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Richard Ivey School of Business
The University of Western Ontario

water
INNOVATION FORUM

A Competitive and Innovative Agriculture Sector

January 23-24, 2011

Lawrence National Centre
for Policy and Management

Canada | OFA Ontario Federation of Agriculture | Ontario | Growing Forward

1st edition, June 2011

Water Innovation Forum Report: A Competitive and Innovative Agriculture Sector
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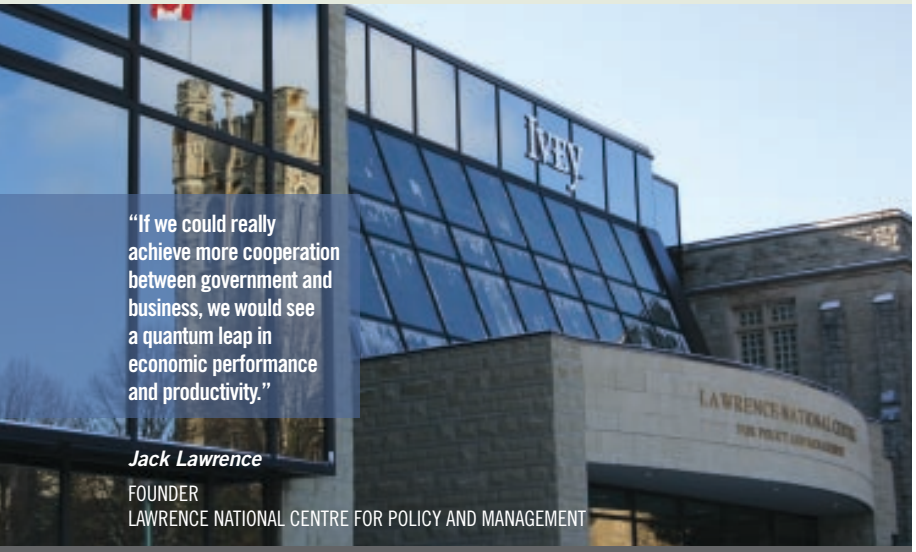
Lawrence National Centre for Policy and Management
1151 Richmond Street North
London, ON N6A 3K7
Tel: 519.661.4253
Fax: 519.661.4027
E-mail: mlharris@ivey.ca

www.lawrencecentre.ca

The Lawrence National Centre for Policy and Management

MISSION

The Lawrence National Centre for Policy and Management bridges business strategy and government policy by: providing a uniquely informed forum for business and government to discuss policy formulation and implementation; educating future business leaders in public policy and government leaders in business strategy; and conducting leading-edge research on major issues that involve business-government coordination.



"If we could really achieve more cooperation between government and business, we would see a quantum leap in economic performance and productivity."

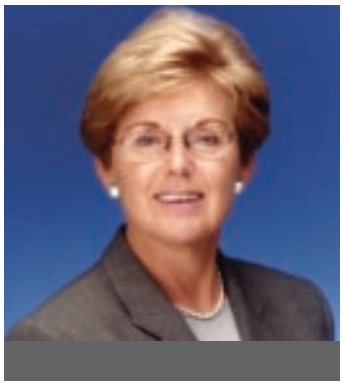
Jack Lawrence
FOUNDER
LAWRENCE NATIONAL CENTRE FOR POLICY AND MANAGEMENT

At the Lawrence National Centre we provide opportunities for our students to be involved in the study, development, implementation and monitoring of public policy. The understanding and application of legislation, regulations and government policy is imperative in the world of business. Many are interested in careers within government, as professional public servants, where they can serve their country within Canada and around the world.

An increasing number of students are attracted to cross-enterprise programs at the Lawrence National Centre. This workshop is a great opportunity for them to participate in this national forum of business leaders, government officials and academics, as they contribute to building a more competitive Canada, through lending their expertise and commitment to the development of timely and innovative public policy.

We are grateful to our Lawrence Centre team and Advisory Council whose efforts contributed to the success of our events over the past year. We extend our thanks to our esteemed Lawrence Centre Advisory Council for their sound advice and continuing support.

Director's Message



DIANNE CUNNINGHAM

DIRECTOR

LAWRENCE NATIONAL CENTRE FOR POLICY AND MANAGEMENT

RICHARD IVEY SCHOOL OF BUSINESS
THE UNIVERSITY OF WESTERN ONTARIO

CAROL STEPHENSON

DEAN

RICHARD IVEY SCHOOL OF BUSINESS
THE UNIVERSITY OF WESTERN ONTARIO

On behalf of Dean Carol Stephenson, the Richard Ivey School of Business and the Lawrence National Centre for Policy and Management, I extend sincere thanks to everyone who contributed to the organization and success of this Water Innovation Forum. An extraordinary assembly of more than 100 representatives of industry, academia, governments, and students came together to share their knowledge and insights on opportunities and challenges facing our agriculture sector, in their use of water and innovative technologies that promote efficiency and conservation. The Ontario agri-food sector is committed to accelerating the pace of innovation to increase their competitiveness and profitability in moving Ontario and Canada forward as world leaders.

This report builds on our previous workshop reports including Developing Sustainable Energy Policy: Building Paths to a Low Carbon Society (2006), The Ontario - Québec Continental Gateway and Trade Corridor (2008), Making Green Energy Happen: Policies and Priorities (2009), and Food and Health: Advancing the Policy Agenda (2010).

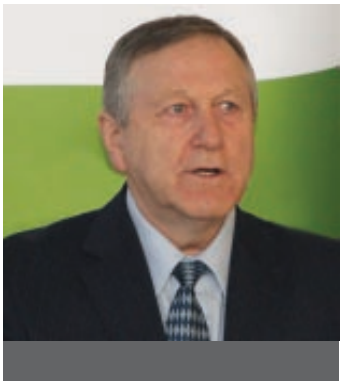
It became apparent over the course of our Forum deliberations that the demand of rapid population growth, the effects of climate change and the urgent need for improvement to governance processes and structures continue to pose challenges.

This report outlines strategies to position agriculture as a leader in the development of an innovative and competitive water-use vision for Canada's agri-food sector. The myth of water abundance must be challenged with a clear understanding of our water realities in Canada. We must further embrace policies that encourage innovation and have flexibility to adjust to local circumstances. Water shortages around the world are increasing. If Canada is to do its share in assisting others, then all of us must be more responsible in our conservation efforts. Governments and industry cannot solve the problem alone.

Participants were strong in putting forward actions that business, government and academia jointly consider important to implement today. Other actions will require a longer-term commitment. In order to fully appreciate these recommendations, we encourage you to read the entire report for examples of practical application of innovative water solutions. We extend our appreciation to our farmers, producers and partners for their sound advice and ongoing support. They have proven that collaboration, leadership and the will to succeed ensure economic success and a healthy quality of life for Canadians.

Thank you.

Deputy Minister's Message



JOHN
BURKE

DEPUTY MINISTER

ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

I would like to congratulate everyone who contributed to the organization of the Water Innovation Forum. This Forum really does bring together a unique group from government, academia and industry to generate ideas on how to look at water and manage our resources, keeping in mind social and economic values.

Water is one of our most essential resources and in Ontario we are fortunate enough to have lots of it, so far. Our province borders on four of the five great lakes, the largest group of freshwater lakes on the planet. Within Ontario there are more than 250 000 lakes, rivers and streams, which contribute to the false sense of security that there is an endless water supply. Even in the midst of plenty, we must protect and conserve our most valuable water resources for the health and well-being of all Ontarians.

Over the next 20 years population growth, which will be significant, coupled with the effects of climate change could lead to a substantial gap between how much water we actually have and how much will be needed for all purposes including agriculture and industry. Having a safe and abundant water supply is important to our economic future as well as our quality of life. This is why Ontario has developed a comprehensive water strategy that will put our Province at the forefront of conservation and innovation.

Our new Water Opportunities Act 2010 lays the foundation for the transformation of our citizens and our industries from being water wasters to water conservers. It encourages our innovators to develop and export clean water technology. This is expected to stimulate economic development and create jobs. It is an ambitious agenda. The government has a vision of Ontario as a North American centre of water technology and innovation, providing innovative solutions for Ontario, Canada and the world. Ontario's water strategy will ensure that our valuable water resources will be available for many generations.

The Ministry of Agriculture, Food and Rural Affairs has an important role to play. We administer the Ontario Small Water Works Assistance program helping small rural and northern communities receive clean, safe and affordable water and wastewater services. We have established water management as a research priority under our New Directions research fund and we provide technical input to our partner ministries, to ensure that the agri-food sector is engaged in the development of water related economic development regulations and initiatives.

This Forum is a unique opportunity to engage and work together for the future of our agri-food industry which is one of the biggest economic generators in Ontario. I really do look forward to your thoughts on how we can lay the foundation for innovation, great investments and great jobs for Ontario and help protect our most valuable resources.

Acknowledgements

We extend our thanks to everyone involved in organizing our Water Innovation Forum and in assisting in the writing of this report. It was a privilege to be involved with so many participants and presenters who contributed their time and insight into future water policy development in Ontario and Canada.

I would like to extend our appreciation to Dean Carol Stephenson and Professor David Sparling, who provided ongoing advice and participated in our deliberations. To Leslie Coates, thank you for your invaluable support, insight and dedication for this most challenging and rewarding project. To Melissa Harris, I extend my sincere personal thanks for her incredible ability to keep us all focused, for the endless hours spent in the supervision of our project and students, from the beginning of the research phase, to the publishing of this report.

We welcome the opportunity to be part of this collaborative planning process and extend our thanks to those who supported this Forum: the Ontario Federation of Agriculture, and Agriculture and Agri-Food Canada and the Ontario Ministry of Agriculture, Food and Rural Affairs through Growing Forward, a federal-provincial-territorial initiative.

To ensure that this initiative led to a relevant and professionally prepared Water Innovation Forum report, the Advisory Committee undertook extensive consultations to identify the most pressing issues, and to carefully develop the topics for discussion. We are particularly indebted to our Advisory Committee members for their commitment of time and expertise. As a diverse group comprised of dedicated and professional government officials, academics, and business leaders, our Advisory Committee exemplified our mission at the Lawrence Centre of working together, across different sectors, sharing ideas and creating opportunities to make a difference in how public policy is developed.

Thank you to Deputy Minister John Knubley, Jamshed Merchant and Ezio Di Emanuele (AAFC), Phil Dick, and Gord Surgeoner for your input and advice. To Stuart Budd and Oswald Zachariah, we would like to thank you for your guidance in seeing this project through from the very beginning to completion.

We also extend our appreciation to Deputy Minister John Burke, the Honourable Chris Bentley, Ted Hewitt and Bette Jean Crews for their warm greetings at our Forum. Our keynote speaker, Margaret Catley-Carlson presented an inspiring and most informative address, with her wonderful sense of humour, leaving us motivated to rise to the challenge.

We are grateful to Deirdre Finigan for dedicating her time to proofing and editing. Thank you to Steve Martin and Justin Harris for contributing the photographs found throughout this report.[1] To Chris Popovich and Michael Regier, our research assistants, thank you for your energy, ideas and enthusiasm throughout the various stages of this project. What a team!

WATER FORUM ADVISORY COMMITTEE

Academia

John Fitzgibbon, Professor, School of Environmental Design and Rural Development, University of Guelph

Gordon McBean, Professor and Chair, Institute for Catastrophic Loss Reduction, The University of Western Ontario

David Sparling, Professor and Chair, Agri-Food Innovation and Regulation, Richard Ivey School of Business

Industry and Associations

Chris Attema, Water Quality Specialist, Ontario Cattlemen's Association

Ted Cowan, Researcher, Farm Policy Research Group, Ontario Federation of Agriculture

Don McCabe, Vice-President, Ontario Federation of Agriculture

Tina Schankula, Policy Researcher, Ontario Federation of Agriculture

Art Smith, Chief Executive Officer, Ontario Fruit and Vegetable Growers Association

LeeAnne Wilson, Science Programs and Issues Coordinator, Ontario Greenhouse Vegetable Growers

Government

Stuart Budd, Senior Research Advisor, Ontario Ministry of Agriculture, Food and Rural Affairs

Heather Cassidy, Senior Policy Advisor, Ontario Ministry of Agriculture, Food and Rural Affairs

Grant Hopcroft, Director of Intergovernmental and Community Liaison, City of London

Maxine Kingston, Technical Director, Agri-Environment Services Branch, Agriculture and Agri-Food Canada

Rebecca Shortt, Engineer, Water Quantity, Ontario Ministry of Agriculture, Food and Rural Affairs

Oswald Zachariah, Unit Manager, Ontario Ministry of Agriculture, Food and Rural Affairs

1 The photographs on the mission page courtesy of Steve Martin; photos on pages 1, 18, 35, 44, 49 and 55 courtesy of Melissa Harris; and photos on pages 4, 8, 17, 23, 36, 50, 54 and 60 courtesy of Justin Harris.

At the opening reception, guests were welcomed by Carol Stephenson, Dean of the Ivey Business School, Ted Hewitt, Vice President of Research at The University of Western Ontario, the Honourable Chris Bentley, Member of Provincial Parliament for London West and Attorney General of Ontario, and Bette Jean Crews, President of the Ontario Federation of Agriculture. Ted Hewitt emphasized the importance of working with students and universities to support innovation. He outlined numerous water projects such as the technology test site for wastewater treatment at Greenway Pollution Control Centre, with the City of London, Trojan Technologies and The University of Western Ontario. The Hon. Chris Bentley welcomed guests on behalf of the Government of Ontario and underlined the strength of collaboration between different levels of government on water initiatives. He stated that the province is determined to be a world leader in water innovation and the Water Opportunities Act can help to facilitate this goal. Bette Jean Crews discussed the importance of a national food strategy, the role that water can play in international conflicts, and the need for effective and efficient water management strategies. Dean Carol Stephenson introduced the keynote speaker and emphasized that water is one of our most valuable resources.

The keynote address was delivered by Margaret Catley-Carlson, Chair of the Crop Diversity Trust and member of the UN Secretary General Advisory Board on Water. In her presentation, entitled *New Worlds of Water,* she emphasized world water realities; the effects of rapid population growth, prosperity and pollution on water resources; the Water-Energy-Food Nexus; and the importance of collaboration.

NEW WORLDS OF WATER: *A KEYNOTE ADDRESS BY MARGARET CATLEY-CARLSON*

World Water Realities:

Fresh water is scarce. There is a misconception about the quantity of fresh water available for consumption; this is known as the "myth of abundance." Only 2.5% of the world's water is fresh. Of that small amount, 70% is in the polar ice caps and the rest is mainly locked up in soil humidity and inaccessible. The usable amount is 1% to 2%, of the total 2.5% that is fresh water.

Water is local. The idea that we have abundant water must be examined through a local lens, in terms of accessibility and water quality. It does not help Canadians who live in Southwestern Ontario that the Mackenzie River has a lot of water. Nor does it help the rest of Latin America that the Amazon has so much water. Thus it is important to have a realistic understanding of water resources, both in terms of what is accessible and where it is located.

Conservation is key. North Americans use roughly 2 500 litres of water per day; 2 litres for drinking, 25 litres for washing and much of the remainder to produce food. The poorest populations in developing countries use as little as 20 litres. Canadians are the largest per capita consumers of water. Surrounded by the Great Lakes and thousands of other fresh water lakes, most Canadians believe that there is an infinite supply of water, making conservation and efficiency difficult to encourage. However water is a finite resource and we must adopt a culture of conservation.

Population, Prosperity and Pollution:

Population - The world's population rose from 1 billion to 6 billion over the 20th century. When one multiplies the climb from subsistence (or 2 000 calories per day), towards 3 000 calories per day by the population increase from 2.5 billion to 6 billion people over the past 50 years, the increase in water uptake becomes clear.

Prosperity - When people have more money they want to consume differently. Eating meat and protein requires more water.

Every calorie of food consumed takes 1 litre of water to produce. Some foods require more. For example, 1 metric tonne of water is required to make 1 kilo of rice, but 8-10 metric tonnes of water are needed to produce 1 kilo of beef. Increases in prosperity, especially in China, are not leveling off despite the recent financial crisis.

Pollution – In the past, when populations had something to get rid of, it was disposed of in the water. As a consequence, the amount of water available has been reduced around the world, whether by the 90% of untreated wastewater returned back into the common stream through agricultural waste and industrial chemicals or by ships. Pollution of our water resources is within our control.

The Water-Energy-Food Nexus

Energy, water and food are inextricably linked. Water treatment, distribution and food production require energy; energy and food production require water; food can be used for energy. When we had less population and less energy demand, we did not think about the water bill for energy. Many of the problems in water would start to attenuate, if not disappear, if water was priced properly around the world. For instance, if people were charged the real cost of the capital works, operations, maintenance, and energy costs of running water infrastructure, money could be invested into better infrastructure. The bill to date for replacing Canada's crumbling water infrastructure is in the billions of dollars. The problem is management, politics and powerful groups. Water is not properly managed and we need to adjust the political and social mechanisms by which we address water.

The Importance of Collaboration:

Water problems cannot be solved by turning to one or two ministries but must be addressed as an integrated whole. We cannot depend on any single "water warrior." The thoughts and actions of many players have to change, and myths need to be adjusted to address local and national developments.

For a complete record of Margaret Catley-Carlson's remarks, please see the accompanying publication New Worlds of Water, Lawrence Centre 2011.

WATER INNOVATION POSTER PRESENTATIONS

Participants extended their thanks to the following professors and students. Their presentations added to our knowledge and appreciation of how involved academia and industry are in working together in research, commercialization and the economic success of Ontario and Canada.

Pankaj Chowdhury, Jesus Moreira, Ajay Ray and Hassan Gomaa,
Department of Chemical and Biochemical Eng., Faculty of Engineering, The University of Western Ontario
Poster Title: Application of Dye-sensitive Photocatalyst in Environmental Detoxification

Tayirjan T. Isimjan, Ghodsieh Malekshoar, Ershat Nayup, Ajay Ray, Sohrab Rohani,
Department of Chemical and Biochemical Eng., Faculty of Engineering, The University of Western Ontario
Poster Title: Kinetic Studies for Photocatalytic Degradation of Methylene Blue on a Thin Film of Layer by Layer Deposited Titanium Dioxide

Hossein Kazemian, Sohrab Rohani,
Department of Chemical and Biochemical Eng., Faculty of Engineering, The University of Western Ontario
Poster Title: Towards Sustainable Agriculture in Canada by using Zeolitic Minerals to Preserve Water Resources

Argyrios Margaritas,
Department of Chemical and Biochemical Eng., Faculty of Engineering, The University of Western Ontario
Poster Title: Rapid Biodegradation of Hydrocarbons in Wastewater using a Novel Immobilized Cell Bioreactor System

Debjani Mukherjee,
Department of Chemical and Biochemical Eng., Faculty of Engineering, The University of Western Ontario
Poster Title: Development of Novel Photocatalyst for Water Purification under Solar and UV Light

Posters and contact information can be found at the end of this report.

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SETTING THE CONTEXT:

Canada needs a Vision for a Competitive and Innovative Agricultural Sector

Water is a precious resource. Only 2.5% of the world's water is fresh. Of that amount, only 2% is readily accessible. While Canada is blessed with much of the world's freshwater, there is a misconception about the quantity of water available for our consumptive use. Only 1% of the Great Lakes are actually renewable on an annual basis. We have been given a great legacy in the Great Lakes that we must work hard to protect. Yet we live with the myth of abundance.

Population growth and increasing demand for water, coupled with climate change, will pose additional challenges to our water security. Ontario's population is projected to increase from roughly 13 million in 2010, to nearly 18 million by 2036. How we address the needs of nearly 5 million more people in the next 25 years and how our society prioritizes competing water uses and conserves water must be determined now, based on science and economic realities. Agriculture is essential to Ontario's economy and culture, and water is essential for agriculture.

We need to understand our water resources by location and accessibility. Water is local. In addressing agriculture's use of water, we must receive local advice, have the flexibility to adjust to local circumstances, measure locally and understand local processes and timeframes.

As Canadians we have not yet truly embraced conservation and efficiency. The world is changing. Our competitors are innovating. Industries located in drought-stricken areas of countries such as Israel, Australia, India, and Pakistan with limited access to water, are often the most efficient water users world-wide. Need drives innovation. We have more opportunities, but less sense of urgency.

Current policies attempt to create a climate for investment but we must invigorate our efforts. Ontario's Water Opportunities and Water Conservation Act (2010) provides a firm foundation for the transformation of our citizens and our industries from being water-wasters to water-conservers. Ontario's new comprehensive water strategy is intended to ensure that our valuable water resources will be available for many generations. Using all relevant initiatives of government, industry and our academic institutions, we must continue to improve the pace of implementation of new technology and significantly increase our water usage monitoring and data collection.

This report focuses on options for responding to water quantity issues in agriculture. Environmental programs must be further integrated with economic programs in order to understand the water-energy-food nexus and ensure gains in the agriculture sector. There is a need to improve our efforts to work together across all levels of government, business and academic disciplines in a more holistic way if we are to better value and manage our water and create the future that we require. Barriers to investment and technological development and implementation need to be adjusted and processes streamlined to ensure innovators can navigate the regulatory process in a timely manner.

It is our responsibility to be part of the dialogue and become more involved as citizens in understanding our water reality and the challenges and opportunities we face in our province, and as a country in ensuring a competitive and innovative agriculture sector.

SUMMARY OF RECOMMENDATIONS

Actions to be considered by government, industry and academic partners in encouraging water innovation

1 TRANSITIONING TO EFFECTIVE AND EFFICIENT WATER USE

- Continue to invest in and develop leading-edge projects in Ontario's water sector. Increase the pace of innovation and decrease the time it takes to bring technology to market.
- Ensure participation and input from the agriculture sector in such initiatives as the Water Opportunities and Conservation Act and the Ontario Water Resources Act. The Water Technologies Acceleration Project (WaterTAP) should include representatives from the water sector including the agricultural sector as they strive to grow globally competitive companies and provide high value jobs.
- Continue to invest in water infrastructure now to increase efficiency and optimize water use. The infrastructure deficit will only be exacerbated as action is delayed and will negatively affect Canada's competitiveness agenda.
- Promote farm-level water supply enhancement, water storage and reuse. Focus on local water supply enhancements that farmers can use to increase the reliability of their water supplies, while decreasing the impacts of their water use on stressed aquatic ecosystems.
- Develop robust economic incentives to encourage early technology adopters to step forward.
- Encourage the agriculture and agri-food industry to employ closed-loop, sustainable operations through economic incentives and markets to increase profitability.
- Bring scientists, industry, economists and decision-makers together to develop integrated programs for market approaches to water quality and quantity management.

2 PROMOTING A SECURE WATER MANAGEMENT ENVIRONMENT

A. WATER MANAGEMENT POLICY

- Balance province-wide action with focused efforts on watersheds and sub-watersheds that are known to be under stress, whether from a water quality or quantity perspective.
- Promote flexibility in water policy, management and implementation to account for differences between urban and rural water use, between sectors and between northern and southern Ontario.
- Link new municipal water-taking infrastructure to agricultural water-taking infrastructure where feasible. For example, the Waterloo Region may need a pipeline from Lake Erie so municipalities and agricultural users could use co-joined pipelines with concurrent construction, shared intake and right of way to reduce costs.
- Develop a provincial irrigation strategy recognizing existing agreements and programs to monitor water use. Emphasis should be placed on locally developed water sharing plans.

B. COLLABORATIVE GOVERNANCE

- Promote collaboration and ongoing cooperation across government, business, environment, agriculture and academia as a means to develop new new regulations and policies as well as services, technologies and practices for innovative solutions to water challenges. Such measures will help to identify complimentary rather than conflicting or duplicating solutions.
- Simplify water governance structures and complex water allocation systems to form clearer, streamlined rules and procedures for balancing economic, environmental and social interests and to ensure expediency and accountability.

- For water related issues, ensure that the Ontario Ministry of the Environment and the Ontario Ministry of Natural Resources continue to seek input from related ministries such as the Ontario Ministry of Agriculture, Food and Rural Affairs, the Ontario Ministry of Economic Development and Trade, Ministry of Infrastructure and Ministry of Municipal Affairs and Housing, as well as the Conservation Authorities.
- Develop the tools needed to enable Integrated Water Resource Management (IWRM) to operate more effectively. Such tools could include legislation and regulation, policies, economic instruments, incentive structures and science-based watershed action plans.
- More attention is needed to address the 'implementation gap.' Many strong public policies intended to improve water management lack commitment and monitoring to ensure that they are properly implemented with measureable results.

3 SUPPORTING RESEARCH AND DEVELOPMENT

- Build science capacity around the collection of water use measurement (data, monitoring networks, budgets, modeling), in order to develop a better understanding of the current state of Ontario's water resources and anticipate future water use trends. For example, increase in-well monitoring programs to assess ground water stocks, recharge, use, and balance.
- Support an integrated information system that is available to all stakeholders, to provide information about water use and availability now and in the future.
- Determine the net use of water by agriculture including how much water goes into food.
- Support research and development for water conservation and efficiency in the agriculture and agri-food sector, pilot projects and demonstration plants, and recognize that research in a full-scale environment is also important.
- Consider establishing an agriculture and water governance and innovation centre.
- Improve the understanding of the impacts of climate change on agriculture in Ontario and Canada. Adaptation policy is integral to addressing the water-related challenges of climate change.
- Conduct case studies on nutrient markets for Canadian lakes and rivers where research already exists due to water quality issues, for example in the South Nations area or Lake Simcoe watershed.
- Conduct further research to assess and build upon preliminary evidence on the success of markets in effectively allocating water and reducing pollution compliance cost.
- Determine which kinds of science, technology and skills related to water management will be required in the future, and support these through research, education and training. For example, more agricultural industry professionals, water economists and applied researchers will be required in the future.

4 ENCOURAGING COMMUNICATION AND KNOWLEDGE TRANSFER

- Continue to monitor and redesign policies and technologies to encourage on-going improvements in on-farm water management. Communicate these improvements to encourage support and stakeholder participation.
- Establish a collaborative and participatory approach to measure, standardize and communicate the water footprint of products to ensure consistency and comparability. Consider including water footprint information as part of the Environmental Commissioner of Ontario's annual report in order to underline the importance of effective water use.
- Promote efficiency-based conservation through public education, emphasizing the relationship between the environment, agriculture, the economy and social systems. Renew our commitments to efficiency and conservation in forests, soils, and water to rebuild the water ethic in Ontario.

Setting The Context: Water Realities

Session One

Chair **John Kelly**
Vice President,
Erie Innovation And Commercialization

TOPIC #1

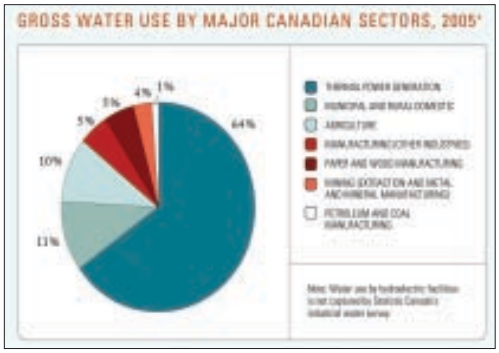
The Water Reality In Canada Now and Challenges For The Future

Panelist **Jill Baker**
Senior Policy Advisor,
National Round Table on the Environment and the Economy (NRTEE)

PRESENTATION OVERVIEW

The "water reality" in Canada varies considerably, depending upon the regional, sectoral and jurisdictional context. The water reality is also reliant upon our state of knowledge, in terms of current and future supplies, as well as future demands. Water use across the country differs depending upon the municipal, industrial and agricultural prevalence within the regions. Canada's natural resource sectors account for approximately 86% of water use in this country. Energy, mining, forestry and agriculture combined account for approximately 12% of our GDP.[1] The agriculture sector contributed about 2% of GDP and is responsible for approximately 10% of water use in Canada, however agricultural use is largely consumptive and has a different impact than many of the other sectors. Despite differences of use and issues facing the natural resource sectors, a number of common issues face the country: climate change and the uncertainties this brings to our knowledge of flows, the water-energy nexus,[2] the public licence to operate,[3] and governance and management, this being one of the most important.

Many of the water governance approaches and management practices in the country are in need of improvement. To address this issue the NRTEE is looking into policy options, including water pricing, technology and innovative opportunities, water data and information, as well as the role that collaborative governance can play in future water strategies. The outcome of the NRTEE's research will be to inform both governments and the natural resource sectors of opportunities that exist today that could help us transition our governance and management practices to better position ourselves for an uncertain water future.



Changing Currents, NRTEE Figure 1.1

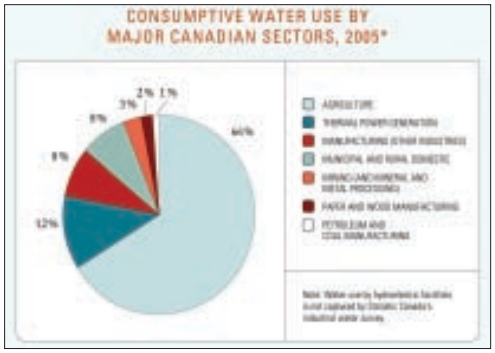


Figure 1.2

1 For more information see NRTEE *Changing Currents* at <http://www.nrtee-trnee.com/eng/publications/changing-currents/changing-currents-eng.php>.
2 This term refers to the linkage of issues related to water and energy. Water and energy policy are interrelated, often requiring integrated policy development. See NRTEE "Chapter 5: National Water Issues." *Changing Currents* for more information.
3 Public pressure to better manage water use is unanimously felt across all the natural resource sectors. Industry must assess such pressures and respond accordingly, to gain the public's acceptance of their water use. "The Canadian public is increasingly concerned with the management and operations of the natural resource sectors… Having representatives from relevant sectors participate in collaborative governance can allay concerns about a public licence to operate. Moreover, it may provide governmental water managers greater insight into the day-to-day water needs of the natural resource sector." Karen Bakker et al. 2011. *Collaborative Water Governance and Sustainable Water Management for Canada's Natural Resources Sectors.* Prepared for the NRTEE.

