REPORT

Agriculture as Part of the Solution for Water Quality in Manitoba

March 29, 2006

Credits

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Funded by:

CANADIAN FERTILIZER INSTITUTE
INSTITUT CANADIEN DES ENGRAIS

Keystone Agricultural Producers
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Water quality has become one of the critical environmental issues for society in Canada, impacting our economy, our recreation and where we live. In Manitoba one of the most important water quality issues is the increasing amounts of nutrients in the water. Some of these nutrients come from natural sources, but a large portion come from human activities. All rivers and streams in southern Manitoba flow into Lake Winnipeg and recent reports are suggesting the health of Lake Winnipeg is being impacted by high levels of nitrogen and phosphorus.

In June of 2005, the Manitoba government passed the *Water Protection Act* to protect the quality of Manitoba's waters. The Act created a systematic framework the government will use to improve water management and protection in Manitoba. One component of the Act allows for the development of regulations to set water quality standards, objectives, and guidelines. The province is in the process of defining water quality management zones and to identify a framework for watershed planning. The first draft regulation being considered under *The Water Protection Act* defines land-based Water Quality Management Zones for Nutrients needed to protect water systems, including those used for drinking purposes, from excessive run-off of nitrogen and phosphorus.

While agriculture recognizes the need to reduce the amount of nutrients entering Manitoba's waterways, concerns have been raised about the plan to restrict the quantity of nitrogen and phosphorus that farmers will be able to apply on their land. The agriculture industry contends there are other methods to reduce excessive run-off of nitrogen and phosphorus that allow farmers to apply the required level of nutrients for healthy plant growth through commercial and manure fertilizers. This involves applying sufficient nutrients to replenish crop removal and applying the nutrients in the right place at the right time. This document addresses the need to improve the health of Manitoba's water while recognizing the need for sustainable approaches to ensure economic, environmental and social concerns are accounted for.

Current Situation

Several studies have documented decreasing water quality in part due to the increasing trends of nitrogen and phosphorus in many of Manitoba's waterways. Research into the water quality of Lake Winnipeg has indicated nitrogen and phosphorus loading has increased by 13 and 10 percent respectively over the last 30 years of monitoring (MWS (b), 2006). These two nutrients in particular, have been determined to contribute significantly to the acceleration of the eutrophication of Lake Winnipeg.[1] Eutrophication can lead to large algal blooms that can cause changes to aquatic life habitat, reduce essential levels of oxygen, clog fisher's commercial nets,

[1] Natural eutrophication is the process by which lakes gradually age and become more productive. It normally takes thousands of years to progress. However, humans, through their various cultural activities, have greatly accelerated this process in thousands of lakes around the globe. Anthropogenic eutrophication is water pollution caused by excessive nutrients. (http://www.umanitoba.ca/institutes/fisheries/eutro.html)

interfere with drinking water treatment facilities, and cause taste and odour problems in drinking water. In addition, some forms of blue-green algae can produce highly potent toxins that are poisonous to human, livestock and wildlife. Monitoring water quality from a number of monitoring stations in Manitoba indicate that excessive nutrient loading is an important issue with rivers and streams throughout the province (Jones and Armstrong, 2001). Jones and Armstrong also pointed out that nutrient loading in some of Manitoba's streams and rivers have decreased.

Table 1 indicates the average nitrogen and phosphorus loads from a variety of sources within Manitoba and outside Manitoba's jurisdiction. Agriculture represents 6% and 15% of the annual nitrogen and phosphorus loads respectively or put another way, 5103 tonnes of nitrogen and 1210 tonnes of phosphorus. Natural background sources represent 21% of nitrogen and 17% of phosphorus, while the City of Winnipeg represents 4% of nitrogen and 6% of phosphorus of the loading in Lake Winnipeg.

Table 1

Category	Average Total Nitrogen (tonnes/year	Average Total Nitrogen (Percent)	Average Total Phosphorus (tonnes/year)	Average Total Phosphorus (Percent)
Overall annual nutrient load to Lake Winnipeg	86,701	100	7,845	100
Upstream jurisdictions	48,940	56	4,155	53
United States (Red River)	18,983	22	2,537	32
United States (Souris River)	1,130	1	209	3
Saskatchewan and Alberta (Assiniboine and Saskatchewan)	8,339	10	359	5
Ontario (East side)	3,671	4	262	3
Ontario (Winnipeg River)	16,817	19	788	10
Manitoba Sources	37,761	44	3,690	47
Manitoba Point Sources	5,070	6	669	9
City of Winnipeg	3,647	4	414	6
All other urban and industrial point sources	1,423	2	255	3
Manitoba Watershed Processes	23,191	27	2,546	32
Estimated natural background	18,088	21	1,336	17
Present day agriculture	5,103	6	1,210	15
Atmospheric Deposition	9,500	11	475	6

