perhaps more importantly, education of the general public on the contributions of agriculture to their health and well being is essential in establishing an informed populace and attendant public policy.

Recommendations

1) It is imperative that Basin policymakers and residents in general, are fully informed of the environmental, economic, social and quality of life consequences of continued farmland conversion and attendant implications of urban/suburban sprawl and rural non-farm development. The latter deserves attention because rural non-farm residents desire a rural lifestyle but are often unprepared to accept attendant conditions (e.g., livestock and manure odors). Local and regional planning commissions have a primary responsibility in this regard, and the farmland conversion issue should receive increased attention from citizen organizations with a public education focus as well. Such information/education initiatives should be supported by research that better quantifies these various consequences.

2) Basin jurisdictions—including state/provincial governments, counties, municipalities, and other multi-jurisdictional planning commissions—should review existing land use plans and policies to ensure that a) farmland conversion is adequately addressed; and b) land-use planning tools and incentives are in place to preserve agricultural lands. In Canada, both Quebec and British Columbia

models for state level land-use planning are found in such states as Oregon, Florida and Georgia, and should be reviewed for potential applicability to Great Lakes jurisdictions.

3) Given the land-use/water quality interface within the Great Lakes Basin Ecosystem, it is evident that land-use practices have pronounced implications for the health of Basin water resources. This speaks to the need for consistency among Great Lakes jurisdictions in land use policies and practices, with a special emphasis on agriculture and other land uses that can directly or indirectly impact water quality and habitat. Toward this end, existing Basin agreements, such as the U.S.-Canada Great Lakes Water Quality Agreement (GLWQA), should be reviewed to ensure that adequate attention is afforded to the land use/water quality interface. The last time the GLWQA was reviewed was in 1987; a new review focused specifically on the land use/water quality interface might be in order. Furthermore, consideration should be given to a formal, Basin-wide process yielding policy recommendations for land use that state and provincial governments can use as guidance in their own efforts, thus promoting Basin-wide consistency. Should a land use component be added to the GLWQA, the IJC would be the most appropriate coordinator of this formal process.

4) It is important that the linkage between adequate transportation infrastructure and the future viability and growth of Basin agriculture be recognized and reflected in public policy. For example, state departments of transportation are advised to ensure that surface road and bridge repair and maintenance are not overshadowed by new road construction. Furthermore, careful consideration should be given to the adverse impacts of new road construction (e.g., potential loss of farmland, exacerbation of urban sprawl) when such construction is in the planning stage.

5) The impacts of climate change on agricultural patterns and productivity must be recognized as a current issue, and one demanding serious research and policy attention relative to adaptive strategies. The existing but modest Basin-specific research on climate change should be maintained and enhanced with an added focus on agricultural impacts and implications. Trends should be documented and analyzed and projected into the future under various possible scenarios, with attendant policy responses. Of particular concern should be the substantial projected increase in irrigation needs and attendant impacts on water quantity and quality. In fact, there are some indications that current policies on water use and quantity will not be adequate in drought years.

6) The economic and production dimensions of agriculture should be fully incorporated into individual farm plans and the relationship between those dimensions and environmentally responsible agricultural practices recognized.

7) Public policies at all levels of government must not lose sight of the individual farmer and local farming communities. "Ground-truthing" should be promoted: policies and research must be applicable at that level. If they are not, implementation is compromised, along with the credibility of the policy process.

8) Marketing policies should be directed at enhancing the income of individual farmers and local farming communities. Federal and state/provincial policies and financial resources should feature creative incentives for innovative marketing. Value-added processes, where possible, should be located in areas of primary production and consumer education should be oriented toward supporting local production.

9) Federal and state/provincial agricultural agencies in the U.S. and Canada have significantly increased their focus on agriculture-related trade issues and, in particular, promoting exports of Great Lakes agriculture. Simultaneously, these agencies need to increase the level of market research they conduct to support their export promotion programs. As recently as 1993, for example, only four percent of U.S. federal research on agriculture went to research on trade issues. In light of agreements such as the North American Free Trade Agreement (NAFTA) and the General Arrangement on Trade and Tariffs (GATT), such efforts will be critical to maintaining the prosperity of Great Lakes agriculture. In addition, environmental protection needs to be incorporated in all trade and production deliberations and agreements.

10) Under the leadership of the Great Lakes governors and premiers, a binational group of stakeholders should be convened to develop a strategic plan for Great Lakes agriculture. Such a planning process, which would involve representatives from all sectors of agriculture and related environmental interests, would yield a consensus-based blueprint to guide individual and collective jurisdictional efforts in many areas including land-use planning, marketing, technology creation and transfer, environmental protection, and other areas where multi-jurisdictional consistency and cooperation can lead to environmentally responsible and sustained productivity.

B. Natural Resources and Environmental Dimensions of Great Lakes Agriculture

Findings

An ecosystem approach to managing the natural resources of the Great Lakes Basin requires a thorough understanding of agricultural activities and their attendant impacts on the Basin environment. Achieving such understanding presents three fundamental challenges to policymakers. The first is to gather the requisite amount of data and information upon which to base decisions. The second is to develop a coherent framework within which such data and information can be analyzed and interpreted in the context of public policy questions. The third is to ensure broad accessibility to the data and framework in the interest of maximizing application by all in a position to either apply or promote the application of environmentally responsible agricultural practices.

The first of these challenges, data and information gathering, is an ominous yet essential task. Agriculture is a leading industry in every Great Lakes state and province and, given its economic, social, natural resource and environmental dimensions, requires extensive, complex and regularly updated data in myriad categories. Further challenges are found in the data acquisition and calibration process. For example, access to proprietary data and information is an issue, and some argue that development of a truly comprehensive database may place an undue burden on the individual farmers ultimately responsible for reporting it. Consistency in data and information— in terms of detail, format, substance, reporting and storage— varies considerably from one jurisdiction to the next. Problems are most pronounced at the binational level, where the United States and Canada exhibit many fundamental differences with regard to definitions, categories of data and information, geographic scale, units of measurement, availability, and storage and retrieval systems.

Data and information requirements must go beyond basic "first order" items such as agricultural acreage, tillage practices, pesticide applications and related figures. "Second order" data and information focusing on impacts of agricultural practices are essential as well. This may include, among many others, habitat and environmental indicators, economic and environmental benefits of Best Management Practices (BMPs), off-site impacts of soil erosion and sedimentation, and human and ecosystem health impacts of pesticide usage. Data and information requirements also include the need for longitudinal data to permit trend analysis. This latter consideration is a critical one given that many BMPs and associated "environmentally-friendly" practices require extended periods (often several years) of data acquisition and analysis to determine effectiveness.

The second challenge, developing a coherent analytical framework for this data and information, must be addressed by developing and applying ecological parameters. Agricultural problems and opportunities vary significantly from one jurisdiction to the next, and often need to be addressed at different scales; Basin-wide approximations may be adequate in one instance, whereas precise county or subwatershed data is necessary in another instance. A hierarchical framework is necessary and should be ecologically and geographically based. "Nested" scales should ideally extend from the field and farm level to the Basin level, with a consistent set of attributes (i.e., data categories and attendant measures). Experience has shown, for example, that county level data has very limited applicability for addressing issues at the individual farm level. It must be acknowledged that complete Basin coverage will be achieved only at the general levels; data at the more detailed levels over the entire Basin is unaffordable, and will be collected when they are particularly relevant. The benefit of a framework is that it minimizes the effort

required to populate the database associated with the framework to the extent that data are entered at the greatest level of detail available and the more general levels are synthesized from the detail.

A comprehensive, well-organized database and analytical framework has little value from a public policy standpoint unless it is an integral and widely available component of the decision support system for agricultural and environmental policy. The database and framework should be made available in both hard copy and electronically, with access through the Internet-based Great Lakes Information Network (GLIN.) It must be user friendly, recognizing that it will be accessed and used by individuals from an array of disciplines and with varying needs, objectives and familiarity with such databases and analytical frameworks. In addition to basic data, it must include the aforementioned "second order" information, program and policy information, case studies, points of contact and other descriptive information necessary to apply the basic data and information.

The limited development and application of evaluation methodologies is perhaps the principle obstacle in understanding the natural resources and environmental dimensions of Great Lakes agriculture. Programs and projects—whether they be small scale demonstrations or binational initiatives—have historically lacked strong evaluation components. This problem is compounded by the general absence of evaluation benchmarks, such as numerical environmental targets and standards, monitoring protocols, and principles for program delivery.

Recommendations

1) The agri-environmental database prepared during the Agricultural Profile project should be placed on the Internet-based Great Lakes Information Network and broadly publicized to prospective users. A particular emphasis should be placed on metadata—the information which describes the data. The first step in making the database available would be to develop a comprehensive package of metadata to accompany the database and to have it reviewed for accuracy. Also, the hard copy version of the project's data and information, as presented in the final Agricultural Profile report, should be made available at cost to all interested parties.

2) With guidance provided by the Agricultural Profile report, the analytical framework, and its associated database, should be enhanced in terms of comprehensiveness, scale and data availability.

   A. Spatial Framework. In terms of structure, the analytical framework should be organized to support a variety of hierarchical ecological frameworks, including terrestrial ecological (e.g. farm practices), watershed (e.g. non-point movement), and political (e.g. policy adoption). These frameworks should feature nested scales, for example from the farm or field level to the Basin level. Inconsistencies from one jurisdiction to the next in terms of data category definitions, scale, units of measurement and detail should be eliminated or minimized.

   B. Data Availability/Gaps. In addition to more comprehensive basic data, the enhanced database should address impacts such as the environmental consequences of pesticide use and offsite impacts of soil erosion and sedimentation. It should also include information on the adoption rates and effectiveness of best management practices land use management and soil conservation practices, manure management, and integrated pest management.

3) With leadership from the Agricultural Profile project team, options for the ongoing expansion and maintenance of the agri-environmental database should be developed, evaluated and implemented. Special consideration should be given to an appropriate "home" for the data base that will ensure broad availability and usage, adequate funding, and periodic updating. Further, efforts should include incorporation into, or linkages with other databases to enhance usage and promote an ecosystem approach to natural resource and environmental management.

4) Improvements in the acquisition of basic data and information must be complemented by concerted efforts to establish an analytical framework featuring benchmarks and protocols to evaluate the environmental impacts of agricultural practices and, in particular, the benefits of environmental protection programs and projects. Specifically, the following should be pursued: extensive monitoring of environmental conditions to document agricultural impacts; evaluation methodologies to document/quantify benefits of BMPs and other programs and projects; development of consistent numerical standards and targets across all Basin jurisdictions; development of Basin-wide environmental indicators to serve as benchmarks for determining the benefits of programs and projects; and development of principles for program delivery to be applied across all Basin jurisdictions.

5) The National Resources Inventory (NRI), prepared every five years by the USDA Natural Resources Conservation Service, provides a wealth of valuable information that can be incorporated into future updates of the agri-environmental data base. To facilitate this, Great Lakes Basin-specific portions of the NRI should be extracted and analyzed and applied to Basin public policy issues. The NRCS and Great Lakes Commission should be lead collaborators on this initiative. In addition, Canada should develop a program to collect data that is analogous to and compatible with the NRI. The Great-Lakes Basin-specific portions of this inventory could then also be added to the agri-environmental database.

6) The Pollution from Land Use Activities Reference Group (PLUARG) initiative of the International Joint Commission (IJC) in the late 1970's was instrumental in focusing public policy attention on the land use—water quality interface. This initiative should be revisited by the IJC, with updated goals and methodology to reflect current and emerging public policy priorities. Among others, the inquiry should focus on the cause and effect of phosphorous reductions over the years, and the relative impact of nitrates on water quality.

7) The cooperation of individual farmers is essential if both the breadth and detail of agriculture data is to be acquired and incorporated into databases to support public policy development and implementation. Toward this end, an effort should be made to a) identify essential data and information that is presently unavailable or otherwise inadequate; b) establish voluntary reporting arrangements, with consistency across all Basin jurisdictions, that avoid or minimize additional burdens on individual farmers; and c) incorporate such information into databases to facilitate use and application. The analytical framework's aspect of minimizing the effort required to populate its associated database would be an advantage in this regard. Farming associations should be consulted throughout the process to maximize the relevance and acquisition of the desired data and information. Consideration should be given to integrating data gathering efforts with existing reporting requirements.

C. Fish, Wildlife and Ecological Dimensions Related to Agriculture

Findings

Habitat and biodiversity within the binational Great Lakes Basin have changed dramatically from pre-settlement times; few habitat areas, plant and animal communities, or ecological processes (hydrological regimes, successional trends, etc.) remain unaffected by human disturbance. Loss of habitat and biodiversity—in terms of both quantity and quality—has been attributable in large part to urban development and encroachment, and agricultural practices such as land clearing and drainage. Such activity, in degrading and fragmenting habitat, has severely reduced the ability to sustain biodiversity. New technologies, economic conditions and government subsidies have historically been responsible for encouraging agricultural drainage of wetlands, and removal of fencerows, buffer strips and wooded areas. New technology enabled farmers and developers to drain and clear land that at one time was considered inaccessible for alternate uses. Economic conditions and loan interest rates have often combined to make agricultural drainage of wetlands a preferred alternative to the purchase of established agricultural land.

Habitat degradation due to off-site impacts of agricultural and other land use practices is an additional concern beyond habitat loss due to conversion of wetlands and other biologically productive areas. Of primary concern is soil erosion and sedimentation, an increasingly well-documented problem in the Great Lakes Basin. Other economic and environmental costs include increased sediment dredging/disposal needs; a multi-billion dollar sport fishing industry whose potential is compromised by contaminant problems; maintenance costs for water treatment and conveyance systems; and the human/ecosystem health implications of pesticide applications.

Recent years have brought an increased recognition of the importance of preserving habitat and biodiversity. Programs at various levels of government—most notably the U.S. federal Conservation Reserve Program— have successfully demonstrated and promoted wildlife habitat conservation practices that are compatible with current agricultural practices and production goals. These programs foster a greater understanding of the interrelationships between agriculture, habitat, and biodiversity, and illustrate the mutual benefits of practices such as conservation tillage, integrated pest management and buffer strips. Despite this progress, however, habitat and biodiversity within the Great Lakes Basin continues to decline and pressure to convert wetlands and other biologically productive habitat to urban, residential, agricultural and other uses remains strong. Ongoing debate among policy makers and opinion leaders in government and the private sector focuses on the reasons for continued habitat and biodiversity loss and attendant solutions that do not unduly compromise the economic viability of agriculture and other sectors of the economy.

Recommendations

1) A necessary first step in developing and implementing an effective, Basin-wide program for habitat preservation is a thorough inventory of habitat and biodiversity. An important first phase of the inventory process would be to better define and identify what constitutes critical habitat in agri-ecosystems and critical biodiversity features (at the species level or higher levels). Only after defining the parameters more precisely will it be possible to move to the inventory stage. The inventory itself would then complete, update, and fill in the gaps of existing inventory work, such as The Nature Conservancy's biodiversity inventory. Issues of housing and maintenance of the

inventory would need to be resolved, though dovetailing it with existing inventory databases (such as Natural Heritage Programs) would be a priority. A qualitative assessment of habitat and species occurrences would be an important feature of the inventory.

2) The agri-environmental database developed by the Agricultural Profile project team should be expanded to address data and information needs associated with habitat and biodiversity loss and degradation, and associated environmental and economic consequences. Specifically, topics to be addressed should include the off-site impacts of soil erosion and sedimentation; the nature, extent and impacts of land use conversions that reduce habitat and biodiversity; and a descriptive inventory of agricultural practices compatible with habitat and biodiversity preservation and creation goals. The preferred database unit should be at the watershed level, and uniform methods for collecting and classifying data should be implemented. Such data and information would be a valuable addition to the agri-environmental database and, therefore, would be a highly useful component of a decision support system for programs and projects concerned with habitat preservation and creation and the maintenance of biodiversity.

3) Long-term data related to habitat and biodiversity issues should be collected. This would include data on agricultural practices and land use (e.g., urbanization; effects of the Conservation Reserve Program). Comparisons of data should be made to establish and analyze trends. Research is also needed to examine the linkages between biodiversity and other variables, on identifying critical thresholds of biodiversity impact (i.e., levels at which agricultural productivity is compromised or at which ecological processes are adversely affected), and also on methods of relating biodiversity change/impact information beyond the site level to broader spatial levels of aggregation, which is the level policy-makers function at. The Basin research community needs to bring capabilities regarding habitat and biodiversity research up to par with current capabilities for other areas, such as land use and soil quality assessment.

4) Conduct small-basin demonstration projects to determine what works and what does not with respect to habitat and biodiversity protection. These projects would allow for hands-on participation in actions that would show results and viable options for land management.

5) Conduct surveys regarding the public's priorities, i.e., what type of ecosystem citizens want and what their expectations are.

6) An assessment of the economic viability of alternate habitat conservation practices is a necessary adjunct to inventory efforts and associated documentation of habitat loss and degradation. The costs and benefits of such practices—to the public and the individual farmer—should be analyzed.

7) Review existing agricultural practices and develop improved methods that are compatible with habitat and biodiversity conservation goals.