DID YOU KNOW

"According to a 2009 Nanos- *Policy Options* poll, Canadians regard fresh water as the resource that is most important for the country's future – by a surprisingly wide 3-1 margin over oil and gas."

***Policy Options*, July-August 2009.**

95% of water use in Ontario is in the Great Lakes region. Approximately 3 billion liters per day is used, with hydro-electrical generation accounting for the majority of gross water use.

"Great Lakes Regional Water Use, Database Repository." *Great Lakes Commission.* 2006

CONTEXT

Definition of water use: It is important to distinguish between consumptive water use and gross water use. Gross use refers to water that is taken in but, for the most part, returned to the same watershed.[4] Thermal power generation[5] is the biggest gross user of water across the country, followed by municipalities. Consumptive use refers to water that it is not returned to the source, mainly due to evaporative losses or water being embedded in products.[6] Agriculture is the biggest net consumer of water. Irrigation accounts for 90% of agricultural water use; however, distribution for irrigation varies significantly across the country. Most irrigation occurs in Saskatchewan, Alberta and British Columbia, with Ontario accounting for only 4%.

Challenge #1:

Insufficient water data: Many questions remain about our current and future water reality. Do we have enough water going forward into the future? What rate is considered sustainable water use? How can we predict if we have enough water for economic sectors to prosper but not at the expense of the environment?

"We need to come up with a better operational definition of the term 'water consumption.' While water can be borrowed for a time or may undergo a phase transition, water is rarely consumed (transformed into something other than water). To promote communication between disciplines, such as science, engineering, and policy groups, we need an agreed-upon nomenclature to understand the movement of water through different reservoirs."

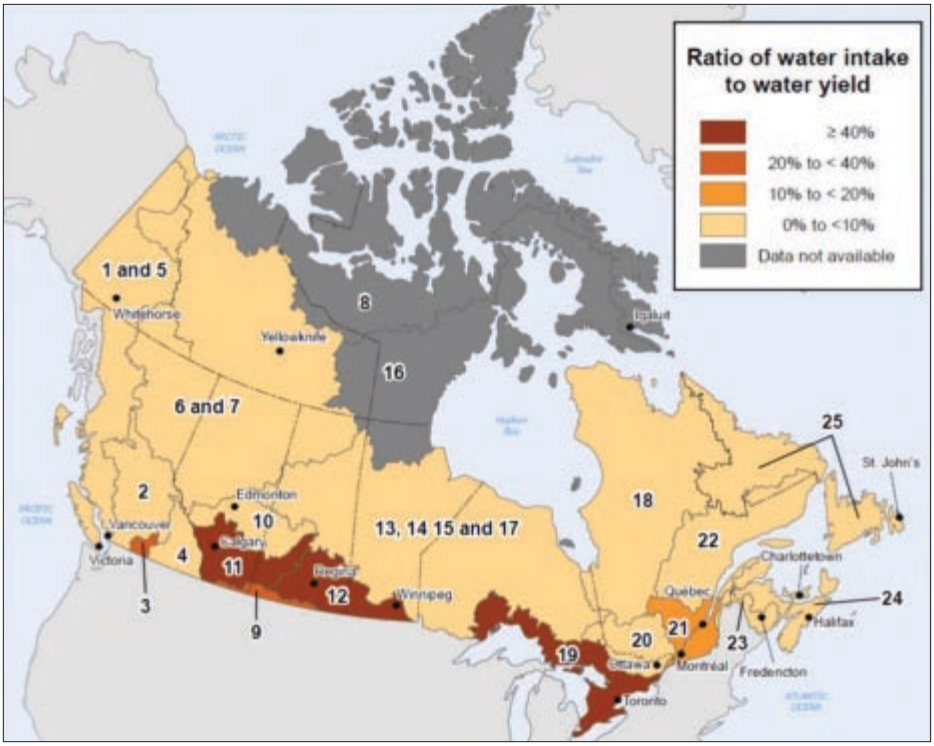
GORDON SOUTHAM, *The University of Western Ontario*

"Very little information is known about water consumption in Canada, little is actually measured, most is only estimated. It puts into question how well we really understand our water use."

JILL BAKER, *NRTEE*

Opportunity #1:

Collection of water data: Currently the NRTEE is working with the provinces in trying to understand how they collect water data, how they share the information, how accessible it is, and if it is in a form that is practical for making future decisions about water allocation. The collection and management of water use data is important for future water governance.



Statistics Canada[7] Figure 2

4 A watershed is an area of land draining into a common body of water. It "includes all of the land that is drained by a watercourse and its tributaries. Watershed boundaries are defined by heights of land. Boundaries are set where a height of land causes water to flow away from the watercourse." Ontario Ministry of Natural Resources, "Watersheds." <http://www.mnr.gov.on.ca/en/Business/Water/2ColumnSubPage/STEL02_ 163599.html>.

5 Thermal power generation refers to power plants that are primarily steam driven. Most coal, nuclear, geothermal and many natural gas power plants are thermal. The survey conducted by Stats Canada refers to 100 thermal-electric power plants. <http://www.statcan.gc.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=5120&lang=en&db=imdb&adm=8&dis=2>.

6 NRTEE *Charting a Path: Water and Canada's Natural Resources Sectors.* <http://www.nrtee-trnee.com/eng/publications/water-discussion-paper/section3-water-discussion-paper-eng.php>

7 Statistics Canada. 2010. *Human Activity and the Environment: Freshwater supply and demand in Canada.*

Challenge #2:

Increased water use: Economic growth of natural resource sectors is expected to increase between 50% to 65% by 2030. It is reasonable to assume that their water use will increase with higher production levels. In the case of agriculture, most of the water consumed is for irrigation and irrigation is expected to increase 2 to 3 fold. This will result in a substantial increase in water consumption, especially in Saskatchewan, Alberta and Manitoba.

Challenge #3:

Key national issues: When the NRTEE consulted the natural resource sectors to determine critical issues, the following concerns were consistently raised:

1. climate change and what it might mean for water resources
2. the water/energy nexus
3. the public licence to operate
4. governance and management

Climate change is expected to impact agricultural production in Canada; the effects will vary depending on the region. For instance, Manitoba is expected to experience an increase in the frequency and severity of floods, whereas the Prairies are likely to see more severe droughts.[8] More research is required to fully understand the effects of climate change and adaptive measures will become increasingly important as the temperature rises.

In addition to climate change, another key national issue is the complexity of water governance in Canada resulting from its constitutional nature. Water is local and yet federal, provincial, municipal, and First Nations governments, as well as other stakeholders are playing a role in how water is managed. Water allocation approaches that work well in some parts of the country may not be appropriate for other regions, nor will they necessarily be well suited to deal with situations in the future. There are competing demands for our water supply that need to be balanced. Limited policy instruments are currently employed, largely command-and-control regulations.[9] There is potential for other instruments to be used such as economic instruments and voluntary approaches.

RECOMMENDATIONS:

- Good data is very important. There is very little information known about consumptive water use in Canada. We need to improve the collection and management of water use data.
- More research is required on the effects of climate change in Canada. Adaptation policy[10] is integral to deal with the challenges of climate change.
- Water governance and management can be improved by using other policy instruments in addition to command-and-control regulations.

DID YOU KNOW

Agriculture is the largest consumer and second largest water user of the natural resource sectors. This makes up approximately 66% of national water consumption and 10% of gross use.

Innovolve Group. *Water and the Future of the Canadian Economy*, 2010.

Nearly one quarter of the total farms in Canada are located in Ontario. There are 57,211 farms in Ontario alone.

Statistics Canada, 2006.

In Canada, there are approximately 1 million hectares of irrigated cropland, most in the interior of British Columbia and the southern Prairies. AAFC.

"Agri-Geomatics." www4.agr.gc.ca

8 For more information see NRTEE Changing Currents <http://www.nrtee-trnee.com/eng/publications/changing-currents/changing-currents-eng.php>; Lemmen et al. 2004. "Agriculture." *Climate Change Impacts and Adaptation: A Canadian Perspective.* <http://adaptation.nrcan.gc.ca/perspective/index_e.php>; Harris, Melissa. 2010. "Canadian Food Security in a Changing Climate." *The Security of Canada and Canadians: Implications of Climate Change.* <www.ivey.uwo.ca/lawrencecentre/events/PDFs/ climate_security_final.pdf>.

9 Command-and-control policy refers to environmental policy that relies on regulation (permission, prohibition, standard setting and enforcement) as opposed to financial incentives, that is, economic instruments of cost internalization. <http://stats.oecd.org/glossary/detail.asp?ID=383>.

10 To date, most government policy has been on mitigation and reporting, however some adaptation initiatives are currently underway. For Natural Resources Canada's program, see <http://ess.nrcan.gc.ca/ercc-rrcc/overview_e.php>. For Ontario's adaptation strategy see <http://www.ene.gov.on.ca/environment/en/resources/STD01_076568.html>. 1 For more information see <http://www.ene.gov.on.ca/environment/en/

TOPIC #2

Drivers For Future Agricultural Water Policy and AAFC's Role

Panelist **Richard Butts**
Director General,
Agriculture and Agri-Food Canada

PRESENTATION OVERVIEW

This presentation looks at Ontario's agricultural water use from a national perspective. It outlines some of the drivers influencing future water policy and the role of Agriculture and Agri-Food Canada (AAFC) in addressing future water availability opportunities and challenges for the sector such as non-agricultural water demand, public opinion, climate change, pressures around "greening the supply chain" and new technology and innovation.

"Water in the Great Lakes region is a major economic driver. Much of the industry that has developed over time has done so because of the significant supply of fresh water."

ERIC BOYSEN, *Ontario Ministry of Natural Resources*

"Plants and animals need water in order to grow and thrive. Water is essential to agriculture otherwise we produce significantly less. As Ontario's population grows our farmers will need to use more water to irrigate in order to get yields that feed Ontarians and ensure our food processors have access to Ontario-grown inputs."

PHIL DICK, *OMAFRA*

"Water use efficiency is a win-win situation because it can reduce risk, stimulate innovation, and prepare farmers for future stresses that they will experience."

RICHARD BUTTS, *Agriculture and Agri-Food Canada*

DRIVERS INFLUENCING WATER POLICY:
1. SECTOR PROFITABILITY

Challenge #1.1:

Water is critical to production systems, and a reliable quality water supply is necessary for sector profitability.

Opportunity #1.1:

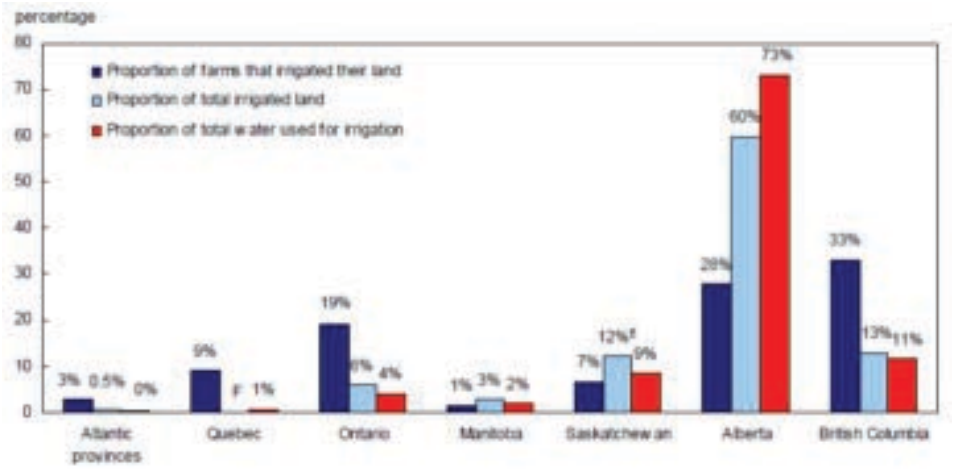
We need to manage the quantity and quality of water as a key component to reduce risk for producers. Water supply can be used to improve the product and increase yields. Our product quality assists in gaining and maintaining market shares.

Challenge #1.2:

Drought has a huge economic impact on the Canadian economy. As a result of major droughts in 2001 and 2002 the agriculture sector suffered $3.6 billion in lost production and 41 000 jobs were lost.[1]

Opportunity #1.2:

When developing Growing Forward 2[2] consideration could be given to further integrating environmental programs with competitive economic programs for gains in the agricultural sector, where appropriate.



Richard Butts, AAFC Figure 1

1 Wheaton, E.Wittrock, et al. 2005. *Lessons Learned from the Canadian Drought Years of 2001 and 2002: Synthesis report.* Prepared for Agriculture and Agri-Food Canada. Saskatchewan Research Council Publication.2 Growing Forward

2 Growing Forward 2 will replace the first Growing Forward Agreement (2008-2012) to "set out an integrated, comprehensive and outcome based framework to support a profitable and innovative agriculture, agri-food and agri-based products industry." <http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1224167497452&lang=eng>.

2. COMPETITION FOR WATER.

Challenge #2:

In the future there will be significant competition between the agricultural water users and the non-agricultural water users. In Alberta, for example, it is expected that demand for water and irrigation water use in the province could increase dramatically, up to 136% by 2046.[3] With increased competition, it becomes increasingly important to develop sound programs for collaboration.

3. PUBLIC PRESSURE TO PROTECT WATER.

According to a recent survey, 49% of Canadians believe water is our most important natural resource and are concerned with the availability and quality of Canada's freshwater.[4]

Challenge #3:

There will be demands on the public to restrict water taking from all sources, including for agriculture, to ensure that the ecosystems continue to function. All industries and stakeholders will be increasingly held responsible for their water use in locations where there is increased competition for water. Increased competition could result from a number of factors that are location-dependent, including changes in availability due to climate change, increased demand for water from other sectors, and increased public pressure to protect water for the environment.

Opportunity #3:

Producers are working through local watershed associations and are educating other producers on the use of new water conservation technologies. Farmers continually take on an environmental stewardship role.

4. CLIMATE CHANGE.

Climate change will increase the variability of the water across the country and agriculture policy should support a variety of adaptation strategies.[5]

Challenge #4:

Ontario certainly could experience changes in rainfall, more extreme weather events, changes in lake levels, higher crop water demands and other challenges. Warmer temperatures could expand the production base in certain parts of Canada, but this will be constrained by higher crop water requirements and reduced soil moisture and other factors.

Opportunity #4:

AAFC led a series of 10 climate change workshops across Canada, where they invited producer groups and other stakeholders associated with agriculture to discuss climate change issues.[6] Meetings of this type, reflecting diverse views, are important because although climate change is a national issue there are regional differences that must be considered in developing programs.

3 Sauchyn, D. and Kulshreshtha, S. 2008. "Prairies." Lemmen et al. *From Impacts to Adaptation: Canada in a Changing Climate.* Ottawa: Government of Canada.

4 Ipsos Reid survey 2010. For more information see <http://www.ipsos-na.com/news-polls/pressrelease.aspx?id=4718>.

5 See Lemmen et al. 2004. "Agriculture." *Climate Change Impacts and Adaptation: A Canadian Perspective.* <http://adaptation.nrcan.gc.ca/perspective/index_e.php>. For Ontario's climate change adaptation strategy, see *Climate Ready.* 2011. <http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_085423.pdf>.

6 A summary report of the workshop proceedings will be released in 2011 and will discuss how agricultural stakeholders view this national issue.

DID YOU KNOW

To protect Canadian Prairie rivers from drying up, a moratorium has been placed on water withdrawals from many rivers, including the Bow, the Oldman, and the South Saskatchewan.

Tony Maas. "Water Footprints: Exposing Invisible Business Risk." *Water Canada,* January 2010.

In a survey of Canadian businesses, Deloitte found that priorities for government action on climate change included: providing weather and climate data and information, delivering education and awareness raising programs, critical infrastructure protection and investment, upgrading design codes and standards and equipping business with decision-support tools to understand risk and appraise adaptation options.

Canadian Business Perspectives on the Role of Government in Private Sector Climate Adaptation: Final Report, 2011

5. GREENING THE SUPPLY CHAIN.

There has been a general push to ensure responsibility along the entire supply chain.

Challenge #5.1:

Greenhouse gas emissions are currently receiving much attention but it is also important to understand how much water is used to produce goods. In most cases water use is greatest in the primary production stage. For example, a Finnish company's water footprint[7] for its oats shows that 99.3% of the water footprint actually occurs in the production system;[8] processing and packaging account for very little. Consequently the focus is on improving water efficiency and reducing the environmental impact in the production stage of the product.

"We have to keep in mind that the agricultural industry is an environmental steward. They are concerned about the water situation and farmers in general have been careful to protect it."

RICHARD BUTTS, *Agriculture and Agri-Food Canada*

Opportunity #5.1:

In OECD[9] countries there has been a general shift from developing new water supplies to making more efficient use of existing water. Innovation is the key. An online irrigation calculator was created in British Columbia, which takes into account things such as regional irrigation characteristics, evapotranspiration for specific crops, and regional climatic information. There have been technology advancements in water reuse and recycling, agro meteorology, and more efficient water use crops. Researchers at AAFC are looking at solutions to minimize the effects of drought, developing salt tolerant crop varieties and other methods to increase efficiency under water scarcity situations.

Challenge #5.2:

Balancing economic competitiveness with environmental sustainability.

"The greatest thing we have done for water is to improve our efficiency. It used to take 4 pounds of feed to get 1 pound of chicken or a dozen eggs. Now it takes 1.8 pounds of feed to get 1 pound of chicken. Where we used to get 45 bushels of corn per acre, now we get 200 bushels for the same acreage."

GORD SURGEONER, *Ontario Agri-Food Technologies*

Opportunity #5.2:

Rather than creating separate agricultural or industrial or ecological solutions, there is a need to recognize that a watershed is a place where we live and work and a local, comprehensive approach is most effective. A place-based solution involves working with the right people to address agricultural and environmental issues while protecting water quality and quantity.

Increased evaporation linked to climate change is expected to lead to a lowering of the Great Lakes, possibly by as much as a metre or more, and that has significant implications for our water supply."

GORDON MCBEAN, *The University of Western Ontario*

RECOMMENDATIONS:

- Integrate our programs to bring science, policy and economics together. Water is critical to production systems; we need a reliable quality water supply to reduce risk for producers and improve the product.
- Water management should move towards a holistic, place-based approach.
- Continue to focus on collaboration: at the federal level the focus is on water use efficiency, while the provinces are studying water use allocation of resources; we need to work together to bring these into one strategy.
- Research, Education and Training: we need to determine which kinds of science, technology and skill sets will be required in the future.
- Continue to improve technology to measure and monitor water usage.

7 Water footprint is an indicator used to identify the total volume of direct (production) and indirect (supply chain) water used to produce goods and services. For more information see <http://wwf.ca/conservation/freshwater/> and <www.waterfootprint.org>.
8 Raisio's H2O label. <http://www.raisio.com/www/page/4397>.
9 There are currently 34 member countries in the Organization for Economic Development and Cooperation (OECD). <http://www.oecd.org>.

TOPIC #3

What is the Provincial Response to Balancing Water Needs?

Panelist **Sharon Bailey**
Director,
Ontario Ministry of the Environment (MOE)

PRESENTATION OVERVIEW

A number of factors have driven recent developments in water policy in Ontario, including increasing pressure on the province's water resources and water-dependent ecosystems, concerns about human health and well-being, and recognition of new opportunities for more green and diverse economies. This presentation addressed how the province is responding to water issues and balancing various water quality and quantity needs. The two issues are strongly interlinked. If there is a reduction in water flow, water quality may be impacted, and there may be less water available for ecological needs and for the protection of aquatic ecosystems.

The recent evolution of water policy in Ontario is discussed, with particular focus on the suite of regulations, policies and programs that are currently being used by the province to manage water. An overview of emerging challenges and opportunities for water management in Ontario is also provided.

KEY MOE WATER LEGISLATION, REGULATION, AND PROGRAMS

- The Water Opportunities Act,[1] passed in November 2010, is a key element of the Government's Open Ontario strategy.[2] There are a number of policies and programs associated with the Act. The Water Technologies Acceleration Project[3] focuses on collaboration among industry, universities, and government, to encourage new ideas and find ways to demonstrate and commercialize them on a broader scale.
- Environmental Protection Act[4] and Environmental Assessment Act[5] are cornerstones to help manage human activity to reduce our impact on water resources.
- Safeguarding and Sustaining Ontario's Water Act,[6] amended to the Ontario Water Resources Act, banned large scale diversions outside of the Great Lakes Basin.
- Safe Drinking Water Act[7]
- Clean Water Act[8]
- Nutrients Management Act[9]
- Great Lakes Charter 1985, updated in 2005[10]
- The Canada-US Great Lakes Water Quality agreement[11]
- Lake Simcoe Protection Plan[12]
- Ontario Water Resources Act[13]

1 For more information see <http://www.ene.gov.on.ca/environment/en/legislation/water_opportunities/ index.htm>.
2 Open Ontario is a new 5 year economic plan unveiled in the 2010 Speech from the Throne. <http://www.premier.gov.on.ca/openOntario/index.php?Lang=EN>.
3 For more information see <http://www.ene.gov.on.ca/environment/en/legislation/water_opportunities/ index.htm>.
4 The Environmental Protection Act is Ontario's key legislation for environmental protection. It grants MOE powers to address water contaminants. <http://www.ene.gov.on.ca/environment/en/legislation/ environmental_protection_act/index.htm>.
5 The Environmental Assessment Act requires an assessment of any major public sector project with the potential for significant environmental effects. <http://www.ene.gov.on.ca/environment/en/legislation/ environment_assessment_act/index.htm>.
6 The purpose of this Act is to provide details about how the Great Lakes states and provinces will manage, protect, and conserve the waters of the Great Lakes–St. Lawrence River Basin (Basin). The Act amends the Ontario Water Resources Act (OWRA) to implement the Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement, 2005. <http://www.ontla.on.ca/web/bills/bills_detail. do?locale=en&BillID=1562>.
7 This Act resulted from the Walkerton Inquiry. It gathers all regulation in one place to address treatment and distribution of drinking water. <http://www.ontario.ca/ONT/portal61/drinkingwater/ General?docId=STEL01_046858&breadcrumbLevel=1&lang=en>.
8 "The Clean Water Act helps protect drinking water from source to tap with a multi-barrier approach that stops contaminants from entering sources of drinking water - lakes, rivers and aquifers." <http://www.ene.gov.on.ca/environment/en/legislation/clean_water_act/index.htm>.
9 The Nutrient Management Act requires farms to develop nutrient management strategies to deal with animal waste to protect water sources from becoming contaminated <http://www.omafra.gov.on.ca/ english/agops/index.html>.
10 The Great Lakes Charter is an agreement between the 8 Great Lakes states and provinces with principles to collectively manage the use of the Great Lakes Basin's water supply. For more information on the 2005 Agreement see <http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@water/documents/document/200046.pdf>. For the 1985 Agreement see <www.cglg.org/projects/water/docs/GreatLakesCharter.pdf>.
11 "The Great Lakes Water Quality Agreement (GLWQA), first signed in 1972, revised in 1978 and amended by protocol in 1987, expresses the commitment of Canada and the United States to restore and maintain the chemical, physical and biological integrity of the Great Lakes basin ecosystem" <http://www.ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&n=88A2F0E3-1>.
12 In June 2009 Ontario released the Lake Simcoe Protection Plan as a model for watershed protection to restore the health of Lake Simcoe <http://www.ene.gov.on.ca/environment/en/local/lake_simcoe_protection/STDPROD_075796.html>.
13 This act focuses on conservation, protection and management of Ontario's ground and surface water resources for efficient and sustainable use <http://www.ene.gov.on.ca/environment/en/legislation/ontario_water_resources_act/index.htm>.

DID YOU KNOW

The clean water industry in Ontario employs more than 22 000 people and generates approximately $1.8 billion in sales.

"Ontario's Water Opportunities Act." Ontario Ministry of the Environment, 2011.

With an allocated $5 million over 3 years from the government, WaterTAP is mandated to provide guidance to major water users on emerging technologies; create an asset map of Ontario water companies, technologies and researchers; identify opportunities for collaboration, research and commercialization; and develop international market intelligence.

"Water Technologies Acceleration Project: Fact Sheet." Ontario Ministry of Research and Innovation, 2010.

Challenge #1:

Myth of abundance: We are fortunate to have access to four of the Great Lakes in Ontario and an apparent abundance of freshwater; however only 1% of the Great Lakes are actually renewable on an annual basis. If more than that 1% is consumed, we will be drawing down on the legacy that we have been given in the Great Lakes.

Challenge #2:

Increasing and competing demands on water resources: As demand increases and supply decreases, both water quantity and quality are affected. There are recurring nutrient and algae issues,[14] as well as emerging chemicals of concern and contaminated sediments that are still impacting water quality in the Great Lakes. There has been a decline in native species and habitat due to aquatic invasive species such as zebra mussels.[15]

"All eyes are on the Water Opportunities Act, a major piece of innovative policy work in the Province of Ontario. I think it's a game changer, and I hope that agriculture comes up on the positive side."

DEB STARK, *Assistant Deputy Minister, OMAFRA*

Challenge #3:

Rapid population growth: Canada's population around the Great Lakes has been increasing dramatically. Conversely, on the U.S. side there has been a decline in population over the last 20 years.

"Ontario's population is projected to increase from approximately 13 million in 2010 to 17.8 million by 2036. How society prioritizes competing water uses and conserves water must be determined now, based on science and economic realities."

GORD SURGEONER, *Ontario Agri-Food Technologies*

Sharon Bailey, MOE Figure 1

Challenge #4:

Existing water issues will be exacerbated by climate change: There is a need to focus on watersheds that are currently suffering the most stress as these conditions are expected to worsen due to climate change factors. There is also a need to focus on water resources in northern Ontario where the impacts of climate change will be most significant.[16]

"The wild card in the water world is climate change, which most experts predict will exacerbate water quality and water availability problems. Demand will increase, while changes in rainfall patterns and increased evapotranspiration will reduce resource availability. The likely result will be an increase in water-stressed areas across Canada"

KAREN BAKKER, *"Water Security: Canada's Challenge." Policy Options. July-August, 2009*

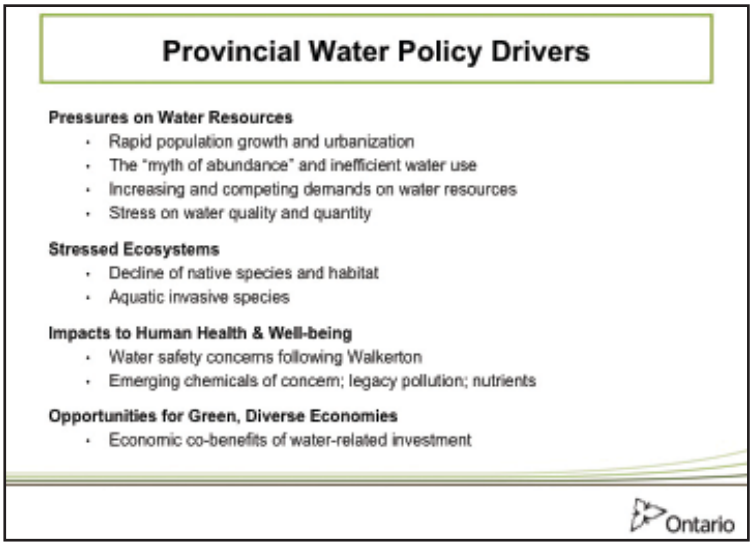
Opportunity #1:

Improved Water Resources Information: With improved monitoring and reporting, MOE is developing a better understanding of existing water resources, not just an increased awareness of the permitted water taken, but also what is actually being used. Knowledge of water volume, sources and watersheds is improving.

14 For more information on nutrient management see <http://www.ene.gov.on.ca/environment/en/subject/nutrient_ management/index.htm>.
15 For information on zebra mussels and other invasive species see <http://www.mnr.gov.on.ca/en/Business/Biodiversity/2ColumnSubPage/STDPROD_068689.html>.
16 Field, C.B. et al. 2007. "North America." *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* M.L. Parry et al., eds. Cambridge University Press, Cambridge, UK, 617-652. For more information on the impacts of climate change on Canadian water resources, see Popovich, Chris. 2010. The Security of Canada and Canadians: Implications of Climate Change. <www.ivey.uwo.ca/lawrencecentre/events/PDFs/climate_security_final.pdf>.

Opportunity #2:

Innovative Water Solutions: Under the Water Opportunities and Water Conservation Act, there are numerous opportunities for green, diverse and innovative economic solutions to water issues. Waterfront revitalization, habitat restoration, and ecological services[17] are important parts of this growing economy.



Sharon Bailey, MOE Figure 2

Opportunity #3:

Improving Water Infrastructure: There is a continued effort to address problems such as inadequate wastewater and storm water structures, and point source and non-point source pollutants[18] in the lakes. Another element of the Water Opportunities Act is to examine municipal water sustainability planning and encourage municipalities to look at water infrastructure for their drinking water, wastewater and storm water in a holistic way. Innovative solutions and new ways of addressing water will create economic opportunities for the future.

