iisd International Institute for Sustainable Development / Institut international du développement durable
http://www.iisd.org

Ecological Goods and Services: A review of best practice in policy and programing

Dimple Roy
Henry David Venema
Matthew McCandless

August 2011

Water Innovation Centre

Prepared for Manitoba Water Stewardship

Co-funded by Manitoba Water Stewardship and the Water Innovation Centre

Ecological Goods and Services: A review of best practices in policy and programing

Dimple Roy
Henry David Venema
Matthew McCandless

August 2011

Prepared for Manitoba Water Stewardship

Co-funded by Manitoba Water Stewardship and the Water Innovation Centre

Published by the International Institute for Sustainable Development

The International Institute for Sustainable Development (IISD) contributes to sustainable development by advancing policy recommendations on international trade and investment, economic policy, climate change and energy, and management of natural and social capital, as well as the enabling role of communication technologies in these areas. We report on international negotiations and disseminate knowledge gained through collaborative projects, resulting in more rigorous research, capacity building in developing countries, better networks spanning the North and the South, and better global connections among researchers, practitioners, citizens and policy-makers.

IISD's vision is better living for all—sustainably; its mission is to champion innovation, enabling societies to live sustainably. IISD is registered as a charitable organization in Canada and has 501(c)(3) status in the United States. IISD receives core operating support from the Government of Canada, provided through the Canadian International Development Agency (CIDA), the International Development Research Centre (IDRC) and Environment Canada, and from the Province of Manitoba. The Institute receives project funding from numerous governments inside and outside Canada, United Nations agencies, foundations and the private sector.

International Institute for Sustainable Development
161 Portage Avenue East, 6th Floor
Winnipeg, Manitoba
Canada R3B 0Y4
Tel: +1 (204) 958–7700
Fax: +1 (204) 958–7710
Email: info@iisd.ca
Website: http://www.iisd.org/

Table of Contents

Executive Summary

This research paper provides a review of programing and research in ecosystem goods and services (EGS) internationally and in Canada. The review was conducted to inform and guide policy that will enable the programing and management of priority EGS in Manitoba.

International Review. A review of international programs supported the understanding that EGS programing has gained significant impetus and momentum in the last few decades. Our review focused largely on the agricultural sector as a primary component of land management for environmental impacts as demands on land-based food production grow exponentially. Agricultural landscapes can provide a range of public and private benefits. Water quality and regulation, habitat provision, carbon sequestration and recreation are among the key EGS provided by agriculture. The use of landowner incentives to manage and conserve EGS in the agricultural sector has emerged as a popular policy instrument in Organisation for Economic Co-operation and Development (OECD) countries.

The 1992 Earth Summit in Rio de Janeiro, Brazil, recognized the "multifunctional aspect of agriculture, particularly with respect to food security and sustainable development" (Rio Declaration on Environment and Development, 1992) and underlies EGS programing in many OECD countries. Although multifunctionality can complicate EGS program design, implementation and monitoring, multi-objective EGS investment decision making is now common, which suggests that the public benefit of harnessing EGS synergies (between habitat conservation and water quality, for example) trumps the administrative simplicity of single-issue programing. Australia leads the way in EGS program design based on multiple objectives. Multiple objectives are optimized with the use of tools, such as the catchment modelling framework in the case of the Australian EcoTender program, and in the form of aggregate environmental indices, in the cases of the Environmental Quality Incentives Program (EQIP) and Wetlands Reserve Program (WRP) in the United States.

An important concurrent trend in EGS programing is the heightened expectation of public accountability, which reinforces the need for clarity in EGS investment decision logic and outcome measurement and accountability frameworks.

Our international review indicated growing attention to EGS program outcomes by government audit offices, including in Canada by the Office of the Auditor General of Canada in 2008 when it made a recommendation for more demonstrated results of agri-environmental programing. Currently operational EGS programs are being redesigned to address accountability concerns.

Geographic targeting of EGS expenditures appears to be an important practice for public accountability purposes and is a prominent feature of EGS programs reviewed in Australia, France, Switzerland, the United States and the United Kingdom. The Chesapeake Bay and the Mississippi River Basin programs are important examples of geographic targeting, where large drainage basins have been prioritized for water quality improvements and are also examples of national EGS programs linking to regional priorities and local targets.

Canadian Review. In our review of Canadian EGS programs, we examined the range of EGS pilots and regional initiatives, including some that were presented at the EGS technical meeting in Ottawa in April 2009. Many of the programs reviewed in this research were funded by Agriculture and Agri-Food Canada's 2008 Advancing Canadian Agriculture and Agri-Food (ACAAF) program, which focused on enhancing EGS.

Canadian programs of particular importance from a water quality perspective include the cases of the Pike River Watershed in Quebec and the Prince Edward Island EGS pilot, both of which effected demonstrable water quality improvements. The Pike River project demonstrated significant technological investments in watershed planning with remote sensing and co-benefit bundling such as biomass production to sequester nutrients. Environmental benefits at the watershed scale were achieved through the aggregation of benefits from hundreds of micro-watershed-based interventions made possible due to a high landowner participation rate.

The Prince Edward Island EGS project also provided valuable lessons that included the use of significant extension and technical support and the use of Comprehensive EGS Land Management Package (CLMP) approaches to yield modelled water quality improvements. The Lower Souris project in Southeast Saskatchewan was motivated by a holistic vision of improving watershed health while maintaining other objectives including biodiversity, landscape and water quality objectives. The use of technical tools and scenarios and community inputs into practice acceptance and historical land use practices are of significant value as a lesson to program design, as well.

Our review of Canadian research on the use of EGS programs and policies for natural resources management issues revealed that most research is focused on motivating EGS programing and on EGS program design optimization in very site-specific contexts. Canadian research has focused on cost-effectiveness, cost-minimization analyses, and social acceptability and willingness to pay for EGS management.

Generally, there is little evidence that suggests that the smaller pilot initiatives, regional impetus and research is being consolidated into any form of comprehensive approach, guidance or program on a national scale, such as the one seen in Australia where Caring for our Country has emerged from

regional initiatives and incorporates years of learning from those initiatives. An important exception to this general observation may be Prince Edward Island, where a provincial EGS program under the ALUS (Alternative Land Use Services) branding has been developed based on smaller pilots undertaken on Prince Edward Island and in Manitoba and Ontario.

There is relatively little experience in Canada of using regional environmental priorities to guide EGS program design, as has been demonstrated in the Mississippi River Basin and the Chesapeake Bay initiatives. A possible Canadian exception to this general observation is the case of Lake Simcoe, where a regional EGS program based on water quality trading is under consideration.[1] Our brief review of Manitoba programs reveals that there are multiple programs currently in place that capture different aspects of agricultural multifunctionality. These include the following:

- The Wetland Restoration Incentive Program (WRIP), administered by Manitoba Water Stewardship, provides incentives to landowners to restore wetlands on their land. The program, delivered in partnership with project partners Manitoba Habitat Heritage Corporation and Ducks Unlimited Canada, provides financial incentives, technical support, and advice to landowners.
- The Riparian Tax Credit Program, administered by Manitoba Finance, is designed to encourage farm operators to upgrade their management of lakeshores and stream banks to reduce erosion, buffer the extremes of the flood and drought cycle, improve water quality downstream, and reduce emission of greenhouse gases. The delivery mechanism for this program is through a property tax credit.
- The Environmental Farm Action Program (EFAP) offered by Manitoba Agriculture Food and Rural Initiatives supports agricultural producers in reducing identified environmental risks, including those to water resources, air quality, soil productivity and wildlife habitat; it also improves the management of Manitoba's agricultural land. Beneficial management practices funded under this initiative cover a broad variety and include waste management, site, management, nutrient management, livestock management, and precision agriculture applications.
- The Manitoba Sustainable Agriculture Practices Program (MSAPP) is administered by Manitoba Agriculture, Food and Rural Initiatives and is designed to achieve greenhouse gas emission reductions in the agriculture sector, as well as improved water quality, enhanced profitability and greater energy efficiency. Funding is provided in areas including fertilizer and nutrient management, manure management and treatment, composting, feeding and grazing strategies, cropping systems and others.

[1]See http://www.ebr.gov.on.ca/ERS-WEB-External/displaynoticecontent.do?noticeId=MTA4ODcz&statusId=MTYzNDU2&language=en.

The Government of Manitoba may wish to consider a consolidated programmatic approach, incorporating the objectives of some existing programs and consistent with emerging norms, including monitoring, performance measurement and adaptive management protocols. The International Institute for Sustainable Development believes the program synergies and water quality improvements will be maximized if the EGS programing in Manitoba is delivered on a watershed basis and, as conceived, as a key delivery mechanism for integrated watershed management and planning. Based on our review, we observe that watershed-based EGS programing is compatible with wetlands, riparian, habitat and greenhouse gas EGS objectives and is uniquely well suited to water quality objectives.

1.0 Introduction

Ecosystem goods and services (EGS) are products of healthy, functioning ecosystems. These goods and services may be valued in markets or may be considered outside of existing markets, but their management constitutes an important investment in environmental and social sustainability for current and future generations.

Many countries have undergone a fundamental shift in the last few decades, from regulatory approaches for the management and conservation of environmental resources, to the use of a wide range of economic and market-based instruments such as taxes and charges based on the "polluter pays" principle. These instruments have evolved further into incentive payments, often from government agencies, for ecosystem stewardship for the restoration and management of EGS (EnviroEconomics, 2009).[2]

Investment of resources into the management of EGS can be found in many different forms—government regulations, incentives, market mechanisms, education instruments, institutional reform and management, and so forth. The use of economic instruments has gained momentum for the management of EGS and within this category lies a variety of market and non-market-based instruments: tax incentives, direct payments, subsidies or simply government resource allocations toward the valuation and management of these EGS constitute non-market instruments. Market-based instruments include trading in carbon offsets, water quality and biodiversity credits, offset banking, and so forth. Apart from the differences in the policy instruments, there are also differences in the delivery mechanisms of incentives for EGS management; these mechanisms include reverse auctions and direct payments (annual, one-time, or phased).