Source: MWS (b), 2006

Many human activities influence the introduction of nutrients to aquatic systems, the rate of loss of nutrients from the landscape, and the availability of nutrients to support nuisance algal growth (Bourne A. et.al., 2002). Nutrients from wildlife waste and leachate from vegetative material also contribute to increases the concentration of nitrogen and phosphorus in surface waters, especially in semiarid regions such as the Canadian Prairies, where the total volume of runoff is relatively small (Flaten et.al., 2003). It has been suggested that the quality of many Prairie water bodies was poor long before the beginning of any significant human activity in the region due to

these factors. However, in many cases, a variety of human activities has probably caused further deterioration in water quality.

Nutrients are deposited into Manitoba's waters through a variety of sources, including: erosion of naturally fertile soils and water courses, surface runoff of fertilizers from cultivated fields and natural areas, run-off from livestock pasture and feedlots, urban run-off and storm sewer discharges, agricultural, industrial, and urban sewage effluent discharges and atmospheric deposition.

Further information on the current situation of Manitoba's waterways can be found at several locations including:

- Manitoba Water Stewardship - http://www.gov.mb.ca/waterstewardship/water_quality/quality/index.html
- Lake Winnipeg Stewardship Board - http://www.lakewinnipeg.org/web/index.shtml
- Manitoba Phosphorus Expert Committee - http://www.gov.mb.ca/conservation/regoperations/livestock/
- Manitoba Livestock Manure Management Initiative - http://www.manure.mb.ca/index.htm

Proposed Regulations

The recently legislated *Water Protection Act* created a framework to improve water management and protection in Manitoba. The Act allows for the development of regulations to set water quality standards, objectives, and guidelines, as well as the development of water quality management zones and the ability to identify a framework for watershed planning (Manitoba Water Stewardship, 2005). Manitoba Water Stewardship has introduced the first draft regulation under the Water Protection Act with the intent to define land-based Water Quality Management Zones for Nutrients. The main purpose of this draft regulation is to protect water from nutrients that may arise from poor management of fertilizers, animal manure, and municipal wastewater sludge to adjacent lands beyond the amounts reasonably required for the benefit of crops and other plants within the immediate growing season.

The draft regulations outline two methods for protection: (a) defining land-based Water Quality Management Zones for Nutrients that are determined by agricultural or productive capability and related environmental factors that affect nutrient loss to water such as climate, moisture limitations, land slope, topography, soil texture, permeability, salinity, distance to ground water, stoniness, and erosion potential; and (b) defining buffer setback distances from water systems including wells and sinkholes.

Manitoba's agricultural landscape has been separated into four zones based on factors that define agricultural capability and include such things as land slope, topography, soil texture, permeability, distance to ground water, erosion potential, soil characteristics, and crop yield potential. The seven agricultural land classes, defined by the Canada Land Inventory Soil Capability Classification were then placed into the four categories to become the proposed Water Quality Management Zones for Nutrients.

The buffer setback distances from water are also identified in the draft regulations. The distances vary depending on crop, fertilization patterns, and type of water body.

For more information on the draft Water Quality Management Zones for Nutrients, refer to the Water Stewardship website, http://www.gov.mb.ca/waterstewardship/wqmz/ where several background documents are posted.

Agriculture Industry Concerns

In Manitoba, agriculture is one of the largest consumers of water and water quality is an important issue for a viable farm operations. Many farm families draw their own water from local ground and surface water sources, and as such know the importance of protecting the water quality. Livestock are particularly susceptible to poor quality water. Farmers know the importance of proper nutrient management, and recently research has provided an increased set of management tools to manage their nutrients on the farm.

Nitrogen and phosphorus are essential components of healthy ecosystems and occur naturally in the environment. This is equally important on a farm as both nutrients are used to improve crop production in agriculture. Replacing nutrients used by the crops is a necessary expense for farmers. Nitrogen is one of the most important nutrients used to increase and maintain crop production. Nitrogen fertilizers contribute to the increase and sustainability of high yields and economic viability across a variety of different agricultural ecosystems. Nitrogen fertilizer is produced in different chemical forms, such as urea, ammonia (NH_3), ammonium (NH_4), and nitrate (NO_3) (Delgado, 2000). Additionally, organic sources of nitrogen, such as manures and/or biological N_2 fixation are also used across different cropping systems. The variety of nitrogen sources differ in their ability to deliver the nutrients at the right time and place. While nitrogen from either inorganic or organic sources supports agricultural production, it can also impact water quality.