Opportunity #4:

Climate Change Adaptation: Over the long-term, research is being conducted in an attempt to understand the impacts of climate change and what is required for adaptation, as well as the cumulative impacts of water taking and water quality issues. This data will be necessary for future water management in a changing climate.

CASE STUDY

Lake Simcoe Protection Plan

The Lake Simcoe Protection Plan is an example of place-based integrated management. The Plan looks at all of the stresses on the lake, from phosphorous, to contaminants and aquatic invasive species, and takes a comprehensive approach to finding solutions. Whether addressing point sources, sewage treatment plants, non-point sources, or agricultural impacts, the Lake Simcoe Coordinating Committee and Science Committee convene to determine the long-term actions that need to be taken. This is proving to be an effective, collaborative model for a watershed-based approach that could be utilized in other parts of the province.

DID YOU KNOW

The Lake Simcoe Region Conservation Authority has done an outstanding job advocating for their watershed and building bridges with other stakeholders. But other watersheds also require protection. A good model might be the US House of Representatives draft *Sustainable Watershed Planning Act*. This Act would promote full water accounting, increased water efficiency, better planning across jurisdictions and more study of the relationships between human needs, hydrologic conditions, climate change and ecological health."

Diane Saxe. "Real protection of watersheds." *Environmental Law and Litigation.* January 7, 2010.

17 Ecological services are benefits to humankind supplied by ecosystems. Krantzberg and de Boer. 2006. *A Valuation of Ecological Services in the Great Lakes Basin Ecosystem* <http://www.eng.mcmaster.ca/civil/facultypages/krantz2.pdf>.

18 Non-point source (NPS) pollution is water pollution affecting a water body from diffuse sources, such as polluted runoff from agricultural areas draining into a river. In contrast, point source pollution discharges occur to a body of water at a single location, like a sewage treatment plant. United Nations Food and Agriculture Organization. 1996. "Introduction to Agricultural Water Pollution." Control of Pollution from Agriculture.

RECOMMENDATIONS

- Build on emerging science and information to continue to improve our understanding of the current state of Ontario's water resources.
- Promote more efficient water use by Ontarians through public education and the implementation of the Water Opportunities Act, such as water conservation planning for the broader public sector.
- Balance province-wide action with focused efforts in watersheds that are experiencing the most stress, whether it is from a water quality or quantity perspective.
- Continue our efforts to address problems with point source and non-point source pollutants entering the lake basins.
- Consider local place-based integrated management, as facilitated by the Lake Simcoe Protection Plan, as a model that could be utilized in other parts of the province.
- Develop and promote innovative solutions and new technologies and services to solve our water challenges through collaboration among government and non-government stakeholders.

"We need to promote more efficient water use by Ontarians. When we look at water conservation, we are looking at it from both the provincial perspective, what provincial agencies can do to improve their water efficiency, and also at what municipalities, universities, schools and hospitals can do."

SHARON BAILEY, *Ontario Ministry of Environment*

"For more than 100 years Canada and the United States have been working together on water management. The Boundary Waters Treaty of 1909 established the framework under which we manage water collectively. The fact that we have had a treaty between our two countries that has worked relatively effectively is a testament to forward thought."

ERIC BOYSEN, *Ontario Ministry of Natural Resources*

"Water scarcity may be more akin to a governance failure than a pure resource crisis… such a crisis can be resolved through better management, stronger governance and smarter financial investiture."

INNOVOLVE GROUP, *Water and the Future of the Canadian Economy. 2010.*

TOPIC #4

The Great Lakes, Legislative Changes and the Effects on Producers

Panelist **Eric Boysen**
Director,
Ontario Ministry of Natural Resources

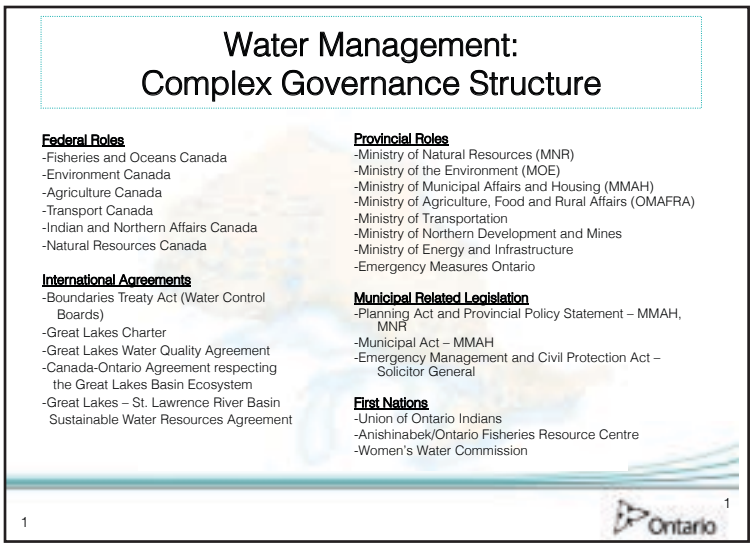
PRESENTATION OVERVIEW

Water management in Ontario falls under the mandate of every level of government; legislative tools are intertwined, and different and complex governance structures exist for Ontario's inland waters and Great Lakes/transboundary waters. With respect to inland waters, the legislative tools are focused on regulating water use and water quality, diversions, conservation and protection of human health. On the other hand, the Great Lakes and other international waters have had legislation and policies in place dating back to the 1909 Boundary Waters Treaty,[1] and set the context for the policies and rules for Canada and the United States to co-manage our shared waters. In this case, transboundary concerns are addressed, and the legislative tools often include a complex interaction between all levels of government on both sides of the border. Collectively, all policies have evolved over time to better protect and conserve water, recognizing its value as a natural resource and a necessity to all living things. But overarching challenges like climate change and increasing water demands make it necessary for Ontario to update, improve and adapt our water management framework. Thus, Ontario is currently working with federal, provincial and municipal partners to improve our governance of water, ensuring that our water supply meets the needs of people and the environment now and in the future.

Challenge #1:

"Who is minding the water right now?" No single group has control over water resources so allocation among competing users and balancing diverse perspectives pose fundamental challenges for water governance. There are numerous federal and provincial ministries, municipalities, First Nations, and other stakeholders who share in water management.

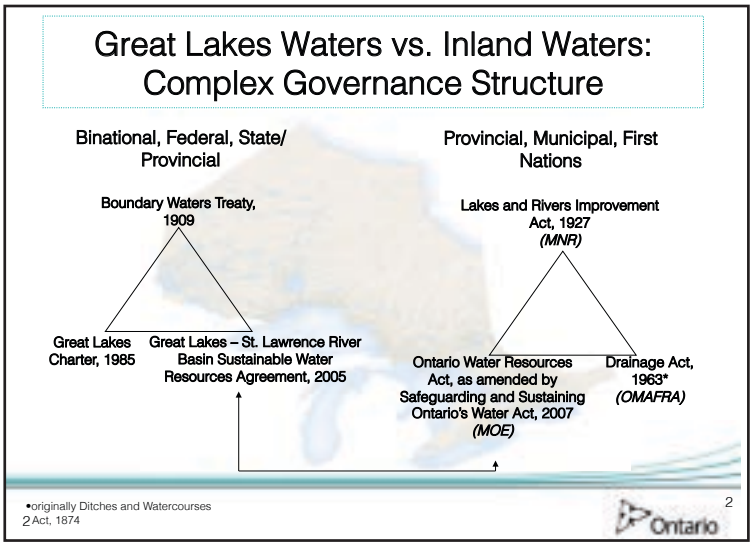
1 The 1909 Boundary Waters Treaty provides mechanisms to address water disputes along the boundary between Canada and the U.S. <http://www.ijc.org/rel/agree/water.html#what>.



Eric Boysen, MNR Figure 1

Opportunity #1:

There is a need to simplify Ontario's water governance structure. Everyone has a role to play, but in terms of a fundamental point of entry into water regulation, it is important to identify the agency best able to act as a single point of contact while ensuring accountability to all agencies involved.



Eric Boysen, MNR Figure 2

Challenge #2:

Existing legislative water policy needs to be more flexible. There is a significant difference between urban and rural use of water, as well as between water use in northern and southern regions of the province. The challenges that these diverse regions face are not the same, therefore a move towards a more flexible policy approach is required.

DID YOU KNOW

There are ten federal government departments or agencies with jurisdiction over some aspect of water. This is in addition to the numerous other provincial government departments with jurisdiction.

Karen Bakker. "Water Security: Canada's Challenge." ***Policy Options.*** **July-August, 2009.**

Opportunity #2:

It is important to understand the interaction between land use practices, forest cover, agricultural land and the urban environment and how this relates to water quality, quantity and ecosystem health. In order to achieve a holistic view of these complex and connected factors, a science-based adaptive measure approach to integrated water management is required.

In making policy choices and creating new water programs it is necessary to identify underlying assumptions and monitor actual program and policy outcomes before establishing best practices. We have an opportunity and a responsibility to identify unintended consequences and unexpected outcomes in order to improve future programs.

"Water policy is not static. It needs to be able to respond to different measures to maintain its currency. You can see it spans a long way back but more importantly we have to figure out where it is headed."

ERIC BOYSEN, *Ontario Ministry of Natural Resources*

Challenge #3:

As resources become more scarce, pressure to transfer water from the Great Lakes region to water poor regions is increasing.

Opportunity #3:

Water in the Great Lakes region is a major economic driver. Much of the industry that has developed over time has done so because of the significant supply of fresh water. The Safeguarding and Sustaining Ontario's Water Act legislates the ban on large scale diversions outside of the Great Lakes Basin. This initiative will help protect Canadian water resources and support our water-reliant industries.

"The Great Lakes represent 20% of the world's freshwater supply but are only renewed at a rate of 1% annually. It is helpful to compare our Great Lakes water resources to a bank account: instead of diving into the capital, only the interest should be used. Just like any bank account, it is important to know how much interest is being accumulated, how much is being deposited and withdrawn, and if transactions are occurring without proper authorization."

ERIC BOYSEN, *Ontario Ministry of Natural Resources*

CASE STUDY

Norfolk County: problem solving with constructed wetlands.

In the past, the Drainage Act guided farmers in draining fields and preparing them for planting in the spring. The excess water was quickly flushed off and no longer available for irrigation. During the warm summer months, water was needed for irrigation. Consequently, farmers in the Norfolk area disconnected some of their tile drains, creating retention ponds, instead of flushing off the excess water. By disconnecting the drains and excavating the grounds the ponds provided both a source of water for irrigation and a constructed wetland supporting migrating birds and other wetland fauna. This innovative idea came from local people to solve a local problem; however the lessons may offer broad scale solutions.

RECOMMENDATIONS

- With all of the tools that we possess, there remains a real need for improved practices and innovation.
- Support increased data collection and monitoring to provide a clear understanding of where the water is coming from, who is using it and how it is being managed.
- Promote flexibility in water policy development and management. There are significant differences between urban and rural use of water, as well as between northern and southern water use.
- In making policy choices and creating new water programs, identify underlying assumptions and monitor actual program and policy outcomes before establishing best practices. Identify unintended consequences and unexpected outcomes in order to improve future programs.
- Simplify the water governance structures to ensure expediency and accountability. Integrated management needs to happen.
- Promote understanding about the interaction between land use practices and forest cover, and agricultural land. How does the urban environment interact with water quality and quantity and ecosystems? Look at integration with stakeholders. We need a science-based adaptive measure approach.
- Improve monitoring of water resources and create better predictive models to anticipate changing water conditions.

SESSION ONE MODERATED DISCUSSION

Q: What is the role of government, academia and industry in the development of a water management framework? What do you think the framework will look like? **John Kelly,** Vice President, Erie Innovation and Commercialization

The role for producers in developing a water management framework is informing policy makers about the on-the-ground problems, the water realities and the kinds of policies that might be put forward. Academia can play a role in breaking down barriers, thinking about what can be accomplished in the long-term, anticipating challenges on the horizon, and identifying best practices. Government can do this as well but we rely on researchers and academia to identify gaps and find innovative solutions.

The role of government is to try to balance all of the competing interests and priorities: competing priorities among different levels of government but also among all of the competing players of water management. **Sharon Bailey,** Director, Ontario Ministry of the Environment

A key role for the producer is to understand water use and appreciate the value of water. Government's role is legislation and regulation but we need to hear from producers about the practical application of regulation. It is not only about a controlling framework but also about an enabling framework. Academia's role is innovative research and long-term problem solving.

A water management framework would include policy, programs, science, and communication to address water quantity, quality, ecosystem management and the net effect on the economy. **Eric Boysen,** Director, Ontario Ministry of Natural Resources

We need a framework that is based on research, science, and implementing best practices. It should be place-based and integration-based, an inclusive framework that integrates agriculture and other major users of water. **Richard Butts,** Director General, Agriculture and Agri-Food Canada

If you take a look at the way that the government is structured, it remains fairly siloed. There is some integration but in the academic world there is greater movement towards integrating some of the sciences and this is an important role. A water management framework should be place-based. Although shared governance can be challenging, local government may be better positioned to make decisions because they are on the ground and know the watershed. **Jill Baker,** Senior Policy Advisor, National Round Table on the Environment and the Economy

Q: How do we integrate water management into a culture of conservation across Ontario's Great Lake basin? **Phil Dick,** Business Resource Specialist, Ontario Ministry of Agriculture, Food and Rural Affairs

I think it is about having good information and really understanding what our water needs are now and into the future. One of the key cornerstones of the Water Opportunities Act is to establish new water efficiency goals and aspirational targets for personal use. It is not only about industrial use but about personal use as well. **Eric Boysen,** Director, Ontario Ministry of Natural Resources

"Working with existing organizations such as the International Joint Commission and existing initiatives such as their Upper Great Lakes study, the Government of Ontario should press for the establishment of a Levels Board for Lakes Huron and Michigan and actively pursue increasing the Lake Huron/Michigan median level by 60 centimeters."

TED COWAN, *Ontario Federation of Agriculture*

"Only 1% of the water of the great lakes is actually renewed on an annual basis. If you take more than that 1% in any one year, you are actually drawing down on the legacy gift that we have. It has been more difficult in Ontario to focus on policies that encourage conservation and efficiency, because it looks like we have a lot of water."

SHARON BAILEY, *Ontario Ministry of Environment*

Q: In determining the water footprint of a product how do we accurately and fairly reflect water use that would naturally occur, such as evapotranspiration?

Gord Surgeoner, President, Ontario Agri-Food Technologies

There has to be a high level decision made if we consider evapotranspiration as part of a water footprint and if so, we must very carefully and clearly articulate this number. Figures can become misleading: it is often cited that it takes 15 000 litres of water to produce 1 kg of beef when in fact, the majority of that water use is the natural process of evapotranspiration and not withdrawal use at all. **Chris Attema,** Water Quality Specialist, Ontario Cattlemen's Association

The problem with using any equation, the carbon footprint, the water footprint, is that they move from an interpretation to where they are used as a tool for marketing rather than as an environmentally conscious tool. **Richard Butts,** Director General, Agriculture and Agri-Food Canada

"Is it fair to count evaporative water as part of our consumption? If by doubling our carbon footprint, we create an atmosphere that soaks up more water through evaporation, does that mean we are in a sense responsible for that additional evaporative footprint? I think we are, but it is an indirect connection."

GORDON MCBEAN, *The University of Western Ontario*

"On the issue of assessing the true water footprint, I don't think anyone can really argue that if I pump 300 000 litres of water for irrigation, then I have 'used' 300 000 litres of water for crop production. But by not considering the natural evapotranspiration that would have occurred off of the land, one is over-estimating the consumptive usage of water by agriculture in non-irrigated crop production systems."

IVAN O'HALLORAN, *University of Guelph*

Water and the Canadian Agri-food Economy

Session Two

Chair **David Sparling**
Chair of Agri-Food Innovation and Regulation,
Richard Ivey School of Business,
The University of Western Ontario

TOPIC #1

Water Innovation in Agriculture: Challenges and Opportunities

Panelist **Deb Stark**
Assistant Deputy Minister, Food Safety and Environment,
Ontario Ministry of Agriculture, Food and Rural Affairs

PRESENTATION OVERVIEW

Agriculture is essential to Ontario's economy and culture, and water is essential for agriculture. We must begin to think about water differently, if for no other reason than because our competitors are. How can we be more innovative and what are the opportunities for water innovation that may exist for agriculture in Ontario?

CONTEXT

The economic and environmental issues surrounding agricultural water use are not substantially different from water use challenges and opportunities faced by other sectors of society. Water is a scarce resource, whether for individual consumption, building a green economy, or contributing to better health, and it is fundamental to agriculture's success.

Deb Stark, OMAFRA Figure 1.1

Figure 1.2

CHALLENGE #1:

Growing our Competitive Advantage: Challenges exist around issues of water quantity, quality, access, use, economics and decision-making. Companies and sectors that are successful in addressing water challenges plan, invest in innovation and measure results. As competitors and stakeholders innovate to address challenges and respond to a changing world, the agricultural sector in Ontario needs to do the same. Innovation is hard work, high risk and expensive to implement. It requires time, financial investment and commitment. Government, in particular, should understand that failures often occur before successes.

DID YOU KNOW

In 2009, Anglo American, one of the world's largest mining groups had difficulty mining in South Africa due to a lack of fresh water. In 2007, SABMiller, the world's second largest beer retailer, was forced to stop production at one of its South Africa plants due to water shortages.

Tony Maas. "Water Footprints: Exposing Invisible Business Risk." *Water Canada*, January, 2010.

40% of Fortune 1000 companies identified water shortages as severe or catastrophic to their business. However, only 17% say they have made preparations.

Marsh Center for Risk Insights, 2007,

Opportunity #1:

1.1 Building on a history of innovation: The efficiency of the North American agricultural sector has been a major success story around the world, and requires continued investment and support. The Ontario Water Opportunities Act[1] builds upon this history as a major piece of innovative policy work. It signals an opportunity to be creative, and consider ways to help Ontarians use water more efficiently, and reduce, reuse and recycle.

1.2 Continued collaboration is key: Agriculture in Ontario supports a multitude of products and initiatives. The challenge of managing the complexity and diversity of the agri-food industry[2] has led to a cooperative system, with numerous examples of public/private partnerships. The agricultural sector operates well within current environmental and water regulations and is intolerant of serious offenders. In seeking solutions to water issues, the sector is willing to work with government, for example, by participating on Source Protection Committees[3] to identify best practices.[4] The skills gained by working together in this complex environment are integral to addressing greater water challenges and managing multiple users and big government.

"There is a need to emphasize water use efficiency across natural resources. In growing more with less, there is no doubt that efficiency is the key."

RICHARD BUTTS, *Agriculture and Agri-Food Canada*

"Water is our oil. We have as much or more of it than anyone else in the world."

CHRIS BENTLEY, *MPP London West, Attorney General of Ontario*

"Companies and sectors that do well plan for it, they invest in it and they measure results. It is not about sitting around and hoping that the next big idea is going to drop out of the sky."

DEB STARK, *Assistant Deputy Minister, OMAFRA*

Deb Stark, OMAFRA Figure 2

RECOMMENDATIONS

- Continue to support efficiency through investing in innovation, technology and collaboration.
- Consider water in the context of innovation; for example, continue research into drought tolerant crops, new technology for dairy barns and a Water Governance and Innovation Centre for Ontario.
- Encourage multi-stakeholder consultations regarding market approaches to gain a better understanding of the most effective market approaches to water quantity challenges, including economic levers and fees utilized by other sectors such as financial services.

1 The Water Opportunities and Water Conservation Act (2010), Bill 72, contains the stand-alone, Ontario Water Opportunities Act (2011), which aims to deliver the following outcomes: make Ontario the North American leader in the development and sale of water conservation and treatment technologies; encourage sustainable infrastructure and conservation planning using made-in-Ontario technologies to solve water, wastewater and stormwater infrastructure challenges; encourage all Ontarians to use water more wisely. Key to delivering these outcomes is the creation of the Water Technology Acceleration Partnership (WaterTAP) - to support research and development as well as the commercialization of new technologies and innovations in Ontario's water sector. The Act also: creates partnerships to develop water innovation among universities, colleges, industry and entrepreneurs and several ministries in Ontario's government; strengthens water efficiency and sustainable water planning for municipalities; and helps Ontarians to use water more efficiently. See <http://www.ene.gov.on.ca/environment/en/legislation/water_opportunities/index.htm>.

2 The term agri-food relates to "industries which are involved in the mass production, processing and inspection of food products made from agricultural commodities" <http://www.agriculturedictionary.com/definition/agri-food.html>.

3 Source Protection Committees were established under the Province of Ontario's Clean Water Act, 2006 to create and carry out a plan to protect municipal sources of drinking water. For more information see <http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_070288_e.htm>.

4 The processes, practices, and systems identified in public and private organizations that performed exceptionally well and are widely recognized as improving an organization's performance and efficiency in specific areas.

TOPIC #2

What Can We Learn From an Economic Analysis of the Value of Water?

Panelist Steven Renzetti
Professor,
Department of Economics, Brock University

PRESENTATION OVERVIEW

" To market, to market, to buy a …?"

A number of Canadian watersheds[1] face declining water quality due to excessive loadings of nitrogen, phosphorous and other compounds released from sewage treatment plants and agricultural operations.[2] Traditional policies and regulations aimed at reducing these loadings have been criticized for failing to promote innovation and leading to excessive compliance costs. An alternative approach harnesses the power of the market by allowing agents to reduce emissions through on-site abatement or by trading in pollution credits. Evidence suggests that these nutrient markets do more to reduce the costs of compliance with environmental orders and to promote innovation. There remain a number of challenges, however, that need to be addressed before nutrient markets can be implemented. Can we come up with a better way to address water quality issues?

Steven Renzetti, Brock University Figure 1

Challenge #1:

Beyond command-and-control[3] approaches: Traditionally, governments have sought to meet environmental goals by instituting a command-and-control approach to policy. Emissions limits were set. Those engaged in a commercial activity that resulted in water or air pollution were instructed, sometimes through Best Management Practices,[4] on how to achieve the goal. The costs imposed upon water users to meet environmental regulations and install new technologies can be significant. They can negatively impact the ultimate users and Canadian competitiveness. Governments are also losing their fiscal capacity to participate in the process of environmental regulation. This approach does not promote innovation beyond being enterprising enough to meet the objective set by government. Because actions beyond achieving the standard do not provide any financial return, the attention of agricultural producers tends to shift to other priority areas.

1 A watershed is an area of land draining into a common body of water. It includes "all of the land that is drained by a watercourse and its tributaries. Watershed boundaries are defined by heights of land. Boundaries are set where a height of land causes water to flow away from the watercourse." See <http://www.mnr.gov.on.ca/en/Business/Water/2ColumnSubPage/STEL02_163599.html>.

2 "Eutrophication is a syndrome of ecosystem responses to human activities that fertilize water bodies with nitrogen (N) and phosphorus (P), often leading to changes in animal and plant populations and degradation of water and habitat quality…Inputs may come from untreated sewage discharges, sewage treatment plants or runoff of fertilizer from farm fields or suburban lawns." See <http://www.eoearth.org/article/Eutrophication>. "Loading is the rate of supply of a particular entity to receiving waters; it is expressed frequently as a rate (e.g., tons N y-1). Pinckney, J. et al. (2001). "The Role of Nutrient Loading and Eutrophiciation in Estuarine Ecology", *Environmental Health Perspectives*, Vol. 109, 701-702. <www.ncbi.nlm.nih.gov/pmc/articles/PMC1240600/pdf/ehp109s-000699.pdf>.

3 "Command-and-control policy refers to environmental policy that relies on regulation (permission, prohibition, standard setting and enforcement) as opposed to financial incentives, that is, economic instruments of cost internalization." See <http://stats.oecd.org/glossary/detail.asp?ID=383>.

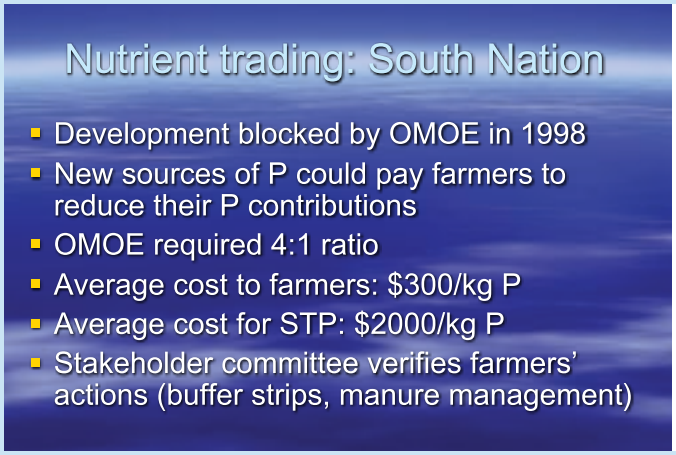
4 Best Management Practices (BMPs) are science-based, practical and affordable approaches to conserving a farm's soil and water resources without sacrificing productivity. BMP documents exist to help those in the agricultural sector act as stewards of the environment and ensure that the proposed development activities are planned and carried out in compliance with the various relevant legislation, regulations and policies. See <http://www.env.gov.bc.ca/wld/BMP/bmpintro.html> and <http://www.omafra.gov.on.ca/english/environment/bmp/series.htm>.

DID YOU KNOW

Approximately 75% of Canadian households are on volume-based pricing, and the remainder are on flat water rates. On a volume-based pricing system, the average Canadian household uses 226 litres per day. When compared to a flat rate system (467 litres per person per day) a 43% variance is evident.

Innovolve Group. *Water and the Future of the Canadian Economy.* 2010.

CASE STUDY



Steven Renzetti, Brock University Figure 2

Nutrient Trading – Local successes: In 1998 excessive levels of phosphorous in the South Nation River, located in Southeastern Ontario, led MOE to freeze new housing developments in the watershed in an effort to control surface water pollutants. Land developers and agricultural producers operating within the watershed formed a collective response to an MOE initiated economic incentive program[5] that allowed water quality trading for phosphorus credits. In coordination with the South Nation Conservation Authority,[6] land developers agreed to pay farmers to reduce non-point source[7] pollution rather than employ costly point source phosphorus treatment measures at the sewage plant to reduce nutrient loading. The MOE agreement proceeded at a 4 to 1 offset ratio,[8] whereby farmers reduced 4 kilograms of emissions for every kilogram of emissions the sewage treatment plant was permitted to dump. Even at this ratio the economics were beneficial to both parties.[9] The farmers could reduce phosphorous loadings at $300 per kilogram versus an estimated $2 000 per kilogram cost for the sewage treatment plant. The deals were struck, commitments were verified by a committee of stakeholders, in this case farmers, and the new residential development ensued. In the absence of these trades, the development would not have occurred.

"Government decisions in the direction of increasingly costly regulations threaten to pose greater regulatory burdens on commercial entities operating in Ontario."

STEVEN J. RENZETTI, *Brock University*

"We need to properly value water, whether we're using it for agriculture, industry, or domestic use."

TED COWAN, *Ontario Federation of Agriculture*

Opportunity #1:

1.1 Develop market-based policies: Evidence suggests market-based approaches to water policy that promote conservation and innovation can achieve the same environmental goals as traditional government approaches, at less cost over the long-term. For instance, agricultural operations and sewage treatment plants that produce phosphorous and nitrogen that enter the water stream will differ in their approaches to emission reductions as varying technological solutions carry different costs of remediation. From a societal perspective, the lowest cost producer should achieve most of the reduction. Nutrient loads should be reduced in watersheds at the least cost to society.

In a market-based approach, the Ministry of the Environment (MOE) would set water quality standards in a particular watershed. Commercial operations would have the right to emit a certain amount of pollution beyond which emissions must be reduced either independently or through retaining an agent better able to reduce emissions on their behalf. The two agents would create an agreement, exchange payments and reductions would be realized at a cost lower than if each agent was required to reduce emissions by the same amount. In order to build innovation and improvement into the system, government could depreciate the base pollution rate by 5% per annum, reducing the right to pollute over time. Lower boundaries would be identified, below which the cost of compliance is likely too great or compliance is technologically infeasible.

5 The MOE developed a framework for the implementation of the Total Phosphorus Management (TPM) program and allowed local stakeholder committees to develop an approach adapted to their watershed. For more information see <http://www.conservation-ontario.on.ca/projects/pdf/fact%20sheets/PHASE%20I/watershed_economic_incentives_english.pdf>.

6 The South Nation Conservation Authority is one of 36 local, community-based environmental agencies based in Ontario. Conservation authorities represent groupings of municipalities on a watershed basis and work in partnership with other agencies to manage their respective watersheds.

7 Non-point source (NPS) pollution is water pollution affecting a water body from diffuse sources, such as polluted runoff from agricultural areas draining into a river. In contrast, point source pollution discharges occur to a body of water at a single location, like a sewage treatment plant. <http://en.wikipedia.org/wiki/Nonpoint_source_pollution>.

1.2 Create a market for emissions: An alternate approach would be to create an environment for people engaged in the marketplace to constantly improve, be aware of their competitors, and continuously reduce emissions through the power of the market. Efficiency gains and technological improvements are traditional in the agricultural sector. If policy moves in the direction of nutrient trading, allowing voluntary trades and allocating credits based on percentage of past flows, there is reason to believe the same environmental goals will be achieved. This reflects a lower cost to society while promoting technological innovation that drives long-term competitiveness.