Manitoba has embarked on a multi-stakeholder process to develop a policy to recognize and enhance the management of EGS. For this purpose, the International Institute for Sustainable Development was engaged to undertake a review of regional, national and international programs that might inform ways in which co-benefits in the broader field of environmental conservation and climate change mitigation and adaptation, maximizing environmental outcomes could be incorporated into economically efficient and targeted EGS programs.

This report contributes to this priority-setting exercise through a review of EGS policies and programs outside of Manitoba. Through a review of their priority setting and targeting processes, as

[2] Copyright Her Majesty The Queen in Right of Canada, Environment Canada, 31 March 2009. Reproduced with the permission of the Minister of Public Works and Government Services Canada.

well as instruments and delivery mechanisms, we can determine the opportunities and challenges for a Manitoba-based EGS policy and programs.

1.1 Ecosystem Goods and Services

Ecosystems goods and services are the benefits arising to humans from the ecological functioning of healthy productive ecological systems. Ecosystems provide food and clean water; they manage disease, they regulate our climate, and they can provide us with spiritual fulfillment (Millennium Ecosystem Assessment, 2005). Humans depend on ecosystems to provide us with these necessities of life, but we have not been managing them well. Challenges have arisen as a result of improper or inadequate human management: approximately 60 per cent of ecosystem services are degrading or are being used unsustainably; these changes are non-linear and often abrupt when systems reach tipping points; the harmful effects of these changes are borne disproportionately by the world's poor (Millennium Ecosystem Assessment, 2005).

The EGS humans depend upon can be market commodities or they can be externalities. Market goods produced by ecosystems include food, fibre and fuel. Non-market ecosystem process benefits include nutrient cycling, water purification and pollination. Non-material EGS benefits are less tangible, such as aesthetic values and recreation. Agriculture is both a beneficiary and provider of ecosystem services.

1.2 EGS and Agriculture

Agriculture is deeply intertwined with EGS. Agriculture is both a provider and beneficiary of EGS. The viability of agriculture depends on ecosystem processes such as soil formation, climate regulation and precipitation. Farmland also provides value to society such as fish and wildlife habitat, scenic views, and purification of air and water through natural processes. As a provider of EGS, agriculture endows us with commodities such as food, fibre and fuel. In contrast to agricultural commodities, environmental stewardship services are often undersupplied by farmers due to absent or weak pricing signals (Mann and Wüstemann, 2008).

The challenge for agriculture and EGS is that producers benefit only from selling commodities such as food and fibre, while EGS such as wildlife habitat and purification of water and air are public benefits. Because these are positive environmental externalities, producers generally do not receive compensation for the enhancement of these EGS. This creates a policy gap to be addressed by governments. Addressing this gap involves gaining an understanding of public demands for ecosystem services and how this differs from the level EGS farmers are willing to provide under existing policy, regulatory and market environments.

The EGS of most relevance to agri-environmental policy-makers are those that produce a perceptible impact and are amenable to quantification and measurement. For example, benefits from the EGS "conservation of soil biochemical structure" are not noticed by the general public. Similarly, for purposes of measurement and accountability, EGS that do not produce quantifiable biophysical change are not ideal for agri-environmental EGS policy. An example of an EGS whose benefits are difficult to quantify would be "creation of favourable microclimates." EGS most amenable to agri-environmental programing include:

- Conservation/restoration of water physical quality,
- Conservation/restoration of water biochemical quality,
- Conservation/restoration of moisture balance,
- Conservation/restoration of biodiversity in wetlands and aquatic environments,
- Reducing odour and dust,
- Carbon storage,
- Micro-climate maintenance, and
- Habitat creation and landscape protection.

1.3 The Evolution of EGS Programing

Programs and policies have been put in place by governments to procure EGS. The first programs began in the 1980s and have been evolving in both scope and complexity since. Expenditures for EGS programing have risen rapidly (see Figure 1). In 1993 the European Commission expended 100 million euros on agri-environmental programs, rising to over 2 billion euros in 2003 (European Commission, 2005). In the United States, the 2007 Farm Bill increased conservation programing in years 2008 to 2017, from US$7 billion to US$48.7 billion (Hajkowicz et al., 2009).

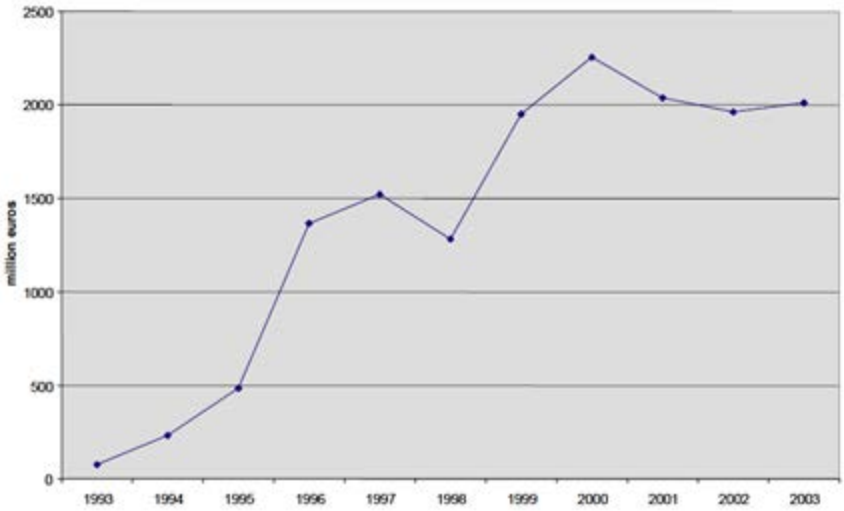

Figure 1: European Commission agri-environmental program expenditures from 1993 to 2003 (European Commission, 2005).

The first programs were often put in place for the benefit of a single environmental good or service. Building on the lessons gained from the first iteration of EGS programs, the second generation can be defined by a scaling up of programs and the recognition of their multiple benefits (Hajkowicz, 2009a). Beginning in the 1990s, programs aimed to increase cost efficiency and began to explore innovative funding mechanisms and the creation of EGS markets (Hajkowicz, 2009a). Presently we are entering an era of accountability, where the focus of changes to EGS programs will shift toward improved targeting and increasing the benefits flowing to the public. The following paragraphs trace the evolution of agri-environmental EGS programs since their first appearance, up to the present time.

1.3.1 Attitude and Awareness Change

Research on the environmental considerations of agriculture is not new. Some beneficial management practices (BMPs), such as terracing on contoured slopes, began shortly after the advent of agriculture on the Fertile Crescent 9,000 years ago, and the adaptation of agriculture to local climatic and environmental conditions through changing management practices has continued since. In North America, the dust bowl of the 1930s led to the formation of the Prairie Farm Rehabilitation Administration in Canada and the Natural Resources Conservation Service in the United States. The goals of these agencies were centred on maintaining the viability of agriculture in sensitive, often drought-prone areas. Through the implementation of BMPs tailored to agriculture on the plains of North America, agriculture has adapted and thrived in the face of multiple challenges.

Traditionally, BMPs have been implemented in order to increase private benefits and reduce on-farm risk. Coinciding with the increasing trend of farming from fence to fence after the green revolution, agriculture received increased scrutiny of its environmental performance. This shift came out of a greater concern about environmental issues and a realization that on-farm activities can produce off-farm externalities. The rise of public awareness regarding the environmental impacts of agriculture spawned new thinking in terms of BMP research and programing. From focusing on on-farm viability and productivity, this new dimension would address demands from society for cleaner air and water, and better wildlife habitat.

The first programs aimed at enhancing EGS from agricultural activities began in the 1980s. One of the most recognized EGS programs was proclaimed in the 1985 US Farm Bill. Under the Conservation Reserve Program (CRP), farmers receive payments for withdrawing land from production. The purpose of the initial five-year implementation of CRP was to reduce erosion (Hajkowicz et al., 2009).

In Australia, pressure from the Australian Conservation Foundation and the National Farmers Federation on agri-environmental issues culminated with the launch of the National Landcare Program in 1989 (Hajkowicz et al., 2009). This program served to increase awareness among farmers and conservationists about on-farm management processes. The program was seen as the building block for the rapid growth and success of EGS programing in Australia.

In the United Kingdom, the Countryside Stewardship Scheme was launched in 1991 with a goal for land managers to conserve, enhance or re-create important landscape types. Projects were funded partly on their abilities to improve landscape and wildlife habitat, conserve historical value, and provide public access. Over 531,000 hectares were enrolled in the program (Hajkowicz et al., 2009).

1.3.2 Multifunctionality

The trend of recognizing the multiple benefits of agriculture reached the international sphere in 1992 at the Earth Summit in Rio de Janeiro, Brazil. It was enshrined that the benefits of agriculture extend beyond the provision of food and fibre, recognizing the "multifunctional aspect of agriculture, particularly with regard to food security and sustainable development" (Rio Declaration on Environment and Development, 1992). This declaration served to reinforce a policy direction upon which many OECD countries had already embarked regarding their agricultural EGS programing.

In 1990 federal auditors in the United States expressed concern that funding allocations under the CRP were being made based on a single criterion (erosion) when in fact the benefits of land

retirement are multiple (Hajkowicz et al., 2009). It was recommended that value to taxpayers could be enhanced if the program could target multiple outcomes, rather than simply soil erosion (Ribaudo et al., 2001). This led to the development of the CRP's Environmental Benefits Index (EBI). Under this scheme, funding would be made to undertakings with the highest total EBI scores.

Further recognizing the multifunctional aspect of agriculture, the 1996 US Farm Bill introduced the Environmental Quality Incentives Program (EQIP). Unlike the CRP, which provides farmers with payments to retire farmland, EQIP provides payments to farmers for enhancing EGS from productive farmland (Soil and Water Conservation Society, 2007; Hajkowicz et al., 2009). The EQIP program uses an index similar to the CRP's EBI. The EQIP's index consists of 31 parameters for allocating funds (Government Accounting Office, 2006; Soil and Water Conservation Society, 2007).