Phosphorus is required by all living organisms for the basic processes of life. In all animals it is required for bone growth and tooth development. Phosphorus is important for crop production, as it is used to form proteins, co-enzymes, nucleic acids, cell membranes, and is involved in energy transfer. Phosphorus has also been shown to be beneficial for root development, especially in cool, wet springs. The root development increases the plant's ability to uptake nutrients, which in turn promotes early crop development, seed development, disease resistance, early maturity and can increase yields (MPEC, 2006). Much of the agricultural land in Manitoba is naturally low in phosphorus and crops benefit from the application of phosphorus in either inorganic form, such as phosphates (PO_4) or organic forms, such as livestock manure (Flaten et.al., 2003).

The science of how nitrogen moves through the agriculture ecosystems and subsequently other ecosystems is better understood than phosphorus, and a variety of techniques to manage nitrogen have been developed. Nitrogen loading from agriculture was determined to be 5% while phosphorus was 14%. The challenge of addressing phosphorus movement from soils into water bodies is very complicated and so is the jurisdictional responsibility for managing these resources (Flaten et.al., 2003).

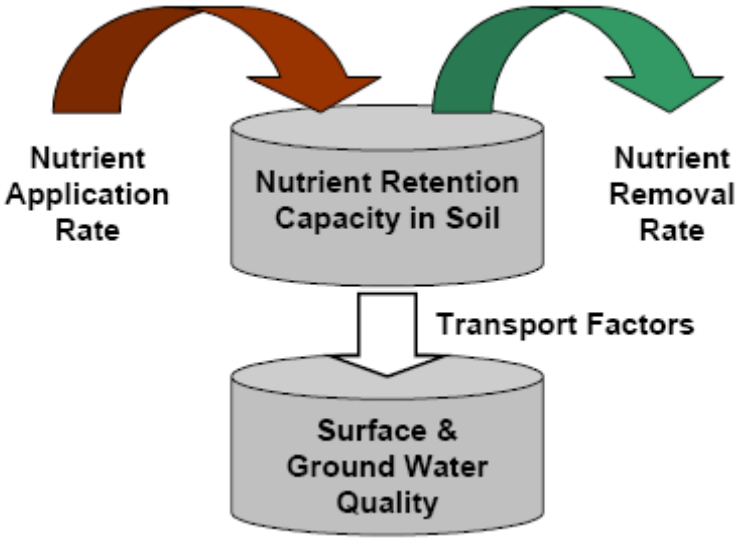
There are several methods to achieve water quality objectives. Quebec used the approach of developing water quality objectives in conjunction with its watershed stakeholders. Farmers and other stakeholders work together to develop strategies to meet the objectives, but are able to determine how (Quebec, 2002). This approach is similar to the methods used in Manitoba's Conservation Districts, but at a large scale. Quebec's Water Policy can be accessed at the following website: http://www.mddep.gouv.qc.ca/eau/politique/index-en.htm

Several examples exist on how the use of regulation has created friction between implementing agencies and farmers. Prince Edward Island introduced regulations on how farmers could farm their land and required the farmers to check with the department of Agriculture when they want to change a practice. This resulted in a breakdown of trust between the department and farmers (MacQuarrie, 2006). The Walkerton incident resulted in a similar problem because farmers were blamed for the water quality problems when it was a combination of a number of issues with the system. These examples highlight the importance of using appropriate systems to achieve objectives.

Some concerns have been expressed about the draft regulations proposed by Manitoba Water Stewardship because of some of the unintended impacts of the draft regulations on agriculture. Agriculture recognizes the need to manage nitrogen and phosphorus to protect water quality, but also recognize the importance of good science due to the complex nature of nutrient movement through the ecosystems.

Localized ecosystems and local management techniques can have a great influence on the movement of nutrients. As such, the use of large scale maps will not likely accurately predict the potential nutrient loading. More detailed maps will be required if that is to be the approached used as well as information on the timing and placement of the nutrients. Individual field assessments will produce the most accurate information. This approach would be quite costly and could prove to be problematic. The key to proper nutrient management knows the capacity of the soil, the amount of nutrients removed during harvest and the amount of nutrients applied to promote healthy plants. With proper soil testing, the nutrient retention in the soil will be known. With this information and proper management, the amount of nutrients able to transport to the surface or ground water will be decreased. The long term sustainability of nutrient management depends on matching the rate of nutrient application with the rate of nutrient removal as shown in Figure # 1.

Figure # 1



Source: Flaten et.al., 2003

Phosphorus is relatively immobile in the soil compared to nitrogen, although even a small amount of phosphorus in surface water can have a significant effect on water quality. The movement of phosphorus from the land to water can occur in particulate form, in a dissolved form, or directly as commercial fertilizer or manure through a process called incidental transfer (MPEC, 2006).