CASE STUDY

Nutrient Trading – successes from around the world: Although not new, markets for nutrient trading are growing in popularity in the United States and Europe. Research indicates that when nutrient markets are in place, parties tend not to trade as much as predicted. Trades that do occur save participants money, but do not necessarily result in significant cost savings. Yet, those located in the watershed but not active in the markets are said to be constantly thinking of ways to apply trade credits in order to save money and accelerate technological innovation in order to keep pace with those participating in the markets. Suddenly everyone becomes an innovator.

A number of U.S. states are working in a coordinated way to reduce nutrient loading. In Long Island Sound, Connecticut, over a ten-year period, both point and non-point sources participated in market trades and significant reductions in nitrogen loading were reached. Estimates suggested a 58% decrease in nitrogen, and savings in the hundreds of millions of dollars relative to conventional treatment methods in order to achieve the same reductions. Evidence of farmer-to-farmer knowledge transfer and dissemination of best practices through farmers' associations is leading to continual innovation.

The earlier success in reducing sulfur dioxide emissions[10] was attributed in part to the expansion of the market trade to include participation of non-polluters. Drives by school children, for example, raised funds to purchase tonnes of sulfur and they raised awareness and received recognition for their efforts. Today, they are buying tonnes of carbon.[11]

DID YOU KNOW

"There are a number of nutrient trading programs currently in operation in North America. The Long Island Sound trading program administered by the Connecticut Department of Environmental Protection, for example, addresses the problem of low oxygen levels in Long Island Sound by trading nitrogen credits between point sources, which are the main cause of excessive nitrogen levels in the Sound."

Suzie Greenhalgh and Mindy Selman. *Nutrient Trading – A Water Quality Solution*, OECD Workshop, 2005.

Challenge #3:

Markets rooted in science: Water markets must be founded on reliable science in order to operate effectively. Science is required, for example, to describe the flow of nutrients from farm and sewage treatment plants into the rivers and the lakes and to identify exchange rates between point and non-point source pollution.

Opportunity #3:

Scientific Capacity: Canada is host to many of the world's best water experts who are qualified to develop the science that will form the foundation for water quality trading.

8 The offset ratio is a multiplier that reflects how much more phosphorus must be removed from point or non-point sources of pollution versus the amount contributed to watercourses by point source discharges. The rate will vary by region depending on the size of the watershed, typology and other factors.

9 There is a natural economic incentive for controlling phosphorus loadings to a watershed through investments in NPS controls. The cost of controlling NPS phosphorus is 7 to 10 times cheaper than controlling point source pollution. <www.conservation-ontario.on.ca>.

10 The Acid Rain Program was a market-based initiative taken by the United States Environmental Protection Agency (USEPA) according to Title IV of the 1990 Clean Air Act, in an effort to reduce emissions of sulfur dioxide (SO2) and nitrogen oxides (NOx), which cause acid rain. See <http://www.epa.gov/airmarkets/progsregs/arp/s02.html>.

11 See <http://www.cleanairconservancy.org>.

RECOMMENDATIONS

- Conduct further research to assess and build upon preliminary evidence on the success of markets in effectively allocating water and reducing pollution compliance costs.
- Determine measures to reduce the environmental regulatory burden and encourage innovation.
- Ensure stakeholder involvement, buy-in and monitoring, in initiating moves toward a water market policy.
- Ensure scientist involvement in identifying market policy details, such as appropriate offset ratios between point and non-point source pollution.
- Consider conducting additional case studies on nutrient markets for Canadian lakes and rivers where science currently exists as a result of water quality issues, for example, Lake Winnipeg or South Nations River.[12]

"Typically in all aspects of trading involving agro-ecosystems one often sees agriculture considered the cheapest source of contaminant to ameliorate, and the one with many easy improvements to make. This is often debatable and what is often overlooked is the fact that agriculture is the one with the greatest difficulty to actually quantify its impact."

IVAN O'HALLORAN,
University of Guelph

"There is some research that indicates that even if you are not actively participating in the markets, firms are accelerating their rate of technological innovation simply to keep up with folks who are participating in the markets."

STEVEN J. RENZETTI,
Brock University

12 It is typically more complicated to conduct the science and identify markets for nutrient trading around rivers than lakes. However, market trading based on the science from the Lake Winnipeg example is made more complicated as part of its drainage basin is in the U.S. Thus, such a scheme would require international co-ordination.

TOPIC #3

What is the Importance of Water to Producers and How Can Environmental Stewardship Be Promoted as a Marketing Tool?

Panelist **Tom O'Neill**
General Manager,
Norfolk Fruit Growers' Association

PRESENTATION OVERVIEW

Water is an essential ingredient in a food production system. Responsible and sustainable use of water will continue to be important to society in general and agriculture in particular. As climate fluctuations increase the risks for crop protection, water can be used as a moderating factor. Documenting the responsible use of water is essential to meet the increasing expectations of consumers. Regulation of water use will continue to evolve as more demands are put on the supply of available water. It is important that new water regulations are science and fact-based to properly manage this resource in the best interests of society.

CONTEXT

Norfolk County is billed as one of the most agriculturally diverse regions in the world, growing more vegetable and fruit varieties than in any other area.[1] Norfolk County represents approximately 15% of apple production in Ontario and is considered a high use area for water. A large percentage of the Norfolk crop is marketed by the Norfolk Fruit Growers' Association (NFGA)[2] which facilitates extensive local and export sales to major retailers and secondary processors throughout Canada, the United States, the United Kingdom, Mexico, Central America and the Caribbean.[3] The NFGA's packhouse facility stores 900 000 bushels of apples, 750 000 of which are in Controlled Atmosphere storage.[4] The facility has a 5 000 bushel a day capacity for pre-sorting and packaging fruit in all forms of retail packages.

Tom O'Neill, NFGA Figure 1

DID YOU KNOW

In Ontario, approximately 8,162 hectares are dedicated to growing apples.
Statistics Canada, 2006.

The total tree population of Norfolk County exceeds 286, 000. To ensure quality control, individual loads of fruit are tracked from the orchard to the market. This helps growers improve production to meet the needs of the market.
www.nfga.ca

1 Norfolk County crops include tree fruit (apples, sour cherries, pears, peaches); a wide variety of berries (wine grapes, strawberries, raspberries, blackberries, gooseberries); and most temperate vegetables and herbs (asparagus, beets, carrots, cole crops, tomato, zucchini, lavender and ginseng).
2 Established in 1906, the Norfolk Fruit Growers' Association (NFGA) is a co-operative organization of fruit growers operated by a General Manger and Board of Directors, but has only ten grower members presently. See <http://www.nfga.ca/>.
3 In addition, the NFGA provides regional consolidation marketing services for strawberries and tomatoes.
4 Controlled atmosphere is an agricultural storage method in which oxygen, carbon dioxide and nitrogen concentrations as well as temperature and humidity are regulated to keep apples from oxidizing and decaying.

Challenge #1:

Changing market preferences drive the need for irrigation: The Ontario apple industry has not traditionally been a large user of water. As the marketplace changes and retailers respond to consumer preferences for newer varieties of individually packed, larger sized fruit,[5] producers are forced to adopt new management systems and change how they produce in order to stay competitive. Over the past 15 years, production systems have shifted from low-density plantings of 100 trees per acre, to high-density plantings of 1 000 trees per acre. Standard 30 foot trees are being replaced with shallow-rooted, dwarf, 10 foot trees. The traditional 10 year planting to production cycle has been reduced to less than 3 years, with trees reaching top production within 5 years. As market preferences change, suppliers are aware that demand for new varieties may occur within a 20-year cycle, forcing a return on investment within this compressed interval. Changes in production systems create the need for supplemental moisture to help trees develop and produce saleable fruit in a condensed time frame.

Opportunity #1:

Knowledge sharing around supplemental moisture: Many of the world's crop production areas require irrigation. In Washington State, for instance, apples cannot be competitively grown without irrigation, and producers rely on a composite of systems to ensure that production requirements are met.[6] The knowledge base surrounding fruit irrigation is broad and accessible to growers as they investigate the best system or combination of systems to address supplemental water needs for production.

"Improving low-tech irrigation infrastructure may be just as effective as funding a significant upgrade to a more sophisticated technology."

KERRY FREEK, *"The Networked Field," Water Canada. November/December, 2010.*

"Water supply shortages that affect the agriculture sector in Ontario cannot be addressed in isolation from the larger strategic question of water security in Ontario."

ROB DE LOË, *Managing Water Shortages for Ontario Agriculture. Prepared for OMAFRA, August 2009.*

Tom O'Neill, NFGA Figure 2

Challenge #2:

Climate change adaptation: Recent changes in the climate are making irrigation an essential component of crop production and competitiveness. Irrigation is required to protect investments against the increased risk of frost witnessed in Ontario over the past 5 to 7 years. Furthermore, warmer than typical summer temperatures experienced over the past decade require overhead irrigation to mitigate evaporation and create cooling in crops.

Opportunity #2:

Available supplemental water: The installation of supplemental water systems will help to ensure that investments and growing systems are protected, that trees remain productive, and that producers remain competitive. Because water is readily available in Norfolk County, supplementation is possible.

5 Consumers are responding less to the traditional pre-packaged smaller sized fruit profiles. The Gala apple has taken over from McIntosh as the leader in market share and the main varieties of the past 100 years including McIntosh, Red Delicious and Golden Delicious are giving way to the rise of the Empire, Pink Lady, Honeycrisp and Ambrosia apples.

6 Irrigation is the replacement or supplementation of rainfall with water from another source in order to grow crops or plants. In contrast, agriculture that relies only on direct rainfall is referred to as dry land farming or rain fed agriculture. Supplemental water systems used in Washington State include, trickle irrigation (also known as drip irrigation or micro-irrigation), which allows water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone through a network of valves, pipes and tubing; and overhead irrigation or sprinkler irrigation is a method of applying irrigation water which is similar to natural rainfall. Water is pumped through a system of pipes and is sprayed above the crop by an impact sprinkler, in gun, over the row or in the row irrigation. See <www.saiplatform.org/uploads/Library/Technical%20Brief%201%20%20Irrigation%20Systems.pdf>.

Challenge #3:

Developing a water management strategy for agriculture: Most of Norfolk County is within the Long Point Regional Conservation Authority watershed, classified as a high use region for surface water. The agricultural sector's water use is estimated at 31 million cubic metres per year, within the region's total ground water recharge[7] of 401 million cubic metres per year.

Opportunity #3:

Flexible Regulation: Future water management strategies need to account for the diverse nature of water use for fruit and vegetable production and processing. Regulations must be flexible to permit the use of new and various supplemental water technologies to assist in crop production. For example, in the spring, irrigation may be used in annual crops to establish moisture in the seedbed or to protect the seedbed from wind erosion. Trickle irrigation is used to assist most trees during planting and to provide moisture to the roots throughout the production season in order to achieve maximum growth. Diversified uses of water constitute good agricultural practices.

Tom O'Neill, NFGA Figure 3.1

Figure 3.2

Challenge #4:

Meeting market standards: Environmental stewardship has become a condition of sale in certain markets, as consumers are interested in whether the products they are buying are produced in a responsible and ethical manner.[8] In addition to food safety, which is the predominant concern of consumers in North America, sustainable production and good agricultural practices are integral to the retail industry in Europe and the U.K. In order to sell to these markets, producers must meet GLOBALG.A.P.[9] a voluntary set of standards for the certification of agricultural products globally.

The Norfolk Fruit Growers Association received GLOBALG.A.P. certification after a process of intensive review of all farm level operations.[10] As the NFGA adopts supplemental water use through irrigation, additional records will be required for GLOBALG.A.P., detailing the water source being drawn, the delivery method, process of decision-making and evaluation.[11] Measurement has not traditionally been a focus for the agricultural sector, and growers will require assistance in order to collect and analyze water-taking data and information.

DID YOU KNOW

For the 2009-2010 fiscal year, the Ontario Ministry of the Environment issued between 1300-1400 permits to take water for all sectors. Agricultural permits for irrigation account for approximately 40% of active permits.

Ontario Ministry of the Environment, 2011.

There are many members in GLOBALG.A.P. including McDonald's, McCain and Del Monte.

www.globalgap.org

7 The water found in groundwater bodies is replenished by drainage through the soil, which is often a slow process. This drainage is referred to as groundwater recharge. Rates of groundwater recharge are greatest when rainfall inputs to the soil exceed evapotranspiration losses. <http://www.britannica.com/EBchecked/topic/247043/groundwater-recharge>.

8 The rise in power of the European consumer is credited to European retailers being more liable for products sold to consumers, and their willingness to transfer liability back to the supplier base. Consumer choice is making a difference to production measures.

9 The Global Good Agricultural Practice (GLOBALG.A.P.) is a private sector body that sets voluntary standards, designed primarily to reassure consumers about how food is produced by minimizing detrimental environmental impacts of farming operations, reducing the use of chemical inputs and ensuring a responsible approach to worker health and safety as well as animal welfare. See <www.globalgap.org/cms/front_content.php?idcat=9>.

10 GLOBALG.A.P. equips members with a tool kit requiring monitoring and submission of product information: spray sheets, records, maps, signs, training, hygiene, policies and procedures, environmental management plans and verification. <www.globalgap.org/cms/front_content.php?idcat=9>.

11 The GLOBALG.A.P. standard does not prohibit any major water source from being used, but requires justification for water-taking.

Opportunity #4:

Standards make for better business: Producers who spend the time evaluating, conducting and reporting on business operations to the extent required to meet GLOBALG.A.P. standards cannot help but improve their entire operations. Securing access to the European and U.K. markets also helps build competitive advantage to being a more professional business receptive to consumer demands.

Challenge #5:

Market vulnerabilities: Canada has been involved in the export market for almost as long as we have grown apples. Export markets are highly reliant on currency and freight rates. We must keep current with export opportunities around the world, particularly in countries such as Brazil, Russia, India, and China (BRIC). At the same time, our own market has developed into one of the premier apple markets in the world, and we have to be prepared to compete with the best products that competitors have to offer.

RECOMMENDATIONS

- Develop flexible regulations to take advantage of the full range of opportunities, such as advancement in irrigation technologies and permits to take water to support crop production.
- Continue to investigate different irrigation strategies to develop best practices for supplemental water use in Ontario.

"While the standards are voluntary, GLOBALG.A.P. is a condition of sale for many customers today."

TOM O'NEILL, *Norfolk Fruit Growers Association*

"Firms that are innovative about one aspect of their business, tend to be innovative about all aspects; water use, energy, labour and capital. This will contribute to our competitiveness domestically and internationally."

STEVEN J. RENZETTI, *Brock University*

TOPIC #4

How are Canadian Industry Strategies Changing in Response to Water Policies and How Will They Change in the Future to New Water Demands?

Panelist **Helmi Ansari**
Director of Sustainability and Productivity,
PepsiCo Foods Canada

PRESENTATION OVERVIEW

PepsiCo is a large international company, with operations around the world. The Canadian business is a smaller but important part of PepsiCo and is innovating to create leading edge sustainability solutions and address issues common to many manufacturers. The sustainability vision PepsiCo Foods Canada is striving for is called "Leave No Trace," and they are re-engineering their business through a series of innovative solutions and technologies called "Net Zero," to advance their Resource Conservation program which began in 1999. PepsiCo Foods Canada and Frito Lay Canada, a division of PepsiCo Canada, have been widely recognized for their efforts in this area, and this presentation will outline a few of these efforts and successes.

Challenge #1:

The Sustainability Journey: Over the past 20 years, PepsiCo Foods Canada has undertaken a three phase strategy to reduce its energy and resource consumption and minimize its overall environmental and ecological footprint.[1] Phase 1 of the sustainability journey began in the early 1990s when Green Teams[2] were assembled to ensure a high level of environmental compliance and awareness in Frito Lay's operations and processing plants. Conservation measures were established in Phase 2 of the journey beginning in 1999, in order to achieve significant reductions in water and energy consumption. For each bag of snacks produced by Frito Lay Canada, water inputs were reduced by over 40%, gas consumption by 25%, and electricity consumption by 20%, over a span of nine years.

Phase 3, initiated in 2008, marked the beginning of a long-term commitment to operate within the broader context of sustainability and a "Net Zero" environment.[3] For example, over 1999 baselines, Frito Lay Canada established goals to improve water efficiency by 75%, increase manufacturing fuel efficiency per kilogram of snacks produced by 50% and reduce fleet fuel consumption by 50%. The division aimed additionally to achieve near zero landfill waste[4] at Canadian manufacturing plants and to lead industry in developing sustainable packaging innovations.[5] Measures on the fleet fuel usage reduction have been very successful with the re-engineering of delivery route systems to remove over 2 million kilometers from the Canadian delivery network while growing sales and maintaining service levels. Also Frito Lay Canada has begun the rollout of its high efficiency Mercedes Benz Sprinter vehicles that reduce fuel consumption by 50% as compared to their predecessor, with almost 200 vehicles projected to be on road by year end 2011. Frito Lay Canada was also the first Canadian Food Manufacturer to roll out all electric Zero Emissions delivery trucks, with six trucks located across Canada in a pilot launched in 2010.

1 "An ecological footprint is a tool that measures the area of land and water required to produce the natural resources consumed by the human population. It helps to measure sustainability at the global, national or individual level. Currently, the world is living in an ecological deficit, which simply means that our demand for natural resources exceeds the supply or regenerative capacity of the earth. To sustain our resource consumption rate at its present-day level we would need more than one planet!" <http://www.ec.gc.ca/education/default.asp?lang=en&n=27763D25-1>.

2 An interdisciplinary team comprised of representatives from various operating departments is committed to helping identify and implement specific improvements to help their business operate in a more environmentally sustainable fashion.

3 Traditionally, net-zero energy refers to a zero-energy building (ZEB) which creates as much energy as it consumes, and is considered energy self-sufficient or near self-sufficient through the use of on-site renewable energy, enhanced with energy efficient building technologies. A net zero-energy community (ZEC) is one that has greatly reduced energy needs through efficiency gains such that the balance of energy for vehicles, thermal, and electrical energy within the community is met by renewable energy. See <http://www.nrel.gov/docs/fy10osti/46065.pdf>.

4 Frito Lay Canada (FLC) has established a goal of reaching zero landfill (ZLF) status which they define as sending less than 1% of manufacturing waste to landfill, in all of its manufacturing facilities. See Frito Lay Canada 2009 <www.sunchips.ca>.

5 <For more information on innovative packaging, see http://pepsico.ca/en/PressRelease/SUNCHIPS-INTRODUCES-THE-WORLDS-FIRST-100-PERCENT-COMPOSTABLE-CHIP-BAG02032010.html>.

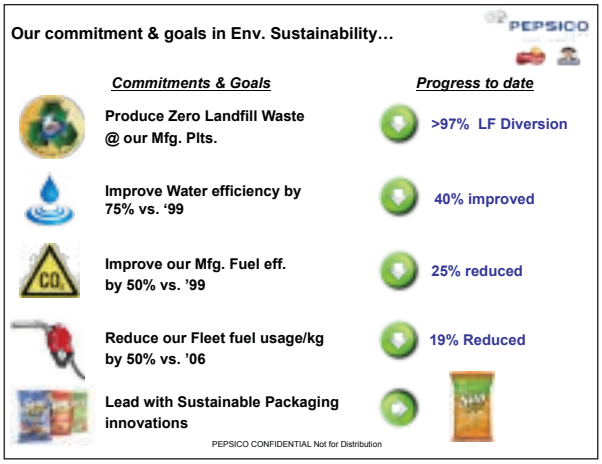
DID YOU KNOW

In Ontario, an estimated $15,000,000 is wasted every year in municipal electricity expenditures due to the energy associated with water loss.

"Ontario's Water-Energy Nexus: Will We Find Ourselves in Hot Water…or Tap into Opportunity?" *POLIS Project on Ecological Governance: Water Sustainability Project.*

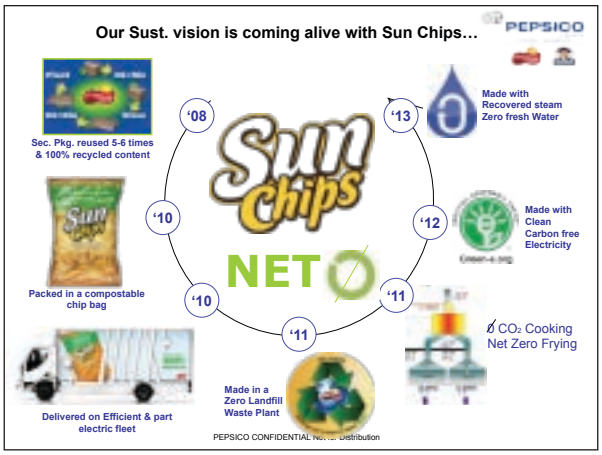
Nestlé has a program to reduce direct water use operations by 40% overall, with a 90% reduction in water use for irrigation and processing crops such as coffee. They have installed equipment with their contract producers, such as soil moisture monitors, so that producers can monitor more closely and decide when it is most efficient to irrigate.

www.nestle.com



Helmi Ansari, PepsiCo Foods Canada Figure 1

Over 97% of manufacturing waste from their Canadian manufacturing facilities is diverted from landfills into re-use streams. Secondary packaging or cartons are made of 70% to 100% recycled paper and are reused 5 to 6 times before being recycled.[6] Environmental measures are further reflected at PepsiCo Foods Canada's corporate headquarters, located in a new LEED Gold (certification in progress) facility and LEED Silver distribution centre in British Columbia.[7]



Helmi Ansari, PepsiCo Foods Canada Figure 2

"Academics, business and government must work together to publish full sustainability metrics because otherwise creative marketing and inconsistent standards risk confusing the consumer and endorsing ineffective policies."

LINDA GOWMAN, *Trojan Technologies*

"As part of the effort to advance adoption of sustainable water use practices by the agricultural industry, I think we need to frame and communicate the business value and benefit in a compelling manner to motivate action."

KEVIN JONES, *OCETA*

"Good companies are able to do a breadth of things really well. We find that when we excel at gross conservation, we also excel at quality, at safety, community engagement and relations and we excel at connecting consumers in different ways. It gives us the triple bottom line; environmental, social, economic and the whole combined benefit of it."

HELMI ANSARI, *PepsiCo Inc.*

Opportunity#1:

Recognition of leadership in innovation: The innovative energy saving and sustainability measures instituted by PepsiCo's Frito Lay divisions[8] have not only led to reductions in operating costs and increased competitiveness, but also to recognition at the highest levels, by the United Nations, the Dow Jones Industrial Index and the United States Environmental Protection Agency (USEPA). In Canada, Frito Lay Canada and PepsiCo Foods Canada have been recognized by Natural Resources Canada and the Canadian Council for Ministers of the Environment for their leadership in conservation. National and international awareness of their achievements raises the company's profile and serves to further their drive and commitment towards environmentally sustainable goals.

6 Secondary packaging for a bag of chips is greater than the primary packaging for the bag itself. Over 200 million shipping cartons have been reused, resulting in a reduction of 80% less corrugated packaging paper being used. This amounts to 30 million shipping cartons annually, the equivalent of more than 300,000 trees, and over 2 million trees since 1999 using this process. For more information see <http://pepsico.ca/en/PressRelease/SUNCHIPS-INTRODUCES-THE-WORLDS-FIRST-100-PERCENT-COMPOSTABLE-CHIP-BAG02032010.html>.

7 Leadership in Energy and Environmental Design (LEED) is a third-party certification program and the nationally accepted benchmark for the design, construction and operation of high-performance green buildings. LEED gives building owners tools to have an immediate and measurable impact on their buildings' performance. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. See <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=222>.

8 Frito Lay Canada initiated the first, compostable snack chip bag, the first net zero water potato chip processing technology, and the first net zero footprint fryer in Canada. PepsiCo is the only food processing company that reuses cartons prior to recycling and will be the first Canadian manufacturer to bring all electric, zero emissions delivery vehicles to their fleet, replacing gasoline and diesel engines.

Challenge #2:

Incentives for industry in water strategies: Economic incentives must be included in government water strategies if business is to remain competitive. Pricing is a tool often used to provide incentives or disincentives to industry and can be a determining factor in an industry's decision to locate or move operations. For example, Frito Lay Canada's manufacturing plant in Cambridge, Ontario has one of the highest combined water and wastewater costs of any Frito Lay manufacturing plant in North America. A conservation campaign was launched a few years ago to reduce water consumption by 40%. The goal was achieved but within 18 months municipal water-taking surcharges, which are based on concentration, increased by almost the same amount. Economic levers influencing water costs will be one of the determining factors in how the Cambridge plant can compete with other North American facilities, especially for U.S. export business. At present, the high water costs are a hindrance to this site competing for U.S. export volume and business.

Opportunity #2:

Developing a Centre of Excellence: Ontario has the unique opportunity to develop Centres of Excellence, to promote teaching and assist in implementing new and innovative ideas. A centre could work with large producers to enable pioneering work and build showcase facilities to promote Ontario and Canada for water technology. This amounts to good business and will save manufacturers money. It could also put Ontario and Canada on the global map of water technology development and implementation.

Challenge #3:

Infrastructure costs: Over $30 billion dollars is targeted over the next 15 years for maintenance and repair of Ontario's water supply and wastewater infrastructure.[9]

Opportunity #3:

Develop alternatives to consumptive[10] water use: The ability of industry to avoid upfront water use could help reduce the need for costly water infrastructure. For example, Frito Lay Canada hopes to pioneer an approach to partly, and perhaps someday completely, produce its Potato Chips products by capturing the water from within the potato in order to make the potato chip, rather than drawing water from municipal sources. As the potato is 80% water, when sliced and fried, the embedded water turns to steam, that if utilized, could lead to zero water input potato chip processing. Additionally, PepsiCo's European sister organization is developing the technology to use the starch from the potato to create the packaging for the potato chips.

RECOMMENDATIONS

- Include incentives for industry to invest in water reduction strategies to remain competitive.
- Ongoing cooperation, dialogue and discussion must continue between government and business.
- Consider how the infrastructure maintenance cost challenges facing municipal treatment facilities and regional water infrastructure could partly be eased by supporting significant conservation measures to reduce usage of water, especially in the food and beverage sector.

DID YOU KNOW

Biochemical oxygen demand (BOD) is a way to assess the amount of oxygen required for aerobic micro-organisms to decompose the organic material in a sample of water discharged from a factory or plant. The purpose of this test is to determine the potential of wastewater and other water to deplete the oxygen levels of receiving water. This test is used by government regulatory agencies to determine how the effluent will affect receiving waters. If BOD levels are too high, a surcharge is triggered. When factories reduce water use without reducing effluent the municipality that supplies water and sewer services will employ sewer surcharges to deal with the added cost of managing high BOD levels.

Ontario Water Resources Act, 1990

9 For more information see <http://www.mei.gov.on.ca/en/infrastructure/sectors/?page=water> and <http://www.airdberlis.com/templates/Articles/articleFiles/312/A&B_Water_and_Wastewater_Financing_Cdn_Institute_Paper.pdf>.

10 The use of a resource that reduces the supply (removing water from a source like a river, lake or aquifer without returning an equal amount).

SESSION TWO MODERATED DISCUSSION

Q: What kind of policy can make a difference to water use along the supply chain? What initiatives would help move the water agenda forward at the policy level? **David Sparling**, Richard Ivey School of Business

In general, business responds to economic levers. PepsiCo plants located in drought stricken areas such as Australia, India and Pakistan, with limited access to water, are the most efficient of all PepsiCo plants worldwide. The least efficient plants are those located in the developed world where water is plentiful because the economics have been made favourable from the supply-side with respect to water. Efficient and proven water technologies are available, but appropriate incentives have not been provided to make implementing the technology economically feasible. When that water reality comes to the Canadian or U.S. facilities, or when the financial means are created where the technology is sensible to install or can deliver a return on investment, of course the company will move in this direction. **Helmi Ansari,** PepsiCo Foods Canada

"If you put a price on water, what would the sectors do? Would they be able to react? Would they be in a position to react?"

JILL BAKER, *NRTEE*

Of greater concern is that new policy is favourable for small businesses working within the agricultural sector and implementation is easily adapted. The apple industry requires assistance in shifting production methods to respond to consumer demand, particularly in supporting the effective use of supplemental water to grow new tree varieties. **Tom O'Neill,** Norfolk Fruit Growers' Association

"Although we are talking about the energy/water nexus, the water/dollar nexus is another area we need to be thinking about."

DEB STARK, *OMAFRA*

It is important to understand the value of water and its various applications before determining how best to signal water use. The mechanism does not have to be solely price based, as pricing is connected with costs, but can be based on markets and other instruments that direct people to understand value, including the ecological value of water. **Steven Renzetti,** Brock University

Putting an economic value on water is fundamental to the way forward. The concept of creating enabling policy that encourages innovation and allows systems to be formed and tested in order to learn and evolve is not something government has historically done. Government needs to be engaged and needs to ensure all players are represented. **Deb Stark,** Ontario Ministry of Agriculture, Food and Rural Affairs

Q: Are there any market instruments that over the next 5 to 10 years would be effective in changing the way the provinces address water? **David Sparling,** Richard Ivey School of Business.

Two instruments can be considered for adoption. The first would be to address water and sewage pricing at the municipal level. Windsor is one of the few Canadian cities that charges more for water use in summer than in winter. A summer surcharge would cut water usage peaks and reduce infrastructure needs. It is stunning that this type of policy has not been instituted across the country. The second instrument would involve pricing carbon in order to address the crucial energy-water nexus.[1] Measures taken to save on energy will lead to savings on water. **Steven Renzetti,** Brock University.