In Australia, the Natural Heritage Trust was launched in 1997 (Hajkowicz, 2009a; 2009b). This program allocated funds through state governments to regional groups for EGS enhancement activities. These activities tended to be centred on wildlife habitat, water quality, water conservation and soil quality (Hajkowicz, 2008; 2009b).

1.3.3 Cost-Efficiency and Accountability

As agricultural EGS program have grown, focus and attention from federal treasuries has also grown, as expenditures rise (Hajkowicz, 2009a). Agriculture departments and ministries have been challenged on how to target programing, how to implement it, and how to track progress. Although focus during the 1980s and 1990s has been on raising awareness and expanding programs, the current trend has been on how to be more accountable to taxpayers (the buyers of EGS) when procuring EGS from private landowners. The current development of EGS programing is generally following this trend.

The Government Accounting Office (GAO) in the United States has to a large extent directed changes and improvements to EGS program efficiency. These include changes to CRP and EQIP to enhance their value to society. It was the GAO that first imposed the concept of multifunctionality on the CRP by proposing improvements that eventually led to the development of the EBI.

In recent years the trend has been for auditors to examine programs not from the perspective of program efficiency, but from the perspective of the EGS buyer (the taxpayer). The buyer is the public that procures EGS. The recommendations have focused on enhancing the value received in exchange for EGS payments to landowners. Excerpts from monumental auditor statements from the United States, Australia, Europe and Canada are presented below.

In 2002 the GAO stated:

> …while USDA's [US Department of Agriculture] conservation programs are generally effective, some targeted programs are more effective than others in addressing specific environmental concerns. (GAO, 2002, p. 3)

> We are making a recommendation to the secretary of agriculture to take into consideration committee members' views on ways to increase the environmental benefits of conservation programs as USDA modifies or develops regulations for programs reauthorized or created by the omnibus farm bill. (GAO, 2002, p. 4)

In 2006 the GAO noted on EQIP:

> NRCS's funding process is not clearly linked to EQIP's purpose of optimizing environmental benefits. (GAO, 2006, p. 3)

In Europe:

> The main shortcoming found in the monitoring and evaluation system was that it does not provide sufficient and reliable information on what was financed and what was achieved. (European Court of Auditors, 2006, p. 1)

In Australia, 1997:

> The lack of operational objectives makes it difficult to determine the extent to which programs are achieving their intended outcomes. (Australian National Audit Office [ANAO], 1997, p. xv)

> …targets and milestones...have not been applied effectively by all parties. (ANAO, 1997, p. xvi)

> Overall, monitoring, review and performance reporting has been variable across programs and falls short of identified better practice. (ANAO, 1997, p. xvii)

In Australia, eleven years later:

> …DAFF and [Natural Heritage Trust] annual reports [have] been insufficient to make an informed judgment as to the progress of the programs towards either outcomes or intermediate outcomes. (ANAO, 2008, p. 102)

> ...stronger targeting of [Natural Heritage Trust] towards the highest priorities and most critical national assets is necessary to achieve measurable results. (ANAO, 2008, p. 24)

The response to these concerns in the United States has been to review and fine tune the indices used to allocate funding. These reviews include examining the criteria of the programs to ensure they conform to public priorities. Because the criteria in the EQIP and CRP indices are weighted, the specific weightings have come under review.

Rather than adjusting the existing funding mechanisms as the United States has done, Australia has opted to redesign the entire process. Previous EGS programs were terminated in 2008 and some elements of them have been incorporated into a new program, Caring for our Country (CfoC). Australia is now working to ensure that its processes conform to public expectations and are accountable. The use of multi-criteria decision-making involving stakeholder input and review is a strong influence on the redesigned program (Hajkowicz, 2009a).

In Canada, EGS programs have gone largely unnoticed by auditors; however, this changed markedly in December 2008:

> The [Agriculture and Agri-Food Canada] Department does not know to what extent its environmental programs have improved the environment. Departmental reporting is limited because it does not monitor and report on program results beyond outputs, such as the number of completed water projects (for example, wells and pipelines). As a result, senior management cannot be certain whether programs are achieving their intended results and where improvements are needed. The Department has spent about $370 million on environmental projects, but lacks sufficient data to demonstrate that action at the farm level has led to positive environmental change. (Office of the Auditor General of Canada, 2008, p. 2)

The need for performance measurement is a crucial criterion that has been identified as a global need, particularly in agri-environmental management. This will need to be considered when initiating, designing and implementing EGS programs both on a regional basis in Manitoba and nationally in Canada.

2.0 Review of EGS Policies and Programs

Many countries around the world have undergone a shift in environmental protection and management, away from regulatory approaches to the use of a wide range of economic instruments. These economic instruments include market instruments such as cap-and-trade as well as non-market-based instruments such as taxes, financial incentives, tax credits, user charges, and so forth. Many countries have begun to set in place frameworks that shift the emphasis from valuing environmental damage to highlighting the value of maintaining and restoring EGS (EnviroEconomics, 2009).[3]

Apart from carbon markets, economic policies for EGS maintenance and enhancement have gained popularity in biodiversity-related, as well as watershed-related, EGS. Drinking water quality has provided the impetus for some of the well-known EGS programs, including the cases of New York City and the case of the natural mineral water company Vittel, a Nestlé subsidiary, paying farmers to improve their agricultural practices to reduce nutrients and improve water quality.

The United States has perhaps the longest history in deploying price-based market instruments for EGS. The CRP, established in the United States in 1985, is typical of many voluntary agricultural EGS programs to compensate farmers for taking land out of production and implementing long-term conservation measures.

Early attempts at EGS incentives programs were in localized regions or issues where cause and effect relationships would be clearly defined. Drinking water quality is one such issue with a close link between cause and effect, and was one of the first areas where price-based compensation policies were adopted. In addition, it was found to be easier to generate long-term recurrent payment streams in watershed -based markets that are local in nature and where water users downstream provide the funds and payments to watershed managers in the upper part of the watershed.

In cases such as Australia, where water-related stresses have been prominent in the last few decades, these localized programs have evolved to national programs on natural resources management incorporating lessons from smaller, regional pilot initiatives. The Australian examples are also rich sources of lessons on designing EGS programs for multiple outcomes and maximizing accountability.

[3] Copyright Her Majesty The Queen in Right of Canada, Environment Canada, 31 March 2009. Reproduced with the permission of the Minister of Public Works and Government Services Canada.

The following section provides an overview of selected EGS policies and programs from around the world. Reviews such as this one have been conducted by Environment Canada (EnviroEconomics, 2009), as well as for the Ontario Ministry of Agriculture, Food and Rural Affairs (Draft—2010). This study has benefitted from those complementary studies.

Each case example is organized to explain the motivation behind the EGS policy–program, implementation instruments and methods, treatment of co-benefits, coordination with other programs, investment/resource allocation decision processes, and outcomes and status, as reported in our review sources.

Our review was limited to policies and programs most relevant to the Manitoba context. This entailed that our review was based on cases in developed countries with a significant agricultural component. In some cases, agri-environmental programing has served as the sole EGS program reviewed. Also for this reason, we did not focus our review on regions with significantly different socio-economic, political or market contexts (for example, on areas of significant water stress and where water quantity markets are prevalent).

2.1 Agriculture Environmental Stewardship Program, United Kingdom

Scale of programing. The scale of programing is at the national level.

Motivation. Ecosystems goods and services have primarily been applied to the United Kingdom's agricultural sector. According to UK Agriculture.com,[4] farmers are responsible for about 75 per cent of the United Kingdom's surface area and for maintaining many features perceived as "countryside," including hedges, ditches, meadows or copses. In 2002 it was estimated that UK-based agriculture-generated environmental services (including aesthetic value, recreation and amenity, water accumulation and supply, nutrient recycling and fixation, soil formation, wildlife protection, storm protection and flood control, carbon sequestration, and so forth) were worth £0.9 billion annually, and the costs of damage to natural resources from agriculture were estimated to be £400 million annually.[5]

The United Kingdom's Agriculture Environmental Stewardship (ES) program is intended to improve the environmental conditions of the rural landscape and target farmers and landowners. It has the following objectives:

[4] Seehttp://www.ukagriculture.com/uk_farming.cfm.
[5] See http://www.ukagriculture.com.

- Conserve biodiversity;
- Maintain and enhance landscape quality and character;
- Protect the historic environment and natural resources; and
- Promote public access and understanding of the countryside.

History. Figure 2.1 outlines an abbreviated history of the United Kingdom's Agriculture Environmental Stewardship program.

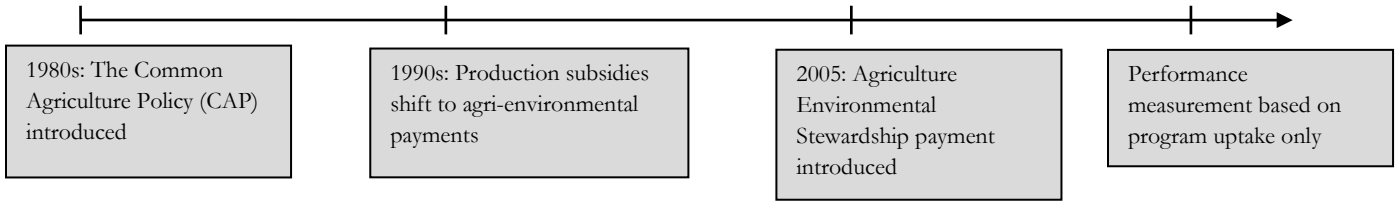

Figure 2.1: Brief history of Agriculture Environmental Stewardship Program, United Kingdom.