Most phosphorus in the soil is attached to soil particles. Soil erosion by water or wind can move this phosphorus into water. Dissolved phosphorus can move with water and is very difficult to control. The most effective way to reduce the risk of phosphorus loss from dissolved phosphorus is to control the build-up of phosphorus in the soil and control soil erosion. Incidental transfer of phosphorus is the direct movement of manure or fertilizer into a watercourse leading to a water body. Incidental transfer can occur when manure is surface-applied and then washed off by rainfall or snowmelt runoff. Winter or late fall surface application of manure increases the risk of incidental transfer of phosphorus from manure to water during spring runoff (MPEC, 2006).

In Manitoba a large majority of the phosphorus load is carried in the spring by snowmelt driven high flow events (Flaten et.al., 2003). This should put more attention on the location of the phosphorus relative to the amount. Both agricultural and urban runoff processes during snowmelt are less well understood than during rainfall events. Recent research from Manitoba, Europe and the U.S. shows that the role of leaching of dissolved phosphorus from vegetative material and crop residues may be relatively large in snowmelt runoff, compared to rainfall runoff. However, there is less research demonstrating methods which may reduce dissolved phosphorus losses during spring runoff. The lack of literature related to the interactions between phosphorus and snowmelt runoff indicates that more research is required to determine if management practices use to reduce phosphorus runoff from non-point sources are to be effective.

Although restricting the amount of nutrient applications will have some impact on the potential movement of nutrients from the soil to waterways, there are still a number of research questions that need to be answered before precise management practices can be identified, particularly in the case of phosphorus. For example, the placement of the fertilizer and the timing of application might prove to be more effective controls. It is important the research is conducted in a timely fashion to ensure that the desired impacts are being achieved and that they are practical.

Another concern is the economic impacts of the draft regulations on family farms, in particular, smaller livestock operations that do not have the necessary resources to address all of the regulations. This does not suggest that the smaller operations should not contribute to improving water quality, but that the necessary management tools and resources are made available to assist these farmers in improving water quality. The environmental impact of the farms might be small, but the economic impact could be quite large if, for example, they are required to store all of their manure for the winter in proper storage facilities. A number of programs do exist to assist with over-wintering and manure storage, but currently still leave a considerable economic burden for the farm. The current Beneficial Management Practices offered through the Canada-Manitoba Farm Stewardship Program allows up to 30% of the total to a maximum payment of $30,000 for this type of improvement, leaving a significant portion for the farm.

Options, in the form of policy and practical solutions, need to be developed that assists farmers in adapting to any regulations that come after the fact. Farmers do not want to ignore regulations that are good for the environment or society, but they need to be implemented in a way that the farmer can respond to.

From an equity perspective, if small scale farmers are expected to address water quality, it is appropriate for other polluters to reduce their nutrients moving into Manitoba's waters. The draft regulations do highlight some of the other sources of nutrients in the Water Quality Management Zones, such as municipal wastewater sludge; inorganic fertilizers applied to parklands and golf courses; cosmetic applications of inorganic fertilizers (to private properties); and location of municipal wastewater lagoons, manure storage facilities, and septic fields. There were some notable exceptions, such as the City of Winnipeg. Manitoba Water Stewardship has pointed out that a number of initiatives are underway in their Issues and Options report, such as:

- Licenses have been issued to the City of Winnipeg's west-end and north-end facilities requiring a 10 % reduction of phosphorus and a 13 % reduction of nitrogen to be achieved by the end of 2006.
- A further approximately 30 % reduction from the City of Winnipeg will be achieved by 2012 and up to a 65 % reduction of the City's nutrient discharges will be achieved by 2014.
- North Dakota and Minnesota have agreed to work with Manitoba through the International Joint Commission to reduce cross-border contributions of nutrients by 10 % by mid-2009 (Manitoba Water Stewardship, 2006).

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In some of the recent discussion documents, there was reference to creating a "Zone 5" for the City of Winnipeg. Including the major urban centres as "Zone 5" in the draft regulation would

improve the equity of the regulations, as Winnipeg was identified as a major source of both nitrogen and phosphorus.

Agriculture as Part of the Solution

In Manitoba, watershed management planning is becoming an increasingly larger component of the agricultural landscape. Farmers working together with other local stakeholders are developing strategies to protect and enhance the quality of water within their watershed with positive impacts down stream. Local planning tends to result in solutions that are acceptable with all stakeholders and are more inclined to be implemented because of the community "buy-in" to the projects as well as the ability to customize to the local operations.

Manitoba's Conservation Districts offer the ability to develop plans to address water quality issues in many of the rivers, streams and lakes in regions with Conservation Districts (CDs). The use of CDs to address water quality issues allows for more innovative solutions to be developed around land and water management. The key would be for the development of provincial or localized water quality objectives.