8) Programs at all levels of government should be reviewed to identify those areas where goals are fundamentally inconsistent (i.e., where some programs may encourage habitat conversion while others discourage it.) Further, consideration should be given to simplifying the administration of such programs by replacing current disparate, multi-agency responsibilities with a single agency approach. In cases where multiple agencies retain program or administrative responsibilities, overlap and duplication across and between agencies must be avoided.

9) Encouraging the preservation/creation of fish and wildlife habitat on agricultural lands is a priority that must be encouraged through both government programs and voluntary cooperation within the agricultural community. A widespread education program in concert with demonstration projects, is needed to highlight the economic viability of habitat programs. This must be complemented by an incentive system to promote habitat preservation/creation. To ensure success, both initiatives must cultivate farmer-to-farmer interactions to maximize participation. Further, success stories need to be publicized, voluntary programs promoted, and farmer and general public input into public policy development encouraged.

10) Incentives should be explored for encouraging development within existing developed areas, in order to reduce the development pressures that adversely impact habitat and biodiversity.

D. Health and Ecological Impacts of Current Use Pesticides

Findings

Pesticide use is an important issue to the people of the Great Lakes Basin. Driving forces behind the use of such crop protection products include pest pressures, economic pressures, and the public's demand for high-quality, inexpensive food which is also aesthetically pleasing (i.e., without blemishes). Other factors influencing the use of pesticides include regulations, available data on pesticides, and grading standards. Pesticides are credited with increasing agricultural productivity and farming income, eradicating disease-carrying organisms, and other benefits.

The acknowledged benefits of pesticide use are accompanied by certain risks, both to human health and to the environment. Pesticide risk is a product of the toxicity, environmental fate, and the quantity and manner in which each substance is applied. As of the late 1980s, it is estimated that annually, some 57 million pounds (26 million kg) of pesticides are applied to agricultural land in the binational Great Lakes Basin. Herbicide applications are highest in the Saginaw Bay region, southwest Ontario, and northwest Ohio. Insecticide use is heaviest along the north shore of Lake Erie in Ontario, the south shore of Lake Ontario in New York, and the southwest corner of Michigan along the Lake Michigan shoreline. Fungicide use is heaviest on the northwest shore of Lake Ontario running up to Georgian Bay, the north shore of Lake Erie, and in an area just southwest of Grand Traverse Bay in Michigan. Information on pesticide-specific rates and locations of application, exposure characteristic data (e.g., persistence, solubility), along with climate and land and water resource data, are needed to form a clear picture of pesticide risk.

Although the use volumes of particular pesticides vary widely, over one-half of the total number of pesticides used in the Great Lakes Basin have been categorized by the U.S. EPA or the U.S. Fish and Wildlife Service[1] as one or more of the following: probable or possible human carcinogen, groundwater contaminant, EPA Toxicity Category I (high acute [immediate] toxicity/ danger to farmers/ farm workers), high acute hazard to birds, high acute hazard to aquatic organisms, or high acute hazard to mammals. Forty four of the estimated 57 million pounds of pesticides applied annually in the Basin (or 20 of the 26 million kg) fall into one or more of these categories.

Pesticide development and use recommendations are the result of collaboration between industry, government, and university research and extension. In recognition of their potential risks, pesticides are registered as safe or acceptable under prescribed use conditions only after extensive scientific review conducted in accordance with internationally established protocols. Both pesticide registration status and compliance standards are periodically reviewed or modified in light of emerging scientific information. The recently passed U.S. "Food Quality Protection Act of 1996," for example, contains additional requirements for the setting of tolerances of pesticide residues in order to take the risks to infants and children into account. It also eliminates the distinction in federal law (the Delaney Clause) between pesticide tolerances in raw agricultural products and processed foods, and replaces it with a uniform standard which mandates a "reasonable certainty of no harm."

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[1] Neither the Canadian nor Ontario governments classify pesticide use according to potential hazard; review of pesticides is conducted in these jurisdictions on a case-by-case basis. An ecosystem approach to addressing health and ecological impacts of current use pesticides in the Great Lakes Basin suggests the need for harmonizing pesticide management policies in the U.S. and Canada.

Historically, concern over toxic chemical usage and impacts in the Great Lakes Basin has focused on persistent and bioaccumulative chemicals such as organochlorides (e.g., DDT.) More recently, however, advances in scientific understanding of biochemical mechanisms suggest that complementary concern may be warranted for additional properties and effects, such as endocrine disrupting effects which occur when chemicals either mimic, block or otherwise interfere with the body's natural hormonal system. Recent research suggests that even a small dose of endocrine disrupting chemicals, at a critical period before or shortly after birth, may have pronounced short and long term implications for human health. In recognition of such concerns, the new Food Quality Protection Act mandates a screening program for substances with estrogenic or other endocrine effects, and authorizes the EPA Administrator to take action to ensure the protection of the public health should a particular substance be found to have an endocrine effect on humans. The EPA plans to work with a multiple-stakeholder advisory committee to develop a screening and testing strategy.

It must be emphasized that research into endocrine effects is limited and still emerging; conclusions regarding current or potential implications for the Great Lakes Basin must be carefully qualified. More information on the effects of pesticides on the endocrine system is needed, and on epidemiological effects in particular. Testing protocols for endocrine disruption need to be further developed and validated, dose response relationships clarified, estimates of potency developed, and existing standards modified. Additional research on the health effects associated with levels of pesticides used and detected is critical, particularly with regard to those with highest exposure levels (i.e., pesticide applicators and farm families, especially women of child bearing age.) Similarly, the adequacy of current procedures for the identification of immunological effects has come under scrutiny. Additional work is also needed to assess and minimize the risk to applicators using fumigants. The impacts and management of "new generation" pesticides, particularly those with low application rates (i.e., less than 1 lb./acre), and biotechnology pesticides, also warrant further investigation.

A fundamental challenge in the Great Lakes Basin is to reduce pesticide risk to human health and the environment without unduly compromising agricultural productivity. Several new technologies, methods, and practices offer hope in this regard and need to be fostered in the Basin. They range from new pesticide application and disposal techniques to integrated pest management and crop rotation practices. Emerging precision farming methods, which utilize technologies such as global positioning systems (GPS), allow farmers to determine which part of a farm field requires a pesticide application, and which part does not, thus reducing overall amounts of pesticide applied and saving money. The challenge also involves shifting the emphasis of public policy and programs from that of pollution control to pollution prevention. A variety of policy and programmatic tools to foster reductions in pesticide risk are available, although a much enhanced level of public policy commitment and private sector leadership (i.e., agricultural producers) is needed if pollution prevention goals are to be met.

Research and data needs associated with the health and ecological impacts of current use pesticides can be grouped into three primary areas: risk assessment, methodology, and implementation of a systems approach.

Risk assessment must be pursued by integrating exposure and toxicological data, and by examining impacts on wildlife and human health. Areas of high pesticide use, such as those mentioned above, should receive particular attention with a focus on loadings, pathways, fate and bioassessment. Research is also needed on the effect that natural resources, land management and landscape ecology have on pesticide degradation.

Research methodology warrants attention as well. Scientifically accepted and valid protocols must be developed for investigating not only endocrine disrupters, but also neurotoxic and immunological effects. Models for pesticide risk reduction should be developed, and should address factors which impede the movement from high-risk pesticide use practices to low-risk practices. Trends in pesticide use need to be tracked, the temporal and spatial variability of pesticide use and Best Management Practices (BMPs) need to be measured, and the impacts of BMPs quantified.

Finally, research on the health and ecological impacts of current use pesticides needs to embrace a systems approach as opposed to focusing on a particular pesticide application practice. The dynamic interactions of all factors must be tracked. The research should address factors such as pesticide loadings from both agricultural and non-agricultural sources and through various pathways such as surface water, groundwater, and airborne transport. Technological factors might include new types of products and non-chemical alternatives to pest management. Sociological factors might include detailed user data and consumer preference research. Economic factors might include distribution of the cost burden of pesticide use reduction among consumers, agricultural producers and pesticide manufacturers.

Recommendations

1) A basic level of consensus on the relative risks and benefits of current use pesticides is needed, given the nature and extent of debate within the scientific community and the larger community of agricultural and environmental interests. To date, however, direct and constructive dialogue among those with differing views has been limited. Such dialogue must be encouraged through a roundtable format that ensures representation of all relevant interests and produces agreement on basic, common goals to maximize benefits and minimize risks through responsible and appropriate pest control measures.

2) Recognizing that the consensus building process should be characterized by openness and trust, all parties, including private and corporate research institutions, should establish a policy of full disclosure of research and monitoring results to the extent possible without jeopardizing proprietary information.

3) Governmental, academic and private institutions should undertake major research programs to provide data and information clarifying the risk-benefit tradeoffs of current use pesticides and other pest control measures. Economic research should provide precise data on the degree to which pesticides and other pest control methods have increased agricultural productivity. Scientific research should address (among others) endocrine disrupters, including combined effects of multiple chemicals, and their effects on fish, birds, and other wildlife; health effects associated with levels of pesticides used; and the impacts and management of "new generation" pesticides. The scientific research should be peer reviewed and, where possible, submitted to a scientific review panel that can draw scientifically valid conclusions from the collective studies.

4) In the interest of an ecosystem based approach to pesticide management, the U.S. and Canadian governments should harmonize policies, data collection procedures, and reporting processes for pesticide usage. State and provincial management plans, as well as those developed at a watershed or individual farm level, should strive for overall consistency in goals and objectives.

5) A necessary tool for pesticide risk reduction efforts in the Great Lakes Basin is a pesticide application database. It will not be feasible to evaluate approaches to pesticide risk reduction unless information is collected to document the amounts of pesticides applied to agricultural and non-agricultural (e.g., recreational areas and golf courses) lands. In addition, it is important to monitor the quantities of pesticides which move off of crops and land by runoff or volatilization. An obstacle to creating such a database might be faced due to the concerns of some farmers and agri-chemical companies regarding proprietary information and privacy. This obstacle might be overcome by aggregating information on specific pesticides to county and/or watershed levels to protect confidentiality and privacy. In this connection, it should be possible to coordinate with the Great Lakes states' toxic emissions inventory effort. There are other existing data collection efforts that could be drawn from to extrapolate data to the Great Lakes Basin level.

6) A regional pesticide risk reduction initiative should be organized, perhaps focusing on those areas of highest documented usage of pesticides of known risk. The initiative would identify promising collaborations among stakeholders who are reducing reliance on and risk from pesticides without unduly compromising productivity. Rather than work on the farm level, the initiative should provide critical support to a) assess and help overcome institutional hurdles to pesticide risk reduction; and b) evaluate the projects and disseminate results. A strong information/education and technical assistance component should be associated with the pesticide risk reduction initiative to maximize its value as a demonstration and promote its application in other areas. This component should focus on pollution prevention through the promotion of environmentally sound agricultural practices and techniques and the adoption of emerging technologies. Further, the initiative should establish a framework for setting priorities and identifying issues according to type of activity, site and known risk.

E. Environmental Programs, Policies and Regulations Affecting Great Lakes Agriculture

Findings

Achieving a state of sustainable agriculture—where goals of economic productivity and environmental protection are pursued and attained in concert—demands a careful mix of regulatory and voluntary programs. The former can be effective in safeguarding human and ecosystem health, such as through the regulation or outright prohibition of certain pesticides and other toxic chemicals with well-documented adverse impacts. The preservation of wetland resources via legislation (such as Michigan's Goemare-Anderson Wetlands Protection Act) is one of many other examples where a legislative/ regulatory mechanism can be an effective tool in achieving the elusive balance between agricultural production and environmental protection. Voluntary compliance and producer-based environmental protection initiatives are an equally critical component of sustainable agriculture. At this level, a growing number of success stories point to the benefits of incentive-based programs where producers have enhanced productivity and protected the environment in the absence of federal, state or provincial regulations or other mandatory programs.

Although their contributions to environmental protection have been substantial, regulatory frameworks at the federal, state and provincial level have been hampered by problems of limited implementation and fragmentation. Funding has been an ever-present issue, as evidenced by the historic lack of resources directed at nonpoint source pollution control mandates. Interagency coordination has been problematic as well; pest management and water quality programs, for example, are typically addressed by separate state agencies. In developing programs, consultation between the regulators and the regulated community has often been viewed as inadequate, leading to resistance by the latter. From a farming standpoint, the regulatory framework has historically addressed only selected aspects of the farming system, bringing into question its responsiveness to concepts of whole farm planning and an ecosystem approach to land stewardship and agricultural sustainability.

Recent years have witnessed a notable increase in the environmental consciousness of the farming community, with a resultant increase in voluntary programs designed to enhance productivity on a sustainable basis while protecting and improving environmental quality. In the Great Lakes Basin and elsewhere, farming associations and other networks have been instrumental in promoting whole farm planning, environmental farm plans, integrated farming systems and other innovations. Unlike the traditional prescriptive regulatory approach, such initiatives encourage producers to apply their specialized knowledge of local conditions and landscapes, and their capacity for innovation, to maximize environmental benefits without sacrificing productivity. Such associations and networks have proved to be effective mechanisms for information exchange and "leading by example." An initiative on the Old Mission Peninsula near Traverse City, Michigan illustrates such innovation. Residents approved a millage to fund a "purchase of development rights" program, thereby establishing a mechanism to protect farmland and orchards from encroaching residential development. Strong popular demand and both environmental quality and quality of life considerations were motivating factors.

In the Great Lakes Basin, the ongoing challenge to establish an optimal mix of regulatory and voluntary programs has, and will continue to benefit from a highly evolved set of institutional arrangements that emphasize multi-jurisdictional, public/ private sector partnerships and a watershed based, ecosystem approach to management. Early successes, such as the phosphorus reductions resulting from the International Joint Commission's Pollution from Land Use Activities Reference Group (PLUARG)

initiative, have been followed by similar ecosystem-based efforts in both the U.S. and Canada. The state of Wisconsin, for example, manages its nonpoint source pollution abatement programs on a watershed basis. The National Nonpoint Source Pollution Forum, chaired by Michigan's Governor John Engler, is moving this concept forward on a national scale. In Canada, a system of indicators of sustainable agriculture is being developed on a regional basis. The aforementioned problems of fragmentation in public policy development and administration—particularly with regard to water quality and land use issues—are gradually being addressed as a watershed-based, ecosystem approach is embraced.

Efforts to achieve an optimal mix of regulatory and voluntary programs have historically been hampered by problems of definition, science and evaluation. While broadly accepted at the conceptual level, "sustainable agriculture" as a desired state is subject to various interpretations and, hence, benchmarks for attaining that state vary accordingly. Pronounced disagreement also persists in some sectors over the impacts of agriculture on human and ecosystem health, highlighting issues of scientific methodology, data availability and interpretation. Further, the absence of commonly accepted agri-environmental indicators for the Great Lakes Basin, as well as validated models, limits the ability to design and implement evaluation methodologies to measure the effects of public policies and programs.

Recommendations

1) In the spirit of public/private sector partnership, the agricultural community must expand its traditional role in public policy development to further embrace issues of environmental protection. The focus of established farm organizations should be broadened to address matters such as pollution prevention and land use, and such organizations should assume a more vocal role in public policy discussion and debate on such issues. Opportunities to demonstrate leadership and innovation in land stewardship and environmental protection should be vigorously pursued and publicized.

2) The pronounced gap—both real and perceived—between agricultural interests and citizen environmental organizations must be addressed. Shared goals and objectives among these groups do exist, but tend to be obscured by pronounced differences over public policy approaches. To ensure informed public policy, meaningful dialogue and consensus building among varied interests must replace a tradition of more indirect public debate played out through the media. Agricultural interests must increase their involvement in citizen environmental organizations and, in turn, environmental interests must pursue opportunities to contribute to the deliberations and actions of agricultural organizations. New alliances among such groups should be pursued in the interest of defining (and clearly articulating to elected officials) areas of consensus on public policy. In the Great Lakes Basin, consideration should be given to developing a "partnership agreement" modeled after the Ecosystem Charter for the Great Lakes-St. Lawrence Basin.

3) Agri-environmental policy is in a highly dynamic and evolving state at this time, and achieving an optimal mix of regulatory and voluntary programs is at the center of associated debate. Great Lakes Basin jurisdictions have gained notoriety for institutional experimentation and innovation, and have much to gain from sharing experiences with one another. Toward this end, the Great Lakes Governors and Premiers should consider convening a "blue ribbon" panel of agri-environmental representatives in the interests of information sharing; promoting consistency in public policy approaches to agricultural and environmental policy; developing public/private sector partnerships; advocating specific programs and approaches at the state, provincial and/or federal levels; and

identifying Basin-wide, multi-jurisdictional initiatives. The data and information presented in this Agricultural Profile—particularly as it relates to laws, policies and programs—will provide a basis for such an initiative.

4) Public policy programs, whether they be mandatory or voluntary in nature, should be outcome-oriented and incentive based. Rather than being highly prescriptive, they should establish high standards and firm goals for protecting human and ecosystem health, and provide the farmer with the latitude to implement creative/ innovative approaches in the spirit of efficiency and cost effectiveness. Similarly, financial support for farmers (e.g., property tax relief, grants) should be weighted in favor of those who practice pollution prevention and otherwise embrace the principles of sustainable agriculture. This policy, however would have to overcome obstacles such as the difficulty of developing acceptable eligibility criteria of sustainability, as well as the costs of tracking compliance.