Execution/implementation. Three levels of programing are available under the ES program:

1. Entry level stewardship (ELS), wherein the applicant is given a list of management practices they must select from that go beyond the regulated requirements to maintain land in good agricultural and environmental condition. Each action has a corresponding point score and the applicant must select enough options to reach 30 points per hectare of land they are entering into the scheme. There are approximately 50 different options. Participants receive £30/year for every hectare in this program, for 5-year terms.
2. Organic entry level stewardship (OELS), where the same processes and rules apply as ELS, but for land under organic agriculture. Participants receive £60/year for every hectare in this program, for 5-year terms. Top-up aid is also provided to convert to organic agriculture: £175 per hectare per year for two years for improved land and £600 per hectare per year for established top fruit orchards.
3. Higher level stewardship (HLS): This scheme requires a higher level of commitment from the applicants, as they will be required to deliver more significant environmental benefits. This program targets environmentally sensitive areas and areas of significant cultural or natural heritage. The management options required of the applicant will be a mix of ELS and OELS options in combination with higher level requirements which depend upon the unique characteristics of the land and landscape. Yearly payments can range from £583 per hectare per year for advanced scrubland management to £2.10/m2 for pond area restored. HLS applicants will also receive up to 100 per cent of the costs associated with capital investments, such as the reversion of land to native species.

Treatment of co-benefits. The program objectives include the following co-benefits:

- Conserve biodiversity;
- Maintain and enhance landscape quality and character;
- Protect the historic environment and natural resources; and
- Promote public access and understanding of the countryside.

Investment/resource allocation decision process. Incentive structures and payments are based on the quality of EGS provided and the type of action undertaken. Payments are per hectare and scaled to the level of EGS supplied, creating an incentive to include a larger area of land under programing. The United Kingdom has mapped environmental stewardship programs, environmentally sensitive areas, sites of special scientific interest, biodiversity action plan priority habitats and targeted areas, as well as agri-environmental delivery on specific areas (www.natureonthemap.org.uk).

Outcome/status/impacts. The ES programs were introduced in 2005, and by 2007 there were 34,000 agreement holders managing 4.7 million hectares under the ELS program. The HLS program had 1,200 agreement holders covering 83,000 hectares of land. Almost all HLS agreement holders had an ELS agreement as well. Performance evaluation has been largely on the basis of program uptake and some relate to bird populations in an effort to indicate biodiversity. Overall environmental success based on soil or water quality, biodiversity, etc. has not been found in this review (EnviroEconomics, 2009;[6] also see http://www.naturalengland.org.uk/ourwork/farming/funding/aesiereport.aspx).

2.2 Natural Resource Management Programs, Australia

Scale. Multiple regional pilots are implemented and lessons incorporated into the design of a national scale program.

Motivation. Around 60 per cent of Australia's land area is covered by agricultural establishments (Australian Bureau of Statistics, 1998; 2007). The enormous land area devoted to agriculture created significant opportunities and challenges for securing environmental services. In Australia, the reinvestment of human-built capital into natural capital has accelerated in recent decades. Over the past 30 years, successive Australian governments have funded increasingly large natural resource management programs (Crowley, 2001).

[6] Copyright Her Majesty The Queen in Right of Canada, Environment Canada, 31March 2009. Reproduced with the permission of the Minister of Public Works and Government Services Canada.

The main agri-environmental issues in Australia and the primary drivers of EGS programing in the agricultural sector are, as determined by a national land degradation survey (Hajkowicz, 2009a):

- Wind erosion;
- Water erosion;
- Vegetation damage; and
- Salinity.

History. Figure 2.2 outlines an abbreviated history of Australia's Natural Resource Management Programs.

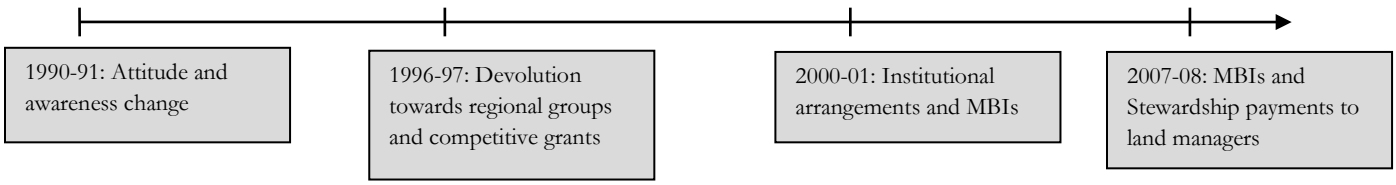

Figure 2.2: Brief history of Natural Resource Management Programs, Australia.

[*Execution/implementation.* EGS programing in Australia has been implemented through a series of pilot initiatives. These include the BushTender, BushBroker and EcoTender programs in Victoria, the BioBanking in New South Wales, Hunter River Salinity Trading Scheme, Load-Based Licensing, Moretom Bay Nutrient Trading and Vegetation Incentives Program. The INFFER tool (see below) is used in agri-environmental resource allocations decisions in government departments and by natural resource management.

Designer Carrots, a website on the use of market-based instruments (MBIs) for natural resource management change (http://www.marketbasedinstruments.gov.au/Home/tabid/36/Default.aspx), gives three case studies of types of MBIs used in Australia: conservation tenders or auctions, and using existing markets and cap-and-trade mechanisms.

The programs are implemented by different agencies at the different levels of government, as follows:

Government of Australia:

- Determining agri-environmental issues of national concern;
- Overseeing financial operation of the agriculture sector and ensuring that agri-environmental programs deliver value for money; and

- Negotiating bilateral agreements with state governments on the implementation of agri-environmental programing.

State Governments:

- Negotiating agreements with the federal government;
- Determining state and local priorities; and
- Allocating funding to local and regional institutions at the sub-state level.

Regional Institutions (the structure and make-up of regional institutions differs for each state):

- South Australia (SA): 8 regional groups whose powers are defined by the Natural Resource Management Act of 2004.
- New South Wales (NSW): 13 watershed -based agencies with authorities established by the Catchment Management Act of 2003.
- Victoria (VIC): 10 watershed -based authorities based with authority granted by the Catchment and Land Protection Act of 1994.
- Tasmania (T): 3 regional agencies with authority vested by the Tasmanian Natural Resource Management Act of 2004.
- Queensland (QLD): 14 regional groups with bilateral agreements with the QLD government formed for regional implementation of NHT initiatives.
- Western Australia (WA): 6 regional groups with bilateral agreements with the state government for allocation and management of NHT funds at the regional level.
- Territories: both the Australian Capital Territory (ACT) and Northern Territory (NT) have one single territorial agency formed by bilateral agreement (Hajkowicz, 2009a).

Treatment of co-benefits. Some Australian pilot initiatives have specifically been designed to derive multiple environmental outcomes (co-benefits) from natural resource and land use management. For example, the Onkaparinga Catchment Care[7] was designed to achieve multiple outcomes from changes in land management. EcoTender[8] was also designed to deliver multiple environmental outcomes associated with enhanced management of native vegetation. The catchment modelling framework (CMF) associated with EcoTender incorporates information on carbon sequestration, terrestrial biodiversity, aquatic function and saline land area.

[7]See http://www.marketbasedinstruments.gov.au/MBIsinaction/MBItypesinaction/Conservationtenders/OnkaparingaCatchmentCare/tabid/225/Default.aspx.
[8] See http://www.marketbasedinstruments.gov.au/MBIsinaction/MBItypesinaction/Conservationtenders/EcoTenderVictoria/tabid/226/Default.aspx.

Coordination with other programs. Australian EGS programing has seen tremendous growth in the past few decades. A longstanding drought, forest fires, and high level national environmental priorities such as the protection of the Great Barrier Reef may all have contributed to the development of high level political and institutional will and capacity with this programing and activities. It evolution has led to more coordination with national and regional level land and water management programs in general, such as the National soil conservation program (1983-1989), National land program (1989-2008), National Heritage Trust (1996-2008), National Action Plan for Salinity and Water Quality (2000-2008), and Caring for our Country (2008-present).

Investment/resource allocation decision process. An innovative framework used in the Australian context is the Investment Framework for Environmental Resources (INFFER). INFFER is a tool for developing and prioritizing projects to address environmental issues such as water quality, biodiversity, environmental pests and land degradation. It can operate at a range of scales and helps decision-makers achieve the most valuable environmental outcomes with limited available resources. Many regional environmental bodies in Australia are using or trying it in the context of environmental management decision-making. The INFFER process involves seven steps: develop a list of significant natural assets in the relevant region; apply an initial filter to the asset list, using a simplified set of criteria; define projects and conduct detailed assessments of them; select priority projects; develop investment plans or funding proposals; implement funded projects; and monitor, evaluate and adaptively management projects. Detailed information on INFFER can be found at http://cyllene.uwa.edu.au/~dpannell/inffer-begin.htm.

As stated above, the EcoTender process uses a CMF to determine the most cost-efficient and effective management actions. The CMF uses soils, topography and land cover in the catchment and considers factors such as daily soil-water-plant interactions, overland flow processes, soil loss, and so forth. This framework provides the scientific assessment of the environmental impacts resulting from either of the changed practices, specific for a given place (farm or field within the catchment). For the EcoTender program, the CMF incorporates information on multiple outcomes including carbon, terrestrial biodiversity, aquatic function and saline land area.

The general process for setting priorities in Australia in the various levels of government programing is as follows:

- At the national level, environmental objectives are identified: biological diversity, soil quality, natural risks, water resource quality, water resource quantity management, air quality, landscape and cultural heritage. A national catalogue of measures—BMPs that go beyond regulatory requirements and entitling implementers to subsidies—has been developed. Priorities are based on European priorities, scientific criteria and a negotiation process.

- Each State goes through a process to determine how funds should be allocated. This is often done through conducting a multi-criteria analysis amongst key stakeholders and representatives of the key regions.
- At the regional level, institutions use various means to allocate funding. These methods include a multi-criteria analysis (EcoTender), indicator analysis (Liverpool Plains Land Management Tenders Program, Northern Tasmanian Sustainability index), and parameters to prioritize bids (McKay-Whitsunday regional group).

Outcome/status/impacts. EcoTender has demonstrated the value of multi-outcome tenders in comparison with single-outcome tenders in the presence of sufficient scientific and modelling capacity to reliably inform the process. EcoTender made it possible to achieve better and more cost-effective outcomes than would be possible under either a single-outcome auction approach, or a number of single-outcome auctions (e.g., separate tenders for salinity, biodiversity, water quality and carbon services associated with native vegetation). The tender process also created an incentive for landholders to reveal the true cost of undertaking the actions in their bids. Much of this information was not previously available to policy and program managers.