Agriculture has been activity on several initiatives that will contribute to improved water quality in Manitoba's waters. Agriculture and Agri-Food Canada, Manitoba Agriculture, Food and Rural Initiatives, Farm Stewardship Association of Manitoba, the Riparian Health Council, Keystone Agricultural Producers, Canadian Fertilizer Institute, a variety of conservation organizations and others are all developing or have developed programs to improve environmental impact. Most of the programs focus on beneficial management practices (BMPs) that farmers can use to improve their environmental impact, while some increase knowledge, such as the Certified Crop Advisor program offered by the Canadian Fertilizer Institute. Usually the BMPs have some form of incentive associated with them. Many of these initiatives have recently started or have been revised to have a greater impact. Although the programs do not necessarily have the goal of reducing nutrient loading in Manitoba's waterways, most of the BMPs do have a positive influence and prove to be useful in improve water quality.

New production techniques are being developed to reduce nitrogen and phosphorus loading. The hog industry has promoted research to reduce the phosphorus in manure by using improved feeding strategies and manure management strategies. Crop rotations have been developed to reduce the build up of nitrogen and phosphorus in the soil decreasing the potential for leaching and erosion impacts. The use of wetlands and other holding ponds to reduce the nutrients and runoff events are being researched with good results.

New technologies are also being developed to improve the measurements of nutrients in the soil and in manure to ensure the right rates. Soil testing and nutrient application technologies are being improved to allow more accurate applications and placement on the fields. Technology is currently being developed that will allow real time measurement of phosphorus and potentially other nutrients in manure during the transfer and application processes (Malley, 2006).

Environmental Farm Plans

The *Farm Stewardship Association of Manitoba* (FSAM) is working with the Governments of Canada and Manitoba to deliver the *Canada-Manitoba Environmental Farm Plan Program*. Farmers participate in an environmental farm plan (EFP) workshop where they receive assistance on an environmental assessment of their farm operation outlining their risks and benefits; and develop a plan to reduce their environmental risks (AAFC, 2005). The objectives of the Program are to help the agriculture sector better identify its impacts on the environment and promote the growth of stewardship activities within the agriculture industry.

Farmers are encouraged to develop environmental farm plans, implement beneficial management practices (BMPs)[2] and to continuously evaluate the environmental performance of their farming operations. The EFP process allows farmers to set priorities for actions which address on-farm environmental concerns, as well as those which serve the public interest. The EFP process is voluntary and confidential. Farmers who develop EFPs may be eligible for technical and financial assistance to implement their on-farm plans.

The Canada Manitoba Farm Stewardship Program (CMFSP) offers a wide range of practices for financial and technical assistance, including BMPs addressing manure and nutrient management, water quality, improved crop management, riparian management and wildlife management. A complete list of BMPs offered under the CMFSP and the level of financial support available for each practice is provided in Appendix A.

A variety of other organizations suggest BMPs to improve the water quality and other environmental concerns. The Riparian Health Council provides a list of BMPs offered by its partners they improve riparian health and improve water quality. Conservation agencies, such as: the Manitoba Habitat Heritage Corporation, Ducks Unlimited Canada, Nature Conservancy of Canada and Delta Waterfowl Foundation also offers programs to improve water quality and enhance wildlife habitat. Many of the programs have specific goals, but most have many other benefits to society and the environment, and in some case economic benefits to the farmer.

A number of organizations are activity in working with farmers to develop practical applications on their farmers. The Manitoba Conservation Districts work with all landowners in their region to develop good management techniques, and supply information to farmers to improve their knowledge for decision making. The Riparian Health Council also provides reports on the status of Manitoba's agricultural watersheds. These reports were developed in conjunction with AAFC-PFRA and can be found at the following website: (http://www.riparianhealth.ca/).

The Keystone Agricultural Producers are working in conjunction with several partners on the Alternative Land Use Services (ALUS) pilot project. The pilot project supports farmers in their efforts to maintain existing wetlands and riparian and natural areas, and to provide for permanent cover on fragile cultivated lands. Farmers in the Rural Municipality of Blanshard receive financial incentive to develop and maintain natural environments on their land, integrated with

[2] Beneficial management practices are actions taken by farmers to reduce the negative impacts on quality of water, soil, air, and/or biodiversity. These practices are practical do not negatively impact the long-term sustainability of the agricultural operation while ensuring the sustainability of the environment. The effective use of BMPs benefits both the farmer and society.

their agricultural lands. The program can also be used to support farming practices that provide environmental benefits. The concept is to motivate farmers to preserve and protect natural and fragile areas of land that have lower agricultural values but can provide environmental benefits for all Manitobans.