In the fruit growing business, demands are made more by the marketplace than by regulations. Retailers push suppliers to respond to customer preferences. **Tom O'Neill,** Norfolk Fruit Growers' Association

1 This term refers to the linkage of issues related to water and energy. Water and energy policy are interrelated, often requiring integrated policy development. See NRTEE "Chapter 5: National Water Issues." Changing Currents. <http://www.nrtee-trnee.com/eng/publications/changingcurrents/changing-currents-eng.php>.

Consumer drivers are in some instances, developing more quickly than can be responded to by government regulation. Consumer preferences are therefore driving market signals. Certain community members are willing to pay more, but in most cases, are simply asking for environmental measures as a condition of sale. This is one of the biggest changes taking place. Private sector standards as opposed to government standards will be a large player in driving the future market. **Deb Stark,** Ontario Ministry of Agriculture, Food and Rural Affairs

In the short-term, pricing is a lever that can be widely employed to encourage small improvements in conservation such as 2% to 5% reductions. Measures to build a system that encourages larger reductions and behavioural shifts towards more costly net zero style initiatives are undetermined in Canada, as water pricing is inexpensive when compared to other countries. Leading edge water technologies have not been applied in the ways that PepsiCo is attempting in other parts of the world. Trying to apply these technologies does not make economic sense today in Canada. PepsiCo is trying to find the mechanisms to create the right environment to put Canada on the map in terms of water technology, develop showcase facilities to demonstrate what can be done on the water forefront and make this a centre for water technology experts. **Helmi Ansari,** PepsiCo Foods Canada

Q: OMAFRA supports the food industry in order to support and grow the agricultural value chain. As the largest processor of contracted potatoes in Ontario, what are the implications of FritoLay's 'Net Zero' style operations at the grower level? **Phil Dick,** Ontario Ministry of Agriculture, Food and Rural Affairs

FritoLay Canada is the largest food processor in Canada with almost 70% of market share. The Cambridge, Ontario plant produces 45% to 50% of FritoLay Canada's product. Nearly 100% of the agricultural potato supply for the company is Canadian based. The only time Canadian potatoes are not used in processing is when the storage crop condition of the potatoes requires a fresh crop. If FritoLay Canada cannot compete economically with sister plants in the U.S., on a lowest managed cost basis in terms of energy, processing and freight costs, it will buy, produce and export fewer Canadian agricultural products. It is as simple as that. **Helmi Ansari,** PepsiCo Foods Canada

Q: In considering the purchase of apples at the grocery store, McIntosh are beneficial from a water footprint perspective, but Pink Lady are less so, as producers need to irrigate in order to grow this variety. Is there a value to the market not yet reflected in quantifying the water footprint of products and is this something that can command preferential treatment? Environmentally responsible production signals a new message, both on the agricultural and processing side. Is this an opportunity that could result in a market advantage if consumers are more informed about the process and does it represent a marketing opportunity for producers? **Linda Gowman,** Trojan Technologies Inc.

A marketing opportunity has not yet availed itself. Perhaps it is a matter of communicating the message better. Most of the production response in terms of adopting environmentally sound agricultural practices, through certification processes, has been driven by the retailers in response to customer preferences. The impetus in Europe was largely as a result of legislation passed in the early 1990s that made the retailer responsible and therefore liable for products it stocked and sold to the consumer. The retailer is interested in sharing that liability with the producer. Certain programmes transfer some liability down to the supplier base. The process of achieving certification causes some measure of anxiety and aggravation for producers. On the positive side, any business that spends this much time examining their business operations to meet requirements cannot help but make their business better. Market advantage is achieved through securing access to market. The retailer does not want to create a competitive advantage for one supplier over another, but prefers a wide supply base in order to pick and choose and achieve the lowest cost. It is uncertain that the method used to grow the commodity, in this case the water footprint of apples, can be used to sell them at a premium. **Tom O'Neill,** Norfolk Fruit Growers' Association

DID YOU KNOW

Over the past decade Labatt Breweries in London, ON has cut the amount of water it uses to make beer by 50%. In 2003, for every bottle of beer produced, the brewery used the equivalent of more than seven bottles of water. Labatt cut that ratio dramatically, saving enough water to fill nearly 400 Olympic-sized swimming pools every year, just at the brewery in London alone.

Craig Saunders, "Beer makers brew a smarter water policy." *The Globe and Mail.* April 26, 2011.

In 2009 Molson Coors established a global water strategy for their breweries around the world. Their global target is to improve water efficiency by 15% by the end of 2012.

"Environmental Stewardship: Water." Molson Coors, 2011.

In looking down the road, the carbon footprint, water footprint, environmental loading or other information is going to be available, absolutely. **David Sparling,** Richard Ivey School of Business

FritoLay partnered with a carbon press to become one of the first companies in the U.K. to print the number of grams it takes to process a bag of chips on the chip bag. The U.K. consumer is in a different place than the Canadian or the U.S. consumer in terms of understanding footprints. FritoLay considered whether they should replicate this type of messaging in other countries and decided it would confuse most North American consumers. They would be unable to determine whether a product is good or bad as they have, as yet, no point of comparison.

In terms of being able to market carbon footprinting, reports from consulting companies outline the green consumers at 10%, the non-green consumer at 10% and a moderate group in between. The marketing of FritoLay as a green product has not delivered the kind of 'bang for the buck' that was anticipated. People do not buy a bag of chips because it is a better bag of chips. It is primarily an impulse product. Fritolay determined that Sun Chips, a more healthy brand containing natural grain and oats and associated with the socially conscious consumer, would be the right brand to introduce as the world's first compostable snack chip bag. One group of people claim they now only buy Sun Chips. However, after investing millions of dollars to invent this technology, the Sun Chips brand has not grown as anticipated. The company has saved 70 million dollars by reducing energy inputs for water and gas and increasing plant efficiency, which has made for good business, but the jury is out as to whether money can be made from investing in green technologies primarily to market. **Helmi Ansari,** PepsiCo Foods Canada

"Producers expressed that the use of fiscal instruments such as water pricing would hinder agricultural operations."

NRTEE *and* **Canadian Federation of Agriculture**. *"Agriculture Meeting Summary." 2009.*

Q: One of the things occurring is the rise of a number of standards such as GLOBALG.A.P. Certain retail chains are putting various standards in place. Some have questioned whether this is from an altruistic impetus or an effort to gain market share. How critical is it that policy instruments or standards in Ontario and across Canada are linked to international standards? Are there any recommendations as to how to ensure that commodities or products developed in Canada are linked to the global situation? **Ron Bonnett,** Canadian Federation of Agriculture

From a producer's perspective, the addition of government legislated standards is not recommended. The GLOBALG.A.P. standard is recognized throughout most of Europe. Producers that sell to importers, who sell to Testco in the U.K. for example, have to meet a different set of standards, akin to GLOBALG.A.P. on steroids. Marks & Spencer U.K. ascribe to another standard. The producer could spend 365 days a year with an auditor in the plant, auditing standards. There is a movement in North America to refuse additional standards because they already meet and trade through global standards, food quality and safety standards in the U.S. There is a body emerging to state that producers cannot afford the auditors associated with meeting all of the various standards. The auditing business is large. Instead of an additional government standard, the primary producers require support to understand existing standards and meet whichever one they choose. Ideally producers could benchmark against a single standard, so if GLOBALG.A.P is chosen, if the customer needs Safe Quality Food certification (SQF), GLOBALG.A.P. will be accepted because it is benchmarked. **Tom O'Neill,** Norfolk Fruit Growers' Association

There is an interesting move away from government standards towards market standard. There is no question it is important for Canada to abide by international standards, especially when considering that the majority of products from Ontario are exports. Government has a role in setting minimum standards to ensure the health and safety of its people. The question of having one standard that can be broadly applied is a dream that the agricultural community on the receiving end of so much of this would like to see. The reason companies institute standards is as a means to differentiate themselves as businesses, and gain market share. The trend towards more standards by companies is not going to go away any time soon. **Deb Stark,** Ontario Ministry of Agriculture, Food and Rural Affairs

Q: There is a key need to understand the economic value of water. Users perceive the value of water differently depending on its use. The answers require research and innovation to properly value water. How is this going to be achieved? **Oswald Zachariah,** Ontario Ministry of Agriculture, Food and Rural Affairs

Much of the data on water taking is partial, and documents record what may be taken rather than what is taken. Models that estimate water use exist but a better measurement of water use in different scenarios is required. Even the most difficult business applications for water use are fairly straightforward. When trickle irrigation is applied to trees previously grown without supplemental water, the water differential can be measured, and the cost delivered. The more complex scenarios involve asking households what their value is for clean and safe drinking water. The problem is partially a lack of capacity in this area to conduct the necessary work. While there are roughly 1 600 ground water scientists in Canada, there are fewer than 10 ground water economists and accountants. **Steven Renzetti,** Brock University

Q: What is the role of the economist in valuing water? **Oswald Zachariah,** Ontario Ministry of Agriculture, Food and Rural Affairs

Consumers making the decisions about what apples they want to purchase, firms deciding whether it is valuable for them to install water efficient technology to save money, people canoeing along the Grand River; those are the folks that decide the value of water. Economists simply distill that information as best they can. **Steven Renzetti,** Brock University

Q: We talk about water as though it is one thing, a static map, but water levels vary from spring to summer. Water use should be priced differently if a farmer puts in a holding reservoir to allow one to draw water out of the river in the spring and not in the middle of the summer when it is critical. When the equation is not just about determining the amount of one's water footprint, but about the land and the time of year water is withdrawn, suddenly the complexity grows exponentially. **Gord Surgeoner,** Ontario Agri-Food Technologies

Everyone knows something about cell phone pricing, and it is amazingly complicated. If anybody has experience with electricity pricing, it is especially complicated. When attention turns to water pricing, everything else seems much simpler. Canada may have the world's best engineers and water scientists and may have built the best water supply system in the world, but as far as anyone can tell it is falling to pieces because it is not priced properly. Talk of the economic value of water is reminiscent of Benjamin Franklin's remark that "we will know the value of water when it's gone." **Steven Renzetti,** Brock University

On a recent trip to Pakistan and witnessing the country's water starved population, it was evident how efficient people in that country are in terms of how they manage water. All kinds of water efficiency ideas are being generated within Pakistan. Why can Canadians not be as innovative? The reality is that need has driven innovation. If people do not seize the opportunity to become innovative, a higher value and cost for water will be seen, as supply and demand situations change over the next several years. **Helmi Ansari,** PepsiCo Foods Canada

DID YOU KNOW

Between 2005 and 2010 Kraft Foods voluntarily reduced their water consumption by 30%. Their goal is to reduce water use an additional 15 percent by 2015.

Creating a more delicious world. **Kraft Sustainability Report 2010.**

"When it comes to big issues such as safeguarding our global water supply, no individual sector – government, NGO or business – can make as big a difference alone as we can make by working together. WWF and The Coca-Cola Company have partnered and worked since 2007 to conserve priority river basins around the world and integrate sustainability into the company's operations worldwide."

World Wildlife Fund. http://www.worldwildlife.org/what/partners/corporate/Coke/

Q: Is the government's role to set minimum standards because in trying to address innovation, a large amount of legislation and regulation has been developed over the past 5 years that sets out prescriptions for water? Is government in fact choking out innovation by setting rules too tightly or can regulation and legislation be used to further innovation? **John Fitzgibbon,** University of Guelph

Government has a role in encouraging innovation. In reflecting on the Water Opportunities Act, government aims to create a framework that will enable actors to build a system in which innovation can happen. Among its many messages, the Ontario government has developed an Open for Business Initiative.[2] Certainly there is a significant amount of regulation that pertains to the agricultural sector and water use. It is important to find ways to assess which legislation is important and required, which regulations will assist people to achieve outcomes in certain areas, and which legislation needs to be put aside and out of the way. There is room for both innovation and regulation. **Deb Stark,** Ontario Ministry of Agriculture, Food and Rural Affairs

If everyone is told that they need to meet a certain standard, then the only incentive is to meet the standard and not go beyond it. Where a market is introduced and innovators are continually rewarded for their efforts in not just meeting a standard but exceeding it, incentives are created. Regulatory environments can be created that promote and reward innovation or environments can be created that promote meeting standards. The latter has unfortunately been emphasized. What is needed is a transition to the former. Climate change policy is an example of regulation being applied incorrectly, with insufficient emphasis on innovation. People are not being rewarded for being non-polluters and they should be. The same goals can be reached through rewarding people, making them more competitive, globally strong and helping our industries succeed, or people can be penalized. **Steven Renzetti,** Brock University

"Many of the problems in water would start to attenuate, if not disappear, if we priced water properly around the world. For instance, if you actually charged people the real cost of the capital works, operations, maintenance, and energy costs of running water infrastructure, you would have better infrastructure and it would not be as crumbling. The bill for replacing water infrastructure in Canada is in the trillions of dollars."

MARGARET CATLEY-CARLSON,
member UN Secretary General Advisory Board on Water

2 Ontario Open for Business is an initiative of the Ontario Ministry of Economic Development and Trade (MEDT), "…to create faster, smarter and more streamlined government-to-business services and to establish a modern system of government." For more information see <http://www.ontariocanada.com/ontcan/1medt/en/ofb_main_en.jsp>.

Sustainable Water Infrastructure and Technological Solutions

Session Three

Chair **Maxine Kingston**
Technical Director,
Agri-Environment Services Branch,
Agriculture and Agri-Food Canada

TOPIC #1

What are the New and Emerging Technologies to Improve Water Efficiency?
Case Study: Crop irrigation

Panelist **Wayne Palichuk**
Chairman,
Leamington Area Drip Irrigation Inc. (LADII)

PRESENTATION OVERVIEW

It took the initiative of 13 growers to build an innovative infrastructure for water management to irrigate crops from one of the world's largest supplies of fresh water.[1] Leamington Drip Irrigation Inc. constructed a 36 kilometer pipeline and irrigation system with the capacity to pump more than 7 000 gallons of water per minute. The system monitors the amount of water delivered to 63 locations and increases the reliability of supply and quality of water to local producers. An eco-friendly approach was taken to protect local watersheds, and the National Water Supply Expansion Program (NWSEP)[2] was also used to help protect the water supply.

The focus was on utilizing water efficiently in producing consistent quality and yield for profitability in a high value crop under strict guidelines under the Permit to Take Water (PTTW).[3] One of the main objectives is to sustain the processing industry in Southern Ontario to meet growing global demands in a shrinking world market that not only supports the growers but also thousands of employees in the growing area. Working together with the support of municipalities and government was necessary, and their continued involvement is a key component to make this venture a successful reality.

DID YOU KNOW

In 2010 the LADII pipeline provided more than 225 million gallons of water to local producers.

Drip irrigation in combination with wastewater reclamation, has brought Israel the highest ratio of crop yield per water unit in the world.

Kerry Freek, "The Networked Field," *Water Canada*. November/December, 2010.

1 The Great Lakes- Superior, Michigan, Huron, Erie and Ontario, account for 20% of the world's freshwater supply. Together, with their connecting channels they form the largest fresh surface water supply. *Great Lakes Information Network*. "Overview." <http://www.great-lakes.net/lakes>.

2 The NWSEP was a federal initiative under the Agriculture Policy Framework (APF). The program focused on development, enhancement and protection of vital water resources to help address water constraints in agricultural areas of Canada. The NWSEP ended on March 31, 2009. See www4.agr.gc.ca for more information.

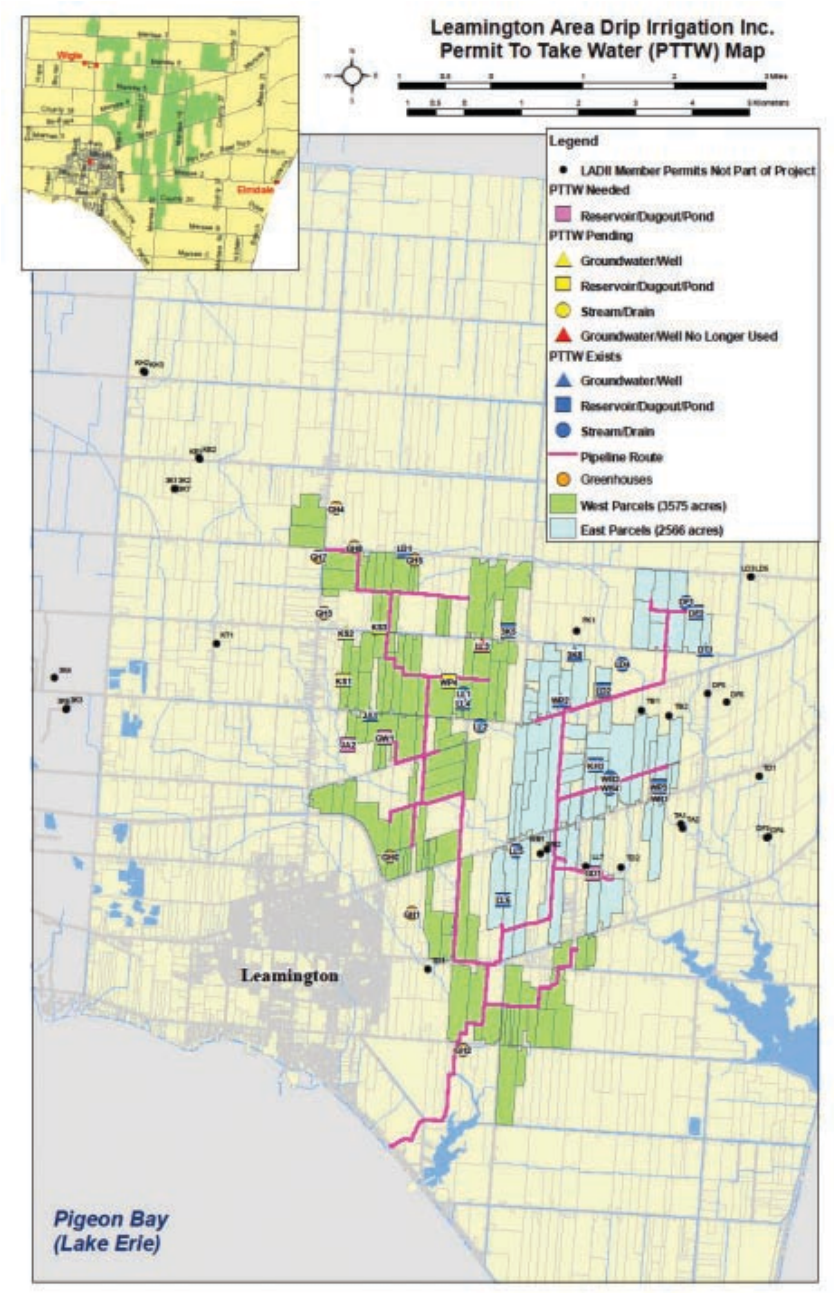
3 A Permit to Take Water (PTTW) must be obtained from the Ministry of the Environment by anyone who takes more than 50 000 litres of water per day from a lake, river, stream or groundwater. MOE. "Permits to Take Water." <www.ene.gov.on.ca/environment/en/industry/assessment_and_approvals/water_taking/STDPROD_075554.html>.

"Six years ago, we sat around in a coffee shop and took ideas from older farmers in the area. We're miles away from the biggest source of freshwater in the world, and here we have crops in the summertime that die. When they first got the idea (for the pipeline) we thought, let's go for it - let's try and see if we can implement it into a reality. The result has far exceeded our initial vision."

WAYNE PALICHUK,
Leamington Area Drip Irrigation Inc. "Pipedream Comes True for Growers." http://www.omafra.gov.on.ca/english/infores/releases/storyideas/2010/apr/innovation.html

"The market that we are trying to sustain is a global one. That market is not only in the U.S., but it is also overseas."

WAYNE PALICHUK,
Leamington Area Drip Irrigation Inc.



Wayne Palichuk, LADII Figure 1

Challenge #1:

Water for irrigation is often drawn from municipalities, many of which are suffering from water shortages and inadequate infrastructure.

Opportunity #1:

Greenhouses do not require potable water and the LADII pipeline offers them an alternate irrigation source. Not only does the pipeline relieve pressure on the local water system but participating growers have seen a reduction in energy costs and an increase in the quality and yield of their crops due to precise water monitoring. The pipeline eliminates the need for much of the annual set-up associated with traditional drip irrigation and has reduced water costs in the growing season by 66%.[4]

4 For more information see <http://www.omafra.gov.on.ca/english/premier_award/2009/events/harrow/ladii.htm>.

Challenge #2.1:

The design and approval process for a project of this size was a lengthy process with many hurdles. In the case of LADII, it took approximately 9 years and is ongoing:

- **February 2003** 30 growers initiated a visibility study for a $20 million project, initially with potable water, but concluded it was too expensive.
- **2004** The Canada-Ontario Water Supply Expansion Program (COWSEP)[5] was undertaken for funding, the Prairie Farm Rehabilitation Administration (PFRA),[6] and OMAFRA supported the initiative. The Technical Advisory Committee (TAC) was formed.
- **2005** The project was redesigned, but issues developed with permits, intake issues such as access to the lake, and other regulatory challenges. Expertise was required so the TAC designed the intake, filters, pumps, based on climatic risks, and a geotechnical study of the area.
- **January 2007** Land acquisition for easement control was acquired. MOE, the Essex Region Conservation Authority (ERCA),[7] Fisheries and Oceans Canada (DFO) and AAFC were positive, so LADII applied for a PTTW. The cost exceeded $12 million.
- **April 2007** A re-design was initiated, and the PTTW was granted.
- **2008** The program was scheduled to end but funding was extended to March 2009, and an opportunity arose for a $2 million COWSEP grant.
- **Fall 2009** The final layout was complete; shareholders approved final tenders; COWSEP funding, ERCA, MOE, DFO, Navigable Waters,[8] and PFRA supported the initiative.

Wayne Palickuk, LADII Figure 2.1

Figure 2.2

Challenge #2.2:

There is no template for this complicated process and no single point of contact to deal with government regulation. LADII established a committee to help navigate through the many policies, bylaws and procedures. They also established their own format for a shareholder's agreement. However, it was difficult to focus on both the actual infrastructure and the regulatory and legal hurdles.

DID YOU KNOW

Collaboration is key. Community partnerships are an integral part of the LADII project and included the following groups:

- Municipality of Leamington
- Erie Shores Golf Course
- Leamington Soccer Fields
- Heinz, Primo (Sunbrite) Jema
- Wiel's Processing Plants
- Leamington Greenhouse Industry

5 COWSEP was jointly funded through OMAFRA and APF (AAFC). The Agriculture Adaptation Council administered part of the COWSEP program, which ended on March 31, 2009. See <http://www.adaptcouncil.org/e/past-programs/cowsep.php>. In 2009 the Innovation Demonstration Fund was announced under the Ministry of Research and Innovation to support partnerships in innovation. For more information see <http://www.mri.gov.on.ca/english/programs/idf/guidelines.asp>.

6 The Prairie Farm Rehabilitation Administration (PFRA), is now called the Agri-Environment Services Branch (AESB) of AAFC. See <http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1186517615847&lang=eng>.

7 ERCA manages the natural resources of the Essex Region in partnership with local municipalities and the Province of Ontario. <http://www.erca.org/>.

8 The Navigable Waters Protection Program ensures the public's right to navigate Canada's waters without obstruction. See <http://www.tc.gc.ca/eng/marinesafety/oep-nwpp-menu-1978.htm>.

Challenge #2.3:

The Permit to Take Water remains the largest obstacle to success. Water demands are not the same throughout the year. Much more water is required during peak growing season, especially in dry weather patterns. LADII delivers water extensively for 50 to 60 days during peak season but minimally throughout the rest of the year. Consequently, they risk default on their water permit allotment during growing season but do not draw water for the remainder of the year. They are significantly limited by the 30-day average usage restriction during peak time. A 90-day average cycle would be much more beneficial to all stakeholders involved. There are many growers interested in receiving water from the pipeline, but there is no opportunity for expansion with a restriction to the 30-day average.

Challenge #2.4:

Unanticipated issues arose involving algae blooms[9] and invasive species such as zebra mussels. Throughout the development process, it was necessary to ensure that ecosystems were not disturbed.

Opportunity 2:

Updates to technology and infrastructure provided numerous benefits and increased the capacity to address ecological issues. Furthermore, LADII introduced a monitoring system with real time data. Each pump station requires flows, pressures, temperatures, faults, and any material malfunctions to be monitored. Other technological improvements included 7 weather stations located along the lake measuring rainfall, wind, and evapo-transpiration, at every location in the grid of more than 8 000 acres. Every farmer has access to the weather stations, which can be accessed online and even through their phones.

"The ability of industry to avoid or significantly reduce up-front water needs could help alleviate the need for costly regional water infrastructure that would be needed for capacity and future growth."

HELMI ANSARI, *PepsiCo Inc.*

"We have restrictions that we have to work with and time frames to keep in mind. We faced every hurdle that we came across, responded and moved on, but there were always other hurdles."

WAYNE PALICHUK,
Leamington Area Drip Irrigation Inc.

RECOMMENDATIONS

- Flexibility is required in the application of regulations.
- Encourage all government agencies to work together.
- Continue to support timely and relevant research with universities.
- Invest in infrastructure. There is a significant infrastructure deficit that only deteriorates as action is delayed and affects Canada's competitiveness agenda.

9 An algae bloom occurs when there is a rapid increase in the population of algae in an aquatic system. As more algae grow, other plants die. The dead organic matter becomes food for bacteria. With more food available, the bacteria increase in number and use up the dissolved oxygen in the water, posing a threat to aquatic life that require oxygen to survive. *Science Daily*. "Algal Bloom." http://www.sciencedaily.com/articles/a/algal_bloom.htm. Phosphorous levels have been increasing in Lake Erie causing blue-green algae blooms. Sharon Hill. "Windsor-Essex Region Urged to Fight Great Lakes Phosphorous Pollution." *The Windsor Star*. Feb. 11, 2011. <http://www.windsorstar.com/health/Region+urged+fight+Great+Lakes+phosphorus+pollution/4299746/story.html>.

TOPIC #2

Case Study- Livestock

Panelist **Garry Fortune**
Energy Consultant
Stanton Farms, Stanton Bros. Ltd.

PRESENTATION OVERVIEW

Stanton Farms is a 2 000 dairy-cow farm, incorporating state-of-the-art farming practices and sustainable family farming through innovation. The four-generation family farm was relocated in 2006 from Hyde Park (now London) to Ilderton, Ontario because of urban sprawl.

While the task of relocating the farm created significant challenges, it also provided a huge opportunity to re-examine the entire farming operation, look at a wide-range of existing technologies, develop new technologies where necessary and combine them all to build a state-of-the-art, environmentally sustainable, closed-loop farm operation.

From the way milk is cooled using a combination of earth-energy from its well-water system and unique heat-exchange technology, to converting on-farm organic waste to renewable energy to power-up the neighbouring community, Stanton Farms is always looking to close-the-loop in every aspect of its operation. Stanton Farms believes that driving clean-water innovation on-farm will also increase sustainable farming practices and lead to new farming opportunities.

Challenge #1:

Stanton Farms believes the need to reduce our clean water footprint is equally as important as the need to reduce our carbon footprint.

Garry Fortune, Stanton Farms Figure 1

DID YOU KNOW

"There are important differences between a carbon footprint and water footprint. When an individual or organization emits greenhouse gases, it adds to the growing global pool accumulating in the planet's atmosphere – the impact of which, while may be different in nature and severity depending on location, are shared around the world. Not so for the impact of water footprints. The availability of freshwater resources and impact on freshwater ecosystems are much more localized."

Tony Maas. "Water Footprints: Exposing Invisible Water Business Risk." *Water Canada.* January, 2010.

Opportunity #1:

A key operational principle of Stanton Farms is the ability to incorporate sustainable, closed-loop systems. The vast majority of water used on the farm goes to feed the cows and the majority of that water ultimately passes through the cows.

The farm recycles water numerous times and in various ways.

For instance, the initial draw of fresh well-water is used to cool the milk through a unique heat-exchange system. The clean water is then stored and portions are used to clean the milk lines, feed the cows and for the flushing system that collects the organic matter (manure) generated by the cows. The manure and waste-water is then processed through the biogas facility to generate renewable energy for the farm and neighbouring community. Manure is a valuable nutrient source for crop growing but as organic matter it releases methane and odours when directly land-applied and contains pathogens. Methane is 21 times more potent as a greenhouse gas than CO2. By treating the manure through the biogas facility, the methane is contained and utilized as a fuel source for renewable energy and the pathogens are killed and odour virtually eliminated from the remaining fibre and nutrient-liquid byproducts. The fibre is utilized as animal bedding, a peatmoss replacement product for the landscape industry, a soil replacement product for the greenhouse industry and a fibre-additive in bio-material manufacturing. The nutrient liquid is land-applied as an organic fertilizer for crop-growing.

By also adding off-farm organic food-waste to its biogas operation and increasing its renewable energy generation, the farm is helping to divert organic waste from landfills and municipal waste-water treatment systems.

In addition to the ability to generate renewable energy virtually 24/7/365, agri-biogas has numerous value-added benefits including: reducing methane emissions; killing pathogens and reducing on-farm odours from manure; reducing disease-causing pests and on-farm herbicide use; greater ground-water protection; diverting organic waste from landfills and waste-water treatment facilities; by-product development (organic fertilizer/bio-fibre); and the ability to provide additional sources of income for farmers, creating a rural green economy and jobs.