Ultimately, the EcoTender pilot project generated proposals covering 84 sites on a total of 40 farms. Of these bids, 46 per cent proposed revegetation and 72 per cent were assessed as benefitting two or more different environmental outcomes. In addition to providing biodiversity conservation benefits, 72 per cent of proposals provided an aquatic function benefit, while 8 per cent demonstrated salinity benefits. Ultimately, 31 bids were successful (62 per cent of total), and 97 per cent of the accepted bids demonstrated two or more environmental outcomes. Funded projects will deliver 259 hectares of protected native vegetation (revegetation 76 hectares, management of extant native vegetation 183 hectares) and sequestration of an estimated 10,078 tonnes of carbon.

The EcoTender pilot also demonstrated that a price for carbon offsets can substantially reduce the cost to government of achieving other environmental outcomes, including terrestrial biodiversity, aquatic function and saline land. In the initial pilot, a price of $12 per tonne of carbon sequestered was offered to land managers. Results indicated that the cost to government to procure the same amount of environmental outcomes without a price for carbon would be 26 per cent higher.

Caring for our Country is a new program that was initiated in 2008 and is based on adaptive re-design of many previously existing programs in Australia. In its first five years, from 2008-2013, Caring for our Country is investing funds to improve strategic outcomes across six national priority areas, including biodiversity, sustainable farm practices, and community skills and knowledge.

A concern raised by the federal auditors around the lack of tangible results from environmental funding has spurred the evolution of allocation mechanisms such as multi-criteria analyses that have developed in several jurisdictions.

Figure 2.3 illustrates some regional and pilot initiatives that have evolved into the national program, Caring for our Country, incorporating lessons from earlier programing.

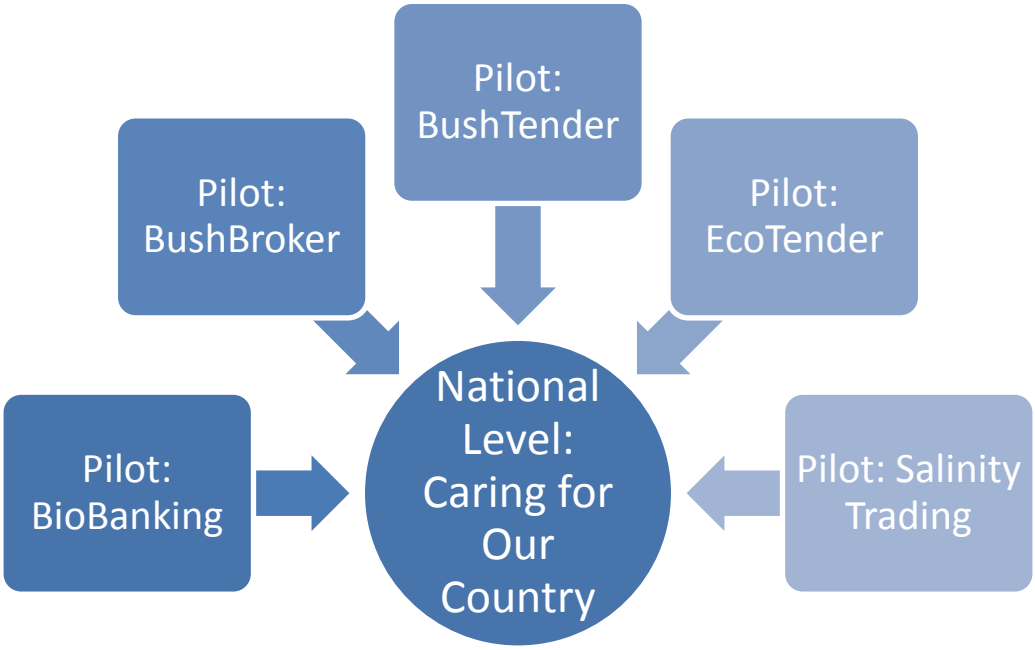

Figure 2.3: Evolution of regional programs into a national program in Australia.

2.3 Natura 2000, France (European Union)

Scale. Supra-national (EU level programing incorporating national level management).

Motivation. Natura 2000 is the EU-wide network of nature conservation areas set up to ensure the survival of Europe's most valuable species and habitats. It is not restricted to nature reserves, but based on a much broader principle of conservation and sustainable use, where people and wildlife can live together in harmony.

Main agri-environmental issues in France:

- Water pollution (nitrates and pesticides);
- Competition between different water users in some regions;
- Soil erosion in some regions; and
- Impact of agriculture on biodiversity and landscapes.

History. Figure 2.4 outlines an abbreviated history of France's Natura 2000.

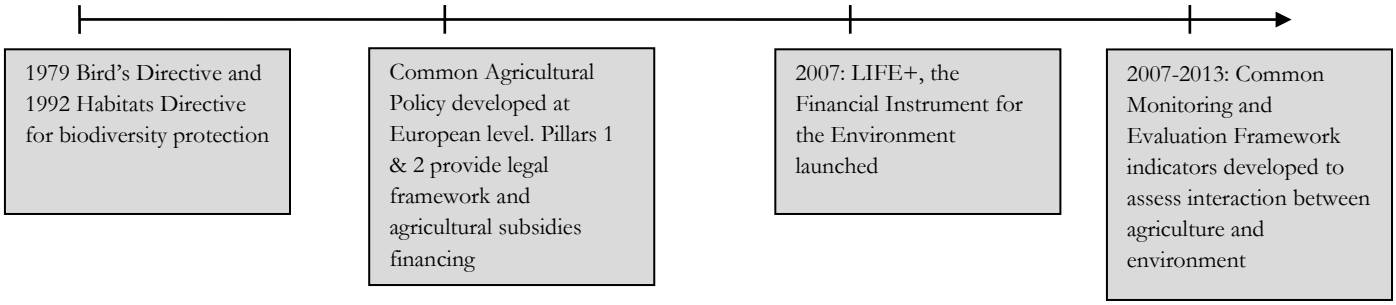

Figure 2.4: Brief history of Natura 2000, France (European Union).

Execution/implementation. Implementation of this program is EU-wide and is by the Centre National pour l'Amenagement des Structures des Exploitations agricoles (CNASEA).

Implementation is through price-based policies, whereby compensation payments are offered for specific actions for conservation and restoration of natural habitats and species within identified Natura sites.

France implements the Natura program through two means: the Nature Contract and the Nature Chart. The Nature Contract is signed by the beneficiary and the prefect. It includes a description of the activities to be implemented as well as the site; a description of the obligations that gives the right to the compensation, as well as the compensation amount, duration (minimum five years) and modality, a description accompanying measures that do not qualify for compensation and, finally, the control measures and outputs to be verified.

The Nature 2000 Chart does not automatically give access to the compensation but it does provide tax exoneration and the right to apply for public aids. This program commitment is signed for a period of five to ten years.

Payments are done in one or two instalments; if it is an investment action and if the action is recurrent, the same amount will be paid every year on the date of the contract signature.

Site visits for monitoring are carried out in approximately 5 per cent of the contracts and are compulsory for contracts over EUR 5,000 or more.

Treatment of co-benefits. General environmental objectives have been identified at the national level: (1) improving biological diversity, (2) improving soil and water resource quality, (3) fighting against natural risks, (4) improving air quality, (5) enhancing landscape and cultural heritage, and (6) improving land management–land use.

Two environmental objectives have been prioritized in practice: Water quality improvement and biodiversity enhancement and conservation. The choice of these environmental objectives is performed (1) under constraint of the European regulation (France has time constraints to comply with the European Water Framework Directive), and (2) with a growing awareness of the main environmental problems in the country.

Investment/resource allocation decision process. For every pre-determined Natura site, there is a management plan, the Document of Objectives, in which a list of specific conservation and restoration measures is given based on two different categories: (i) forestry measures, and (ii) non-forestry and non-agricultural (rehabilitation or plantation of certain trees, restoration of burned land, creation of ponds, mini-hydro works, maintenance of open spaces through mowing, and so forth).

Priority is given to actions (depending on the conservation state) at biogeographical level, priority habitats or species according to the Habitat Directive, condition of species and habitat in the site and efficiency level of measures.

Outcome/status/impacts. In France, there were 1,700 sites in 2007 covering 6.82 million hectares. In total 261 beneficiaries and EUR 2.6 million were paid. The program is described within a government audit conducted in 2006 as "complicated but efficient." There is no effective framework or indicators for judging impact on EGS maintenance and delivery. Auditing to date has primarily focused on the implementation and cost effectiveness of the program. The general finding in the European Union was that the network has strengthened and stabilized conservation efforts in individual countries but no quantifiable data has been collected[9] (EnviroEconomics, 2009).[10]

[9] See http://www.wgea.org/portals/0/auditfiles/report-implementation-NATURA-2000-NETWORK-in-Europe[1].pdf.

[10] Copyright Her Majesty The Queen in Right of Canada, Environment Canada, 31 March 2009. Reproduced with the permission of the Minister of Public Works and Government Services Canada.

The Natura 2000 Barometer provides an evaluation on the progress made in establishing the Natura 2000 network, both under the Birds and the Habitats Directives. It is based on information on number of sites and areas covered, as indicated by Member States, and is published in the Natura 2000 newsletter.[11] Indicators include country-specific listing of number of sites, total area number of sites and qualitative indicators of progress as "notably insufficient, incomplete, largely complete and recent significant progress."

2.4 Ecological Direct Payments, Switzerland

Motivation. Main agri-environmental issues include soil quality and erosion in some regions; nutrient pollution of water; pesticides pollution of water; and biodiversity conservation and enhancing.

Execution/implementation. The Agricultural Policy Reform program (1999-2003) established the conditions under which farmers have access to direct payments: (1) a balanced use of nutrients; (2) at least 7 per cent of the farm area to be under extensive practices or semi-natural habitats (ECAs); (3) crop rotation; (4) soil protection; (5) improved pesticide management; and (6) animal welfare. These are all beyond legal environmental requirements. Execution-related roles and responsibilities involve the following entities:

- The Federal Office for Agriculture (FOAG): Management;
- Canton[12]: Monitoring; and
- The Swiss Agency for the Environment (FOEN): Management and monitoring.