5) The agricultural community should pursue, among others, market-driven strategies to reduce the environmental impact of agricultural practices. For example, farm organizations should educate consumers on customary consumer standards and their relationship to the environment. Lessened demand for "cosmetically optimal" produce would be reflected in reduced levels of pesticide applications.

6) A set of agri-environmental indicators for the Great Lakes Basin should be developed, accepted and broadly applied to provide a much-needed benchmark for evaluating progress in public policy development and implementation. This work should be initiated at the binational level (either through the International Joint Commission or Great Lakes Commission), and should build upon recent efforts such as "Indicators to Evaluate Progress under the Great Lakes Water Quality Agreement" (Indicators for Evaluation Task Force of the International Joint Commission, April 1996).

7) Growing regional interest and activity in brownfields redevelopment/greenfields preservation should acknowledge the fact that preservation of prime agricultural land is an investment in environmental protection. Conversion of such land to alternate uses can force marginal farmland back into production, with a concomitant increase in chemical applications often needed to enhance productivity. Emerging institutional arrangements at all levels of government to promote and facilitate brownfields redevelopment/ greenfields preservation should provide for agricultural representation and fully acknowledge the environmental implications of the loss of prime farmland.

8) Technical assistance, demonstration projects and on-farm research are all critical tools to promote voluntary measures for environmentally responsible agriculture. Such tools should be developed, adequately funded and broadly applied in the Great Lakes Basin. Great Lakes jurisdictions should support, in particular, region-specific initiatives, such as the Great Lakes Basin Program for Soil Erosion and Sediment Control (USDA/ EPA/ Great Lakes Commission), the Great Lakes Nonpoint Source Initiative (Conservation Foundation), Farm*A*Syst (University of Wisconsin), and others. On-farm research that promotes the development of practical and adaptable measures for sustainable agriculture has enjoyed notable success and should be maintained and enhanced.

9) The Great Lakes Basin is home to a growing array of agricultural nonpoint source control programs and initiatives at all levels of government, the private sector, and foundation-supported nonprofit

organizations. Many of these initiatives feature demonstration projects and various voluntary incentive-based programs that are of interest in all Great Lakes jurisdictions. Thus, it is essential that either new or existing institutional arrangements (e.g., Great Lakes Commission, U.S. Environmental Protection Agency, professional associations) serve as vehicles for information exchange, cooperative initiatives, policy coordination, and ensuring comprehensiveness and consistency between and among approaches at the individual jurisdictional level. To support this effort, the Great Lakes Commission should develop and maintain a descriptive inventory of the institutional framework in the Basin and all its components. This guide should provide a basis for the periodic review of strengths, weaknesses, successes, failures and prospective initiatives.

10) Consistency in statutes from one Great Lakes jurisdiction to the next should be pursued in the interest of developing an ecosystem-based approach to sustainable agriculture. Consistency in both regulatory and voluntary approaches to nonpoint source pollution control is a priority. Other areas for consistency include state standards for manure handling, storage and application; an inter-jurisdictional nutrient trading program between point and nonpoint sources; mechanisms to secure agricultural community support and leadership in municipal well-head protection programs; watershed planning and management models that address agri-environmental issues and ensure appropriate representation; and model legislation and/or zoning ordinances designed to prevent or discourage development of prime farmland. The Great Lakes Commission, as a regional, multi-jurisdictional agency with federal, state, provincial and local involvement, is a prospective lead agency for pursuing such initiatives.

F. Technology Creation and Transfer

Findings

The application of modern science and technology to agriculture and food processing systems has ensured continued and pronounced growth in productivity. Over the last 50 years in the United States, for example, total agricultural productivity per unit of input (e.g., yield per acre or per animal) has increased by approximately 2.0% per year. New technology enables farmers to increase efficiency and cost effectiveness, thereby lowering unit production costs and producing higher value products. Higher yielding crop varieties, improved livestock breeds, improved methods of pest and disease control, and increased mechanization are among many examples of new technologies that have increased agricultural productivity. Basic and applied agricultural research conducted by government agencies, academia and the private sector has provided the foundation for such advances.

Historically, research and attendant technological applications have been directed more toward enhanced productivity than toward mitigation of the environmental impacts of agriculture. Yet, it is often these very advances in productivity and associated intensive use of the resource that exacerbate these impacts. Hence, an integrated approach to research and development that focuses on environmentally responsible and sustainable practices for productivity increases is well advised.

It is important to note that the last two decades have seen an increased research and development focus on agri-environmental technologies. One example is found in Integrated Pest Management (IPM) technology, which optimizes pest control in an economically and ecologically sound manner. It involves the coordinated employment of multiple tactics to ensure stable crop production and maintenance of pest damage below the economic injury level while minimizing hazards to humans, plants and the environment. Intensive Rotational Grazing and Management Intensive Grazing are gaining wider acceptance. Also, emerging nutrient management technologies supply crops with precisely formulated quantities of nutrients at predetermined times to improve efficiency and eliminate or reduce excess applications. Nutrient management involves several interrelated techniques, including soil testing, split fertilizer applications, green manuring, and the use of nitrogen-capturing crops. Animal waste management and, in particular, storage and utilization technologies, are now a research focus as well.

The Great Lakes Basin has long been the locus for development and application of an array of conservation tillage technologies. Precision farming is an emerging practice that shows great promise. It is an information and technology based agricultural management system that optimizes profitability, sustainability and environmental protection by analyzing and managing site/soil spatial and temporal variability within fields. Increasingly, it is viewed as a best management practice (BMP) in its own right as well as a means to implement other BMPs, particularly those most sensitive to soil conditions and other spatial attributes.

Existing needs in the area of technology creation and transfer are found in both research and development, and in the information/outreach initiatives vital to promoting application. In addition to continued/enhanced development of the technologies, research is needed to identify both the barriers and opportunities for widespread application; factors to be addressed include sociological, cultural and economic considerations. One key question is how tenure patterns—ownership vs. rented agricultural land—may affect a farmer's desire or ability to adopt new technologies. Also, on-farm research should be undertaken to facilitate the design of ecologically-based technology, particularly as a component of

integrated farming systems and whole-farm planning. The Holistic Resource Management decision making process aids farmers in identifying the appropriate tools to develop a sustainable farming system.

More research and development needs to be directed at established and emerging technologies that include, among others, filter strips, alternative methods for weed control such as smother crops and crop rotation, various conservation tillage practices including no-till, biological pest management, alternative methods of livestock waste processing and nutrient management, "new age" pesticides whose chemical compounds break down into inert substances, and methods for adaptation to climate change. Such methods research should be complemented by research into natural conditions that may determine the extent to which new technologies can be applied. This would include, among others, groundwater and aquifer data, soil quality trends and changes, global positioning system (GPS) data, and transport and fate research.

An associated challenge is technology transfer and application. Long-standing public and nongovernmental mechanisms (e.g., NRCS, soil and water conservation associations, university extension) have been effective and their services should be continued and enhanced. A greater focus does need to be placed on revising existing mechanisms (or establishing new ones) with a greater emphasis on multi-stakeholder participation, goal setting and joint initiatives among an array of interests. The agri-environmental data base developed through this Agricultural Profile project, along with the aforementioned Great Lakes Information Network, hold promise as additional mechanisms to promote technology transfer to a much-expanded audience. Regularly updated, this information would allow all agriculture and environmental interests to monitor progress in application of new technologies.

Recommendations

1) Applied research on agri-environmental technologies should receive enhanced funding and greater focus from U.S. and Canadian federal agencies that have traditionally emphasized research with a primary/exclusive focus on expanded productivity. Among others, such technologies warranting further attention include Integrated Pest Management, Management Intensive Grazing, nutrient management, precision farming, alternative weed control (e.g., smother crops), crop rotation, "new age" pesticides, and appropriate biological technologies. Priority setting for such research should be an open and inclusive process with involvement from the farming community ultimately responsible for technology application.

2) Despite the current availability and demonstrated benefits of various agri-environmental technologies, widespread application has not yet been observed. Barriers and opportunities for such need to be researched and addressed, with an emphasis on sociological, cultural and economic considerations. Such research should be integrated into the development of technologies to ensure maximum usage once they are commercially available.

3) Monitoring and evaluation of both established and emerging agri-environmental technologies should be a fundamental component of the technology application process and, therefore, should be integrated into individual farm plans. Government agencies, university extension offices and related entities should assist in this effort, as resultant data and information is essential in fine-tuning, marketing and maximizing application of agri-environmental technologies. At the farm level, the Holistic Resource Management decision system should be employed to select appropriate technologies and practices for developing a sustainable farming system.

4) An agri-environmental database should be used as a means to better track technology applications in the Great Lakes Basin. Data and information should include type of technology; application process; location and acreage; cost; yield; environmental benefits/implications; and other issues and concerns. Additionally, electronic communications technology can serve as a means to publicize success stories; share data and information; strengthen/expand networks among farmers; and publicize grant/technical assistance programs. To accomplish this, the Great Lakes Commission should expand GLIN to offer World Wide Web pages that explain new technologies, practices, and methods, and to provide linkages to the agri-environmental database for specific information and data regarding technology creation and transfer.

5) Existing farmer networks and outreach programs (e.g., soil and water conservation districts, university extension programs) should be challenged to more aggressively promote agri-environmental technologies through farmer education demonstration programs incentive systems.

6) Stronger alliances are needed between agricultural and environmental interests if agri-environmental technologies are to be effectively promoted and widely applied. Within existing organizations—whether they be farmer associations or citizen environmental groups—a greater emphasis must be placed on multi-stakeholder participation, consensus based goal setting and joint initiatives with other organizations promoting such technology.

III. APPENDICES

A. **Agriculture Summit Abstracts and Presentations (Selected)**
B. **Final Agriculture Summit Agenda**
C. **Breakout Session Attendees Lists**
D. **Roster of Summit Attendees**
E. **Agricultural Profile Project Team and Advisory Committee**

Welcoming Remarks

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With great pleasure I welcome you to Michigan State University as participants in this Great Lakes Agriculture Summit. We stand on the brink of a new challenge, an opportunity to forge a plan to benefit agriculture and the quality of life of citizens of the Great Lakes Basin now and in the future. What we do here over the next two days will enable us all to look back on this gathering with a sense of pride and accomplishment. I say this with assurance and I thank you in advance for your contribution, for taking the time and expending the effort to be part of what has rightly been identified as an agriculture summit. I predict our success confidently because our objectives are worthy, our knowledge base is broad, and our participants are well-informed and dedicated.

This conference is a significant aspect of the Great Lakes Commission project entitled *An Agricultural Profile of the Great Lakes Basin: Characteristics and Trends in Production, Land-Use and Environmental Impact.* Funded by the Great Lakes Protection Fund, the significance of this conference is that it addresses the development of agriculture from a Great Lakes Basin or watershed perspective. Just attempting to correlate agricultural activities with their impact on the Great Lakes ecosystem is a major undertaking. This Agriculture Profile project reflects the mandate of the Great Lakes Commission "to promote the orderly, integrated, and comprehensive development, use, and conservation of the water resources of the Great Lakes Basin." Through its program areas, professional staff, and many task forces, the Commission pursues its mandate via three principal functions: information sharing among the Great Lakes States, as well as Ontario and Quebec; coordination of state policy positions on issues of regional concern; and advocacy of those positions on which the states agree.

The data and associated analyses presented here today and tomorrow will provide information with respect to agriculture's impact on the Great Lakes economy and environment. This information will be used not only by the Great Lakes Protection Fund but also by other organizations such as the Council of Great Lakes Governors, federal and state agency directors, and NGOs. It will enable us to develop research and policy agendas that can encourage acceptance of agricultural and industrial practices based on methods that minimize the release of pollutants. This will help protect the water quality and ecosystem of the Great Lakes Basin within a framework of a sound economic base, one that will improve the productivity of agriculture and maintain a high-quality stewardship of the land and surrounding waters.

To assemble and present the data, the Great Lakes Commission acknowledges with gratitude the work of the Agricultural Profile Project Team: Michigan State University, Agriculture and Agri-Food Canada, World Wildlife Fund, and the University of Guelph. Their dedication and expertise have laid a foundation of knowledge which will be presented here as a basis for planning future directions. That is where our present task begins, so once again I bid you welcome and thank you for coming forward to accept this challenge.

Greeting Remarks

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Good morning. It's a pleasure to be here in Michigan, and to bring greetings from the Government and people of Ontario.

This Summit marks an important coming together of representatives from agricultural and environmental groups, the research community, and government—a partnership focusing on the revitalization and protection of the Great Lakes Basin. But it is also a partnership that recognizes the important role the agriculture plays in our respective states and provinces.

In Ontario, the agri-food sector generates more than $50 billion each year in direct economic activity—making it second in importance to only our automobile and auto parts sector. Agri-food also provides a livelihood for half-a-million Ontarians. Much of our agricultural activity takes place in the Great Lakes Basin—in fact, 25 percent of all Canadian agricultural production comes from Basin farms.

The Governments of both Ontario and Canada are well aware of the contribution agriculture makes to our economic well being. But just as important, they are committed to the long-term health of the Great Lakes Basin. Witness the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem, signed in 1994, that aims to restore, protect, and sustain the Great Lakes by addressing three target objectives:

- the restoration of degraded areas;
- the prevention and control of pollution; and
- the conservation and protection of both human and ecosystem health

Ontario's agricultural community is just as committed to protecting the environment. I've been around agriculture for a long time, and I know that in farm circles, environmentalism is nothing new. Farmers have always been in touch with the land—it is part of their life, day in and day out. They do not view the land as something to be used for short-term gain, but instead it is seen as something to be nurtured for this generation and all generations to come.

Such awareness and foresight has led to the environmental developments we are seeing today in Ontario Agriculture. For example, the results of the last Pesticide Use Survey show that pesticide use continues to decline in Ontario—down 13 percent from 1988, and almost 30 percent since 1983. Such figures are quite remarkable, especially in light of the fact that we have achieved half of the pesticide reduction target set out in Ontario's Food Systems 2002 project.

Much of this success is due to improved soil management techniques. As you may know, the arrival of conservation tillage methods such as ridge tillage, no-till, and mulch tillage required new weed control strategies, as well as new and improved herbicide products. Such strategies and products not only meant success for conservation tillage, but they also provide alternative methods of weed control—methods that are more environmentally friendly.

But without the support of farmers, many new environmental initiatives—such as conservation tillage—would have died on the drawing board. In my book, farmers have always been good stewards of the land—a fact that is borne out, time and time again, through both their vision and their actions. The Environmental Farm Plan Program stands as testimony to the Ontario farm community's commitment to environmental protection. Right from the start, farm plans have been an initiative of Ontario farmers. A coalition of organizations representing farmers—including the Ontario Federation of Agriculture and the Ontario Soil and Crop Improvement Association, who are here at the Summit—worked together to develop a comprehensive environmental agenda for the agriculture industry.

The Environmental Farm Plan Program represents the first step in putting that agenda into action. Over the past few years, the EFP program has helped farmers to not only plan how to improve their operations—but it has let them implement a wide variety of projects: from water well upgrades and pesticide and fuel storage improvements, to methods of protecting waterways from runoff.

As I say, the Environmental Farm Plan program has been farmer-driven. And I am very pleased that the Ontario Ministry of Agriculture, Food, and Rural Affairs has been able to help out -by providing staff technical specialists and advisors for the EFP workshops. I would also like to point out that the Federal Government of Canada provided funding to help launch the EFP program, and keep it going.

Success today grows out of such partnerships—people working together to achieve common goals or a shared vision of the future. And it is in this spirit of cooperation that we have come together at this Summit. I know that—as partners—we can achieve the dual goals of sustainable agriculture and an improved and healthier ecosystem in the Great Lakes Basin.

Keynote Speech

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1.0 INTRODUCTION

Good afternoon ladies and gentlemen. I would like to congratulate the Great Lakes Commission on organizing a Great Lakes Agricultural Summit. Unlike some keynote speakers—those who dash in as dessert is being served and have only time for two quick questions once they have presented their remarks—I am actually registered for this conference and intend to benefit from both the plenary and breakout sessions. On behalf of the Ontario Federation of Agriculture (OFA), I would like to thank the organizers for providing me the opportunity to provide a farmer's perspective to the summit's objective of developing a series of research and management priorities to address the impact of agricultural production on the physical environment found within the Great Lakes Basin.

By way of introduction, I think it will be helpful to briefly describe the OFA. The OFA is a general farm organization with a membership comprising 38,000 Ontario farm families as well as 28 farm organizations, most of which can be described as commodity specific. The mission of the OFA is to improve the economic and social well-being of farmers in co-operation with county, commodity and rural farm organizations. It is one thing to develop a mission statement; quite another to actually carry out a mission. The OFA draws on volunteers from its pool of 38,000 farm family members to make things happen.

I am a farmer. The Chairman of OFA's Environment Committee is a farmer, as are the members of his committee, most of whom are in this room today. Each of the 111 individuals sitting on the OFA Board of Directors is a farmer. The OFA is an organization of farmers working for farmers. While we do have professional staff, they serve in an advisory capacity. The policies of the OFA are developed, approved and voiced by farmers.