"Since almost all of Ontario's pasture, forage, and livestock fed grain are produced through natural rainfall, the livestock water quantity impact is limited to water taken from surface or groundwater for direct animal use. In the context of other water uses, the amount of water utilized for livestock consumption is almost insignificant."

CHRIS ATTEMA, *Ontario Cattlemen's Association*

"Agricultural biogas is the orphan of green energy. This reliable, renewable energy source has the potential to generate power 24-7-365, not just when the wind blows or the sun shines."

GARRY FORTUNE,
Stanton Farms

"Every calorie of food that we eat takes 1 litre of water to produce. Some foods require more. For example, 1 metric tonne of water is required to make 1 kilo of rice, but 8-10 metric tonnes of water are needed to produce 1 kilo of beef. The equation holds for bio-fuels."

MARGARET CATLEY-CARLSON,
member UN Secretary General Advisory Board on Water

Garry Fortune, Stanton Farms Figure 2

1 A closed-loop system is one in which some or all of the system's outputs are also used as inputs.
2 "Through the generation of biogas, a process where organic materials break down in an oxygen-free environment, Ontario's agricultural sector produces clean, renewable energy, reducing greenhouse gas emissions." For more information see <http://www.omafra.gov.on.ca/english/engineer/biogas/>.
3 Methane is 21 times more potent than carbon dioxide in trapping heat in the atmosphere. Thus reducing methane emissions is an important part of addressing climate change. For more information see <http://www.ec.gc.ca/>.

Garry Fortune, Stanton Farms Figure 3

Challenge #2:

Government regulation needs to keep up with new technology, otherwise innovation is stifled.

Opportunity #2:

In its drive to increase efficiency, Stanton Farms incorporated a state-of-the-art instant, milk cooling system utilizing a combination of earth-energy from the well-water system and unique heat-exchange technology. This process reduces energy consumption and eliminates temperature fluctuations during milking sessions. Heat generated from the equipment in this process is recouped for an innovative heat-exchange process used for the farms hot-water needs, further reducing energy consumption.

This new technology also could have eliminated the need to transfer milk from traditional storage tanks to the highway tanker by having an empty highway tanker available to directly deposit the milk in. Although it was recognized as a good idea, regulations at the time prohibited this process so the traditional tank system was installed and today the driver of the tanker truck waits while the milk is transferred from the farm tank to the tanker truck.

In addition, the Ontario Power Authority has ignored the true potential of agri-biogas in their new Feed-in Tariff (FIT) program and actually includes a clause in their contract for biogas that claws-back 80% of any revenue generated from developing any other by-products. This action flies in the face of the very intent of the "green economy" part of Ontario's new Green Energy and Green Economy Act.

Government can encourage innovation by ensuring regulation supports new technology and speed-to-market.

RECOMMENDATIONS

- Focus on reducing both our water footprint and our carbon footprint.
- Create incentives for early innovators and adaptors. Reduce the risks associated with investing in new technology.
- Support research and development, pilot projects, and demonstration plants, but also recognize that there is a need to do research in a full-scale environment.
- Government regulation needs to keep up with new technology. For example, with our new milk cooling system, current regulations did not allow us to transfer milk directly to a highway tanker by having an empty tanker available. Although it was recognized as a good idea, it would have taken more than 2 years to change this regulation.

DID YOU KNOW

Stanton Farms has developed a unique collaborative relationship with 5 universities including The University of Guelph, Toronto, Waterloo, Western and Windsor, to provide a mutually beneficial, practical application site for science and leading-edge research. In a microalgae research project with Dr. Amarjeet Bassi, Faculty of Engineering at the University of Western Ontario, CO^2 along with nutrient liquid from the biogas operation is fed to algae which then grow, multiply, and can be used to create biodiesel. The remaining protein byproduct can then be used as a supplement in animal feed.

4 Milk is cooled with a glycol cooling system. Glycol is an organic compound used as a medium for heat transfer. Siegfried Rebsdat and Dieter Mayer "Ethylene Glycol." *Ullmann's Encyclopedia of Industrial Chemistry*, 2002.

TOPIC #3

Innovative Water Technologies and Waste Water Strategies

Panelist **Alex Keen**
President,
ALTECH Technology Systems Inc.

"Agricultural producers depend on their watershed for safe and efficient production. At the same time, their practices impact the environment. Watershed health and on-farm water needs are interlinked issues that need to be well managed for the agricultural sector to be resilient in the long-term."

AAFC, *Growing Forward 2. Charting the Way Forward to 2020: Discussion Paper, 2011.*

"Without reliable supplies of water of appropriate quality, the profitability of farming is reduced, and farms can fail. Relative to many parts of the world, Ontario is blessed with substantial water resources. Nonetheless, water shortages that affect agriculture do occur."

ROB DE LOË, *Managing Water Shortages for Ontario Agriculture. Prepared for OMAFRA, August, 2009.*

"Water availability in Ontario is extremely variable. Thus, local water supplies, demands and pressures all must be taken into account when evaluating water security for agriculture."

ROB DE LOË, *Managing Water Shortages for Ontario Agriculture. Prepared for OMAFRA, August, 2009.*

PRESENTATION OVERVIEW

Algoma Orchards is a family-run grower and processor of apples located in Newcastle, Ontario, producing apples from several hundred acres of apple orchard. In 2009 and 2010 Algoma moved from production facilities in Whitby to new production facilities close to Newcastle. In 2010 Algoma added a juice production operation, which demanded more water. In addition, they own and operate an apple washing, sizing, polishing, and packaging production operation that distributes fresh apples to supermarkets across Canada.

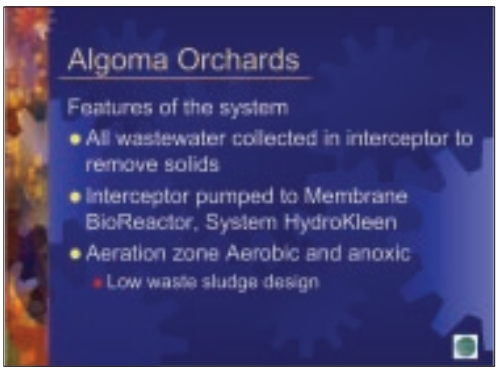
Algoma understood that potable water supply would be a problem for the company, including for expansion. They decided to invest in a complete wastewater treatment and recycling system, System HydroKleen, to treat all the effluent water[1] from the apple sizing and juice operations and to recycle all water back to process. This meant that the effluent water had to be treated for all of the contaminants from processing, and upgraded to potable water standards. Algoma worked with ALTECH Technology Systems Inc. to implement new technology to achieve these objectives. Algoma is the first company in North America to implement such a technology to treat wastewater to potable water standards. Algoma is now treating their wastewater and upgrading it to potable water for use in sanitation and contact with food, compliant with food safety standards.

Challenge #1:

Water Availability: One of the issues with locating production facilities in rural areas like Newcastle is the availability of water. Water is provided from groundwater sources and is in limited supply.

Opportunity #1:

Water Treatment: The solution was to install a wastewater treatment system that treats the Algoma effluent and upgrades it to potable water standards for complete reuse back into the plant. The treatment is several stages including an anaerobic and an anoxic aeration system,[2] which is meant for higher levels of treatment efficiency, followed by ultrafiltration membrane separation. The final step is Reverse Osmosis and disinfection.



Alex Keen Figure 1.1

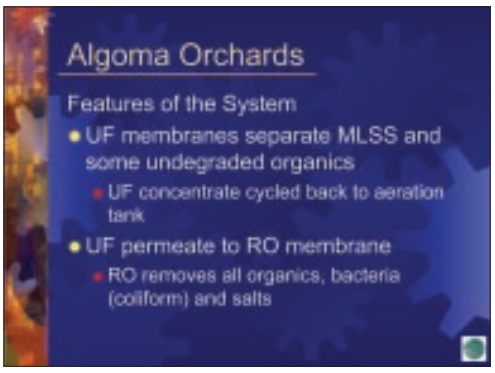


Figure 1.2

1 Effluent water refers to treated or untreated wastewater that is produced and discharged. Simon Toze. "Reuse of effluent water- benefits and risks." Fourth International Crop Science Congress, 2004. <http://www.cropscience.org.au/icsc2004/symposia/1/5/2086_toze.htm>.

2 Both anaerobic and anoxic processes take place in an oxygen-free environment, anoxic processes are typically used for the removal of nitrogen from wastewater. <http://www.swrcb.ca.gov/water_issues/programs/septic_tanks/techonsite/chapter5.pdf>.

Challenge #2:

Risk for early adopters: There are significant risks for early adopters of new technology. The buyer takes on substantial risk of failure, and the decision to invest is often made on faith or perception that there will be social, environmental and economic benefits. The risk associated with early adoption of new technology or approaches is the largest barrier.

Opportunity #2:

Economic Incentives: Provide economic incentives that encourage early adopters to step forward and take action. These economic incentives can include various approaches. There are currently subsidies for pilot plants for research and development. However, some non-cash incentives, such as 100% depreciation of equipment in the first year of operation would also be beneficial. This would encourage adopters to move towards full-scale installation. Consequently, with increased exposure to successful full-scale installations, there will be more of a market generated for innovative solutions.

RECOMMENDATIONS:

- Further develop economic incentives to encourage early adopters to step forward
- Establish and support a market for water innovation and technology
- Create incentives for closed-loop, sustainable companies

DID YOU KNOW

Scientists from the University of Cordoba (Spain) have developed sophisticated aerial photography technology to capture water stress levels that can provide data for farmers to manage water efficiency. California and other water challenged regions are also investigating this technology.

Kerry Freek, "The Networked Field," *Water Canada*. November/December, 2010.

The only two systems that actually upgrade effluent water to potable water standards in the food industry are in Algoma Orchards and a beet washing system in England. In 2007 Aquabio Ltd. (United Kingdom) began commercial application of wastewater from beet processing recycled to potable water standards for reuse in food processing and boiler feed water at Kanes Foods G's Beetroot plant.

www.aquabio.co.uk.

TOPIC #4

Case Study- Irrigation and Greenhouse Technological Solutions

Panelist **Guido van het Hof**
President and General Manager,
Soave Agricultural Group

PRESENTATION OVERVIEW

Soave Agricultural Group is comprised of three agricultural entities including Great Northern Hydroponics with a 50 acre greenhouse producing tomatoes on the vine and Campari® Cocktail tomatoes, Great Northern Seedlings which is a hydroponic plant raiser of greenhouse vegetables, and Soave Hydroponics Company which includes a $20 million cogeneration[1] facility. Electricity generation creates byproducts of heat and CO2, which are both required by the greenhouse industry. Consequently, the cogeneration facility improves efficiency by producing power for the Ontario electricity grid and heat and CO2 for Great Northern Hydroponics.

The greenhouse sector is an important industry in North America and Ontario. In Ontario alone, the greenhouse production of tomatoes, bell peppers and cucumbers are responsible for $543 million in farm gate revenue. However, when we look at the greenhouse sector's consumption of water, the average intake is about 4 000 cubic meters per acre per year. There is significant potential for water to be recovered. In addition the greenhouse sector produces 13 calories for every 1 litre of water consumed as opposed to the general 1 calorie per litre produced as a total agricultural average. If recirculated, net water consumption would be 2 800 m3 per acre per year with 30% leachate[2] created. Modern hydroponic-irrigation-strategy-management at Soave Agriculture Group has an important role to play, including maximizing leachate recovery with the help of pasteurization, ion-filtration and constructed wetlands.

"We were one of the first greenhouse companies in the region that started recirculating leachate water and that was not so much because we wanted to be the best kid in the classroom, but because of the economic value of nutrients we were getting rid of."

GUIDO VAN HET HOF, *Soave Agricultural Group*

Challenge #1:

Existing conventional recirculation systems such as UV sterilization, thermal pasteurization and ozonation are beneficial in eliminating bacteria, fungi and viruses but there are also numerous disadvantages. For example, thermal pasteurization results in the destruction of chelates, an important part of fertilizer composition for optimal plant uptake. The destroyed chelated fertilizer components cannot be reused and need to be re-added to the fertilizer with increased costs to the farmer. While recirculation can result in the destruction of some elements, it also causes the buildup of other unwanted elements and therefore flushing or discharge is needed, again with additional charges to the farmer.

Opportunity #1:

At the Soave Agricultural Group, new technologies have been implemented with great success, reducing water consumption by 15%. These technologies maintained valuable nutrients, removed pathogens, and allowed for 80% of the water to be recovered. This resulted in significant cost savings both in reductions in water purchasing costs but also in the increased recovery of leachate with associated reductions in fertilizer expenses.

1 Co-generation is the production of electricity and heat from a single source. The process involves capturing heat lost during the production of electricity and converting it into thermal energy, usually in steam or hot water. While traditional power plants have an efficiency rate of 30%, co-generation systems are typically 60-80 percent efficient. "Combined Heat and Power Partnership." *U.S. Environmental Protection Agency.* <http://www.epa.gov/chp/basic/index.html>.

2 Leachate is any liquid that drains through another substance and contains elevated concentrations of undesirable material derived from the substance that it has passed through. <http://leachate.co.uk/main/>.

Guido van het Hof Figure 1

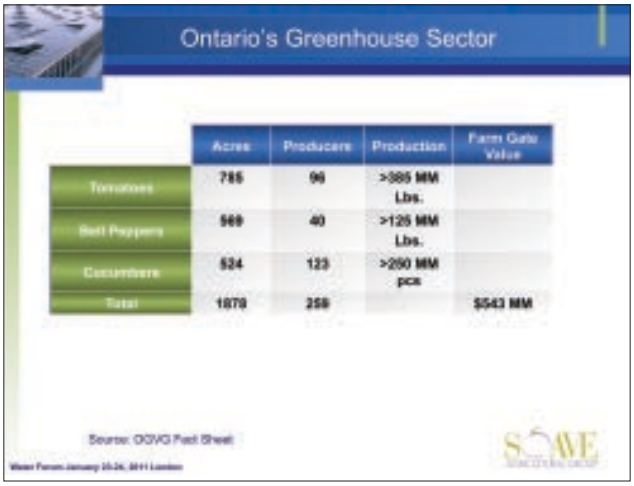


Figure 2

Challenge #2:

The goal is to develop an entirely closed-loop system for the greenhouse industry.

Opportunity #2:

Soave Agricultural Group will continue to focus on the development of constructed wetland and ion specific filtration in order to establish a complete closed loop system for its greenhouses, reducing the use of freshwater, and ultimately reducing the discharge into the environment.

RECOMMENDATIONS:

- Continue collaboration among municipal, provincial, and federal levels of government, business and academia to find collective approaches to research problems.
- Support ongoing research and invest in innovative water technology and retrofits.

DID YOU KNOW

Approximately 108,210,000 m^3 / yr of water is used for irrigating crops, greenhouses, sod and nurseries in Ontario.

"Ontario's Water-Energy Nexus: Will We Find Ourselves in Hot Water…or Tap into Opportunity?" ***POLIS Project on Ecological Governance: Water Sustainability Project.***

In March 2011, The United States Agency for International Development (USAID) announced $12m in funding for a five-year program to improve agricultural output in Lebanon. The Developing Hydroponics to Access International Markets (DHAIM) project aims to establish a high-value fruit, vegetables and flowers hydroponic sector by strengthening horticulture export market linkages.

The Leamington Grower. **2011. http://leamingtongrower.com/?p=1474**

SESSION THREE MODERATED DISCUSSION

Q: How much of a motivation was environmental stewardship and appearing greener versus the operational efficiencies in adopting innovative technology? **Zoltan Tompa,** Strategic Development Technology Canada

It is a combination of both the wish to embrace environmental stewardship and the operational efficiencies gained from embracing environmental stewardship. Our philosophy of always "looking to close-the-loop" in every aspect of our operations allows for creativity, to look at new ways of doing things, to adapt new farm practices and to develop new technology; all of which can lead to creating new farm opportunities. However, there needs to be government incentives for the early innovators as well as the need for government regulations to keep up with new technology development. **Garry Fortune,** Stanton Farms

"How important is it to integrate the economics and the farm profitability into water management decisions that producers are making?

MAXINE KINGSTON, *AAFC*

In the case of Algoma, the motivation was the lack of available water. They wanted to move their industrial facility onto their operating farm, and they did not have enough water. That was the problem. They required ALTECH to develop an innovative solution and the only way to do it, considering increased irrigation and processing needs, was to reuse water. The total cost for the project was $380 000. There were no alternatives to compare, a process was designed that would work in Algoma's situation. **Alex Keen,** The ALTECH Group

"Taking ownership of your water supply decreases vulnerability and risk."

PAUL CHOQUETTE,
Casco London

Q: How much did regulatory compliance add as a percentage of the project cost? **Phil Dick,** Ontario Ministry of Agriculture, Food and Rural Affairs

It is difficult to say for LADII because the whole process was influenced around some type of regulation. For example, with zebra mussel control and disposal of back-wash water from filters, we faced limitations of what could be put back into the lake and therefore faced additional costs. In the end there were additional costs to meet with compliance issues as they arose throughout the project. Some of these costs were from emerging issues, others were afterthoughts that became pre-requisite for the pilot to proceed. Without research, development, government support and leadership of individuals throughout the process, this project would not have gotten off the ground. The cost is too great to assume alone. Government needs to support the private sector, and the two need to work together. **Wayne Palichuk,** LADII

"Our myth is that we comfortably restore the water that we take out. In fact the reality is, in major grain growing areas and populated areas there is a major overdraft of ground water. Water is finite. When you get to the bottom, there is not any more there."

MARGARET CATLEY-CARLSON,
member UN Secretary General Advisory Board on Water

Q: There is a huge range in agriculture from very sophisticated, large-scale operations to very small ones. How do we bring that together in policy recommendations? **Ron Bonnett,** Canadian Federation of Agriculture

Helping to drive innovation will do that. Government needs to incentify the drive to innovation in a timelier manner. "The need for speed to market" is very important. Caution must be exercised when putting everything into the same basket; it will stifle innovation. There are differing needs for both large and small operators. Yet, one can also learn from the other's practices. **Garry Fortune,** Stanton Farms

Q: If you were to start over again what advice would you give, particularly for government? **John Fitzgibbon,** University of Guelph

If I had to do it over again, it would be great to have the knowledge that we have today. One of the key elements to success is all of the agencies working together. Events like the Forum today are a great place to start: all agencies coming together and moving forward. **Wayne Palichuk,** LADII

The need for speed is important and the need for government policy and regulations to keep up-to-date with new technology is equally important. Stanton Farms' new state-of-the-art instant milk chilling technology is an example of this. Through this new technology it would have been possible to eliminate the need to transfer milk from traditional storage tanks to the highway tanker by having an empty highway tanker available to directly deposit the milk in. Although it was recognized as a good idea, current regulations did not allow for this and it would have likely taken two years to change the regulations. Consequently, the traditional tank system is still used and today the driver of the tanker truck waits while the milk is transferred from the tank to the tanker truck.

There is potential for change through Ontario's new Green Energy and Green Economy Act. While we strongly support this initiative by the Ontario Government and applaud OMAFRA, who has been very supportive of the development of agri-biogas, there is a disconnect between government policy and its implementation. Biogas has been the "renewable orphan." Yet unlike other renewables, biogas provides energy 24/7/365 and has numerous environmental and rural economic development benefits the other renewables do not provide. The Ontario Power Authority has ignored the true potential of agri-biogas in their Feed-in Tariff (FIT) program and actually includes a clause in the contract for biogas that claws back 80% of any revenue generated from developing any other by-products. This action flies in the face of the very intent of the "green economy" part of Ontario's Green Energy and Green Economy Act. **Garry Fortune,** Stanton Farms

Q: What are the business value benefits to agriculture producers from adopting innovative water technologies and practices in terms of competitive advantage, market share, and customer satisfaction? How do we get more producers to implement sustainable water use practices? **Kevin Jones,** OCETA

One of the principles of Stanton Farms is the importance of closed-loop farming. While there are clear environmental benefits, we also believe that closing the loop has numerous economic benefits. Whether we use the fiber generated from wastewater in soil replacement or animal bedding, we look at all of the values and make our business case around that. **Garry Fortune,** Stanton Farms

Water technology that increases efficiency saves money. With Soave recovering leachate water and reusing it, our fertilizer bill is reduced significantly by 15% to 30%. By installing a recirculation water treatment unit and using a thermal pasteurization method there were improvements in competitiveness and financial savings. **Guido van het Hof,** Soave Agricultural Group

In developing the pipeline, the benefits go well beyond efficient use of water. Innovative water infrastructure increases water accessibility, decreases the risk of polluting water sources, limits disease factors, preserves soil integrity, improves irrigation consistency and product quality while decreasing annual start-up costs for producers. Ontario farmers are competing in a global market, and water technology helps preserve local jobs, create new jobs, and increase competitive advantage. **Wayne Palichuk,** LADII

DID YOU KNOW

"The water industry's reach includes water utilities that provide drinking water and wastewater services to end-users, and the myriad of companies providing supporting technologies, services and products to municipalities and industries alike. With proven knowledge and technological capacity to excel, Canadian companies are actively defining the role they will play in shaping this dynamic sector."

Innovolve Group. Water and the Future of the Canadian Economy. 2010.

In 2003 Gay Lea Foods commissioned one of Canada's largest dairy installations in Guelph, Ontario. Water conservation is an important objective in this energy efficient plant. Each day 200 000 litres of water is generated from producing skim milk powder and used to clean and disinfect product lines and wash floors and equipment. The average amount of water conserved at the plant each year is 73 million litres, enough to supply water for over 600 homes.

Gay Lea Foods Co-operative Ltd. Environmental Sustainability Report, 2008.

Algoma was driven by specific interests of manufacturing on their own land and overcoming local water shortage obstacles. The visibility that Algoma receives as a result of their innovative water technology is difficult to measure in dollars but they are very excited. They are attracting new customers, such as Loblaws. All of the presenters here today are visionary but there is a need for a new wave of companies who can see the opportunity and are not afraid of adopting innovative solutions early. **Alex Keen,** The ALTECH Group

"In water-rich Canada, we tend to take this natural resource for granted. But water conservation, already a subject of vital importance in drier parts of the world, including much of Africa and the western United States, is becoming an issue of global concern. And as climate change concerns intensify, water conservation will become an ever bigger issue."

CRAIG SAUNDERS, *"Beer makers brew a smarter water policy." The Globe and Mail. April 26, 2011*

The Implementation Gap

Session Four

Chair **John Fitzgibbon**
Professor,
School of Environmental Design and
Rural Development, University of Guelph

TOPIC #1

The Role of Conservation and the Need for Collaboration Between All Levels of Government

Panelist **Don Pearson**
General Manager,
Conservation Ontario

PRESENTATION OVERVIEW

Ontario's culture of water management has traditionally been sector or issue-based, characterized by a complex array of legislation administered by several ministries and agencies. The approach is inefficient in terms of public sector human and financial resources and ineffective in terms of addressing stakeholder and resource needs. Given some of the significant water management challenges faced by the province, including population growth, aging and stressed infrastructure and climate change it is necessary to move towards an integrated watershed-based approach that addresses both water and related land resources; goes beyond a single sector or issue; and more effectively assesses and balances ecological, social and economic interests.

The key characteristics of such an approach include: developing proactive rather than reactive approaches to problem solving; considering all resource management issues together; allocating resources fairly; developing collaborative frameworks with shared responsibility for plan development and implementation; and identifying complementary rather than conflicting or duplicating solutions. Integrated watershed management (IWM)[1] balances ecological, economic and social interests of the watershed together in an open and transparent process, recognizing and managing the influence they have on each other.

Don Pearson, Conservation Ontario Figure 1

1 Integrated Watershed Management (IWM) is the process of managing human activities and natural resources on a watershed basis. This approach allows for the protection of important water resources, while addressing critical issues such as the current and future impacts of rapid growth and climate change. See <http://www.conservation-ontario.on.ca/watershed_management/integrated_watershed_management.html>. While Integrated Water Resource Management (IWRM) has become the standard term in Europe; in Ontario IWM has been chosen because of its reference to the historical watershed based institutional framework. Also, there may be a subtle distinction in terms of scope by introducing the term "Resource", potentially implying a limited scope; e.g. is land use planning or habitat a water resource issue? The watershed basis and the inclusion of land and habitat are explicit in IWM whereas in IWRM they are implied.

DID YOU KNOW

More than 11 million people, approximately 90% of Ontario's population live in watersheds managed by Conservation Authorities.

Conservation Ontario Factsheet, 2011.

In 2006, water withdrawals in both the municipal and private sectors in Ontario were 31,810,968,653 (m3/d).

"Ontario's Water-Energy Nexus: Will We Find Ourselves in Hot Water…or Tap into Opportunity?" POLIS Project on Ecological Governance: watersustainabilityproject.

"A recent report on water saving opportunities mentions that Ontario has the potential to reduce water use by 46% for the residential sector, 36% for the commercial and institutional sector, 16% for the manufacturing sector and 41% of leaks in municipal systems."

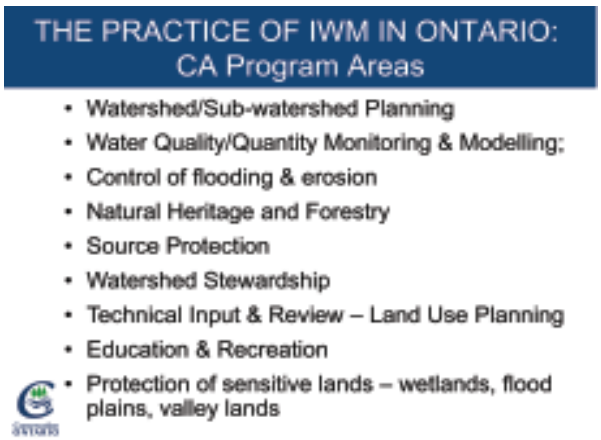
"Ontario's Water-Energy Nexus: Will We Find Ourselves in Hot Water…or Tap into Opportunity?" POLIS Project on Ecological Governance: watersustainabilityproject.

CONTEXT

The institutional arrangement for water management in Ontario falls primarily under provincial legislation and the Conservation Authorities Act[2] created in 1946. Under this enabling legislation, municipalities petitioned the province to create 36 community-based Conservation Authorities, granted responsibility to define and manage Ontario's natural resources on a watershed basis. Over time it became apparent that water can only be managed through having a significant influence or concern over the land. The management of watershed hydrology expanded to address wetland recharge areas, valley lands, natural heritage lands and recreational areas. Yet in recent years, the broadened scope of the Conservation Authorities raised criticism that their mandate is unclear and they are without the necessary human and financial resources to address the array and complexity of issues not strictly related to watershed management.

"Stakeholders, such as producers, are unable to effectively navigate the complex regulatory environment. The significant government overhead required to administer the various regulatory and legislative instruments frustrates their ability to respond to threats such as climate change in a timely and effective manner."

DON PEARSON,
Conservation Ontario



Don Pearson, Conservation Ontario Figure 2

"Watershed management is not so much about managing natural resources, but about managing human activity as it affects those resources."

BRUCE MITCHELL,
University of Waterloo

Challenge #1:

Single sector management approach: Ontario has historically addressed water management by a sector or issue-based approach operating within a patchwork of provincial and federal legislation to address a variety of concerns including, flood control, fisheries, drought, water-taking, nutrient management and drinking water source protection. Stakeholders, such as producers, are unable to effectively navigate the complex regulatory environment. The significant government overhead required to administer the various regulatory and legislative instruments frustrates their ability to respond to threats such as climate change in a timely and effective manner. The lack of strategic direction and comprehensive policy for water management in Ontario has lead to conflicting objectives, duplication of efforts and inefficiency in terms of human and financial resources.

"Despite the accomplishments of the Conservation Authority and its mature, historical framework, a different mechanism for water management is required over the next 50 years."

DON PEARSON,
Conservation Ontario

Opportunity #1.1:

Integrated Watershed Management (IWM) strategy: Movement is required towards a proactive planning approach, able to address multiple critical resource management issues simultaneously. Justice O'Conner, in the outcome of the Walkerton Inquiry,[3] recognized the need for a comprehensive and broad watershed management strategy as an essential context from which to conduct source protection planning. Ontario's Expert Panel Report on Climate Change Adaptation (2009)[4] also called for an integrated approach to help watershed management meet climate change adaptation requirements. Rather than conflict-driven or piecemeal approaches, various regulatory instruments and system elements that relate to one another can be considered through a context of mutual understanding and shared goals to produce complementary outcomes.

3 For the summary of the public inquiry into the E.Coli contamination of the water supply in Walkerton, Ontario, and the safety of Ontario's drinking water, established by the government of Ontario under the Public Inquiries Act, see <http://www.walkertoninquiry.com/>.
4 See <http://www.conservation-ontario.on.ca/watershed_management/CO_response_climate_change.html>.

Opportunity #1.2:

Building an institutional framework through a single point of contact: Through an Agreement with the Ministry of Natural Resources and the Department of Fisheries and Oceans, two agencies with primary responsibility for aquatic resources and management, the Conservation Authorities have been granted a role to integrate the administration of the Fisheries Act[5] with certain other regulatory instruments. This allows the land-owner to deal with one agent in fulfilling the various obligations of multiple acts, and marks an important step towards a future vision. The Lake Simcoe Protection Act[6] similarly prescribes an integrated planning framework and assigns responsibility for developing the science and policy to those qualified. Unlike other watershed plans that are dependent on influencing certain key players in order to achieve results, official municipal plans must be consistent with the Lake Simcoe Protection Plan.[7]

Don Pearson, Conservation Ontario Figure 3

Challenge #2:

Drivers of change add complexity to the water agenda: The population in southern Ontario is anticipated to expand rapidly over the next 25 years, placing increased pressure on existing farmland, the Great Lakes, and aging or undersized infrastructure that is prone to failure and expensive to address. As the water agenda becomes more complex, linkages to initiatives such as the protection of endangered species, the management of aquatic habitats and development of green opportunities in Ontario are often overlooked.