Environmental objectives and BMPs are defined consensually through consultation processes.

- Consensus is facilitated by Switzerland's democratic culture at the various levels of the decision-making process. FOAG and FOEN propose environmental objectives, which are based on existing legal requirements and scientific knowledge, and take both ecological and agronomic aspects into consideration.
- For the use of BMPs to achieve environmental objectives, FOAG officials worked on a preliminary proposal based on scientific criteria (agronomic and ecological) that was then submitted to stakeholders involved. Representatives from the cantons, producer organizations, researchers and civil society agencies (environmental groups, consumer organizations, etc.) participated in the working sessions arranged by the FOAG.

[11] See http://ec.europa.eu/environment/nature/natura2000/barometer/index_en.htm.
[12] The cantons of Switzerland are sovereign member states of the federal state of Switzerland and maintain their own constitution, legislature, government and courts.

Stakeholders were asked to agree with or suggest changes to the proposals from the State representatives. If the proposals from the various organizations were not accepted, the FOAG had to provide a rationale for rejecting them. The FOAG reviewed the proposals made during the working sessions, and either did or did not incorporate them, and then forwarded them to the government for approval before the program was presented to Parliament.

Parliament approves the allocated budget for the program.

General and ecological direct payment programs involve compensation to farmers for implementing BMPs.

There are mandatory agri-environmental practices for access to general direct payments as well as more restrictive practices that differ by program and give rise to ecological direct payments. The first condition for having access to direct payments (general or ecological) is providing certain required ecological services (prestations écologiques requises, or PERs). The Federal Office for Agriculture grants ecological direct payments only to those farmers who develop practices that go beyond the PERs.

This program is voluntary and participants have to satisfy certain general conditions such as legal form of the farm operation, operator's residence and age; structural conditions such as minimum size of the farm, labour requirements; and economic conditions such as income.

History. Figure 2.5 outlines an abbreviated history of Switzerland's Ecological Direct Payments.

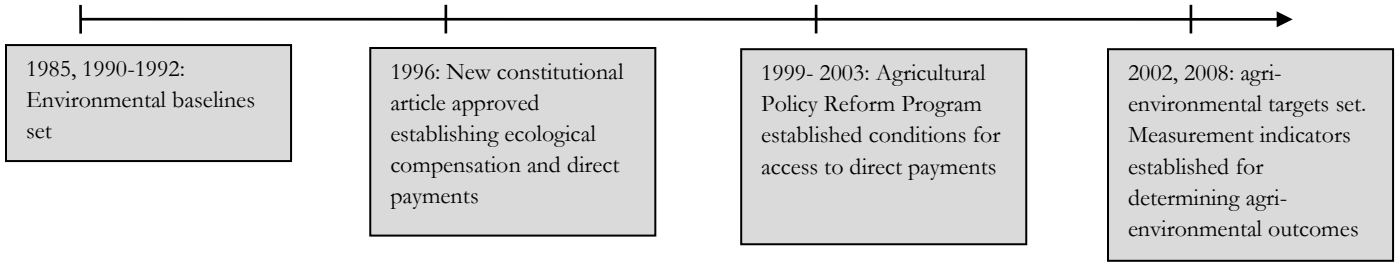

Figure 2.5: Brief history of Ecological Direct Payments, Switzerland.

Treatment of co-benefits. Program co-benefits include soil quality and erosion; water quality, including nutrient pollution and pesticide pollution; and biodiversity conservation, as well as animal welfare.

Investment/resource allocation decision process:

- At the federal level: The ecological direct payments program applies to all of Switzerland. However, measures can differ depending on the zone: cereal zones, intermediate zones, hill zones and mountain zones (I, II, III and IV) to adapt them to the specific conditions of the local environment. These zones are defined through the following criteria: climatic conditions, transport infrastructures and land topography. Conditions to have access to direct payments, as well as payments themselves, vary on a zone basis[13].
- At the canton level: Nitrate projects[14]: All catchments presenting nitrates concentrations in water exceeding 5.6 mg NO3 – N/l must be identified and cantons must launch nitrates projects aimed at improving water quality in those areas. Project areas are defined by the canton's project team and approved by FOAG. According to FOAG, the project's size must be "large enough to allow the implementation of a water quality improvement project, using resources available in an optimal way."
- Type of contaminants (in water): Nutrients (mainly nitrates), phytosanitary products (pesticides) and veterinary medicinal products.
- Scientific/information base: Qualitative and quantitative data concerning main environmental and agronomic issues in different zones (cereal zones, intermediate zones, hill zones and mountain zones): land use and farming systems, crop yields, nutrients loads in soils and water, use of phytosanitary products, ammonia emissions, and so forth. The FOEN has constructed the Eco-Fauna Database, which is a matrix of the habitat and other requirements for nearly 3,000 species of fauna (e.g., mammals, butterflies, birds), as well as monitoring networks for water, air and soil quality.

Outcome/status/impacts. In 2008 there were more than 120,000 hectares of Ecologic Compensated Surfaces (the total agricultural surface in Switzerland is 10.6 million hectares. The General Direct Payments represented 2.2 million CHF. Nearly 48,000 farms were involved, approximately 70 per cent of registered farms. The Ecologic Direct Payments represented nearly 540,000 CHF. The mountain and hill regions benefitted from 61 per cent of the total amount of the payments.

In 2005 the FOAG published a synthesis report covering all existing assessment projects (see Bibliography). The report presents the results from the assessment of agri-ecological and animal welfare practices over a ten-year period, from 1994 to 2005.

[13] See FOAG, 2008, Mesures définies en fonction des zones pour 2009, http://www.blw.admin.ch/themen/00015/00183/index.html?lang=fr.
[14] Projects aiming at improving water quality in zones where nitrates concentrations in groundwater exceed 5.6 mg NO3 – N/l.

The main finding from the report is that ecological compensation areas must be maintained. Even so, according to the study, the targeted environmental objectives required more advanced, results-based measures adapted to regional and local contexts.

Environmental impacts of programs are being measured through established indicators. FOEN is the responsible authority and bases its calculations on three sources: national database, data collected at the farm levels, and recordings in the fields. Table 2.1 presents an overview of these indicators.

Table 2.1: Indicators of environmental performance in Switzerland.

		Type of Indicator		
		Driving forces: agricultural practice	**Environmental effects: agricultural processes**	**State of the environment (overall responsibility: BAFU)**
Topic	**Nitrogen**	Nitrogen balance for agriculture	Potential emissions of nitrogen (emissions of nitrate, ammonia and nitrous oxide) Ammonia emissions	Pollution of groundwater by nitrate from agriculture
	Phosphorous	Phosphorous balance sheet for agriculture	P content of soils	Pollution of lakes by phosphorous from agriculture
	Energy/Climate	Energy Consumption in agriculture	Energy efficiency Greenhouse gas emissions	
	Water	Use of plant protection products Use of Veterinary medicinal products	Risk of Aquatic ecotoxicity	Pollution of groundwater by plant protection products Veterinary medicinal products
	Soil	Soil Cover	Risk of erosion Potential effect of agriculture on microbial biomass Input of heavy metals	Content of contaminants Soil quality
	Biodiversity/ landscape	Ecological compensation (including quality)*	Potential effects of agriculture on biodiversity*	Diversity of wildlife Diversity of habitats Distinctive elements of the landscape

3.0 EGS Programing in the United States

EGS management and incentives payments are most prominent in the US agriculture sector. Understanding of the rising impacts of agriculture on the environment has increased the momentum of agri-environmental management payments over the last few decades. An early institution working in agri-environmental management was the Soil Erosion Services that worked with farmers to transform eroding fields into a region with contouring, stripcropping, terracing and for enhancing benefits for soil, water, land and life. The early incarnation of the National Resources Conservation Service (NRCS) emerged from this organization in 1935 and was called the Soil Conservation Service (SCS). The initial impetus for its establishment came from the issue of soil erosion from the time of the "dust bowl era" and the need for conservation practices to fit the land and its owners. Establishment of nationwide soil conservation works was hastened by the passage of the Soil Conservation Act of 1935 and recognition of the first watershed-based conservation district in 1937. The Agricultural Conservation Program (ACP) was established in 1936 and provided cost sharing to farmers on selected conservation practices. In the late 1970s, Congress passed the Soil and Water Resources Conservation Act of 1977 (RCA), incorporating lessons from four decades of conservation programs.[15] The RCA process influenced the inclusion of a conservation title in the Agriculture and Food Act of 1981 (the first farm bill to include a conservation title). The conservation initiatives of the 1985 farm bill focused on conservation compliance concepts, including the "Highly Erodible Land Conservation" and "Wetland Conservation" provisions. This legacy of including conservation practices has been reinforced in subsequent farm bills in the United States and the current farm bill came into effect in 2008—the Food, Conservation, and Energy Act of 2008.

The US Department of Agriculture currently uses a portfolio of programs to address a variety of agri-environmental issues at the farm level. Major programs and their highlights are described in Table 3 below.

[15]See http://www.nrcs.usda.gov/about/history/articles/perfbasedconservation.pdf.

Table 3: Summary of agri-environmental programs in the United States.