Several industry stewardship initiatives are being developed by organizations such as the Canadian Fertilizer Institute that focus on agricultural research that promotes efficient, environmentally responsible use of fertilizers for maximum economic yield for farmers. The initiatives include such activities as the Certified Crop Advisor (CCA) program and science based Best Management Practices.

A variety of efforts are underway to improve agriculture's ability to work sustainability. Building on these activities will be beneficial to Manitoba farmers and Manitoba's water quality.

Practical and Economical Solutions

One of the key measures to reduce potential nutrient loading in the waterways is the knowing capacity of the soil to retain the nutrients. Soil testing can be used to determine the soil retention capacity of the soil. Proper soil testing can ensure nutrient application rates, whether commercial fertilizer or animal manure, are appropriate for crop and soil needs and based on the amount of nutrients already in the soil. In the case of manure, testing the manure is also necessary in order to determine its nutrient concentration and appropriate rate. Proper application rates not only help to prevent excess nutrients from moving into the water system, either by direct runoff or into groundwater, but also help reduce the input costs for farmers.

Manitoba Agriculture, Food and Rural Initiatives reports that 26 per cent of the farmers soil test every year, 27 per cent every two to three years, 22 per cent every four years, and 25 per cent never test (Manitoba Agriculture, Food and Rural Initiatives, 2004). Many farmers who soil test regularly are not testing all of their fields, but only a few fields depending on the crops planted and the last soil test. A variety of agriculture companies offer soil testing to ensure their products are used correctly and the results are optimum. Testing regularly may also result in economic benefits by avoiding expenditures on un-needed fertilizers. Currently, test methods vary in laboratories across Manitoba and often differ from those in other jurisdictions providing service to Manitoba farmers (LWSB, 2005).

Commercial fertilizer use has risen substantially over the past three decades in Manitoba. Nitrogen and phosphorus applications have increased from about 25,000 tonnes each in 1965 to 309,000 tonnes of nitrogen and 46,000 tonnes of phosphorus by 2002 (LWSB, 2005). Most of the increase occurred before the 1980s. This increase in fertilizer application has generally been matched by an increase in crop removal of nitrogen and phosphorus, resulting in a nutrient balance in the soil.

Appropriate land management has been shown to have beneficial impacts on water quality. For example, conservation tillage is increasing in Manitoba and reduces erosion and movement of soil particles rich in nutrients into waterways. When done in conjunction with appropriate crop rotations, nutrient balances are achievable at reduce costs to the farmer.

Achieving a nutrient balance is important to the sustainability of agricultural production. If nutrients are removed through harvested grain or forage and not replaced, the fertility of the soil will decline. However, if excess rates of nutrients are applied, significant amounts of nitrogen and phosphorus can move off the land or through the soil and into surface water bodies. This is particularly essential for using manure for nutrients. One of the reasons why phosphorus from manure can increase to a point of being in excess of the crop's phosphorus requirements is that the N:P ratio of manure is typically 3:1 or less, whereas the N:P ratio of most crops is 4:1 or more (Flaten et.al., 2003). Most of soils outside of South Eastern Manitoba are able to accept commercial fertilizer or manure applications of phosphorus at rates which exceed crop requirements for several years. However, soils do not have an infinite capacity to store phosphorus without creating environmental hazards (LWSB, 2005). It is important to test manure and soil phosphorus levels and match the timing of crop demands to those levels. Currently in Manitoba the regulations focus on nitrogen levels in manure, resulting in surplus phosphorus in the soil. Soil and manure testing would be able to indicate the status of the nutrient levels in the soil and what application rates are required.

The recent increases in Manitoba's livestock production increases the risk of manure nutrients moving from agricultural land to surface water. Nutrients removed from the soil for feed production are not necessarily returned to the same soil to maintain soil quality and fertility. Most feed is not produced close to the livestock operations and land area surrounding the livestock operations is often insufficient or unsuitable for continued heavy application of nutrients. Research has given livestock producers a wide variety of potential techniques for reducing phosphorus discharge from their operations:

- **Location of livestock facilities.**
- **Improvement in feed efficiency.**
- **Improvement in phosphorus availability.**
- **Reduction in over-formulation.**
- **Phase feeding and feeding for optimum gain**.
- **Reduction of feed waste**.
- **Treatment systems to redistribute, recover or immobilize phosphorus.**

(Flaten et.al., 2003)

By using these techniques, farmers also have the potential to reduce feed costs, resulting in economic benefits.

In an effort to improve agriculture productivity, drainage networks have been developed over the decades due to the relatively flat nature of much of the agricultural landscape in Manitoba. This drainage has improved the potential for a successful crop by removing excess amounts of water from spring snowmelt and heavy rains. This drainage can increase the environmental risk to downstream water bodies, because the increased water velocity also increases the potential to erode stream banks and streambeds and release more nutrients into the water ways. This water can carry substantial quantities of dissolved nutrients, as well as suspended nutrients bound to soil particles (LWSB, 2005).