My point in describing all of this is to assure you that while farmers work very long hours running their respective farm businesses, they do make themselves available, generally through a farm organization structure, to study and comment, ideally at an early stage, on proposed government policies that may impact upon the agricultural community. Note that I have said government policies that impact upon the agricultural community. That means that our lobbying is not restricted to the provincial ministry responsible for agriculture. While Assistant Deputy Minister Ingratta may sometimes feel that we are concentrating exclusively on his ministry, we actively lobby the Ministry of Environment and Energy, the Ministry of Natural Resources, the Ministry of Municipal Affairs, the Ministry of Community and Social Services—we are well prepared to review and comment on any government policy, generated by any ministry, that will have an impact on rural Ontario. Farmers prefer to prevent rather than fix problems.

The focus of this summit is to identify and develop means by which to address environmental concerns associated with agricultural production. I would like to share with you some experiences of Ontario farmers in this regard. I will begin by outlining an environmental success story that has attracted international recognition, and conclude with some thoughts on research.

2.0 MANAGEMENT

2.1 Environmental Farm Plans

In 1990 Ontario elected its first social democratic government. Incidentally, this government was defeated in 1995 and replaced with what we refer to as a Progressive Conservative government. (In Canadian parlance this is akin to a liberal conservative government and not to be confused with a conservative liberal government.) The Minister of Environment in the newly elected social democratic government immediately announced her intention of quickly introducing a 'world class' Environmental Bill of Rights. The Minister of Agriculture, who was a neophyte politician, correctly assumed that such a bill had the potential to negatively impact upon agriculture, and assembled a Minister's Advisory Committee on Environmental Responsibility.

Sixteen Ontario farm leaders sat on this committee. Sixteen Ontario farm leaders quickly became frustrated. The source of their frustration was the fact that they were hearing from various ministries how agriculture would have to change in order to be more environmentally responsible. There was little or no recognition given to advances being made in such areas as crop rotation, reduced tillage, erosion control, or integrated pest management, to name just a few. Nor was there recognition of the fact that farmers themselves were best equipped to both identify and address environmental concerns associated with agricultural practice. Farmers were expected to respond to agricultural agendas developed outside of their community by people with little practical knowledge of the farming industry.

This level of frustration resulted in the formation of the Ontario Farm Environmental Coalition (OFEC) in July 1991. The four lead agencies in this coalition were: The OFA; the Christian Farmers Federation of Ontario (CFFO); AGCare (Agricultural Groups Concerned About Resources and the Environment); and, the Ontario Farm Animal Council (OFAC). Both OFA and CFFO are general farm organizations. AGCare is an umbrella group representing 45,000 field and horticultural crop producers on pest management issues, while OFAC is a council of livestock organizations that address animal welfare issues. In total over 30 Ontario farm organizations and virtually every commercial farmer in the province is represented by the Ontario Farm Environmental Coalition. Dr. Gordon Surgeoner, a professor at the University of Guelph, accepted our invitation to chair this coalition of farm organizations, and we are most appreciative of his tireless work in helping us to achieve our goals. Gord is one of our afternoon speakers.

The Coalition's first task was to produce a booklet we titled 'Our Farm Environmental Agenda'. Having been faced with the possibility of responding to an agenda developed outside of the farm community, farmers decided to develop their own agenda. Farm organizations and farm organizations alone worked to develop this agenda document. It took thousands of hours, countless revisions and a few rewrites to produce a text that met the needs of each of the over 30 farm organizations represented by the coalition. In January 1992, 'Our Farm Environmental Agenda' was released. It outlined environmental concerns that farmers identified with respect to soil quality, water quality, air quality, agricultural inputs, and natural resources. The major recommendation contained within the booklet was to address concerns by

having every commercial farmer in the province produce an environmental farm plan tailored to his or her own particular farm operation.

Essentially, we were recommending the development of what we have come to call an EFP (Environmental Farm Plan), but at that time we had no template. We did not know what an EFP would look like. At this point we invited representatives from both the provincial and federal levels of government to join us and help develop an EFP Program. As many of you know, Ontario's EFP Program has been modelled after the Farm*A*Syst Program developed at the University of Wisconsin.

Our federal government has provided funding for the EFP Program (roughly $10 million Canadian over four years), while the provincial government provided a substantial number of person years to assist in writing a 217 page EFP Workbook containing 23 modules. Indeed, over 100.individuals were drawn into the writing of the EFP Workbook. This demonstrates the confidence we have in the technical expertise of the provincial civil service. It also demonstrates the confidence our government has in farm organizations. It was farmers, through their organizations, who identified environmental concerns associated with agricultural practices, described those concerns, and decided upon the concept of an environmental farm plan. We looked to the civil service to provide the technical expertise required to implement the environmental farm plan concept.

To this point approximately 7,500 Ontario farmers have voluntarily participated in the EFP process. This process involves a one and one-half day workshop administered by the Ontario Soil and Crop Improvement Association (a farm organization) with technical support provided by the Ontario Ministry of Agriculture, Food and Rural Affairs. As well, several hours of homework are required of the farmer to complete the risk assessment and action plan components of the EFP. We are very proud of this level of participation and attribute it to the fact that farmers are extremely interested in raising their awareness level of environmental concerns associated with agricultural production. Another important factor is that the EFP Program has been conceived, developed and delivered by Ontario farmers. I firmly believe that had our government offered exactly the same program the uptake by farmers would have been considerably reduced.

The EFP Program serves as an example of farmers working in partnership with government agencies and universities to combat potential environmental concerns. A direct outcome of the EFP process is a quarterly meeting between the Ontario Farm Environmental Coalition Steering Committee—which includes representation from farm organizations and the University of Guelph—and the Deputy Ministers of Agriculture, Environment and Natural Resources. These meetings provide an opportunity for frank discussions on a broad range of policy issues.

There are two other examples of farm management initiatives that I would like to touch upon. One is the publication of several Best Management Practice Booklets; the other is the Ontario Grower Pesticide Safety Course.

2.2 Best Management Practice Publications

At about the same time that the EFP Program was being launched, federal funding became available for technology transfer. To date, Ontario has attracted $3 million of this funding for the production of a series of Best Management Practice booklets. This project has been led by the Ontario Federation of Agriculture in conjunction with both our federal and provincial ministries of agriculture. Writers and

reviewers have been drawn from a range of government ministries, universities, and non-government agencies, including farm organizations. These publications, which include titles on water management, nutrient management, soil management, irrigation management, integrated pest management, and manure management, to name just a few, serve to complement the EFP Program in that they offer practical suggestions to farmers as they develop their EFP Action Plans.

2.3 Grower Pesticide Safety Course

Another example of this type of co-operation is Ontario's Grower Pesticide Certification Program. Prior to the establishment of the Ontario Farm Environmental Coalition, AGCare, one of the Coalitions lead agencies, lobbied Ontario's Ministry of the Environment for what has become a Grower Pesticide Certification Program. You heard me right, a farm organization lobbied for the development of a program to train farmers in the safe transportation, handling and application of pesticides.

Farmers could quite easily dismiss the concerns raised by environmentalists with regard to pesticide use as alarmist. We could cite, for example, arguments presented in the book Saving the Planet with Pesticides and Plastic by Dennis Avery, Director of the Centre for Global Food Studies at the Hudson Institute. Or we could remind people that Dr. Bruce Ames, a prominent biochemist from the University of California at Berkeley, has determined that 99.99 per cent of the pesticides in the diet of people are naturally present in plants. Or we could rely on testimony from Dr. Elizabeth Whelan, an esteemed epidemiologist, who, when she spoke in Ontario in 1990, was President of the American Council on Science and Health. Dr. Whelan stated that the best estimate as to how many people in North America have died as a result of pesticide residue on foods is **zero**. Not one!

But farmers chose not to dismiss public concerns around pesticide use. While we certainly agree with the positions put forward by Avery, Ames and Whelan, we recognize that there are potential health and safety risks associated with pesticide use and we are committed to managing those risks. Hence agriculture's request for, and continuing support for a program that provides training in the safe handling of pest management products.

A Grower Pesticide Safety Certificate is now required of anyone purchasing agricultural pesticides in the province of Ontario. While not all farmers are ecstatic with regard to this requirement, the majority of farmers recognize the value. It is noteworthy that as with the EFP Program, farmers are far more accepting of a pesticide training program that a farm organization suggested and helped to develop than one imposed upon them by government.

3.0 RESEARCH

Moving on to agricultural research, I would like to make three points. The first is to suggest that agricultural research projects should lead to production practices that balance both environmental and economic considerations. The second is that farmers and their organizations need to be more active in agricultural research, not only as co-operators, but also in the identification of research priorities and, to a limited extent, in the actual design of research projects. Finally, while farmers utilize the products of applied agricultural research, we have strong concerns as to the availability of funding for basic research.

3.1 Balanced Research

While it is universally acknowledged that a sustainable agriculture must have both environmental and economic components that are positive in nature, I'm confident that a review of the sustainable agriculture literature would yield far more references to environment than it would to economy. I referred earlier to agricultural best management practices. We support research that leads to best management practices, but those practices to be truly 'best' must meet both economic and environmental criteria. This concept is a cornerstone of the EFP Program where we acknowledge that a solution which is 70 percent effective in addressing an environmental concern and affordable to the majority of farmers is preferable to a 95 per cent solution that is cost prohibitive.

With respect to balanced research, farmers would also like to see more emphasis put on determining the extent to which agriculture can enhance the environment. The objective of this summit, for example, is to explore ways to reduce the impact of agricultural production on the natural environment. We accept that this is an important exercise, but there is a great need to acknowledge and reward farmers for their efforts and achievements in environmental responsibility. Farmers need to be treated less like the enemy and more like a partner in environmental progress. Recognition must be given to the contribution farmers have made to the quality of life on this planet.

3.2 Farmer Involvement in Agricultural Research

Both the agricultural community and the research community would be better served if there was a closer working relationship than there is at present between agricultural researchers and farmers—the end user of research deemed to be successful. That is not to say that researchers are not currently seeking the advice of farmers. However, farmers would appreciate being more involved in agricultural research, while agricultural researchers would benefit from being more closely aligned with farmers through their farm organizations.

We have in Ontario a Field Crop Research Coalition. This coalition was formed about two years ago to address the fact that researchers were setting research priorities on the basis of individual research interests rather than the practical research needs of Ontario farmers. Given how scarce research funding has become in this era of cutbacks, farm organizations felt they had to organize and more clearly express what they believe to be the research priorities of Ontario farmers.

A similar exercise is underway with regard to agricultural biotechnology. An Ontario Agricultural Biotechnology Steering Committee has recently been established. The OFA chairs this committee which has representation from farm organizations, agricultural input suppliers, government, universities, food retail organizations and a consumers group. It was heartening to have these various groups determine that a general farm organization should be the lead agency in managing an issue as complex as agricultural biotechnology. It is magical to see the vast expanse of common ground these partners are discovering among themselves

Water quality is another important area that Ontario farm organizations have identified as a research priority. To coordinate this effort a Water Quality Working Group has been established by the Ontario Farm Environmental Coalition. Dr. Gary Kachanoski, a soil scientist from the University of Guelph accepted our invitation to serve as chairman. Once again this Working Group demonstrates farmers' commitment to partnering with academics as well as federal, provincial and municipal administrators to

develop farming practices that ensure Ontario's groundwater quality is not compromised by agricultural activities.

3.3 Funding of Basic Research

The final point I would like to make relates to the funding of basic research. Farm organizations can and will continue to actively support agricultural research that has the potential to be readily applied. However, applied research builds on basic research. We worry that it may become increasingly difficult for researchers to attract funds for basic, fundamental research that is not directly related to agricultural production. Last month the OFA Environment Committee heard a presentation from an individual wishing to conduct a study which would help to develop a strategy for assessment of nitrate contamination of groundwater. From our perspective this serves as an example of basic research. In supporting research on developing best practices for nitrate management, the OFA would assume that a mechanism for accurately measuring soil nitrate was already available. The presentation we heard was useful in making us aware that such is not always the case. However, farm organizations are unlikely to fund basic research.

The research priorities that will be discussed at this summit will, I'm sure, fall into the applied research category. It is impossible to set a schedule for scientific discovery. Yet continued progress in agricultural efficiency relies on scientific discovery. Where will the funds for the basic research that ultimately leads to applied research come from?

CONCLUSION

By way of conclusion, the priority I offer as a farmer relates to process. It must become a priority that farmers, through their farm organizations, are given the opportunity to take a lead role in the setting of agricultural research agendas and in the development and implementation of agricultural management strategies. Farmers will certainly look to civil servants, academics, and other relevant agencies for assistance, but there always needs to be a lead agency. I strongly believe that farm organizations are best positioned to provide that leadership on issues pertaining to agriculture and the environment. I would like to close with the following question:

Are you willing to pick up your phone or open your door, and avail yourself of the practical knowledge, experience, and wisdom available to you from the farm community so that we might work together to achieve our common goals?

A. Agriculture Summit Abstracts and Presentations (Selected)

Panel Session #1: Agriculture and the Great Lakes Economy

Great Lakes Basin Agriculture: An Overview of Production Attributes

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At the time of early settlement, the region's economy was strongly dependent on its agriculture sector. This connection has been maintained as the region developed, but agriculture now has more of a supporting role. Within the Great Lakes Basin, the important role of agriculture is unquestioned. It's diverse and productive. It's a livelihood. It's been a major force affecting land use. And it is part of the Basin's ecosystem.

Agricultural land use constitutes about 35 percent of the Basin's land base, much of it within a 3-1/2 degree band of latitude encompassing the southern half of the Basin. Topography and a favorable soil and climate regime have combined to make this part of the Basin acknowledged "farm country", supporting some of the most productive rainfed cropland anywhere.

Let's start with that place of production— the farm. For the 1991-92 census period, the Basin had nearly 204,000 farms; seven of every 10 were in the U.S. There were nearly 20 percent fewer farms than a decade earlier. The relentless pressure of bottom line profitability and natural culling forces have improved productivity of the remaining farm operations. Farmland is also declining and this trend could eventually erode the Basin's productive capacity. The conversion of 4.5 million acres of farmland, thirty-nine percent of which was classified as cropland between 1981 and 1992 is worrisome.

Commodity sales from all Basin farms for the 1991-92 census period, as expressed in U.S. dollars, amounted to $15.2 billion. This figure represents nearly 36 percent of the total farm marketings from all eight Great Lakes states and the province of Ontario. That's significant because with only 30 percent of the greater region's cropland, Basin production appears to have a relatively large share of higher-valued commodities.

Corn, at more than a third of cropland acreage, is the principal crop of the Basin. Most of it is used for animal feed. Corn came to our area as a traveler in the company of our native populations. It's now the quintessential American crop having progressed from a subsistence food to the feedstock of an industrial enterprise. This revolution in use can be traced back to place nearby where William Beal in 1877 became the first to cross fertilize corn for the purpose of increasing yields through hybrid vigor.

Soybeans, another major Basin crop with a multitude of uses are concentrated in the central and southern parts of the Basin, particularly around the western end of Lake Erie. The six million acres for 91-92 represented about 22 percent of Basin cropland. As with corn, more than three quarters of these acres were in the U.S.

Basin wheat acreage is more balanced between the countries but the acreage is small potatoes considering the national figures. The Basin wheat connection though, is much more than production. As a major Canadian export commodity and important in the U.S. as well, wheat has historically moved through Great Lakes ports in large quantities. Wheat from bonanza farms of the Upper Midwest made the port city of Buffalo once the largest milling center in the world. For many years, three-fifths of Canada's wheat exports moved from its prairies to the world's largest concentration of elevators at Thunder Bay.

With the opening of the modern St. Lawrence Seaway in 1959, shipments from U.S. ports have usually been via ocean-going, foreign flag "salties," whereas most Canadian shipments are moved in lake freighters as a backhaul cargo for westbound iron ore from Labrador - Quebec. The Canadian shipments are usually to large export terminals on the lower St. Lawrence River where they are transshipped. Grain shipments through Great Lakes ports are declining. Now, the Great Lakes account for only 6 percent of total U.S. shipments and Canadian eastward movements are down to about 40 percent of their national total.

Several factors have contributed to the system's growing residual grain shipping status. A major reason has been the substantial increase in grain shipments to Pacific Rim countries thereby shifting more North American grain to Gulf and West Coast port ranges. The winter shutdown of Seaway locks has limited year round shipping arrangements C a necessary flexibility in response to volatile market conditions. The vessel size limitation imposed by Seaway locks is another major competitive disadvantage vis-a-vis tidewater ports as are Seaway tolls and system pilotage costs. The 1995 elimination of certain rail subsidies, particularly those applying to the movement of Canadian grain will likely turn more east-west commodity flow into a north-south orientation further drawing grain cargoes away from the Seaway route. Also, rail competition with its long-haul unit trains (single commodity/dedicated service) has captured some of the former lake business.

The export market for agricultural commodities is important for the Canadian and American national economies. Such trade between the two countries is becoming more balanced at around $5.5 billion each. Tight global grain supplies and higher commodity prices this year will spur production for export and Basin farmers and shippers will likely benefit.