Program	Aim	Details
Conservation Reserve Program (CRP) is a nationwide program that is applied at the farm-level. It is administered by the Farm Service Agency (FSA) in cooperation with the Natural Resources Conservation Services (NRCS) of the US Department of Agriculture (USDA)	Aims to remove from production highly erodible land (HEL) and other environmentally sensitive cropland.	CRP is a voluntary program that offers long-term rental payments, cost-share assistance and technical capacity for farmers to take land out of production and plant long-term resource-conserving covers. Land is generally enrolled in the CRP for a period of 10-15 years (contract period) in exchange for annual payments. Contracts are renewable. Uses Environmental Benefit Index (EBI) to target financing.
Environmental Quality Incentive Program (EQIP) is a national program applied at the farm level. It is administered by the NRCS of the USDA	Payments defray costs for respectively adopting sustainable farming practices, such as for soil and water quality conservation.	EQIP is a price-based policy that compensates farmers for the lack of market incentive to invest in public goods. Payments are based on fixed assets and management practices and come in the form of cost-sharing and incentives.
Wetlands Reserve Program (WRP)	Aims to provide technical and financial assistance to restore, protect, and enhance wetlands in exchange for retiring eligible land from agriculture.	Subject to 30-year or permanent easements. Three enrollment options include permanent easements, 30-year easements and restoration cost-share agreements without easements (this option offers 75 per cent of the wetland restoration costs).
Wildlife Habitat Incentives Program (WHIP)	Payments defray costs for providing wildlife habitat.	Increased cost share payments are available for eligible farmers. NRCS State Conservationists may identify state priorities for enrollment in WHIP that complement the goals and objectives of relevant fish and wildlife conservation initiatives at the state, regional, and national levels. NRCS can pay up to 90 per cent of the cost to install conservation practices in these long-term agreements. Payments made to a person or legal entity cannot exceed $50,000 per year.

Conservation Security Program (CSP)	Pays farmers who have met a high standard for environmental performance to adopt or maintain practices to further enhance environmental performance, such as improving soil and water quality or wildlife habitat.	Introduced in 2002. Total payments are determined by the tier of participation, conservation treatments completed and the acres enrolled: Tier I offers 5-year contracts, maximum payments are $20,000 annually; Tier II offers 5-10 year contracts, maximum payments are $35,000 annually; Tier III offers 5-10 year contracts, maximum payments are $45,000 annually.
Grassland Reserve Program (GRP)	Aims to preserve and improve native grass species.	Introduced in 2003 Provides options of a long-term rental agreements (10, 15, or 20 year contracts); permanent easements or restoration agreements where 50 per cent cost share is available.

In addition to nationally administered programs through USDA's NRCS, a few watershed-based initiatives have emerged from a sense of priority created often through an environmental crisis. Two of these watershed initiatives are the Chesapeake Bay Watershed Initiative (CBWI) and the Mississippi River Basin Initiative (MRBI). These two programs were reviewed in some detail as they offer analogous contexts to the Manitoba one, as indicated by the Lake Winnipeg Initiative. The CBWI and the MRBI offer insights into the value of priority-setting, augmenting national priorities with regional objectives, as well the challenges and benefits of integrating institutional layers toward well-defined regional goals. While federal programs illustrated in the table above provide the bulk of the resources for agri-environmental management at the farm level, initiatives such as the CBWI and MRBI provide watershed-based impetus, resourcing and monitoring for complementary programing. Specifically, these initiatives have identified priority sub-watersheds through monitoring and modelled results and extra funding is available for agri-environmental management in prioritized hot spots in these basins. Environmental outcomes from these programs are monitoring for basin-level impacts. As a result, the efficacy of federal level programing s enhanced through regional prioritization and monitoring and regional objectives are enhanced thorough federal programing and resources. Lessons from federal programs have also been leveraged for design of these regional initiatives.

3.1 Chesapeake Bay

Scale. The scale is regional and watershed-based.

Motivation. The Chesapeake Bay Watershed Initiative (CBWI) was authorized in the Food,

Conservation and Energy Act of 2008 (2008 Farm Bill) to provide assistance to agricultural producers to minimize excess nutrients and sediments in order to restore, preserve, and protect the Chesapeake Bay. Nearly one-quarter of the Bay watershed's land area is devoted to agricultural production. Agriculture contributes a relatively large per cent of the nitrogen, phosphorous and sediments that contribute to the low oxygen levels in Chesapeake Bay. The initiative offers financial and technical assistance to eligible agricultural producers to install practices to help control erosion and nutrient loading before they reach the Bay. It is administered by the USDA Natural Resources Conservation Service (NRCS). The "Strategy for Protecting and Restoring the Chesapeake Bay Watershed" was developed under the executive order issued by President Obama in May 2009, which declared the Chesapeake Bay a national treasure and ushered in a new era of shared federal leadership, action and accountability.

The Chesapeake Bay Program (CBP) comprises a regional partnership that has led and directed the restoration of the Chesapeake Bay since 1983. The Chesapeake Bay Program partners include the states of Maryland, Pennsylvania and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the Environmental Protection Agency, representing the federal government; and participating citizen advisory groups. While there does not seem to be a formal relationship between the CBWI and the CBP, it is anticipated that CBWI represents the formal fund resource allocation vehicle for the federal government and CBP is the primary institutional relationship between states and non-government players that enables sharing and learning across the basin.

The main environmental issues identified in Chesapeake Bay are water pollution (nitrogen loads, phosphorous loads and sedimentation) and the impact of agriculture on biodiversity and aquatic vegetation.

History. Figure 3.1 outlines an abbreviated history of Chesapeake Bay restoration programs.

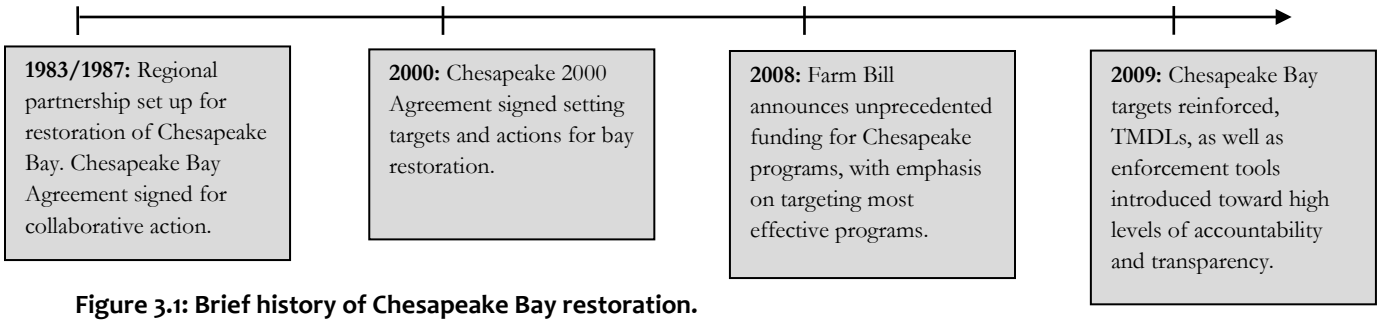

Figure 3.1: Brief history of Chesapeake Bay restoration.

Execution/implementation. Water quality goals were set in a program known as Chesapeake 2000. These goals included over 100 specific actions designed to restore the health of the bay and its living resources. A watershed-based TMDL[16] is in the process of being finalized (2010) since it has been acknowledged that the targets developed under Chesapeake 2000 have not been met. TheCBWI funds BMP implementation in identified priority watersheds.

The United States Environmental Protection Agency (USEPA) is currently administering the development of Bay TMDLs for nitrogen, phosphorous and sediment and working with jurisdictions to develop state TMDLs. Two-year goals (called milestones) are being developed toward a restored Bay for no later than 2025. The current two-year goals were put in place in December 2009 and are scheduled to be met by 31 December 2011.

State departments are responsible for state level programing and payments.

Treatment of co-benefits. While the impetus for this initiative is water quality, the programs in it deal with water quality, soil erosion and biodiversity.

Investment/resource allocation decision process. In 2007, the US Geological Survey and USEPA began a joint effort to develop a suite of internet accessible decision-support tools and to help meet the needs of CBP partners to improve water quality and habitat conditions in the Bay and its watersheds. The Chesapeake online adaptive support toolkit (COAST) is a collection of Web-based analytical tools and information, organized and intended to aid decision-makers in protecting and restoring the integrity of the Bay ecosystem (Mullinix et al., 2009).

Federal agri-environmental programs are augmented by special initiatives such as the CBWI. For example, the US government announced $188 million for the CBWI as a program of the 2008 farm bill, to be released over the four-year period. This provides an important example of federal resources flowing directly into regional agencies and extra resources for watershed-based priorities offering a means for enhancing synergies between federal and regional conservation efforts.

State level priority watersheds also provide the means for targeted programing. For example, in Virginia, priority watersheds were identified on the basis of a SPARROW model with estimations of NPS pollutant loads (for Nitrogen, Phosphorous and Sediments).[17]

[16] TMDL, or total maximum daily load, is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards (see http://www.epa.gov/owow/tmdl).

[17] Data requirements for the model included land use data, hydrological soil groups; average water content and K factors of all soils, stream flows from gauge stations, climate records, growing seasons, dominant crop by hydrologic regions, Chesapeake Bay Watershed Model Output, animal numbers by type and location, location and numbers of population using septic systems, distribution and extent of agricultural conservation practices, slope, and manure application schedules by manure type.

Figure 3.2 depicts priority watersheds in the Chesapeake Bay Watershed.

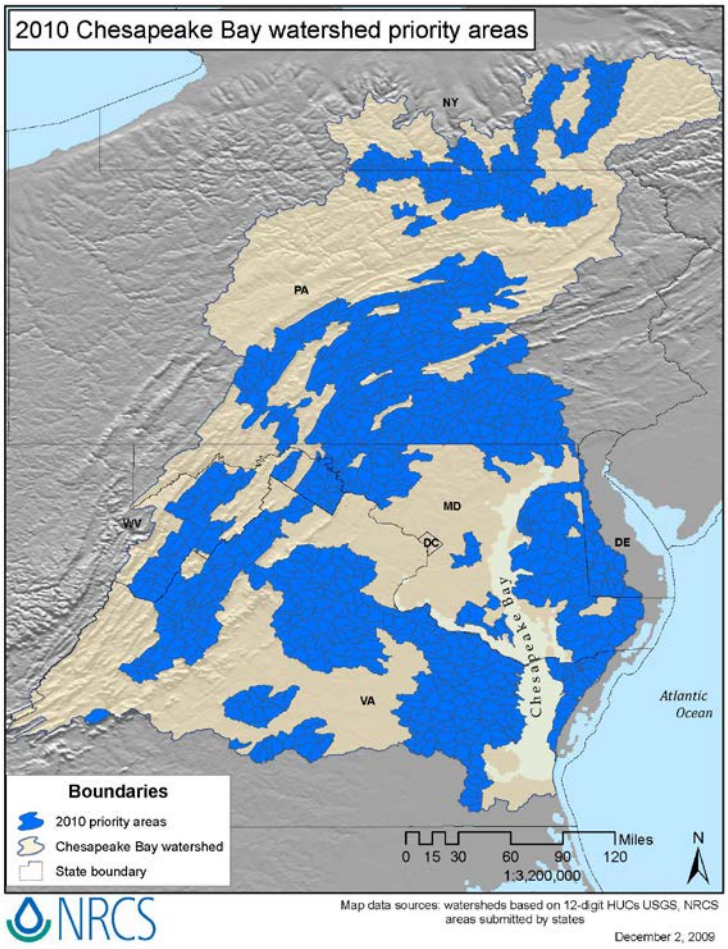

Figure 3.2: Priority watersheds in the Chesapeake Bay Watershed.