Opportunity #2:

A more integrated approach to water management: The ability to address multiple, critical issues simultaneously, rather than engage in crisis management, and move towards the sustainable use and protection of the natural environment and ecosystems on which agriculture depends requires the integration of both land and water related resources in management approaches. The development of specific initiatives such as the Endangered Species Act (ESA)[8] and Species at Risk Act[9] has lead to linkages with other terrestrial-based systems and programs that look beyond water to the management of aquatic habitats and their relationship to the land.

5 "The Fisheries Act is federal legislation dating back to Confederation. It was established to manage and protect Canada's fisheries resources. It applies to all fishing zones, territorial seas and inland waters of Canada and is binding to federal, provincial and territorial governments. As federal legislation, the Fisheries Act supersedes provincial legislation when the two conflict. Consequently, approval under provincial legislation may not necessarily mean approval under the Fisheries Act." <http://www.dfo-mpo.gc.ca/habitat/role/141/1415/14151-eng.htm>.

6 The Lake Simcoe Protection Act was passed in 2008, and provides a legislative framework for protecting the Lake Simcoe watershed. <http://www.ene.gov.on.ca/environment/en/local/lake_simcoe_protection/STDPROD_075796.html>.

7 In June 2009 Ontario released the Lake Simcoe Protection Plan as a model for watershed protection to restore the health of Lake Simcoe. For more information see <http://www.ene.gov.on.ca/environment/en/local/lake_simcoe_protection/STDPROD_075796.html>.

8 Ontario's original Endangered Species Act (ESA) was written in 1971. Since then changes in land and resource use, planning processes, and increasing threats to native species led to a need for updated species at risk legislation. With the passage of the Endangered Species Act, in 2007, Ontario became a North American leader in species at risk protection and recovery. See <http://nslegislature.ca/legc/statutes/endspec.htm> and <http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/STEL01_131232.html>.

9 "The adoption of the Species at Risk Act in 2002 completed the National Strategy for the Protection of Species at Risk. Two other components preceded this Act: the Accord for the Protection of Species at Risk signed in 1996, and the Habitat Stewardship Program established in 2000. Through these initiatives, Canada is making its commitment under the United Nations Convention on Biological Diversity a reality." <http://www.ec.gc.ca/alef-ewe/default.asp?lang=en&n=ED2FFC37-1>.

DID YOU KNOW

Conservation Authorities deliver watershed-related programs and services totaling more than $275 million annually through more than 4,000 full time and seasonal, part time staff.

Conservation Ontario Factsheet, 2011.

In 2008 there were more than 1 700 active boil-water advisories in place across Canada. The provinces with the most advisories were Ontario and British Columbia. Some of the advisories have been in place for more than 10 years.

Karen Bakker. "Water Security: Canada's Challenge." ***Policy Options.*** **July- August, 2009.**

Don Pearson, Conservation Ontario Figure 4

"Accurate information on the condition and trends of a country's water resource--surface and groundwater; quantity and quality-- is required as a basis for economic and social development, and for maintenance of environmental quality through a proper perception of the physical processes controlling the hydrological cycle in time and space.... almost every sector of a nation's economy has some requirement for water information, for planning, development, or operational purposes."

WMO/UNESCO *Report on Water Resources Assessment, 1991*

"I heard the term watershed used over and over again, but I think some hydro-geologists might take this as a too restrictive view of water resource management. Even though we may not be taking water directly from aquifers, we can be impacting water balances based on our activities within recharge zones."

IVAN O'HALLORAN, *University of Guelph*

Challenge #3:

Integrating knowledge systems: Conservation Authorities have identified significant problems with gaps in science, mapping deficiencies and incomplete data as related to watershed management. There is a need not just for data but for information and mechanisms to share understanding, in order to fill knowledge gaps and avoid duplication of efforts.

Opportunity #3:

Adopt mechanisms to gather and share information: Information and mechanisms to integrate knowledge systems are necessary in order to incorporate new ideas and technology into water management strategies. In a step towards water budgeting, Ontario has made significant investments in developing Source Protection Plans[10] under the Clean Water Act[11] in order to identify water sources and understand the means by which they are replenished and used. Good science is being developed from this initiative.

Challenge #4:

New regulatory approaches stifle stakeholder participation: The ability to develop an integrated water management approach is reliant not just on the scope of the plan and scale to which it is applied, but on who participates. For example, the current provincial move towards a more rigid regulatory process as seen through The Endangered Species Act[12] hinders responsive collaboration with land-owners. The stewardship approach is frustrated by the fact that assets are perceived as potential liabilities under this Act. Current regulation impedes the ability to build a high level of trust with the land owner which is necessary to relay information about endangered species, due to fear of involvement by regulatory authorities.

10 A Source Protection Plan builds on information collected in an Assessment Report to establish policies to protect drinking water supplies. The Clean Water Act states that the plans must address significant threats to drinking water. Various tools may be included in a Source Protection Plan, such as land-use planning, regulations, stewardship and monitoring. <http://www.conservation-ontario.on.ca/source_protection/source_protection_FAQs.html>.

11 "The Clean Water Act helps protect drinking water from source to tap with a multi-barrier approach that stops contaminants from entering sources of drinking water - lakes, rivers and aquifers." <http://www.ene.gov.on.ca/environment/en/legislation/clean_water_act/index.htm>.

12 Compared to Ontario's previous Act, the new Endangered Species Act 2007 provides: broader protection for species at risk and their habitats; greater support for volunteer stewardship efforts of private landowners, resource users, and conservation organizations; a stronger commitment to recovery of species; greater flexibility; increased fines; more effective enforcement; and greater accountability, including government reporting requirements. <http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/STEL01_131232.html>.

Opportunity #4:

Building participation through collaboration over a common vision: Integrated watershed planning involves a participatory process wherein action plans based on science are built-up through collaboration among a variety of sectors and stakeholders to ensure common ownership over shared objectives and accountability for achieving goals. Agriculture sometimes perceives itself in conflict and competition with the interests of natural heritage protection. When integrated watershed management is understood as a means to collaborate around a common shared vision, agreement over the goal is more likely to occur. The practice of Integrated Water Management aims to direct discussion around the protection and maintenance of water sources for agriculture. Agricultural lands should be seen to co-exist with natural heritage systems in order to maximize benefits, rather than choosing one over the other.

Challenge #5:

Risk tolerance in government: Governments tend to be risk averse and in periods leading up to an election, they become risk intolerant, impairing the ability to advance a sustainable legislative and policy agenda.

Challenge #6:

Sharing or redistributing power: IWM in Ontario has until recently been perceived as an attempt to shift power away from certain government sectors while placing the burden of responsibility onto others. This has lead to turf protection and the sense that no one is accountable.

Opportunity #6:

Applying existing tools to a new management context: Existing tools can be applied with discretion to a new management context. Some of the existing tools include the Development, Interference and Alteration Regulations;[13] Fisheries Act Authorizations;[14] Lakes and Rivers Improvement Act;[15] Permit to Take Water (Ontario Water Resources Act);[16] Clean Water Act (Source Protection)[17] Endangered Species Act; Species at Risk Act; Planning Act and Provincial Policy Statement.[18]

13 See <http://www.conservation-ontario.on.ca/planning_regulations/CO_Section_28_Brochure_2008_08_15_final.pdf>.
14 See <http://www.pac.dfo-mpo.gc.ca/habitat/steps/authorization/request-demande-eng.htm>.
15 See <http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90l03_e.htm>.
16 See <http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_040387_e.htm>.
17 See <http://www.ene.gov.on.ca/environment/en/legislation/clean_water_act/index.htm>.
18 See <http://www.mah.gov.on.ca/Page215.aspx> and http://www.mah.gov.on.ca/Page1485.aspx>.

DID YOU KNOW

A water budget is a tool that can be used to indentify location and availability of water as well as evaluate the occurrence and movement of water through the natural environment. Water budgets have been carried out in the province since the 1960's in basin studies under the management of the Ontario Water Resource Commission.

IWM: Navigating Ontario's Future. **Conservation Ontario, 2010.**

RECOMMENDATIONS

- Move towards an adaptive, co-management governance model.
- Increase stakeholder and public involvement.
- Collaborate across sectors (business, environment, agriculture, government, academia), and share responsibility for plan development and implementation in an effort to identify complimentary rather than conflicting or duplicating solutions.
- Develop proactive rather than reactive approaches to problem solving.
- Increase transparency through shared knowledge, resources and priority setting.
- Adopt an integrated watershed-based approach that addresses both land and water related resources, goes beyond a single sector or issue-based approach, and more effectively assesses and balances ecological, social and economic interests.
- Develop the tools needed to enable Integrated Water Management to operate more effectively (legislation, policies, watershed action plans, regulatory instruments, economic instruments, incentive structures).
- Refrain from renovating the existing watershed management structure until a new vision and institutional framework is determined within a vested provincial and regional context.
- Build science capacity around water measurement (mapping, data, monitoring networks, budgets), and establish science-based watershed action plans.
- Educate Ontario citizens on the relationship between the environment, the economy and social systems.
- Communicate science better in order to engender greater participation.
- Improve understanding of Ontario-specific impacts of climate change.
- Establish a Great Lakes agenda that coordinates existing, competing Agendas and includes consideration of water quantity issues.

"Justice O'Conner, in the aftermath of the tragedy at Walkerton, bought into the idea that a comprehensive approach to a broader watershed management strategy was an essential context from which to conduct source protection planning."

DON PEARSON, *Conservation Ontario*

"Integrated watershed planning is not something that is done to you or for you. It is done hopefully with you and by you."

DON PEARSON, *Conservation Ontario*

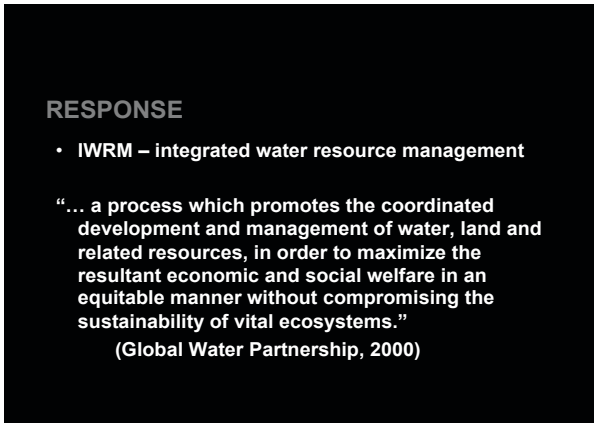
TOPIC #2

The Implementation Gap: From Policy to Action

Panelist **Bruce Mitchell**
Associate Provost, Resources, and Professor,
Geography and Environmental Management,
University of Waterloo

PRESENTATION OVERVIEW

Integrated water resource management (IWRM)[1] is one means to resolve challenges arising from the 'silos' that often characterize water management structures, mechanisms and processes. Critics argue that IWRM has frequently failed to be effectively implemented. Implementation challenges are endemic in planning and management and are not unique to IWRM. Thus, more attention is needed to address the 'implementation gap.' In this context, the purpose is to explore how to improve implementation of strategies and plans, and thereby enhance water management.



Bruce Mitchell, University of Waterloo Figure 1

CONTEXT

Managing interconnected systems characterized by change, complexity, uncertainty and conflict leads to implementation challenges. In water management, the implementation gap or challenge of moving from policy to action seems ineradicable due to complex interconnections with the land base and other resource systems, including surface and ground water, upstream and downstream areas of basins and ecosystem integrity. Consideration is required not only for the technical aspect of managing natural resources but the way in which human activity interacts with those resources and the environment, through economic development and social activity.

Integrated Water Resource Management (IWRM)[2] as popularized by the Global Water Partnership has been one design response to overcome the challenge of the implementation gap. However, it has received criticism for not being well-defined. In planning and management, widespread recognition of the 'implementation gap' reflects the difficulty in moving from visions, strategies and policies, to action. It is important to consider the challenges and obstacles. If addressed, the following 12 considerations should lead to greater implementation success.

DID YOU KNOW

IRWM in the Chesapeake Bay region (U.S.) began in the 1970s. The Chesapeake Bay Program evolved from a well-funded scientific study to a national model for a participatory ecosystem approach that is very popular at the community level. While success at improving water quality has been limited, efforts have not been. The Chesapeake Bay Program demonstrates how local communities can be formally organized to participate in the protection of a watershed area.

Global Water Partnership, 2010.

1 Integrated Water Resource Management (IWRM) is an internationally recognized term; in Ontario Integrated Watershed Management (IWM) has been chosen because of its reference to the historical watershed based approach and institutional framework. There is no substantive difference between the two terms. In IWM, the inclusion of land and habitat are explicit whereas in IWRM they are implied.

2 "… a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." Global Water Partnership, 2000.

Bruce Mitchell, University of Waterloo Figure 2

"Almost all planning and management has the challenge of an implementation gap. It seems to me the world is littered with visions, strategies and policies and frequently not very much commensurate action."

BRUCE MITCHELL, *University of Waterloo*

"If we don't systematically and in a disciplined way pay attention to some of these things, we leave ourselves vulnerable to having a lot of implementation failures and that gives us no credibility with the people out there who have higher expectations, as they should, of us."

BRUCE MITCHELL, *University of Waterloo*

"We need a long-term vision of 15 years for water governance, but when we have governments that only sit for 4-5 years and policy frameworks that only go for 5 years, how do we get that long-term vision?"

JOHN KELLY, *Erie Innovation and Commercialization*

Consideration #1:

The importance of context or local conditions: Water is a local issue. Ideally, it requires place-based planning and custom designed solutions to reflect site-specific conditions and needs. Often however, high-level analogies are developed for application across a broad region such as a province or country, due to pressure on legislatures and public servants to develop a standardized approach that is fair and can be defended based on principle. The notion of equitable treatment resonates with Canadians. On the other hand, not every place is the same. One recipe or template does not always work.

Consideration #2:

Necessity of a long-term perspective: Most of the current environmental problems whether land degradation, water security or water quality, occurred over decades or centuries. It is therefore unreasonable to expect solutions to avail themselves within a period of one or two years. Time horizons for decision-making, whether through municipal, provincial or federal elections, tend to be short-term. Those in public office want to offer tangible results to problems in order to demonstrate that their office is making an impact and deserves public support and endorsement. Pressure exists against thinking in the long-term[3] in favour of designing systems that favour short-term action. Both are required.

Consideration #3:

Need for a vision outlining the future desired condition: In order to have a vision outlining a desired future condition, both forecasting and backcasting must be considered. Absent backcasting, any journey or path will suffice. Where extrapolations made through forecasting emphasize the most probable future, backcasting helps to identify an ideal or desirable future situation from which to work back to the present in order to determine the various measures or steps that can be taken to address the long term aim.

3 Long-term planning is considered anything beyond a 15 year time-line. The logic behind this is based on the notion that individuals with the potential to be influential in their careers will normally have reached positions where they start to have influence within 15 years, and those who currently hold positions of influence may have less, as they will be towards the end of their careers. Therefore, 15 years is an optimum time period around which to think about having a different perspective and planning for change.

12 Considerations for Greater Implementation Success

1. Importance of context or local conditions
2. Necessity of a long-term perspective
3. Need for a vision outlining the future desired condition
4. Create legitimacy for the proposed direction and means to realize it
5. Ensure one or more leaders or champions are in place
6. Share or redistribute power to facilitate change
7. Adopt a multi-stakeholder approach to incorporate various interests
8. Acknowledge that turbulence and uncertainty will be encountered
9. Commit up-front to monitor and assess results
10. Note that high quality communication is essential
11. Use demonstration projects wherever possible
12. Celebrate accomplishments, with credit openly acknowledged

Consideration #4:

Create legitimacy for the proposed direction and means to realize it: A vision must have legitimacy or credibility in order for it to progress. Legitimacy is achieved through a combination of political commitment, a legal foundation or statute, administrative and regulatory arrangements, and financial allocation. Achieving all four conditions may be elusive, however it is important to secure at least one of these conditions without which the probability of implementation failure is high.

Consideration #5:

Ensuring one or more leaders or champions are in place: Research and experience indicate that the presence of a leader or champions may be the most important of the 12 considerations. Uncertainty, complexity and turbulence surrounding issues can create unpredictable situations. In the absence of leadership, individuals may become discouraged or disappointed and abandon the fight to achieve a certain goal or outcome.

Too often the same individuals are relied upon to lead, and they can become fatigued. There are enough problems for everyone to become involved and champion an issue, to the extent that current leaders should not be concerned that their role will be eclipsed. It is critical to be clear when leaders or champions are being identified. Opportunity for the next generation of leaders or champions must be created and coaches must be mindful of the importance of mentoring the leaders of tomorrow.

Consideration #6:

Willingness to share or redistribute power and authority to facilitate desired and positive change: Progress may only occur if power is shared and redistributed among stakeholders. This is a difficult point to consider for municipal, provincial or federal agencies with legal authority and responsibility over certain functions. A conscious decision must be made in order for power and responsibility to be shared. The co-management model[4] has become an attractive and effective tool in some situations.

Consideration #7:

Use of a multi-stakeholder approach so various values, interests and needs can be heard and incorporated: It is important to recognize that complex situations require the attention of a broad array of players. Whether from the private or public sector, civil society groups or the academic community, without the cooperation and collaboration of these groups and their engagement as real partners and genuine participants, it is difficult to make progress towards stated goals.

Principles for water security in Ontario

- Program and policy options for managing water supply shortages that affect Ontario's agriculture sector should be developed within a larger strategic framework that has as its goal increasing water security in the province.
- A shared, participatory approach to water governance is essential.
- Top-down, one-size-fits-all solutions are inappropriate, and unlikely to be effective.
- Any strategy to increase water security in general and to address water supply shortages for Ontario's agriculture sector in particular should maximize flexibility and the potential for adaptation.

Rob de Loë, Managing Water Shortages for Ontario Agriculture. Prepared for OMAFRA, August 2009.

4 Co-management is a process of management in which government shares power with resource users, with each given specific rights and responsibilities relating to information and decision-making. <http://stats.oecd.org/glossary/detail.asp?ID=382>.

Consideration #8

From the outset, acknowledge that turbulence, uncertainty and surprises will be encountered: Adaptive management practices[5] are being promoted as a means to prepare for the uncertainty and turbulence that will inevitably be encountered when striving to achieve a goal. The use of an adaptive approach requires preparation, the ability to acknowledge mistakes, and a willingness to learn from experience. A tension exists between being honest, candid, open, and aware that surprises will occur and that understanding is imperfect, and trying to plan for all scenarios and overcome uncertainty. In preparing for the latter scenario, the world will bypass the planners and the complex problems will remain. Planning for the unexpected requires a cultural shift, which is not easy to achieve.

Consideration #9:

Up-front commitment to monitor and assess results: Adaptive management requires commitment, constant awareness, evaluation of the surrounding environment, and continual monitoring and assessment of results. During times of fiscal restraint, monitoring is typically one of the first activities to be eliminated.

"We have to be prepared and comfortable to publically acknowledge when things don't work."

BRUCE MITCHELL, *University of Waterloo*

Consideration #10:

High quality communication is essential: Communication in plain language that everyone understands is critical to achieving goals. Communication is a time-consuming activity, but cannot necessarily be achieved enough or conducted often enough. Messages must be communicated a number of different ways and many different times in order for them to be heard and clearly understood. Research indicates that most people need to hear a message 26 times before it registers.

"When money gets short, one of the first things to go is monitoring, because people feel we have to put our money into other things."

BRUCE MITCHELL, *University of Waterloo*

Consideration #11:

Use demonstration projects wherever possible: Demonstration projects that are tangible and visible are important because unlike policy makers, strategists and visionary thinkers who are comfortable with abstract notions, most people relate to concrete examples when trying to envisage a strategy or policy.

Consideration #12:

Note and celebrate accomplishments, with credit openly acknowledged: It is important to pause and celebrate our accomplishments and give credit to everyone who is involved in achieving a goal.

"Adaptive management means we pay attention to what is going on and commit from the beginning to monitor and assess results."

BRUCE MITCHELL, *University of Waterloo*

Attention to the 12 considerations does not guarantee smooth or successful implementation. Nevertheless, experience and research suggestions that attention to these 12 considerations leads to greater success in implementation, especially in situations characterized by rapid change, complexity, uncertainty and conflict – all elements frequently characterizing water management.

5 A systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, management is treated as a deliberate experiment for the purpose of learning. <http://www.greenfacts.org/glossary/abc/adaptive-management.htm>.

SESSION FOUR MODERATED DISCUSSION

Q: It used to be that roughly 400 million dollars a year was spent by the government to count fish. Likely less than $40 million a year is spent measuring water. The net loss on producing fish approximated $1 billion per year. Less is likely lost now, because there are fewer fish to process. Society actually gets a benefit out of water. What is the institutional arrangement and implementation process necessary to count and measure water to understand if this resource is being depleted, being recovered, or staying static? **Ted Cowan,** Ontario Federation of Agriculture

In southern Ontario, a fairly good understanding of the water budget has been established, at least in gross terms, as an average annual measurement. One of the challenges being discussed with the provincial government is how to move source protection plans forward once prepared. New entities such as Source Protection Committees have been created to take on certain responsibilities under the Clean Water Act. Municipalities have expressed concern that source protection not become a financial burden, and the province has agreed to provide up-front funding for plan development. Investment in place-based science is forming the foundation for a more refined assessment within different source protection regions, but no legislation has been proposed to modify the institutional framework. A renovation of the Conservation Authorities Act is not being suggested, as that can quickly lead to multiple agendas and turf wars. Water management legislation should be created which features some elements of the Lake Simcoe Protection Act and an institutional framework rooted in collaboration, co-management and provincial responsibility for maintaining and moving that forward. **Don Pearson,** Conservation Ontario

There seems to be a growth industry at the moment by resource and environmental organizations in terms of indicators. Municipalities and communities are also developing indicators; however, there doesn't seem to be much connection between them. Certain groups are developing indicators in silos rather than working together, and as a result the overall information gleaned is less useful, despite the many different kinds of indicator systems. Barbara Veale, a staff member at the Grand River Conservation Authority, completed her PhD dissertation in the fall of 2010, and used 13 case studies from across the country to examine how water indicators are being derived, whether or not the different stakeholder groups are finding them useful, and how they are being used by different levels of government organizations. Her research identifies significant opportunities to improve the design and application of indicators, which is one tool to track what is happening to water resources. **Bruce Mitchell,** University of Waterloo

DID YOU KNOW

The Water Survey of Canada (WSC) is responsible for collecting, interpreting and disseminating water resource data in Canada. In partnership with the provinces, territories and other agencies, WSC operates more than 2500 active hydrometric gauges across the country.

http://www.ec.gc.ca/rhc-wsc/

Q: As a farmer representing the farming community, how do policy makers use farmers as stewards of the land to help preserve water and the environment? On a scale of one to ten, how are farmers in southern Ontario doing with regards to environmental stewardship? **Ron Bonnett,** Canadian Federation of Agriculture

From the perspective of a practitioner, rather than policy maker, farmers have done a remarkable job given the limited support they have received. Of concern is their tendency to keep certain kinds of information "close to the vest." Without environmental farm plan reports and updates, it is difficult to assess their effectiveness and gauge the relative success of policy implementation. Monitoring and other parameters provide a general sense of the watershed and changes in ground water. Farms are complex enterprises that people depend on for their livelihood. From the standpoint of policy makers, more attention should be given to the interests of landowners. This is not to say that government does not have any rights, but if government determines a way to engage the interests of the sector that owns and manages the land, more successful and sustainable outcomes will be achieved.
In terms of regulation, human resources to conduct monitoring, compliance and prosecution have not been sufficient. If this is an approach that people want to take, it will be important to spend time thinking about instruments that incent this kind of behaviour. **Don Pearson,** Conservation Ontario.

"Agricultural producers not only implement projects on their properties but are also engaged as local steering committee members to assist in reviewing applications for project funding."

JO-ANNE RZADKI,
Conservation Ontario. Water Canada, November/December, 2010

It is hard to generalize as to how well farmers are doing. Average numbers reflect a broad distribution that includes those doing really well and those doing less well. No group will be homogenous, and the needs and capacities of individuals within the group will vary. Strategies that work for one group may not work for another. It is critical to recognize various target groups and propose different packages or sets of strategies in order to help them progress. The signals that excite and propel early innovators are not as relevant for the laggards; those who are the last to undertake new initiatives. Improvement will not come through proposing average options and incentives, but by addressing real needs and determining the initiatives that will make a significant leap forward. **Bruce Mitchell,** University of Waterloo

Q: How can long-term vision be promoted, particularly when policy frameworks are set for five years? **John Kelly,** Ontario Fruit and Vegetable Growers' Association.

A long-term vision is difficult to create, given the need to achieve consensus among stakeholders which often have diverse and sometimes conflicting interests and needs. Citizens, through voting, have the opportunity to elect people and are partially culpable of consistently supporting leaders with a short-term focus on issues. When 42 Areas of Concern were identified around the Great Lakes system, there was recognition that it would take a long time to remediate the degradation at each site. It also seemed overwhelming to approach issues for a region that touches 40+ million people, 8 states, 2 provinces, 2 central governments and hundreds of municipalities. The Remedial Action Program (RAPs) targeted 'local' areas, such as harbours or near shore areas, and required a will and awareness to address the problems through a long-term and complex process. The presence of champions who were enthusiastic, committed and persistent, and received some support, was an essential component in achieving progress. It is important to consider which mix of the 12 best practice approaches is most likely to advance a vision. Working and communicating in order to identify a common vision helps to ensure that as governments change, which they inevitably will, the vision will not necessarily change completely along with the government. Sustained momentum is normally derived from a shared vision that has been developed within the community. **Bruce Mitchell,** University of Waterloo

Industry/Associations

Ansari Helmi, Director Sustainability and Productivity, PepsiCo Inc.

Armitage Dave, Manager, Farm Policy Research Group, Ontario Federation of Agriculture

Attema Chris, Water Quality Specialist, Ontario Cattlemen's Association

Baker Jill, Senior Policy Advisor,
National Round Table on the Environment and the Economy

Bonnett Ron, President, Canadian Federation of Agriculture

Brayford Tom, Vice-Chair, Innisfil Creek Water Users Association

Catley-Carlson Margaret, Chair, Crop Diversity Trust and Vice Chair Agenda Council for the World Economic Forum; member UN Secretary General Advisory Board on Water; Patron, Global Water Partnership

Choquette Paul, Plant Manager, CASCO Inc.

Cowan Ted, Researcher, Farm Policy Research Group, Ontario Federation of Agriculture

Crews Bette Jean, President, Ontario Federation of Agriculture

Currie Keith, Executive, Ontario Federation of Agriculture

Fortune Garry, Energy Consultant, Stanton Farms, Stanton Bros. Ltd.

Gilroy Brian, Chair, Ontario Fruit and Vegetable Growers' Association

Glickman Steve, Director, Business Growth and Retention,
London Economic Development Corp.

Gowman Linda, Chief Technology Officer, Trojan Technologies

Haskett Tom, President, The Cider Keg, Norfolk County

Hill Barry, President, Ontario Soil and Crop Improvement Association

Jones Kevin, President and CEO,
Ontario Centre for Environmental Technology Advancement

Keen Alex, Chief Executive Officer, ALTECH Technology Systems Inc.

Kelly John, Vice-President, Erie Innovation and Commercialization,
Ontario Fruit and Vegetable Growers' Association

Lambert David, Property Section Chair, Ontario Fruit and Vegetable Growers' Association

Lehn Mark, Secretary, Leamington Area Drip Irrigation Inc.

McCabe Don, Vice-President, Ontario Federation of Agriculture

McLaughlin Murray, Executive Director, Bioindustrial Innovation Centre

O'Neill Tom, General Manager, Norfolk Fruit Growers' Association

Palichuk Wayne, Chairman, Leamington Area Drip Irrigation Inc.

Parks Bill, Director, Ontario Berry Growers Association

Picard Rej, Chief Executive Officer, Westbrook Greenhouses Ltd.

Smith Art, Chief Executive Officer, Ontario Fruit and Vegetable Growers' Association

Snaith Gregory, President, Principle Water Resources Inc.

Starozik Carol, Executive Director, Principle Water Resources Inc.

Stevens Nathan, Research and Policy Advisor, Christian Farmers Federation of Ontario

Surgeoner Gord, President, Ontario Agri-Food Technologies

Tompa Zoltan, Director Applications, Sustainable Development Technology Canada

Tiessen Paul, Treasurer, Leamington Area Drip Irrigation Inc.

van het Hof Guido, President and General Manager, Soave Agricultural Group

Vanden Bussche Marc, Vice President and General Manager,
Vanden Bussche Irrigation Inc.