Two other crops, sugar beets and dry edible beans, are also significant in terms of Basin production but are more concentrated geographically. Within the Basin, sugar beets were grown only in Michigan and Ohio but amounted to 13.5 percent of the national acreage for this crop. Almost all the beets are grown under contract to two major processing companies. For dry beans, the U.S. acres represent nearly a quarter of national acreage.

Livestock has an important role in Basin agriculture. Although the trend has been to fewer farms with livestock operations, the remaining larger operations generate sizable cash returns, as well as particular environmental problems. The Basin's relatively large forage base gives the area inherent production advantages. Poultry has advantages too with proximity to markets and feed inputs but the large operations are most competitive— concentrating production at fewer places. As an aside, the word livestock brings to mind the current headlines about mad cows and Englishmen and what Oprah Winfrey thinks. Products for human consumption are vulnerable to this kind of public reaction whether justified or not. Farming entails risk and this kind of risk adds to the uncertainty of it all.

Dairy farming today is a highly evolved form of agricultural production and a far cry from its modest beginnings. It is one hallmark of Great Lakes Basin agriculture even though, in 1993, America's former dairyland, Wisconsin, was replaced by California as the number one milk producing state. Substantial structural change has occurred with well-established trends of fewer but larger and more efficient dairy farms along with changing utilization of product. From 1981 to 1992, the number of dairy cows in the Basin declined 18 percent as the number of dairy farms decreased by a third. Distribution of dairy cows in the Basin indicates areas of concentration such as eastern Wisconsin, upstate New York and central Ontario where the industry is an important factor in farm sales and processing activity.

Changes are occurring not only on Basin dairy farms but also in the processing sector. Some of these changes are consumer-driven. With less raw milk going to the fluid milk market regionally and nationally, much of the raw milk produced in the Basin ends up as a manufactured dairy product. Wisconsin leads the way with more than four-fifths of its huge milk volume processed into cheese. In New York, fluid products represent less than a third of total utilization and cheese production is way up. One company, appropriately named Great Lakes Cheese, with two New York plants in the Basin, illustrates this trend. The Adams NY plant receives a million pounds of milk daily and produces only cheddar. The Adams supply is generated by 300 farms in a 5 county area. The cheese is shipped to packaging plants in Ohio and Wisconsin from where it is distributed nationally. This company, which ties its demand for local milk to a national market for a manufactured product, is becoming more typical in the Great Lakes Basin.

Another distinguishing feature of Basin agriculture is speciality crop production— its diversity and areas of geographic concentration. Fruit crops such as apples, cherries and grapes can serve as an example. Part of the Great Lakes Basin could be described as a "fruit factory" where microclimate factors and market access have combined to focus production and related processing activity. Production areas for these fruits are concentrated in the Great Lakes coastal counties and a few inland areas.

U.S. Basin apple production which represents about four-fifths of the Basin total was 1.74 billion pounds in 1992 or about 18 percent of the U.S. total. Michigan and New York account for about 75 percent of Basin production. The fresh market in New York captures about 40 percent of its production. For Michigan, about two-thirds of its supply is directed to processors. Along with production, packing and storage capacity is also expanding, tapping into the region's transportation cost advantage to the east-of-Mississippi market and the importance of year-round supply.

Cherries is another key Basin fruit crop with more than fifty percent of Canada's and U.S. acreage. More than 95 percent of Basin acreage, though is in the U.S. and much of that is in western Michigan. Tart cherries and sweet cherries are both grown, but it is the tart cherry that is the principal kind. In recent years, tart cherry production has suffered from an oversupply problem and sluggish demand. When growing conditions provide an abundant crop as was the case last year, prices come down with ramifications for future production. In response to these cycles of oversupply, orchards are taken out of production. Much of the current Michigan acreage was planted 15 to 20 years ago and as these trees became less productive during the 1990s, growers may replace them with other fruit or even leave the industry. In an effort to increase demand, processors and growers are supporting research and market development such as the Cherry Marketing Institute established in Michigan.

Ontario's Niagara Peninsula along with the southwestern Michigan, Lake Erie and upstate New York viticulture areas are the principal grape growing regions of the Basin. Most of the Michigan and the Lake Erie grape harvest is processed into juice, while other areas are oriented more toward winemaking. The Lake Erie viticultural area in three states—Ohio, Pennsylvania and New York—makes up the largest grape growing area outside of California. Lake Erie's moderating influence on temperature along with ridges parallel to the shore have concentrated many vineyard operations into a three-mile zone, especially in the eastern half of the area. Growers have been modestly successful in establishing a Great Lakes Basin wine industry. Winemaking exists in all Basin viticultural areas but the Finger Lakes-Cayuga Lake district is the largest and best known. It has more than 50 wineries, the largest such concentration in the eastern U.S.

We've heard about how the western end of Lake Erie is right smack dab in the middle of Basin farm and food processing country. Well, with these slides— all but two taken only a week ago— you will have some visual proof. Here is the La Choy Plant in Archbold, Ohio where a full line of packaged and canned foods are prepared.

These grain terminals on the Maumee River near downtown Toledo shipped 2.7 million tons of corn, wheat and soybeans last year. There are three facilities here owned by Cargill, Country Mark Coop and the Andersons. These last two merchants of grain also have nearby elevators such as this one, only a few hundred yards north of the Ohio-Michigan line. It shipped 11.4 million bushels last year mostly by unit train although some went out through the river facility. Most of the grain for this terminal comes from a 2 to 3 county radius but occasionally from as far away as Michigan's Thumb region.

This bird's eye perspective is the H.J. Heinz Co. plant in Leamington, Ontario. In operation since 1908, its products include beans, pickles, and vinegar but the mainstay of production are tomato products with more than 200,000 tons of tomatoes processed each year. The plant's connection to Lake Erie besides the growing conditions for its raw materials is its dependence on water for various production purposes. About 40 percent of its annual 1.6 billion gallon demand is self-supplied directly from the Lake. Water is used mainly as a process tool for raw product preparation and for equipment cooling.

The area around western Lake Erie is the second largest concentration of tomato growing and processing north of Mexico. Although Basin tomato acreage is generally split evenly between Canada and the U.S., the Ontario figure represents nearly 90 percent of Canada's total whereas the U.S. Basin amount pales in comparison to California. Grower associations and contract arrangements with the major processing companies predominate among tomato farms. Some seedlings are imported from the South but local greenhouse transplants are becoming a more important source. Migrant workers also have a role in this crop. Here is a state-funded Migrant Rest Center near Napoleon, Ohio where workers assemble for a few days before going out to neighboring farms. There is a medical and dental clinic here also.

With production so intimately tied to processing, the major companies which contract for supply must consider the vagaries of supply and demand in their national production plans. As a result, contact acreage and processing activity fluctuates from year to year, although overall acreage has declined by about a third since 1991. In 1994, the large Campbell Soup Co. operation at Napoleon, Ohio eliminated its tomato paste production which required about a third of its fresh tomato demand thus having a large impact on contract acreage. This facility, which is billed as the world's largest food plant, employs more than 2400 people. Low-cost tomato paste production is concentrated in California where growers are bigger, more mechanized and have a longer growing season. Northwest Ohio processors have

maintained their stake in the business by using California tomato paste in making other products, namely ketchup. In Fremont, Ohio, the largest ketchup plant in the world operated by Heinz, uses California base product for 80 percent of its production which moves out in 130 trailer shipments each day.

Not so many miles from the Campbell's plant is this scene where a new steel minimill and finishing plant are under construction. This project has eliminated 640 acres or a square mile of prime farmland in the Basin. Here is one of the affected farmsteads with the mill in the background. These classic "greenfield" facilities, scheduled to open later this year, are uprooting lives of landowners but, on the other hand, will offer employment opportunities for many more farm families. Although the steel mill represents a dramatic new use for farmland, much of the conversion of farmland in the Basin is taking place for residential development. This slide shows a house going up where a cornfield grew last year.

Most of the sedimentation in tributary rivers to the Great Lakes is caused by human activity. Although agricultural practices are the primary culprit in many sub-basin areas, construction activity and the relative imperviousness of the built environment do contribute to sediment loads and transport dynamics. The largest tributary of Lake Erie, the Maumee River where agriculture dominates the watershed, transports huge quantities of silt and clay sediment that cause shoaling in parts of the river and downstream at the Port of Toledo.

The control of erosion is recognized as a key component for reducing this form of sedimentation as well as reducing associated chemical pollution. The increasing adoption of soil conservation measures such as conservation tillage and filter strips is helping to put Great Lakes Basin agriculture on a firmer, if not more sustainable, path.

Regardless of what one of my favorite authors, Wendell Berry hopes for, mechanized agriculture is here to stay. What we need to do is to integrate our modern methods with the practices of old. Farming is a business now more than ever but it is also a way of life. Is it also the staff of life?

Current and Future Economic Issues of Importance to Great Lakes Agriculture from an Ontario Perspective

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Current Agricultural Land Use

Ontario represents 42% of the land base in the Great Lakes basin. Agriculture is Ontario's second largest industry and as such, is one of the most influential factors in the economy, environment and social structure of this region. Ontario Agriculture represents over $6 billion of farm gate sales to the Canadian economy.

The total land base in Ontario is 226,702,720 acres with 13,470,000 under the control of farm owners/operators. 8.551 million of these acres is under crop production. 80% of the Ontario land base is in the Great Lakes Basin.

The 1995 crop acreage was divided among the following major crops:
(Source: Jan. 1996 OMAFRA Monthly Crop and Acreage Report)

Commodity	Acreage
Hay	2,550,000
Soybean	1,815,000
Grain Corn	1,730,000
Barley, Oats, Mixed Grain	760,000
Winter Wheat	730,000
Fodder Corn	290,000
Vegetables	151,000
White and Coloured Beans	150,000
Canola	90,000
Fruit	71,000
Tobacco	65,000
Nursery products	50,000
Rye	50,000
Spring Wheat	40,000
Misc.	5,000
TOTAL	8,547,000

Over 50% of the farms include some form of livestock, therefore, most of the field crops are fed to livestock in Ontario, with grain supplies historically supplemented by Western Canada or the USA. From an environmental perspective, with the high proportion of hay in rotation, winter wheat, no-till and other recently adopted conservation cropping methods, close to two-third of the soil surface on the field crop acreage is covered with crop or crop residue over the Winter and Spring when most soil erosion potential exists.

Market Demand Dictates Land Use Decisions

With a population of over 11 million people in Ontario, competition for non-agriculture use of land is intensive. Agriculture land is lost from food production each year. Although this trend moderated to some extent through the recession of the 1980s and 1990s, current indicators point to sustained economic growth and with reduced interest rates and a growing Ontario population, competition for non-agricultural use of agriculture land will continue.

The current upsurge in grain commodity prices is also fueling competition for land among farmers. This has strengthened both land rental and market values of land in recent months. Cash rent of $250 dollars per acre has been reported for a few field crop situations. Given the strengthening world demand for food products due to both increasing populations and increased standard of living in developing countries, demand to the North American Agri-Food systems is expected to accelerate. For example, the world grains Stock-to-Consumption Ratio has declined sharply since 1992 and trending downward since 1986. The market will respond in 1996 by shifting commodities in grain growing regions to crops of greatest potential for profit. Ontario corn acreage in 1996 is expected to increase 2 - 3%, but crop rotation and no-till commitments will limit major shifts. There will be incentive to convert hay land (which may have provided marginal returns in 1995 due to depressed prices for hay and beef in Ontario) to grain or oilseeds.

The agricultural economy in the Great Lakes Region, as elsewhere in the world, is market driven. Consumers want convenience, value added (semi-prepared), inexpensive, safe, nutritious food with consideration for the environment and animal care. A market research study completed in 1994 by Dr. Tom Funk, Economics Department at the University of Guelph, predicts that by the year 2000, 90% of the food production in Canada will come from 10% of producers. Large volume production will be highly efficient and intense competition world wide will result in slim profit margins per unit which will continue to encourage high volume production through economy of scale.

The study predicts that the larger operations will become more sophisticated in information management, financial controls, marketing strategies with more linkages and partners. Food safety, environmental considerations and trace-back mechanisms through identity preserved production will become more common. Increases in industrial use of agriculture products which include ethanol, pharmaceuticals, cosmetics and colouring products are in the works. Leading edge producers will be more consumer oriented.

Near population centres, opportunities exist for direct, value added sales to consumers, either through farm retail outlets or near-by farmers' markets. Producers will utilize the highest level of technological sophistication to maintain a competitive edge.

Producer Organizations Demonstrate Leadership

Current deficit concerns by governments in Canada have weakened financial assistance support for production agriculture. It is apparent that the limited financial resources will be more targeted and programs will have to be delivered more efficiently and effectively. For example, Canada's Green Plan provides support for environmental activities for all rural resources ranging from Environmental Farm Plans, Conservation Clubs, Wetlands, Woodlands and Wildlife. In virtually all cases, programs are delivered at the grassroots level. In Ontario, as competition for funds becomes tighter, producer groups are becoming more self-reliant, demanding more ownership in the design and delivery of programs. In 1987, an experiment was launched with a producer group, the Ontario Soil and Crop Improvement Association, contracting with the Ontario Ministry of Agriculture Food and Rural Affairs to deliver the Land Stewardship program—an educational and financial assistance program. Lead by local farm leaders at the county/district level, farmers were put in charge of solving their own problems with regards to conservation tillage and cropping methods. Subsequent programs by both Ontario Ministry of Agriculture, Food and Rural Affairs, and Agriculture and Agri-Food Canada reinforced the concept of successful producer delivery through these partnerships. Other examples include the certification of producers through the Grower Pesticide Safety Courses, pesticide container recycling project and Canada's Permanent Cover program.

The trend in producer organization delivery continues with the Ontario Environmental Farm Plan program. Driven by a coalition of 28 farm organizations (encompassed by Ontario Federation of Agriculture, Christian Farmers Federation of Ontario, Ontario Farm Animal Council and AGCare) farmers have become proactive on environmental issues. Spearheaded by "Our Farm Environmental Agenda", farm leaders have laid out a framework for environmental policy and programs into the next century. Along with the Environmental Farm Plan program, a Groundwater Quality Working Group has been formed to focus specifically on issues and best management practices to deal with nitrates. As well, a recent Agricultural Adaptation Council has been formed with a board of 15 farm leaders to assist the agriculture community with programs, policy and research to adapt to change in marketing, the environment and rural community development. Our involvement with the Great Lakes Comprehensive Farm Planning Network (funded by Great Lakes Protection Fund) has allowed us to share our experiences with farmers in our neighbouring Great Lakes States, and at the same time learn about approaches being taken in neighbouring U.S. states.

These examples of farmer lead initiatives are facilitated by staff from the Ontario Ministry of Agriculture, Food and Rural Affairs as well as Agriculture and Agri-Food Canada. Farmers working with farmers with the support of government and research is becoming the norm. A new ethic is emerging among farmers who are taking responsibility for the environment. At a time when government economic constraints cannot support the cost of increased enforcement, it is anticipated that this approach will lead to a much higher level of environmental achievement than through increased regulation.

Current and Future Policy Issues of Importance to Great Lakes Basin Agriculture: A U.S. Perspective

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While there are numerous factors affecting agriculture in the Great Lakes Basin, this presentation will focus upon the following three (3) factors:

A. The Federal Agricultural Improvement and Reform (FAIR) Act (Farm Bill)
B. The industrialization of U.S. agriculture
C. Other environmental legislation and its input on agriculture

A. Farm Bill (The Federal Agricultural Improvement and Reform (FAIR) Act)

1. Conservation Provisions.

   a. Conservation Reserve Program (CRP)—up to 36.4 million acres can be enrolled. Farmers with CRP contracts will be given a termination option, except land with high environmental value. While environmentally sensitive land is covered, the CRP is still primarily targeted toward highly erodible acres.

   b. Environmental Quality Incentives Program: $130-200 million/year for 5-10 year contracts for technical assistance and cost-share. Crop and livestock farmers will share program benefits.

   c. Wetlands Reserve Program: Caps enrollment at 975,000 acres.
      1/3 of acres in permanent easements
      1/3 of acres in 30-year easements
      1/3 of acres under cost-share agreements

   d. Everglades: $200 million for purchase of land and another $100 million from sale of surplus federal properties in Florida.

   e. Conservation of Private Grazing Land: $20 million/yr. up to $60 million in Year 3.

   f. Farmland Protection: Easements to protect 170,000 to 340,000 acres; up to $35 million to protect farmland from conversion to urban development (e.g., $100-200 per acre). Large questions concerning the level of funding for the quantity of acres.

   g. Wildlife Habitat Incentives Program: Redirects $50 million from CRP for cost-sharing.

h. Reforms of Swampbuster, Conservation Compliance: Primarily provide greater freedom for USDA to implement these regulations in a more flexible manner.

i. Other:
Conservation Farms
Flood Risk Reduction

2. Commodity Provisions—through 2002: Seven years— eliminate target prices and deficiency payments. Establishes Production Flexibility Contracts (PFCs). PFC payments for all eligible cropland. Payment made regardless of market price. No supply control; no annual land retirement. Certainly with present prices, cropland and plantings will likely increase.

Future prices for corn (April, 1996): May 1996, $4.50 +; Dec. 1996, $3.25 +; Dec. 1997, $2.90.

The lack of a no stock policy will likely lead to greater variability in prices and plantings in future years. During the seven years, eligible acres have restrictions on planting of fruits and vegetables but haying/grazing restrictions have been eased.