The use of grassed waterways can reduce the nutrient loading by slowing the flow of water, and allowing some of the excess nutrients to settle out. The grass itself will also consume some of

the nutrients. To ensure the health of the grass waterways and protect the water from becoming more of a source for nutrients, it is important not to let dead plant material build up. Several agencies offer BMPs to address the health of drainage waterways.

Containing run-off, from either livestock enclosures or crops, is also an appropriate technique to reduce nutrient loading. Wetlands and other forms of holding ponds allow nutrients to settle out of the water and also create a supply of water.

While it is difficult to establish how many farmers have adopted some form of BMP to improve water quality, the recent efforts from all of the organizations promoting BMPs will have a significant positive impact on the landscape. For example, the Farm Stewardship Association of Manitoba has been working with over 2,000 farmers to develop environmental farm plans. Since 1994, the Manitoba Habitat Heritage Corporation has worked on 105 projects, protecting 122 miles of shore line, 3,296 acres of riparian areas and 20,367 acres of pasture (MHHC, 2006). These are just some of the activities underway on the landscape, many others exist.

Conclusions / Recommendations

Water quality in Manitoba is in need of assistance from all stakeholders. The purpose of the Water Protection Act and the subsequent draft regulations, to protect water from nutrients that may arise from the over-application of fertilizers, animal manure, and municipal wastewater sludge to adjacent lands, is relevant to Manitoba's waters. The purpose should be modified to ensure that nutrients stay in the agro-ecosystem and are available at the right rate, place and time. It is important that nutrients from all sources are reduced from entering the water. Sectors contributing nutrients to Manitoba's waters should be treated based on their impacts on water quality.

The methods to improve water quality must be conducted in such a way to benefit the environment, society and the economics of the farm operations as well as the communities in the long term. Given the complex nature of nutrient loading and the impacts on water quality, accurate science must be the basis for all actions. A more proactive approach would be to follow the Quebec example and the example of Manitoba Conservation Districts and develop watershed management plans based on water quality objectives for Manitoba's waterways. Developing water quality objectives for local organizations, such as conservation districts, to address, will result in innovative solutions that could be shared throughout the province.

Although regulations can be an important component for a water quality strategy, they should be used to back stop more proactive initiatives. Regulations tend to create friction as people are being told what they must or must not do. Allowing local ideas to be developed to address problems result in more acceptance and in many cases better results. Opportunities must exist for the customization of BMP for local areas. When regulations are used, it is critical that they are based on the most accurate science possible, and updated as the science improves. A number of sources of information on water quality are available and should be accessed.

Given the complexity of water quality and the variety of potential method available to reduce nutrient loading, it would advantageous to implement pilot projects on areas of concern. Rivers

and streams that have shown substantial nutrient loading would be good tests of a variety of techniques. Lessons learnt from these watersheds could be applied to other watersheds.

Water quality issues are the focus of a variety of federal and provincial government agencies, as well as farm and conservation agencies. A number of these agencies have developed beneficial management practices for farmers to implement on their farms. Some of the agencies have financial incentives linked to the BMPs, while others have extension assistance. Opportunities exist for Water Stewardship to work with these agencies to ensure an appropriate balance is achieved between practical application and research and development to improved water quality in Manitoba. The Manitoba Water Protection Act provides resources, including funding to improve water quality in Manitoba. These funds could be used in conjunction with some of the other programs offered in the province to reach water quality goals.

Key Recommendations

- The Agriculture industry should highlight the type of activities currently underway on the landscape to improve water quality. Efforts should be made to document the impacts of these activities.
- Watershed management plans should be developed for watersheds of concern with specific objectives of water quality. This would create community "buy-in" and innovative solutions to improving water quality.
- Pilot projects should be developed to test a number of potential solutions to nutrient loading in Manitoba's waterways.
- Focus should first occur on areas of sensitivity, then applied on a broader basis once more accurate information is available.
- Adopt a sustainability approach that minimizes nutrient losses to the environment while considering economic, social and environmental impacts.
- Beneficial management practices should be developed specifically for water quality and specific regions of Manitoba and used in conjunction with other BMP programs.
- The current structure of the Canada-Manitoba Farm Stewardship Program requires significant financial input from the farmer to access BMP funds. Water Stewardship should use some of its resources to raise the amount of funds available to farmers to implement projects to improve or protect water quality.
- Regulations should not be introduced until sufficient tools and resources are available for the impact farmers. The regulations need to be based on as accurate as possible science, and efforts must be made not unduly impinge on the financial viability of the farm.
- Develop standardized testing of soils and manure designed for Manitoba soils and crops.