Wilson Leanne, Science Programs and Issues Coordinator,
Ontario Greenhouse Vegetable Growers-Leamington

Academia

Bansal Tima, Director, Ivey's Centre for Building Sustainable Value, Richard Ivey School of Business

Coates Leslie, Policy Advisor, Lawrence National Centre for Policy and Management, Richard Ivey School of Business, The University of Western Ontario

Cunningham Dianne, Director, Lawrence National Centre for Policy and Management, Richard Ivey School of Business, The University of Western Ontario

Fitzgibbon John, Professor, School of Environmental Design and Rural Development, University of Guelph

Harris Melissa, Project Manager, Lawrence National Centre for Policy and Management, Richard Ivey School of Business, The University of Western Ontario

Hewitt Ted, Vice-President, Research & International Relations, The University of Western Ontario

McBean Gordon, Professor and Chair for Policy, Institute for Catastrophic Loss Reduction, The University of Western Ontario

Mitchell Bruce, Associate Provost, Resources, and Professor, Geography and Environmental Management, University of Waterloo

O'Halloran Ivan, Associate Professor, Soil Fertility and Nutrient Use Efficiency, Ridgetown Campus, University of Guelph

Robert Adam, Media Relations Intern, Richard Ivey School of Business, The University of Western Ontario

Renzetti Steven, Professor, Department of Economics, Brock University

Rudolph Dave, Professor, Department of Earth and Environmental Sciences, University of Waterloo

Shrubsole Dan, Professor and Chair, Department of Geography, The University of Western Ontario

Southam Colette, Assistant Professor, Richard Ivey School of Business, The University of Western Ontario

Southam Gordon, Professor and Director, Centre for Environment and Sustainability, The University of Western Ontario

Sparling David, Professor and Chair of Agri-Food Innovation and Regulation, Richard Ivey School of Business, The University of Western Ontario

Stephenson Carol, Dean, Richard Ivey School of Business, The University of Western Ontario

Government

Albright Ken, Assistant Deputy Minister, Ontario Ministry of Research and Innovation

Antle Dave, Assistant Deputy Minister, Ontario Ministry of Agriculture, Food and Rural Affairs

Aspinall Doug, Land Resource Specialist, Ontario Ministry of Agriculture, Food and Rural Affairs

Bailey Sharon, Director, Land and Water Policy Branch, Integrated Environmental Planning Division, Ontario Ministry of Environment

Boysen Eric, Director, Ontario Ministry of Natural Resources

Brooker Deborah, Program Analyst, Ontario Ministry of Agriculture, Food and Rural Affairs

Budd Stuart, Senior Research Advisor, Ontario Ministry of Agriculture, Food and Rural Affairs

Burke John, Deputy Minister, Ontario Ministry of Agriculture, Food and Rural Affairs

Butts Richard, Director General, Agriculture and Agri-Food Canada

Cassidy Heather, Senior Policy Advisor, Ontario Ministry of Agriculture, Food and Rural Affairs

Chan Karen, Assistant Deputy Minister, Ontario Ministry of Agriculture, Food and Rural Affairs

Dick Phil, Business Resource Specialist, Ontario Ministry of Agriculture, Food and Rural Affairs

Evanitski Cliff, Chair and General Manager, Long Point Region Conservation Authority

Gainham Chris, Senior Project Manager, Public Works Department, City of Hamilton

Haverson Clarence, Director Environmental Management Branch, Ontario Ministry of Agriculture, Food and Rural Affairs

Hopcroft Grant, Director of Intergovernmental and Community Liaison, City of London

Jacques Craig, Source Water Protection Technician, Long Point Region Conservation Authority

Jamieson Andrew, Senior Irrigation and Drainage Engineer, Agriculture and Agri-Food Canada

Jensen Jill, Manager, Policy Analyst, Agriculture and Agri-Food Canada

Khosla Shalin, Greenhouse Specialist, Ontario Ministry of Agriculture, Food and Rural Affairs

Kingston Maxine, Technical Director, Agriculture and Agri-Food Canada

Mandrapilias George, Team Leader, Ontario Ministry of Economic Development and Trade

Marinigh Dan, Director, Ontario Ministry of Natural Resources

Morrison Bruce, Senior Policy Advisor, Ontario Ministry of Natural Resources

Pearson Don, General Manager, Conservation Ontario

Popovich Chris, Great Lakes and Water Policy Intern, Ontario Ministry of Natural Resources

Post Ryan, Source Protection Coordinator, Nottawasaga Valley Conservation Authority

Shewfelt Bruce, Acting Chief, Agriculture and Agri-Food Canada

Shortt Rebecca, Engineer, Ontario Ministry of Agriculture, Food and Rural Affairs

Stark Deb, Assistant Deputy Minister, Ontario Ministry of Agriculture, Food and Rural Affairs

Toombs Michael, Director, Ontario Ministry of Agriculture, Food and Rural Affairs

Topp Ed, Principal Research Scientist, Agriculture and Agri-Food Canada

Villeneuve Michel, Manager, Sustainable Water Management, Environment Canada

Zachariah Oswald, Unit Manager, Ontario Ministry of Agriculture, Food and Rural Affairs

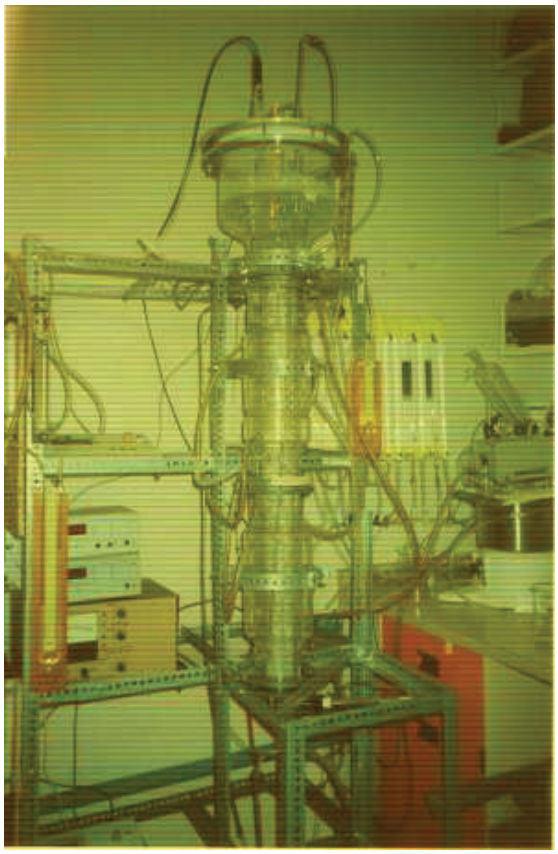
Rapid Biodegradation of Hydrocarbons in Wastewaters using a Novel Immobilized Cell Bioreactor System.

Dr. Argyrios Margaritis , Professor of Biochemical Engineering, Department of Chemical and Biochemical Engineering, University of Western Ontario, London, Ontario, N6A 5B9

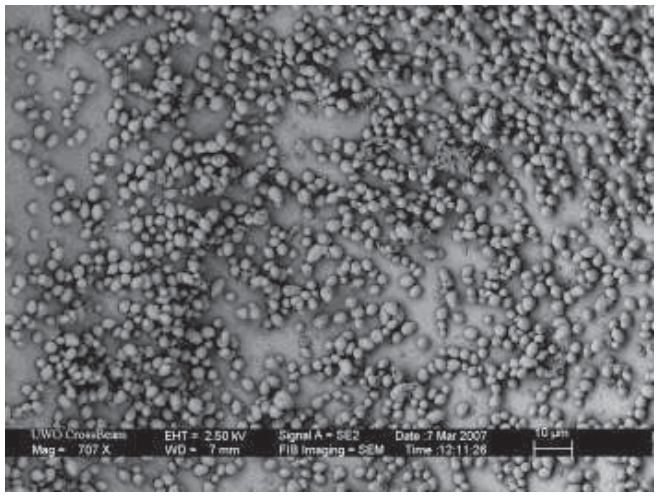
Email: amarg@uwo.ca, website: http://www.eng.uwo.ca/people/margaritis/

Summary

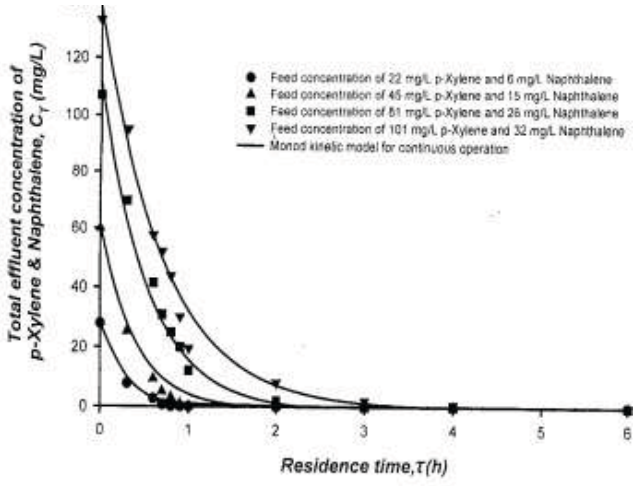
A 21 Litre novel bioreactor system has been developed and used to biodegrade p-Xylene and Naphtalene present in wastewater. The microbes were immobilized by attachment to the surface of fibrous matrix stacked inside the bioreactor which produced very high rates of biodegradation, compared to traditional bioreactors that use freely suspended cells. This novel bioreactor system has excellent potential for commercialization for the rapid biodegradation of a large number of organic contaminants present in wastewater systems.



Immobilized cell bioreactor system



Immobilized cells on fibrous matrix



Biodegradation results of p-Xylene and Naphthalene

Dr. Argyrios Margaritis, The University of Western Ontario

DEVELOPMENT OF NOVEL PHOTOCATALYST FOR WATER PURIFICATION UNDER SOLAR AND UV LIGHT

Department of Chemical and Biochemical Engineering
Debjani Mukherjee
The University of Western Ontario
London, Canada

Abstract

According to world health organization more than 1 Billion people are suffering from lack of access to clean drinking water. Presence of different dyes and Pharmaceutical products have been identified in the drinking water of South western Ontario.

These organic pollutants being carcinogenic and harmful to human health. required to be degraded completely

In this study a new buoyant porous photocatalyst composite has been synthesized to investigate the degradation of organic pollutants (Methyl orange and Aspirin) .

Introduction

- Water treatment technologies→ Advanced oxidation Processes→PCO (photocatalytic oxidation) is the most promising one.
- TiO_2 gets activated by UV /solar lights and can oxidize organic pollutants into non toxic materials like CO_2 and water . Also disinfects the water .
- Degussa is a mixture of anatase and rutile form with higher efficiency has been used in these studies.

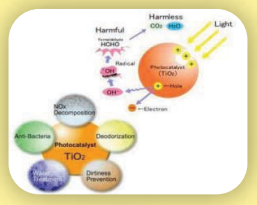


Fig 1:Functions of of TiO_2

Fig 2: Mechanism of removal of drugs and dyes to produce clean water

Objective

To develop an efficient photocatalyst for portable and economical water treatment process both under UV and Solar light

Methods

TiO_2-polymeric composite prepared by complex polymerisation method .

To optimize the catalyst ,the crosslinking densities of polymeric composites were varied by several chemical-physical crosslinking techniques.

Aspirin and methyl orange solutions were degraded under both UV and solar light in presence of this composite.

The kinetic rate constants and its dependence on the flow rates, initial concentrations of the pollutant, light intensity , types of catalyst, catalyst loading and pH of the solution have been studied.

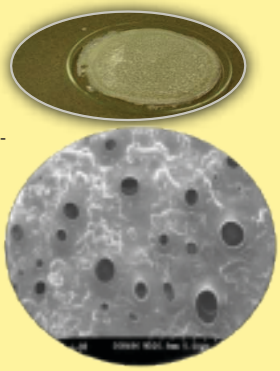


Fig 3: SEM image of the TiO_2/polymeric composite

Results

Sources of Lights and Light intensities play an important role in degradation of pharmaceutical products and dyes.

Effects of slurry TiO_2 and composite catalysts on degradation rate have been studied and compared

FTIR, TOC,HPLC of the degraded aspirin and methyl orange solutions were studied.

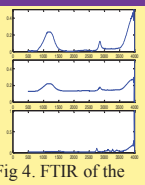


Fig 4. FTIR of the aspirin solution before and after degradation

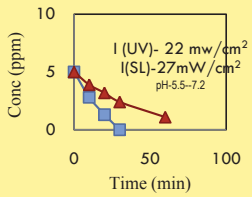


Figure 5: The degradation kinetics of MeO

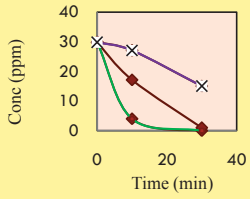


Figure 6: The effects of pH on degradation of MeO

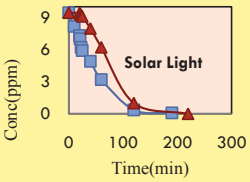


Figure 8: The Effect of catalyst types

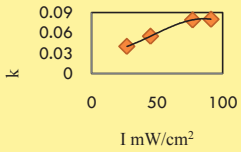


Fig 8: The effect of Light Intensity on Aspirin degradation

Discussion

The degradation kinetics of methyl orange followed the Langmuir-Hinshelwood (L-H) model. $1/r_0 = 1/kKC_0 + 1/k$.....eqn (1)

Cross linked polymer backbone attached to the CN radical and metal atom makes it more efficient than TiO_2 alone.

The degradation under solar light was observed to be higher as UV light crosslinks the composite which decreases it efficiency with time.

Varying the pH level changes the surface charges of TiO_2 particles and the pollutant molecules nature, which affects the degradation.

Conclusion

The porous buoyant TiO_2-polymeric catalyst composite was found to be highly efficient in degrading the organic pollutants under both solar light and UV.

This composite catalyst can exclude filtration from the water purification technology.

In brief the film photocatalyst holds the potential to be an efficient,economical process of water treatment technology and can also recover oil spills.

Future Research

This experiment can lead to an efficient novel buoyant catalysts which can use natural source of light.

Introduction of hydrogel films, pills for water purification processes.

- This film photocatalyst can be used recovery of chemicals/oils spills.

Development of cheaper and portable water treatment technology

Acknowledgements

Thanks to Dr. Ajay Ray, Dr. S.Barghi and a special thanks to university of **Lawrence National Centre for Policy and Management** Richard Ivey School of Business Western Ontario and a special thanks to sarnia research symposium

Any sufficiently advanced technology is indistinguishable from magic

Debjani Mukherjee, The University of Western Ontario

Zeolitic and Nanomaterials Laboratory (ZNML)
Department of Chemical & Biochemical Engineering
The University of Western Ontario
London, ON, Canada

URL: http://www.eng.uwo.ca/zeolite

Toward Sustainable Agriculture in Canada by Using Zeolitic Minerals to Preserve Water Resources

Hossein Kazemian , Sohrab Rohani

E-mail: hossein.kazemian@uwo.ca & srohani@uwo.ca

Background

Environmental protection and balancing consumptive water use are known as essential criteria for a sustainable agriculture.

Canada is blessed with huge water and land resources, however, the water is not always available when and where needed by the agriculture industry. In a sustainable development, while we meet the needs of present society, we should not compromise the resources of future generations.

Taking into account the climate changes, global warming, social influences, and increasing needs to water resources, the country is experiencing new challenges and competition for water resources, which is affecting agriculture production.

Having these complex and serious concerns; effective management of agricultural water resources and particularly reusing of the contaminated surface and underground water streams are essential to benefit all Canadians.

Scientific evidences ascertain that the agricultural industry impacts on water quality and the environment, which identifies the urgent need to adopt agricultural activities that protect water in the natural environment.

Some of the typical well known agricultural contaminants are: pest control products, suspended sediments, nitrogen and phosphorus (i.e. risks associated with fertilizer runoff), waterborne pathogens (i.e. animal waste products, manure runoff and handling), heavy metals, organic compounds, bacteria, etc.

The occurrence of waterborne disease outbreaks in the period of 2000 to 2005, particularly in Walkerton, ON; (where the *E. Coli* contaminated drinking water killed 7 people and 2,300 became ill out of a total population of 5,000), has dramatically affected water management and governance criteria in Canada.

Studies showed that the source of the pollution was livestock manure that had been applied on farmland as fertilizer. It is noteworthy that this accident was preventable.

One of the effective approaches to address the impacts of agricultural industries on water resources is to incorporate environmental friendly agricultural activities that protect water in the natural environment. Following can be considered as examples:

1- Applying correct dosage of the chemical and nutrients to minimize their environmental exposure (i.e. chemicals fate and mobility).

2- Applying waste management techniques (e.g. for animal manure, oil and gas, etc.) to decrease potential contamination of water resources.

One of the effective approaches to addressing most of the environmental concerns of the agricultural industry, particularly for preservation and recovery of the water resources is to use natural and modified porous zeolitic minerals as multifunctional adsorbent materials

Zeolites, Magic materials!

Zeolitic molecular sieves are renowned aluminosilicate family of inorganic adsorbents with over 60 naturally occurring species and more than 150 synthetic types.

Zeolites are microporous, high- surface area, crystalline and hydrated aluminosilicates of alkali and alkaline earth cations with an open and rigid three-dimensional structure.

Zeolite 3D framework consists of $[AlO4]^{5-}$ and $[SiO4]^{4-}$ tetrahedral units linked through shared oxygen.

Substitution of Si^{+4} by Al^{+3} in tetrahedral sites results in more negative charges and a high cation exchange capacity.

Huge resources of natural zeolite exploited all around the world particularly in north America

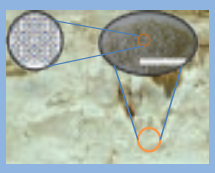
Thanks to the unique structural chemistry, zeolites exhibit excellent ion-exchange, adsorption and catalytic properties.

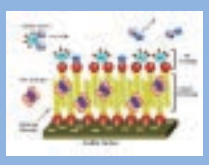
Having the extraordinary characteristics, zeolites have gained a growing attention for different environmental remediation processes.

One of the main areas of zeolite applications in industrial scale is water and wastewater treatment processes.

While all of the natural and most of the synthetic zeolites are cation exchangers, they can be modified as multifunctional adsorbents

Surface (surfactant) modified zeolites (SMZ) can be used for adsorption of cations (e.g. heavy metals), anions (e.g. chromate), and organic molecules such as Volatile Organic Compounds (VOC).





Agri-environmental applications of zeolites

❖Some of the studied and developed applications of zeolitic materials in agriculture are as followings:

A *soil conditioner* (amender); to keep soil moisture for longer time and saving water by increasing irrigation intervals

zeolite based smart fertilizers;

✓Less risk of volatilization losses as zeolite adsorb free ammonia.

✓Less fertilizer losses by leaching, so the nutrients in zeolite are longer available to extend fertilizer life. Long term soil improvements by increasing the CEC and nutrient retention in soil.

Treating of wastewater streams for reusing in agriculture

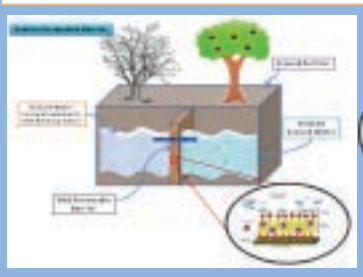
✓Scientists developed an advanced physico-chemical nutrient-removal Process based on selective ion exchange and chemical precipitation, called RIM-NUT (i.e. Removal of Nutrients) that uses the selective exchange by clinoptilolite and an organic resin to remove N and P from sewage effluent.

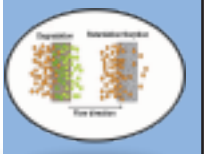
✓RIM-NUT produces decontaminated water for reuse in agricultural practice and a Sturvite as a NPK fertilizer!

Surface-Altered Zeolites as Permeable Barriers for in Situ Treatment of Contaminated Groundwater.

✓A barrier made of SMZ and Iron nanoparticles can be used as a permeable engineering barrier to decontaminate the polluted ground water from organics, anions and cations.

✓This barrier mechanism is degradation (catalysis) and retardation (adsorption)





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Hossein Kazemain & Sohrab Rohani, The University of Western Ontario

Application of Dye-sensitized Photocatalyst in Environmental Detoxification

Department of Chemical and Biochemical Engineering
The University of Western Ontario
London, Ontario, Canada

Pankaj Chowdhury, Jesus Moreira, Ajay Ray and Hassan Gomaa

Introduction

❖ **Photocatalysis** - a well known technology where light energy is utilized to excite the semiconductor material producing e^-/h^+ pair which ultimately involves in the detoxification of pollutants and/or splitting water producing hydrogen.

Pollutant detoxification

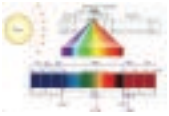
❖ **Target compounds**

- Phenol
- Chlorophenols
- Pesticides
- Mercaptans
- Halocarbonds
- Colorants etc.

Why Visible Light ?

❖ **UV** photocatalysis is quite effective but it operates in a narrow wavelength range (4 % of solar spectrum).

❖ **Visible** light, however, occupies 46% of solar spectrum.



Solar spectrum

❖ **Solar Energy – a good option**

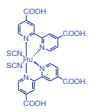
➢ **Energy** from Sun: $3x10^{24}$ J/year (or 10,000 times more than the global population currently consumes.

Visible Light Active Photocatalyst

- ❖ Cation/anion doping on photocatalyst
- ❖ Valence band-controlled photocatalyst
- ❖ Composite semiconductor
- ❖ Solid solution
- ❖ Metal ion implantation on photocatalyst
- ❖ **Dye-sensitization**

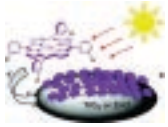
Dye-Sensitization

❖ **Dye-Sensitization**: When a photocurrent is generated with light energy less than that of the semiconductor band gap, the process is known as sensitization, and the light-absorbing dyes are referred to as sensitizers.



The most effective dye N3

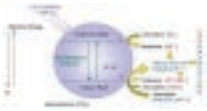
Mechanism of dye-sensitization



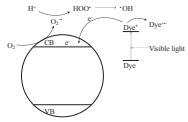
Dye on Semiconductor Surface

UV photocatalysis and Dye-sensitized photocatalysis

❖ **UV Photocatalysis:**



❖ **Dye-sensitized Photocatalysis:**

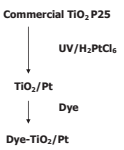


Catalyst preparation and Characterization

❖ **Dye-Sensitization Methodology**: The process is simple but functions of

- Dye type
- Dye concentration
- Semiconductor type
- Semiconductor surfaces morphology
- Solution pH and
- Incorporation of electron donor into the system

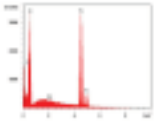
Synthesis of visible light active TiO_2 Photocatalysts:



Powdered TiO_2 sensitized with different dyes

SEM image of TiO_2 P25

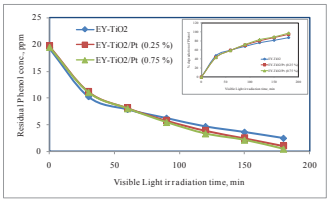
SEM image of TiO_2/Pt-Eosin Y



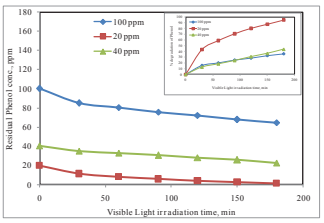
EDX of TiO_2/Pt

Results

❖ **Effect of Pt dose on Phenol degradation under vis. light**



❖ **Effect of initial phenol concentration under vis. light**



Conclusions and Future Study

- ❖ Pt loading onto TiO_2 surface improved the phenol degradation rate.
- ❖ Degradation rate of phenol follows first order reaction rate.
- ❖ Maximum degradation of phenol was found at pH=7.0.
- ❖ Further study of the variables affecting degradation rate of phenol (photon flux, Catalyst dose, electron donor concentration, etc.) will allow us to establish a precise kinetic model for phenol photo degradation under visible light.

Acknowledgments

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For More Information Contact Professors: Dr. Ajay K. Ray (ajay@uwo.ca)

Pankaj Chowdhury, Jesus Moreira, Ajay Ray & Hassan Gomaa, The University of Western Ontario

Kinetic Studies for Photocatalytic Degradation of Methylene Blue on a Thin Film of Layer by Layer Deposited Titanium Dioxide

Tayirjan T. Isimjan, Ghodsieh Malekshoar, Ershat Nayup, Ajay Ray, Sohrab Rohani

Chemical and Biochemical Engineering, The University of Western Ontario 1151 Richmond Street, London, Ontario, Canada, N6A 3K7.

Introduction

TiO_2 nanotube arrays have demonstrated remarkable properties that include solar cells, hydrogen sensors, drug eluting surfaces, hydrogen generation, and water purification along with numerous other applications [1].

Extensive research has focused on the developments in TiO_2 photo-catalysis for the degradation of various phenols and substituted phenols under either by UV or visible lights [1].

TiO_2 catalyst has been used in two forms in photo-degradation processes: freely suspended in an aqueous solution and immobilized onto a rigid inert surface. The former case is very efficiency but it requires a liquid-solid separation and then become costly [2]. Although, the preceding problem can be eliminated by immobilizing the TiO_2 catalyst over suitable supports, the TiO_2 nanoparticles come off easily during the reaction [3]. Here, we use layer by layer deposition of P25 on the surface of glass to overcome this problem. The layer by layer deposited surface is not only very stable but also uniform [1].

Experimental Set Up

The reactor consists of circular glass plate with diameter of 12.2 cm that is placed between soft padding fcased with stainless steel and aluminum casing. The catalyst was deposited on the top of the plate. The aqueous solution (480 ml) was introduced tangentially into the reactor by a pump and exited from the center of the top plate. The lamp with the light intensity of 75 mW/cm^2 was placed underneath the glass plate.

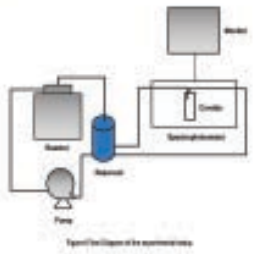


Figure 1 Experimental Set Up

Before the light is turned on, it is necessary to circulate the solution for half an hour to ensure that the adsorption equilibrium of the pollutant on the TiO_2 has been reached. The change in the concentration was continuously analyzed and recorded by spectrophotometer.

Coating

TiO_2 was coated on the surface of glass through layer by layer deposition process which has following steps: 1) The glass was immersed into anionic polymer solution then washed with water. 2) Positively charged glass surface was immersed again into cationic polymer solution. 3) negatively charged surface was put into TiO_2 suspension. 4) The TiO_2 coated surface was annealed at high temperature.

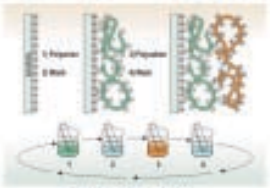


Figure 2 Layer by Layer deposition technique

SEM images

SEM images show that the glass surface was fully covered by TiO_2 nanoparticles

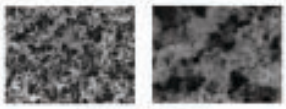


Figure 3 SEM images of TiO_2 coated surface

Layer Selection

The catalyst layer thickness is an important parameter in photocatalytic degradation. Experimental results show that photocatalytic rate goes through a maximum at an optimum catalyst layer thickness (48 nm).

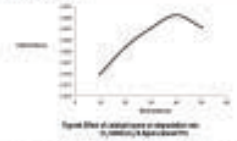


Figure 4 Effect of catalyst layers on degradation rate

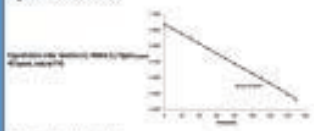
There are two counteracting affects, which is resulting this optimum rate. The increase of the catalyst loading increases the degradation rate due to more available catalyst surface sites but there are two loss mechanism within the catalyst films due to increase of the catalyst layer thickness.

1) Attenuation of light due to absorption by the catalyst
2) Increased probability of charge carrier recombination [4,5]

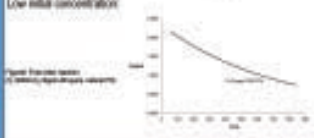
Kinetic Study

Heterogeneous photocatalytic degradation often follows Langmiur-Hinshelwood expression.

High initial concentration:



Low initial concentration:



pH study

The PH of the point of zero charge was found to be 7.2. For a solution PH more than that the groups with negative charges on the TiO_2 surface are assumed to increase gradually, according to [6]:

$$TiOH + H^+ \Leftrightarrow TiOH_2^+$$

$$TiOH + OH^- \Leftrightarrow TiO^-$$

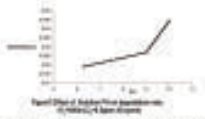


Figure 5 Effect of Solution PH on degradation rate (C_0 5.88x10^{-6} M, Agitation 400 rpm)

Since MB has a cationic configuration, its adsorption is favored in alkaline solution.

Conclusion

Up to 50 layers TiO_2 nanoparticles were deposited on the surface of conductive glass by layer by layer deposition process. The resulting surfaces were subjected to the kinetic studies.

The results show that the degradation rate of methylene blue under UV irradiation. The 48 –layer shows the highest rate constant. The reaction rate keep increases along with the increases of pH due to the high negative surface charge of TiO_2 surface under basic condition.

Future Work

1) Visible light responsive TiO_2 nanoparticles will be applied to the surface by layer bay layer deposition process and then photocatalytic activity will be measured under visible light.
2) Use different nanomaterials such as TiO_2 nanowires as well as quantum dots instead of TiO_2 nanoparticles.
3) Design nanoparticles coated large scale reactor for photo-degradation.
4) Investigated TiO_2 nanotubes based photo reactor.

Acknowledgement

The financial support from WITACS and the University of Western Ontario are gratefully acknowledged.

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Tayirjan T. Isimjan, Ghodsieh Malekshor, Ershat Nayup, Ajay Ray & Sohrab Rohani, The University of Western Ontario

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