The higher prices and no acreage reduction program (ARP) may result in ripping out fence rows and planting up to the edge of roads and streams. Producers tell me that with $4-5 corn, they can't afford to keep fencerows, etc. Sounds very similar to what I heard when corn was under $2.00.

But the Farm Bill does establish that farmers will generally produce what they think will be in demand and those products they can profit from RATHER than what the federal government thinks is needed. Another significant point is that the 1949 Act will be reverted to without legislation in the future, so this is not the last Farm Bill.

B. Industrialization of Agriculture

The application of modern industrial manufacturing, production, procurement, distribution, and coordination concepts to the food and industrial product chain.

Implications:

1. Produce food products NOT commodities; products with specific attributes.

2. Specialization—for efficiency gains.

3. Use of more manufacturing-type processes to routinize production, make better use of facilities, more efficient use of personnel, and reduce overhead.

4. Separation of production stages: ownership, operation, geographic location separated. Animal agriculture.

As agriculture becomes more industrial, producers are increasingly viewed as businessmen in three-piece suits not as characters from American Gothic. This leads to the increasingly common view that agriculture should be viewed as any other industrial sector, namely, point sources of

pollution. This concept, combined with new technologies, allows for new, stricter environmental rules which treat agriculture as a sector to be controlled rather than a sector to be helped.

The Agriculture RAPIDS database outlined at this conference suggests that agriculture conforms to manufacturing categories and thus might be viewed similar to other manufacturing concerns.

Site-specific agriculture is being aggressively marketed but will require more management expertise as well as increased capital investment. Therefore may be a factor in speeding the industrialization of agriculture.

C. Environmental Legislation—How Will Agriculture Be Controlled?

1. Clean Water Act

   a. Will NPDES permits be required for all production activities?

   b. Will farmed wetlands continue as a category or be exempt?

2. Safe Drinking Water Act— with greater concern about agriculture. chemicals in water.

   a. Small rural system will have large monitoring expenses.

   b. Controls on quantities and placement of agricultural chemicals (Is atrazine restriction the foot in the door?)

   c. Liability of producers?

   d. Mandatory testing of rural domestic wells?

3. Endangered species— takings vs. biodiversity.

4. FIFRA—future controls on chemical protection. Chemicals treated like a prescription drug?

5. CZMA—present rules can be very restrictive. Reauthorization may come up on House floor this week.

Summary

Changes in farm programs will speed up the industrialization of agriculture. The manufacturing model for the production of biological products, what was formerly known as farming, will increasingly be held responsible for any and all environmental problems associated with that production process. This will undoubtedly lead to greater cries for control of the production process to reduce environmental externalities. When farmers were counted in the millions, this was unlikely; when they number a few thousand, it is a certainty.

There real question is: Can we influence the policy process so that the restrictions are reasonable, that we get good environmental value for our dollars expended, and that our food products remain a good value?

Let's not make the same mistake as we made with Superfund, Acid Rain provisions, CAFE standards, etc.

In other words, environmental protection is too critical to waste tens of billions of dollars, AND our food production system is too valuable to sacrifice.

Panel #2: Agriculture and the Great Lakes Environment

Environmental Practices and Programs Relating to Agriculture

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I was asked to provide an overview of the changes in environmental practices and programs relating to agriculture as I have seen them over the past two decades. There have been many. I am largely positive about the changes I have seen and been a part of. However, there are areas where significant progress remains to be made. In looking at such a large subject, I had to break it down into some discrete components so I could get a better handle on it.

I've divided the changes I want to talk about into five broad categories:

a) Awareness of environmental issues, especially water quality;

b) Changes in Program Emphasis—at all levels of government;

c) Technological Changes—and they have been very significant;

d) Changes in Program Implementors; and lastly

e) Funding—both in terms of levels and where it comes from.

Awareness —I can remember being in many meetings through the 1970s and even up to the 1990s with highly-placed officials, representing both agricultural production and conservation programs, who steadfastly refused to believe that agriculture was a significant source of pollution, even when confronted with years of high-quality tributary loading data—some of it from rivers in their own backyards. This is no longer the case.

In Ohio, as elsewhere, Soil and Water Conservation Districts (SWCDs) prepare annual plans of operation. Rarely did these plans have water quality goals 10-15 years ago; now I know of none that don't. Livestock waste pollution control had almost no priority in Ohio until relatively recently; in fact, more resources were spent on it in the late 1960s and early 1970s than through the 1980s when the trend toward concentration became evident.

Today we are as much, if not more, concerned about off-site impacts as on-farm production. Land uses that had little or no value just a few years ago—and here I am speaking of wetlands, floodplains, stream corridors—are now viewed as critical parts of the landscape where programs and practices should be targeted.

Not so very long ago, even the worst farm managers were excused and the "wagons circled" when a member of the fraternity was criticized. Today, bad-actor legislation is as apt to be proposed by industry

and producer groups as it is to by government agencies. We no longer have to fight about whether agriculture is a source of pollution, only the most effective ways of reducing it.

With Awareness has come the inevitable changes in Program Emphasis.

The days when we spent money on the first person coming through the door are largely gone. Today programs are targeted to priority watersheds, and usually not whole watersheds but specific areas within them. Protection of public resources is beginning to displace concern about private holdings at the top of conservation agencies' "to do" lists. There are worries about reaction to this, as evidenced by the "Wise Use Movement," but I believe that it is itself a reflection of how far public agency attitudes have moved.

I also note that within the last ten years, probably starting with the 1985 Farm Bill, more attention and resources are being focused on long-term protection versus short-term practices. The CRP and Wetlands Reserve programs are examples, and the new Farm Bill has even more programs directed at the long-term protection of critical areas.

I referred earlier to livestock pollution. Finally people are beginning to wake up and look at the problems associated with large concentration of animals, and I don't mean just the mega-farms but also watersheds with large numbers of small to medium-sized operations.

Lastly, under Program Emphasis, I'll just mention how much farm planning has changed. I can't help but think about the level of planning that was acceptable for an operator to get thousands of dollars in public assistance for an animal waste management structure 10-15 years ago versus today. Farm planning has gone from focusing on one or two problem areas to addressing just about everything. I would not be surprised to read one today that includes a financing plan for the kids' college education and the internment wishes of mom and pop.

Technology — I really don't have to spend much time on this one, the changes are so obvious—from completely changing the way the land is worked to the quantities and types of chemicals used. Agriculture in much of the Basin bears only a resemblance to the agriculture of the 1970s.

Conservation tillage has become so widely accepted that I must question the continuation of any government subsidies for it. And, unfortunately, while much of the nonpoint focus of the environmental community is on pesticides, rather than on pollutants of mass destruction like sediment, application rates and longevity of these chemicals have been vastly improved in less than a decade.

Another change has occurred, relatively unnoticed I think, in both technology and awareness too. And that is in the area of water quality monitoring. Five to ten years ago the only people taking water samples were a handful of agencies like EPA, or USGS, or the universities and consultants they paid to do it. Today, everybody is doing it. Whether it is school kids, lake volunteers, and even local conservation agencies, people are getting out to assess conditions for themselves. And if you are tempted to brush off these activities as academic exercises, don't. It is bringing more people, of different backgrounds, out into the streams, the lakes and the rivers. And being there and learning about conditions firsthand will change them. Accepting pollution of a resource they have experienced personally won't be easy.

Before I leave Technology, I have to return to one of my pet subjects—animal waste—again. I think we are just beginning to see some major changes in how this part of agriculture addresses pollution control.

By necessity, animal wastes cannot be viewed as wastes per se, as they so often have. Rather, their use is being maximized through site-specific application plans, transported through brokerages, and transformed through composting to a product that transcends the countryside into the cities. Site-specific application, that is, precision farming through use of GPS is growing rapidly, not just on livestock farms. As a practice, I think it will be commonplace before the middle-aged bureaucrats in this room retire. (Unfortunately, I can't count myself in that number anymore.)

Program Implementors—who were they and who are they now? It was not so very long ago that most people in the field were federal employees or at least derived a good chunk of their salary from Uncle Sam. No longer. In Ohio, for example, during the 1990s county SWCD employees surpassed their federal counterparts in number. And soon they will have equally high levels of education and training. Also, conservation agency staff, wherever their pay comes from, are a much more racially, academically, and geographically diverse group. They do not possess many of the ideas and precepts that were dogma five to ten years ago. Also new are the state EPAs, who rarely had a presence in agriculture in the 1970s and now routinely are found at the table in every watershed meeting. And whereas many programs in the past were singular agency initiatives, almost none are today. "Partnership" is the buzzword, as it should be since problems are multifaceted and require a variety of resources to solve.

Lastly, I want to touch on Funding and then close by offering some thoughts about where our future priorities concerning agricultural pollution control might go.

I was trying to think if we really have less funding today (taking into account inflation) than during the 1970s. Certainly federal dollars for water pollution control are less due to the demise of the construction grant program, but for agricultural pollution control I really feel we have more today than we did yesterday. For example, the old ACP program may have had more money than its offspring does today, but much of it went for practices that had little positive environmental impact. Today federal conservation funding is not asked to serve two masters—and it is more targeted and therefore more cost effective. States have begun to help finance conservation and agricultural pollution control programs in a big way, in some cases eclipsing the amount spent federally. And overall, I think funding levels are growing, even though individual programs may not.

So having said all this, what is the problem? In many areas of the Basin I feel the threat of agricultural pollution is ebbing, with a few exceptions such as the growth of concentrated livestock operations.

Precision farming, as it advances across the Basin, will bring with it a level of data management and tracking unparalleled in nonpoint source pollution control. We will know who, where, when, and precisely what was applied. Such tracking tends to encourage greater efforts at doing things right. Coupled with this will be even more efficient application of pesticides and nutrients. It will become even harder to justify loading soils with phosphorus when levels are already economically sufficient.

Speaking of soils, I see where our concept of their value is beginning to change, to become broader. Soils need to be valued, not just for the productive capabilities but also for their tremendous ability to help remediate the ever-growing amounts and types of wastes our urban society generates. More attention and resources need to be focused on this aspect of soil quality—to ensure we do not damage it and to help educate the public and many groups of the desirability of maximizing the use of soils for waste neutralization.

Discussing soil reminds me of one of its "by-products," sedimentation. I do hope that environmental organizations, environmental protection agencies, and citizens active in watershed protection projects begin to realize the destructive nature of sediment on aquatic species' diversity and abundance. All too often, attention is given to chemicals that have no documented impacts on streams and rivers, while entire ecosystems are sacrificed due to uncontrolled erosion. I am hopeful that, as habitat issues come more to the forefront, the impacts of erosion and sedimentation will be more obvious and spur stronger public response.

My last point concerns how we view agriculture, at least from an environmental perspective. Big Darby Creek is a watershed in Central Ohio that was chosen by The Nature Conservancy as one of the world's "Last Great Places" because of its large numbers and diversity of aquatic life. It is truly a beautiful stream by any standard. However, when The Nature Conservancy, and several state and federal agencies, began to organize pollution efforts in the watershed, they were almost all targeted at agriculture. Agriculture makes up around 65% of the land use in the Big Darby watershed. I often wonder about this, since the aquatic life in the stream survived the era of "fencerow-to-fencerow" agriculture, fall plowing, conventional tillage, and persistent pesticides applied by pounds/acre rather than ounces/acre. How did it survive and become a "Last Great Place?" Why are watershed pollution control programs focused on agriculture rather than the Columbus megalopolis which is rapidly devouring its green spaces?

In defense of the people involved, whom I deeply respect, they took the path of least resistance. They found a receptive audience in federal, state, and local agricultural assistance agencies and the producers in the watershed. They have received no such warm welcome from the development community or municipal officials.

For most of my career in Ohio, I have attempted to get local agricultural agencies, producer organizations, and state officials to put more emphasis on and devote greater financial resources to agricultural pollution control. I certainly do not think we should stop addressing agricultural pollution or divert resources from it. But, in witnessing the impacts of urbanization on small streams and rivers, I now feel that we should do all we can to preserve agricultural land use and view it as banking for the future—not from a food production point of view, but to preserve the quality of our water resources. In truth, even the worst farm manager can do little in today's society to a stream that a few pollution control practices and time can't repair. However, once the land is converted to homes, apartments, shopping centers and highways, the streams affected will never recover. The goals we can attain for streams in agricultural watersheds bear little resemblance to those we can achieve for our urban areas.

In closing, I think we have to view agricultural land use in the Great Lakes Basin as an environmental treasure under severe threat. We can solve the small problems of chemical management, livestock waste utilization, and cropland erosion; but once the land is converted, none of our existing environmental programs can afford to cope with the consequences.

Human and Ecosystem Health Issues of Importance Concerning Great Lakes Agriculture

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Cutting-edge science in toxicology, embryology, molecular biology, endocrinology and wildlife ecology is raising new questions about how toxics—including pesticides—affect the endocrine system. Animals (ourselves included) depend on hormones from the endocrine glands to reproduce, grow and be healthy.

We do not understand the full risks we take when using pesticides. Our data on toxicity, especially when it comes to affecting the endocrine system, are sorely lacking. We also have limited data on the likelihood of exposure to pesticides through our environment. Unfortunately, toxicity and environmental exposure data are what we use to determine risk and set health standards.

A team at World Wildlife Fund looked more closely at three pesticides used commonly in the Great Lakes Basin to discern what we know and what we don't know about the risks associated with these pesticides. We also looked at alternative pest control strategies and were happy to discover there are promising ways to reduce the risk associated with these three pesticides by reducing reliance on them for pest control. Not only should and can the use of these three pesticides decrease, but it is decreasing on some farms. As policy-makers, it is unlikely that we will ever have sufficient data to determine the full risks to health and the environment from pesticide use. But that need not stop us from using policy and programs to assist innovative farmers ready to reduce their reliance on pesticides.

Our WWF team conservatively estimates approximately 160,000 pounds active ingredient (ai) of endosulfan, 1.7 million pounds ai of mancozeb and 7.8 million pounds ai of atrazine are used in the Great Lakes basin each year (see our report "Reducing Reliance on Pesticides in Great Lakes Basin Agriculture"). Endosulfan, mancozeb, and atrazine are endocrine disrupting chemicals, although additional research is needed to determine exactly the effects they can have on human and animal health. Endosulfan is acutely toxic to mammals. Mancozeb is a probable human carcinogen and atrazine is a possible human carcinogen. Atrazine has a range of impacts on the immune systems of test animals. Humans are exposed to atrazine via multiple paths, including food and water. Atrazine and its metabolites have been found in Lakes Michigan, Huron, and Erie, as well as in drinking water samples from private rural wells throughout the basin. Elevated levels of atrazine in groundwater have led to restrictions on its use in Wisconsin. Seasonal exposures to atrazine are also elevated along the Sandusky and Maumee Rivers in Ohio. Mixtures of pesticides may have effects far greater than the effects of individual pesticides acting alone, but far too little research has been conducted on the effects of such mixtures.

The good news is that our reliance on all three pesticides can be significantly lessened by replacing them with information technology and innovative on-farm management. Some producers have adopted these new strategies to varying degrees, as is evidenced by lower-than-label application rates. Other growers continue to apply the full label rate, despite the opportunity to reduce use while controlling pests.

Integrated Pest Management (IPM) shows great promise for reducing the use of the insecticide endosulfan, primarily applied for pest control on potatoes and apples. The IPM tools producers can employ are many and vary greatly by crop, but in general, any practice that breaks insect cycles, blocks or disrupts insect behavior, feeding or reproduction, or limits habitat for pests can be helpful. Increasing the diversity and numbers of beneficial insects and other arthropods is another successful tactic to reduce reliance on endosulfan.

Most fruit and vegetable growers in the Basin are using basic IPM techniques to delay the first application of the fungicide mancozeb to sweet corn, potatoes, apples and other crops susceptible to disease. They use expert systems and careful field scouting to keep sprays to a minimum. To further lessen risks from mancozeb, producers need to improve soil quality to lessen plant pathogen pressure. In orchards, crop rotations and understory diversity are important options. In potatoes, producers need to lengthen rotations and include small grains, either for harvest or as cover crops. Current irrigation and fertilization practices may be inadvertently worsening disease pressure. It may also be possible to strengthen plant immune systems so that the plants can tolerate a slightly higher level of disease pressure. Breeding plants for disease resistance and new microbial biocontrol technologies hold great promise, but further research is needed in both these areas to tap their potential.

Atrazine is the most commonly used herbicide in the Great Lakes Basin, primarily applied to manage weeds in corn. There is a wide array of chemical and non-chemical choices in managing weeds. The selection of any one approach is a matter of personal preference, experience and convenience. The grass herbicide market is very competitive, with new herbicides competing aggressively for market share. Atrazine retains its market share because it is still the cheapest material on a per acre treated basis, although the environmental costs associated with atrazine-contaminated groundwater are very high.

The volume used of atrazine (or any herbicide) can be cut in half easily, by switching from broadcast applications to "banding" pesticides in the crop row and cultivating between crop rows. The average rate of atrazine application in 1994 was 1.07 pounds active ingredient (a.i.) per acre—well below the minimum label rate of 1.6 pounds a.i.. Clearly, many farmers have found ways to cut back on atrazine use. Federal and state regulators should, among other things, lower the allowed label rate to perhaps 0.75 to 1.2 pounds a.i. per acre, to encourage a further reduction in use.