References

AAFC, *Advancing the development and implementation of environmental farm plans across Canada*, Agriculture and AgriFood Canada, 2005. (http://www.agr.gc.ca/env/efp-pfa/index_e.php?section=nfsp-png a&page=mb-efp-pfa)

Bourne, Alexandra, Nicole Armstrong, and Geoff Jones, *A Preliminary Estimate of Total Nitrogen and Total Phosphorus Loading to Streams in Manitoba, Canada*, Water Quality Management Section, Water Branch 2002.

Delgado, Jorge, *Control of Nitrogen Transformations to Increase Nitrogen-use Efficiency and Protect Environmental Quality*, in **Erosion Control**, Forester Communications Inc., May/June 2000.

Flaten , Don, Ken Snelgrove, Ian Halket, Kathy Buckley, Grant Penn, Wole Akinremi, Brian Wiebe, and Ed Tyrchniewicz, *Acceptable Phosphorus Concentrations in Soils and Impact on the Risk of Phosphorus Transfer from Manure Amended Soils to Surface Waters,* A Review of Literature for the Manitoba Livestock Manure Management Initiative, Phase 1 of MLMMI Project #02-HERS-01, May, 2003.

Jones, Geoff and Nicole Armstrong, *Long-term Trends in Total Nitrogen and Total Phosphorus concentrations in Manitoba Streams*, Water Quality Management Section, Water Branch, December 2001.

LWSB, *Our Collective Responsibility: Reducing Nutrient Loading to Lake Winnipeg: An Interim Report to the Minister of Manitoba Water Stewardship*, Lake Winnipeg Stewardship Board, 2005.

Malley, Diane, PDK Projects Inc., (Personal Communications) 2006.

Manitoba Agriculture, Food and Rural Initiatives, *Test Your Soil*, Manitoba Government, 2004.

MHHC, *Riparian Stewardship Program*, Manitoba Habitat Heritage Corporation, 2006 http://www.mhhc.mb.ca/riparian/steward.html

Manitoba Phosphorus Expert Committee, *Recommendations for Regulating Phosphorus from Livestock Operations in Manitoba*, Final report to the Manitoba Minister of Conservation January 2006.

Manitoba Water Stewardship, *Regulation under the Manitoba Water Protection Act*, Manitoba government, 2005.

Manitoba Water Stewardship, *Issues and Options Arising from Initial Consultations on Water Quality Management Zones for Nutrients, A Proposed Regulation Under the Water Protection Act*, Manitoba Government, 2006 (a).

Manitoba Water Stewardship, *Questions and Answers: Water Quality Management Zones for Nutrients, A Proposed Regulation Under the Water Protection Act*, Manitoba Government, 2006 (b).

Quebec, *Water. Our Life. Our Future. Quebec Water Policy*, Quebec, 2005 http://www.mddep.gouv.qc.ca/eau/politique/index-en.htm

Appendix A – Canada Manitoba Farm Stewardship Program BMP List

	BMP Category	Cost Share	Up To
1	Improved manure storage and handling	30%	$30,000
2	Manure treatment	30%	$30,000
3	Manure land application	30%	$10,000
4	In-barn improvements	30%	$20,000
5	Farmyard runoff control	50%	$20,000
6	Relocation of livestock confinement and horticultural facilities	50%	$30,000
7	Wintering site management	50%	$15,000
8	Product and waste management	30%	$15,000
9	Water well management	50%	$6,000
10	Riparian area management	50%	$20,000
11	Erosion control structures (riparian)	50%	$20,000
12	Erosion control structures (non riparian)	50%	$20,000
13	Land management for soils at risk	50%	$5,000
14	Improved cropping systems	30%	$15,000
15	Cover crops	30%	$5,000
16	Improved pest management	30%	$5,000
17	Nutrient recovery from waste water	30%	$10,000
18	Irrigation Management	30%	$10,000
19	Shelterbelt establishment	50%	$10,000
20	Invasive alien plant species control	50%	$5,000
21	Enhancing wildlife habitat and biodiversity	50%	$10,000
22	Species at risk	50%	$10,000
23	Preventing wildlife damage	30%	$10,000
24	Nutrient management planning	50%	$4,000
25	Integrated pest management planning	50%	$2,000
26	Grazing management planning	50%	$2,000
27	Soil erosion and salinity control planning	50%	$2,000
28	Biodiversity enhancement planning	50%	$2,000
29	Irrigation management planning	50%	$2,000
30	Riparian health assessment	50%	$2,000

(Source: http://www.agr.gc.ca/env/efp-pfa/index_e.php?section=nfsp-pnga&page=mb-nfsp-pnga)