In addition to a wide array of chemical alternatives, there are many cultural and mechanical practices that can be combined in integrated weed management systems. By combining rotations to lessen weed pressure with timed planting and minimum tillage, weed pressure can be reduced over time low enough to provide successful control in most years with little or no herbicide. There is also encouraging new evidence that high levels of soil microbial activity can give rise to what scientists are calling "weed suppressive soils"—soils that support diverse microbial communities including weed pathogens.

So how should we as Great Lakes decision-makers respond to these scientific uncertainties? Developing policy in the face of scientific uncertainty is nothing new. In many ways the debate surrounding pesticide risks is plagued with the same uncertainty surrounding the relationship between smoking and cancer, or any number of issues where it is difficult for scientists to make a clear link between cause and effect. While policy-makers must make use of the best science available to determine a course of action, science is not always able to provide the answers necessary to make a prudent decision. At what point is the weight-of-evidence great enough to warrant protection of the public interests?

Take the case of the NIH Minnesota study where pesticide applicators are more likely to father children with serious birth defects. Like studies in Iowa, Nebraska, and Colorado, this study links pesticide use to a higher frequency of birth defects. The Minnesota study also finds that 1) the most birth defects were associated with a wheat/sugar beet/potato cropping system, especially for children conceived in spring when herbicides and fungicides are usually applied. A corn/soybean cropping system was second; 2) children born to the general population residing in high-pesticide use regions were more likely to have birth defects than children born to the general population; and 3) male children were more likely to exhibit birth defects than female children. The pattern of excess birth defects by pesticide use, season and alteration of sex ratio suggests exposure-related effects in appliers and the general rural population.

What are our responsibilities to inform people applying for an applicator's license of these study results? What are the implications when it is not just the applicators but entire rural regions that are affected by an increased exposure to the pesticides?

As policy-makers we have a tough job on our hands. We are expected to balance societal needs and rights—to a clean environment, a viable food system, and the need and right to do business. While researchers continue to study risks from pesticide exposure, we need to encourage reduced reliance on them, emphasizing more bio-intensive pest management approaches. In doing so, we should employ a judicious mix of regulations, economic incentive programs, research and education, recognizing the needs and limits of each approach. Existing standards have knocked some of the worst "bad actors" from the market place, but this has been a long and costly process. Well-head protection areas and exclusion zones are valuable and should be deployed were needed. But the existing regulatory system serves neither farmers nor the public well. Although essential, costs for maintaining regulatory programs are enormous. Long lag times for pesticide registration frustrates industry. Consumers and environmental organizations think children, wildlife and water are not adequately protected. Farmers fear the loss of chemical tools for controlling pests.

For these reasons, it is essential that we expand our commitment to voluntary prevention-oriented programs. So far, our efforts to clean up and protect watersheds and the Great Lakes have focused on industrial point-source toxics, municipal waste, and non-point pollution from nutrients and soil erosion. We must include pesticides as a nonpoint pollutant in our voluntary watershed programs and in other programs where we work directly with farmers to conserve the environment, and improve on-farm profitability. We applaud USDA's efforts to develop whole farm plans that will encourage farmers to operationalize each state's 595 Pest Management Standard. We need to renew our financial commitment to IPM, especially bio-intensive IPM and Integrated Weed Management research and extension, if we are to achieve USDA's goal of 75% of US cropland under IPM by 2000 in a meaningful way. Documenting the movement form chemical intensive to bio-intensive systems will require cooperation between researchers and farmers to market this progress. IPM will be most strongly supported where it is least reliant on pesticides and maximizes opportunities for managing pests through ecological processes.

Our state management plans to protect groundwater from pesticides need to reflect this pollution prevention approach. New York State's plan is exemplary in that it draws on preventative IPM principles, defines roles for key players, and addresses education and outreach issues effectively. Some states are expanding the Farm*A*Syst program from the farmstead to the field in an effort to flag prevention opportunities for farmers.

It is essential to involve all the stakeholders including rural residents who may not use pesticides but are also bearing health risks associated with pesticide use. Bringing all the stakeholders to the table will demand the utmost of our conflict resolution skills, but the process of developing policy and programs to protect public health demands this of us.

From focus group research, we know that consumers believe it is common-sense to support farmers in their efforts to reduce reliance on pesticides. What is more, they expect government to assist farmers as much as possible in reducing pesticides. They may not know much about how their food is produced, but citizens recognize that pesticides are toxic and believe we can always develop less risky alternative pest control options.

There is growing understanding that the risks from pesticides—risks affecting our ability to reproduce, grow and be healthy—are much greater than we once thought and that it may take decades to develop a data base that accurately reflects those risks. Our WWF team thinks the good news outweighs the bad—there are pest management alternatives for many of these pesticides that could be promoted through existing voluntary programs for farmers.

Emerging Human and Ecosystem Health Issues Related to Great Lakes Agriculture

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Research into what might broadly be termed agroecosystem health has historically been divided into several broad and only occasionally overlapping streams of inquiry. These have included the occupational diseases of those working in agriculture, the degradation or health of the rural environment, the socio-economic and medical health of rural communities, and the health of consumers of agricultural products.

This conventional research has made some impressive progress in identifying multiple effects of pesticide use on farms, risk factors for some forms of cancer, injuries, allergies, and for respiratory diseases in general. Furthermore, practices associated with soil erosion and conservation, ground-water contamination, lowered pesticide use and the like have also been identified. The outcomes from this conventional research have, in several cases, been impressive. These have included environmental farm plans, regulation of pesticide use, training courses for pesticide users, integrated pest management plans, and farm-based land stewardship activities.

For the most part, however, the literature which claims to speak of health more often focuses on disease and injury, and the separate streams of inquiry rarely give more than lip-service to the notion that the world they are investigating is whole and complex. Furthermore, these short-comings occur in a research context driven by urban consumers that consistently under-value agricultural activity and agricultural workers. Thus, considerations of scale (individuals, farms, communities, regions), perspective (social, economic, medical) and complexity (interactions across scale and perspective) are glossed over even in the newly emerging literature on agricultural sustainability. These are issues that the research community can no longer avoid if it we are to remain relevant to local decision-making, regional policy and the improvement of our collective lives.

Food-borne disease outbreaks associated with organisms such as vero-toxin producing E. Coli, Salmonella or Hepatitis A virus, community-wide water-borne outbreaks of parasitic diseases such as giardiasis, cryptosporidiosis, and toxoplasmosis, Lyme Disease and rabies epidemics associated with semi-urban wildlife, and "mad-cow" disease scares might all be viewed as emergent issues in agroecosystems. While they may be of interest in and of themselves, for some of us they are of greater interest as indicators of systemic changes in agriculture which also include farm bankruptcies, centralization of food processors and rural job loss, intensification with attendant associated energy costs and human and animal health problems, globalization of markets, chemicals and pathogens and rural community breakdown. Each of these outcomes can be dealt with on a short-term basis within a conventional scientific research paradigm, and solutions can be devised such as filtration devices, end-of-pipe regulation of intensive farms, food processing technologies, social safety nets, re-training programs and so-called rationalization of services.

The development of integrated policy initiatives, however, which explicitly recognize the links between human nutritional requirements, consumer demands, economic incentives to agriculture, the nature of those agricultural enterprises, and the landscape and human disease effects of those enterprises will require new inter- and trans-disciplinary research approaches based on emergent complex systems, soft systems methodologies, and what has been called post-normal science. Conventional science, in this context, is a tool to help answer specific technical questions once the broader, negotiated system goals are articulated.

Emergent issues in agroecosystem health will occur in a context of rapidly shrinking budgets of government agencies and changing communications technologies. These new research approaches will only succeed by utilizing both local knowledge and international expertise, and by quickly translating the best available information into effective decision-making at the appropriate scale. In this, communities and researchers in the Great Lakes region may learn a great deal from research methodologies developed for use in poor Third World countries, inter-disciplinary eco-research projects such as the Agroecosystem Health Project at the University of Guelph, and the natural resource management approaches developed by people such as James Kay at the University of Waterloo. There will be no silver bullets to solve the problems of a healthy Great Lakes agroecosystem, only an incremental learning our way into a more sustainable future.

Panel #3: Sustainable Agriculture in the Great Lakes Basin

Sustainable Farming Systems Benefit the Great Lakes Basin

George Boody and Dana Jackson
Land Stewardship Project
2200 Fourth St.
White Bear Lake, MN 55100
612-653-0618

The loss of biological diversity, continuing soil erosion, contamination of groundwater and surface water from agricultural chemicals, the intensification of flooding because wetlands have been drained to make fields, and silt load in rivers are consequences of the modern way of farming. At the same time, the number of farmers is dwindling to very low levels. Converting farmland to low density urban sprawl removes land from food production and may further reduce farm numbers. Moreover, other land-use trends such as raising livestock in increasingly concentrated production facilities which necessitate large-scale lagoons further exacerbate pollution and other problems.

Typically, governmental funds are allocated to the application of best management practices designed to solve one or two problems at a time. The Land Stewardship Project (LSP), its constituents and other colleague organizations throughout the Basin ask: Why invest so much in technologies that are intended to mitigate pollution from existing farming systems? Instead, why not focus significant resources to develop and implement farming systems that are flexible enough to address multiple goals including pollution prevention, diversity, durability and profitability?

Farmers, scientists and advocates of sustainable agriculture long ago came to the conclusion that sustainable agriculture is more than just a group of practices. A truly sustainable farm is viewed as a whole, linking biophysical and human systems. This means that energy use, crop rotations, soil fertility, pesticide reduction, animal welfare, wildlife habitat, water quality, quality of family life, the quality of relationships with the larger community and effects on the regional ecosystem all have to be taken into consideration in any decisions/recommendations about the management of farm resources.

LSP, a Minnesota-based, private non-profit, membership organization, works with farmers who are learning to understand how their land is part of a larger whole and how their management will affect the landscape around them. They employ farming systems that not only prevent soil erosion and water pollution, but work more in harmony with natural cycles, encouraging biological diversity. Through these systems the farm family strives to enhance the environment, yield food abundantly, generate a profit, and support healthy communities.

This presentation will describe three influences that have led some farmers in Minnesota and other parts of the Great Lakes Basin to establish more sustainable systems. First, there are several Kellogg Integrated Farming Systems Initiative (IFS) projects throughout the Basin, including one in which LSP is involved. Second is a system of whole-farm decision making called Holistic Resource Management (HRM)™. Third is a method of raising livestock called management intensive grazing (MIG). IFS projects, HRM and MIG have improved the quality of life for farm families and benefitted landscapes. This paper will also discuss two areas of work by Land Stewardship Project and collaborating organizations that support farmers applying HRM and management intensive grazing. The first is the Biological, Social and Financial Monitoring Project, a collaborative, team driven, on-farm research

project to help farmers monitor the impacts of sustainable agriculture on the ecosystem and family well-being. The second is a several-faceted project in western Minnesota to restore wetlands and improve water quality in the Minnesota River and its tributaries. Very importantly, these efforts are grounded in a process of working in community, through partnerships and collaborations.

Fundamental policy changes are needed to support this movement toward sustainable, integrated farming systems. In *A Better Row to Hoe*[2], the Northwest Area Foundation, concludes that: "Greater emphasis needs to be placed on research and education programs to develop refine and teach the management systems sustainable agriculture requires." The report also called for several additional policy changes that we believe can be implemented within the Basin: Farmers should be rewarded for environmental performance; More also needs to be done to support beginning farmers and help them adopt sustainable practices, and; Policies are needed that support development of the local business infrastructure needed by sustainable agriculture and thereby advance both sustainable agriculture and sustainable development.

The World Wildlife Fund[3], through meetings with Basin stakeholders, identified a policy objective for the Basin: "to reduce the risk from and reliance on pesticides and to support the broader goal of sustainable agriculture." The stakeholders also agreed on a set of principles that include stakeholder involvement, meeting producers' and regional needs, transparency of government and private sector activities, accountability of farmers' practices and addressing pesticide use within the context of other farm goals.

LSP and many other sustainable agriculture groups throughout the Basin have concluded that people must work together in community to bring about the changes in agriculture that will enhance the environment and be able to meet the needs of future generations. Governmental agencies cannot do it alone by regulation and enforcement. Environmental organizations cannot do it alone through education and lobbying. Handfuls of individual farmers will not create significant changes in the broader ecological context. However, partnerships and collaborations among farmers, rural citizens, private non-profit organizations, universities, and government, farm and environmental agencies can develop the public dialogue that creates a climate where change toward long-term sustainability is encouraged and supported.

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[2] Northwest Area Foundation. 1994. *A Better Row to Hoe: The Economic, Environmental, and Social Impact of Sustainable Agriculture.* St. Paul, MN 55101. 39 pp.

[3] World Wildlife Fund. 1995. *Reducing Reliance on Pesticides in Great Lakes Basin Agriculture.* Washington, D.C. 20037. 16 pp.

Sustainable Agriculture in the Great Lakes

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Sustainability has been defined as the ability of the present generation to meet their needs without compromising the ability of future generations to meet their needs.

In this regard, I believe that in most analyses of sustainable agriculture in the Great Lakes Basin we, as academics, have not placed agriculture in the context that farmers do:

1. In Ontario, our population is growing by 223,350 per year likely ($r^2 = 0.95$); ca. 40,000 per year more in rural areas (non-farmers). A population which will double from 11 million to 20 million in 40 years.
2. The global village is now. Most consumers buy on the basis of quality and price not the environment. Your customer is the world; your competition is the world. Watch shoppers at Meijers here in Michigan, and see how they make purchasing decisions.
3. Farmers are no different than others. They must get fair return for their labour and investment. They have aspirations of vacations, children going to university. If fair return does not occur, capital both monetary and human, will flow to other sectors.

The most important communication skill is "to listen". As Chair of the Ontario Farm Environment Coalition, I have been privileged to listen to the concerns of our elected leaders of our major commodity and general farm organizations in Ontario. A couple of key points:

1. Farmers are concerned about environmental issues. They and their families live on the farm (human safety).
2. They have aspirations to have their children inherit more than they received (environmental protection).
3. We have two-page fact sheets on legislation that can impact agriculture. Legislation is necessary for those few who abuse but peer pressure and knowledge are the solution.
4. The balance we face is:
   i) Double productivity (or decrease demand as individuals) over the next 40 years.
   ii) Be globally competitive, in some cases against jurisdictions where labour costs and environmental concerns are far less than ours.
   iii) Protect the environment for our children while receiving a fair return on labour and investment.

In Ontario, we have reduced pesticide use by 28% (by tonnes AI) in the last ten years. Since 1985, phosphorous sales have declined 36.3%, potassium 35.5% and nitrogen 28.6%. Reduced fossil fuel inputs per tonne of corn and soybeans by 50% in eight years. We have done this while feeding ten million people on a smaller land base that fed 4.5 million people 40 years ago.

By voluntary action, 7,000 (of ca. 50,000) farmers have entered the Environmental Farm Plan process (ca. 6 hr of self assessment and 1-day workshop); ca. 2500 have completed the peer-reviewed process. Farmers have spent over $3.5 million of their own money ($6 for every $1 provided by government) over 17,000 documented hours making changes on their farms. We have, through consultation, developed extremely popular Best Management Practice documents. Sure there are producers who are not participating and even organizations less than enthusiastic but in the final analysis we have come a huge distance in four years.

Government, both federal and provincial, deserve a great deal of credit too. They stepped back and listened, facilitated (e.g. ensured confidentiality of plans) and provided resources to the Environmental Farm Coalition (personnel and financial). They didn't lead or dictate, they helped. In so doing, the farm community developed pride and peer pressure became a vehicle for change. Ontario farmers were recently provided $35 million to compensate for a massive loss in government support (e.g. freight, crop insurance). The farm community chose: 1) marketing, 2) environment, 3) human skills development to focus their resources as they adjust to a new future with much less government support.

Finally, I would like to emphasize the need to essentially double production. Toronto, Detroit and Chicago are not going to disappear but will grow. I personally believe that one of the greatest threats to sustainability is fewer young innovative minds entering agriculture and less investment in agriculture research. Continued advances in plant and animal breeding, nutrient management, biotechnology, information analysis (precision farming) are the key to our future. In my opinion, the enemy is not technology but rather poor management skills. Our human capital is as important as our natural resources (soil, water, air). We (academics, government) must treat that capital (farmers) as equal partners who deserve our respect.

I will leave you with some quotes:

"Take change by the hand before it grabs you by the throat".—Churchill
"People like progress but they hate change".
"Change is polluted with opportunity".
"The only constant is change—except from a vending machine".
But finally, *"The best way to predict the future is to invent it".*

Impacts of Land Use Trends on Great Lakes Basin Agriculture

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Land use issues are critical to the long term future growth of agriculture. Current land use trends are having a direct and significant impact on agriculture. This impact can be seen in the loss of productive farmland to low density development and in the resulting land use conflicts and potential nuisance suits as more non-farm people move out next to rural farming operations. The agricultural community must be involved in implementing innovative approaches to dealing with land use issues. Many of the successful options include voluntary, locally implemented and incentive driven approaches.

Current land use trends can be characterized as a large percent of the population moving from our urban centers out into more rural areas. For example, over 850,000 people have moved from the City of Detroit out into more rural areas over the last 30 years. With the movement into more rural areas has come a dramatic expansion in housing lot sizes and increased land fragmentation. The density of new residential development has decreased over 75% since 1950 with many houses now located on 2, 5 or 10 acre lots. From 1995 to 2020, Michigan is projected to experience a 11.8% population growth but will convert 67-83% more land to residential use. Michigan will use as much land to locate 1.1 million more people from 1995 to 2020 as was used for residential purposes in 1978 for over 9 million people.

More and more productive farmland is converted to development. From 1982 to 1992, Michigan lost 854,000 acres of farmland, almost 10 acres converted every hour of every day, representing an annual economic loss of approximately $100 million in local farm revenue. During this same period, Michigan's population only grew by 33,000 residents (0.4% population growth) and over 250,000 new houses were built. Similar trends are being observed in other Great Lake States as indicated below (U.S. Bureau of Census):

GREAT LAKES REGION FARMLAND LOSS: 1982—1992

STATE	ACRES LOST	ACRES PER HOUR	PERCENTAGE
ILLINOIS	1,475,774	16.8	5.1%
INDIANA	675,437	7.7	4.1%
MICHIGAN	854,002	9.7	7.8%
MINNESOTA	2,041,512	23.3	7.4%
NEW YORK	731,544	8.4	8.9%
OHIO	1,156,085	13.2	7.5%
PENNSYLVANIA	1,108,172	12.7	13.4%
WISCONSIN	1,770,576	20.2	10.3%
UNITED STATES	41,265,075	471.0	4.2%

The impact of increasing rural non-farm residents goes beyond the loss of productive farm soils. Many remaining farmers find it difficult to operate with competing land uses as land values soar, as traffic and nuisance complaints increase and as the number of farm suppliers and processors decrease. The impact is significant upon the remaining farm operations who wish to continue farming but now are faced with new land use issues. Great strides are being made in applying pesticides and minimizing livestock odors but it is also important that an agricultural oasis or blocks of farmland be maintained to minimize these conflicts.

Several communities and states have taken a proactive role in addressing these land use impacts on agriculture. Governor Engler establish the Michigan Farmland and Agriculture Development Task Force in 1994 to provide policy recommendations to help maintain land in agricultural production. It is important to insure that agriculture remains profitable in order to compete with other land uses. Several legislative initiatives have passed or are pending in the state legislature as a result of the recommendations, including the establishment of agricultural security areas wherein farmers would agree not to develop the land in exchange for numerous incentives and benefits. Local communities such as Peninsula Township are also taken action by clustering development, adopted a purchase of development rights program and implementing a transfer of development rights program. It is equally important that rural-urban and farm-nonfarm partnerships be built to address these problems. Urban redevelopment is as important as insuring that our most productive agricultural land will be available for the future growth of agriculture.

For more information contact Dr. David Skjaerlund at the Michigan Department of Agriculture (517-335-4560) or obtain a copy of the following resource materials:

FARMLAND PRESERVATION VIDEO: Two part video produced by Michigan Department of Agriculture—first half (18 min) discusses current land use trends and the impact on agriculture while the second half (20 min) outlines several options to protect farmland. Contact Michigan Farm Bureau at 517-323-6648.

FARMLAND AND AGRICULTURE DEVELOPMENT TASK FORCE REPORT—52 page policy report by Governor Engler's Task Force outlining policy recommendations to help keep agricultural land in production and to enhance the agricultural industry. Contact Michigan Department of Agriculture at 517-335-4560.

MSPO TREND FUTURE REPORT ON AGRICULTURE—110 page report documenting current land use and agricultural trends. Part of a 11 part series on various issues documenting current trends and future projections for Michigan. Contact Michigan Society of Planning Officials at 810-651-3339.

PENINSULA TOWNSHIP CASE STUDY ON PDR—78 page booklet, "Forging New Protections: Purchasing Development Rights To Save Farmland," describes how Peninsula Township, near Traverse City, Michigan, adopted, funding and implemented the first purchase of development rights program in the Midwest. Contact Peninsula Township at 616-223-7322 or American Farmland Trust at 202-659-5170.

B. Final Agriculture Summit Agenda

Great Lakes Agriculture Summit
April 23-24, 1996
Kellogg Center for Continuing Education
Michigan State University
East Lansing, Michigan
Sponsored by: Great Lakes Commission

FINAL AGENDA

MONDAY, APRIL 22		
5:30 - 7:30 p.m.	Joint Reception with Michigan State Section, American Water Resources Association (Red Cedar B)	
TUESDAY, APRIL 23		
7:30 a.m.	Registration (Auditorium) Coffee (Lobby)	
8:30 a.m.	Welcome (Auditorium)	**Frank D'Itri**, Commissioner (MI), Great Lakes Commission and Professor, Michigan State University
	Summit Overview and Objectives	**Michael J. Donahue**, Executive Director, Great Lakes Commission
8:45 a.m.	Opening Speeches Welcoming Remarks:	**Gordon Guyer**, Director, Michigan Dept. of Agriculture **Frank Ingratta**, Assistant Deputy Minister, Ontario Ministry of Agriculture, Food, and Rural Affairs
9:00 a.m.	Opening Keynote: *(topic to be announced)*	**Paul Johnson**, Chief, USDA, Natural Resources Conservation Service
9:30 a.m.	Presentation of Agricultural Profile An Agri-Environmental Database for the Great Lakes Basin • Summary of Profile narrative & database • Key findings and conclusions	*Moderator:* **Michael J. Donahue** **Bruce MacDonald**, Agriculture & Agri-Food Canada **Jon Bartholic**, Michigan State University
10:30 a.m.	Break (Lobby)	
10:45 a.m.	Agricultural Profile: Issues and Process • Impacts of Current Use Pesticides • Nonpoint Source Regulatory Framework • Application of a Client-Server System to The Agricultural Profile	**Lisa Lefferts**, World Wildlife Fund **Isobel Heathcote**, University of Guelph **Leonard Bruckman**, Radian Corp.

11:45 a.m.	**Luncheon** (Big Ten Room A) Keynote Speech: *A Farmer's Perspective*	Ken Kelly, Vice President, Ontario Federation of Agriculture
1:00 p.m.	**Perspectives from Basin Interests** (Auditorium) Several panels will be convened to permit various interests to present their interpretation of Profile data and information, share their questions, comments, and concerns, and offer their own ideas on research and policy needs.	
1:00 p.m.	**Panel 1: Agriculture and the Great Lakes Economy** Major Themes: • The economic importance of agriculture in the Great Lakes Basin • Current and future issues of importance to Great Lakes Basin agriculture; Canadian perspective • Current and future issues of importance to Great Lakes Basin agriculture; U.S. perspective	*Moderator:* Christine Lietzau, Michigan Department of Agriculture Stephen Thorp, Great Lakes Commission Harold Rudy, Ontario Soil & Crop Improvement Association Stephen Lovejoy, Purdue University
2:00 p.m.	**Break** (Lobby)	
2:30 p.m.	**Panel 2: Agriculture and the Great Lakes Environment** Major Themes: • Environmental practices and programs relating to agriculture • Human and ecosystem health issues of importance concerning Great Lakes Basin agriculture • Emerging human and ecosystem health issues concerning agriculture in the Great Lakes Basin	*Moderator:* Patricia Roberts-Pichette, Environment Canada Jerry Wager, Ohio Department of Natural Resources Michelle Miller, World Wildlife Fund David Waltner-Toews, University of Guelph
3:45 p.m.	**Panel 3: Sustainable Agriculture in the Great Lakes Basin** Major Themes: • The trade-offs—costs and benefits—of using substitute agricultural products or methods • Market opportunities for products and services generated through sustainable or alternative agricultural methods and practices • Impacts of Land Use Trends on Great Lakes Basin Agriculture	*Moderator:* John Hebblethwaite, Conservation Technology Information Center George Boody, Land Stewardship Project Gordon Surgeoner, University of Guelph; Ontario Environmental Farm Coalition David Skjaerlund, Michigan Department of Agriculture
5:00 p.m.	Adjourn for Day	
5:00 p.m.	Reception (Hors d'oeuvres, cash bar) (Lincoln Room)	

WEDNESDAY, APRIL 24

8:00 a.m.	Coffee (Lobby)	
8:30 a.m.	Plenary Session (Auditorium) Case Study: Database Applications: A Case Study Approach	Jon Bartholic and Bruce MacDonald
9:30 a.m.	Remarks *Opportunities for Building Partnerships in the Great Lakes Region*	Lois Morrison, Environmental Policy Director, Council of Great Lakes Governors
9:40 a.m.	Introduction to Break-out Sessions Summarize previous day's discussion and present objectives/procedures for break-out sessions.	Tom Crane, Great Lakes Commission
9:45 a.m.	Break-out Sessions (Rooms to be Announced) Attendees will participate in one of numerous break-out groups. The objective is to use the previous day's session, and the Profile document, to work toward consensus on priority research and policy needs, issues associated with Great Lakes Basin agriculture, and associated environmental, economic, and land use implications.	
	• Economic and Production Dimensions of Great Lakes Agriculture	*Moderator:* Richard Aucoin, Ontario Ministry of Environment and Energy *Resource People:* Steve Thorp, Great Lakes Commission; Yung Tsung Kang, Michigan State University
	• Natural Resources and Environmental Dimensions of Great Lakes Agriculture	*Moderator:* Tom Crane, Great Lakes Commission *Resource Person:* Ian Jarvis, Agriculture & Agri-Food Canada
	• The Effects of Agriculture on Human Health and the Environment in the Great Lakes Basin	*Moderator:* Bob Burris, USDA Natural Resources Conservation Service *Resource Person:* Laurie Maynard, Environment Canada
	• Health and Ecological Impacts of Current Use Pesticides	*Moderator:* Bruce Kirschner, International Joint Commission *Resource Person*: Rosalind Rolland, World Wildlife Fund; Dave Baker, Heidelberg College
	• Technology Creation and Transfer	*Moderator:* John Lamb, Minnesota Project *Resource Person*: Peter Boyer, International Joint Commission

	• Environmental Programs, Policies, and Regulations Affecting Great Lakes Agriculture	*Moderator:* Jim Nicita, Great Lakes Commission *Resource People:* Jerry Wager, Ohio Department of Natural Resources; Isobel Heathcote, University of Guelph
10:45 a.m.	Break (Lobby)	
11:15 a.m.	Break-out Sessions, Cont'd	
12:15 noon	Luncheon (Big Ten Room A) Keynote Speech: *Farm Containment of Production Materials under High Productivity*	Richard Harwood, C.S. Mott Chair of Sustainable Agriculture, Michigan State University
1:30 p.m.	Plenary Session--Reporting Out A reporter from each break-out group will summarize key points and respond to questions. Presentations will be facilitated to ensure that the key ideas from all groups are pulled together.	
2:45 p.m.	Break (Lobby)	
3:00 p.m.	Open Forum • Questions and comments from audience	
3:45 p.m.	Plenary Session--Closing Project Team and Advisory Committee members discuss next steps: proceedings document, refinement, distribution and updating of Profile, and recommendations to Great Lakes Protection Fund.	
4:15 p.m.	Adjourn	

C. Breakout Session Attendees Lists

Economic and Production Dimensions of Great Lakes Agriculture

Steve Thorp	Great Lakes Commission
Richard Aucoin	Ontario Ministry of the Environment and Energy
Bill Wenzel	Wisconsin Rural Development Center
Meg Moynihan	Michigan Integrated Food and Farming Systems
Lynn Forster	Ohio State University
John Baugh	Purdue University
Stephen Shine	Michigan Department of Agriculture
Bob Craig	Michigan Department of Agriculture
Yung-Tsung Kang	Institute of Water Resources, MSU
John B. Kohl	National Association of Conservation Districts
Bob Bedggood	Christian Farmers Federation of Ontario
Harold Rudy	Ontario Soil and Crop Improvement Association
Jim McWilliam	Ontario Soil and Crop Improvement Association
Eileen Van Ravenswaay	Michigan State University

Natural Resources and Environmental Dimensions of Great Lakes Agriculture

Tom Crane	Great Lakes Commission
Patricia Roberts Pichette	Environment Canada
Larry Antosch	Ohio EPA Division of Surface Water
Gerald Matisoff	Case Western Reserve University
Natalie Carroll	Purdue University
Murray Brooksbank	Environment Canada
Dana Jackson	Land Stewardship Project
Marie Adam	Environment Canada
Cindi Barton	U.S. Geological Survey
Terri Novak	Michigan Department of Environmental Quality
Catherine Fox	Agriculture & Agri-Food Canada
Bill Horvath	National Association of Conservation Districts
Fred Bergsrud	University of Minnesota Extension Service
Greg Mund	Michigan Agricultural Stewardship Assoc./NRCS
Ken Kelly	Ontario Federation of Agriculture
Tom Bruulsema	Potash & Phosphate Institute
Gary O'Neill	USDA-Natural Resources Conservation Service
Ian Jarvis	Agriculture & Agri-Food Canada
Len Bruckman	Radian Corporation

Fish, Wildlife and Ecological Dimensions of Great Lakes Agriculture

Laurie Maynard	Canadian Wildlife Service, Environment Canada
David Rankin	Great Lakes Protection Fund
Ken Krieger	Heidelberg College
Margaret Vilez	Ontario Federation of Agriculture
Terry Fleck	Indiana Pork Producers Association
Jim Porterfield	American Farm Bureau Federation
Mark Elster	U.S. EPA
Jim Ray	Indiana Department of Natural Resources
Gord Wichert	University of Guelph
Heather Potter	The Nature Conservancy
Cindy Dutcher	Michigan Ag. Stewardship Association
Kevin Laidley	Ontario Ministry of Agriculture, Food & Rural Affairs
Bob Burris	USDA - Natural Resources Conservation Service

Health and Ecological Impacts of Current Use Pesticides

Bruce Kirschner	International Joint Commission
Liz Nevers	National Farm *A*Syst/Home*A*Syst
Larry Rosenmann	New York State Dept. of Environmental Conservation
Robin Zucollo	NRCS
Jim Smith	Environment Canada
David Waltner-Toews	University of Guelph
Bruce MacDonald	Agriculture and Agri-Food Canada
Rob Dittner	DuPont
Neil Strong	Ciba Crop Protection
Jeff Wilson	Farmer
Judy Shaw	Ciba Crop Protection
Eckhart Dersch	Michigan State University Extension
Charles Edson	Michigan State University IPM Program
Craig Harris	Michigan State University Dept. of Sociology
Larry Olsen	Michigan State University IMP Program
Gerald Kirbach	Indiana State Dept. of Agriculture
Tom Gilding	American Crop Protection Association
Alain Baril	Environment Canada
Ted McKinney	Dow Elanco
Donna Myers	U.S. Geological Survey
Dave Baker	Heidelberg College
Lisa Lefferts	World Wildlife Fund
Ruth Shaffer	Natural Resources Conservation Service

Technology Creation and Transfer

Renee Robinson	Illinois Stewardship Alliance
Jane Frankenberger	Purdue University
Larry Dyer	USDA Natural Resources Conservation Services
Don Eckert	Ohio State University, School of Natural Resources
John Crumrine	USDA Natural Resources Conservation Services
Paul Verkley	Ontario Federation of Agriculture
Jack Rigby	Innovative Farmers Association of Ontario
Alan G. Herceg	USDA Natural Resources Conservation Services
John Lamb	Minnesota Project
Peter Boyer	International Joint Commission
Steve Bonney	Indiana Sustainable Agriculture Association
Norman Fausey	USDA-Agricultural Research Service
Gart Overmeir	USDA Natural Resources Conservation Services
Kim Stone	Great Lakes Protection Fund
Ben Bartlett	Michigan State University Extension

Environmental Programs, Policies and Regulations Affecting Great Lakes Agriculture

Jim Nicita	Great Lakes Commission
Steve Lovejoy	Purdue University
Ron Culler	Indiana Commissioner of Agriculture's Office
Don Hill	Ontario Soil & Crop Improvement Association
David Armitage	Ontario Federation of Agriculture
Dick Coote	Agriculture & Agri-Food Canada
Terri Novak	Michigan Department of Environmental Quality
John Bobbe	Great Lakes Intensive Rotational Grazing Network
Tim Marta	Agriculture & Agri-Food Canada
Bill Lasher	Michigan Department of Agriculture
Laura Dolmer	Health Canada
Becky Pfeifer	Purdue University
Chris Sigwdson	Purdue University
Lois Morrison	Council of Great Lakes Governors
Sam Hines	Michigan Pork Producers Association
Nancy Erickson	Illinois Farm Bureau
Pat Norris	Michigan State University
Michelle Miller	World Wildlife Fund
Emily Oren	Institute for Agriculture & Trade Policy
Tom Guthrie	Michigan Farm Bureau
Ivan Myers	Lucas County (OH) Soil & Water Conservation District
Robert White	Indiana Farm Bureau
Jerry Wager	Ohio Dept. of Natural Resources

D. Roster of Summit Attendees

GREAT LAKES AGRICULTURAL SUMMIT - ATTENDEES
EAST LANSING, MI
APRIL 23-24, 1996

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