Outcome/status/impacts. Active BMP funding in the Chesapeake Bay has been going on since the development of nutrient reduction goals in 2000. Renewed funding and commitment is moving toward the development of TMDLs for the basin and the different jurisdictional levels and toward an inter-state nutrient trading system to meet the goals (CBP, 2010).

The lessons of previous programs have been taken into account and developed based on experience gained through previous NRCS programs. Evaluations of previous agri-environmental programs have stressed the need for increased performance measurement to ensure that value for the dollars invested has been realized (GAO, 2006). A clear need for accountability is seen in this program and is enhanced by the tangible outcomes that this program is seeking (reduced nutrient to the Chesapeake Bay).

3.2 Mississippi Basin

Scale. Continental Basin.

Motivation. An area of water off the Gulf of Mexico's northern shore exhibits low oxygen or hypoxic conditions every year. The size of this zone has been steadily increasing and agricultural nonpoint sources have been identified as one of the primary causes (NRCS, 2008).

In response, a federal-state task force was struck and produced an action plan in 2001 for improving water quality in the basin. The action plan calls for reducing the size of the hypoxic zone to 5,000 sq km by 2015, improving water quality within the basin and improving economic conditions across the basin. The 2001 Action Plan identified the need for increased assistance to producers for voluntary implementation of conservation practices that would help reduce nitrogen runoff and leaching (NRCS, 2008).

The main agri-environmental issues identified are nutrient loading (nitrogen and phosphorous) and sediment erosion.

History. Figure 3.3 outlines an abbreviated history of Mississippi Basin restoration programs.

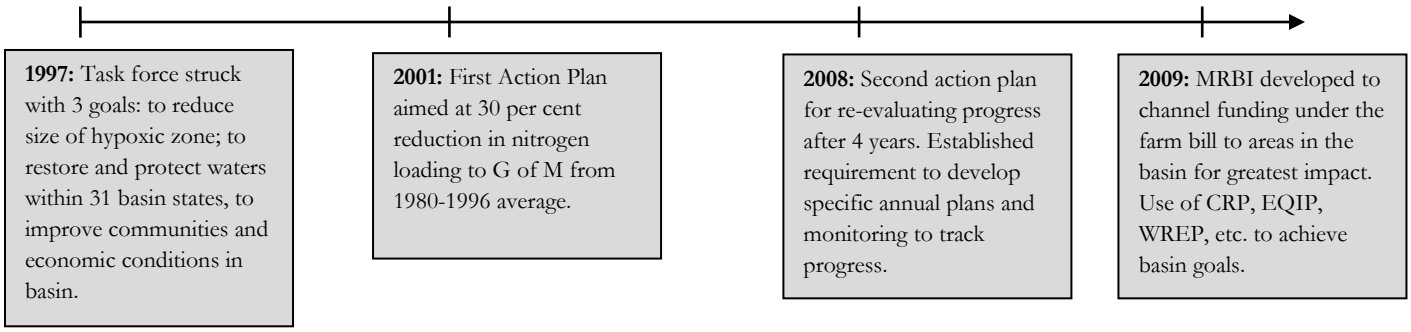

Figure 3.3: Brief history of Mississippi Basin restoration.

Execution/implementation. Currently in development by the USDA's Natural Resources Conservation Service (NRCS), the MRBI is a program to channel USDA funding under the Farm Bill to the areas in the Mississippi basin where they can have the greatest impact on addressing Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (MGMTF) priorities, while balancing state and local priorities at the same time. This initiative coordinates funds presently available from existing Farm Bill programs such as the Conservation Reserve Program (CRP), Environmental Quality Incentive Program (EQIP), Wetlands Reserve Enhancement Program (WREP), Cooperative Conservation Partnership Initiative (CPI) and Conservation Innovation Grants (CIG), as well as

dedicating $80M per year for three years, from 2010 to 2013, in targeted watersheds. This money is in addition to funds the states receive from NRCS programs such as EQIP. The program involves the selection of targeted watersheds (see Figure 3.4) by each state. States will select three watersheds for increased focus. The specific selection methods are determined by each state, balancing both local and Mississippi basin priorities.

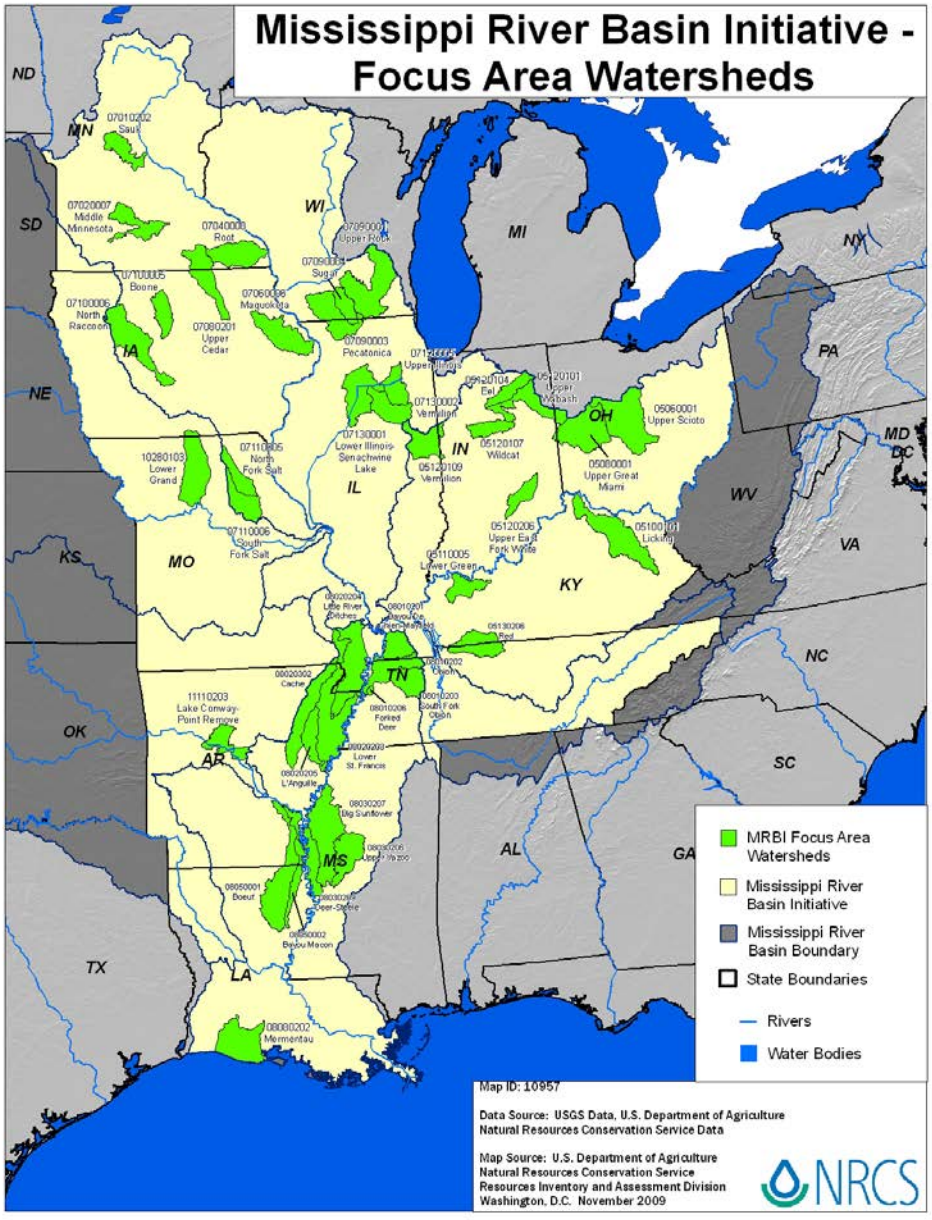

Figure 3.4: Priority watersheds in the Mississippi River Basin.

Treatment of co-benefits. Nutrient loading and soil erosion are the primary co-benefits examined under

this program.

Coordination with other programs. The USDA provides most program funds and support through the NRCS.

Investment/resource allocation decision process. At the basin level, priorities are established through the MGMTF. Individual programs offered by agencies such as NRCS have different decision-making protocols. The EQIP program uses the Interstate Allocation Index to allocate funding to individual states. This consists of 31 weighted parameters (Hajkowicz et al., 2009; SWCS and ED, 2007). The CRP uses its Environmental Benefits Index to allocate funds to individual projects. This index consists of six weighted parameters (Hajkowicz et al., 2009; USDA, 2003). The WRIP program uses a four-parameter index to determine allocations by state (Hajkowicz et al., 2009).

Similar to the Chesapeake Bay Watershed Initiative, federal agri-environmental programs are augmented by special initiatives such as the MRBI. The US government has announced that a minimum of $80 million will be spent annually on the MRBI programs. Such extra resources for watershed-based priorities offer a means for enhancing synergies between federal and regional conservation efforts.

Outcome/status/impacts. The MRBI is a new initiative and is not yet operational. Lessons from previous NRCS programing have informed newer programs and their designs. Previous evaluations of EQIP from the US government accountability office, as well as evaluations by outside agencies, stress the need for increased measures to ensure that value for the dollars invested has been realized (GAO, 2006; SWCS and ED, 2007; Hajkowicz et al., 2009).

4.0 Canadian Context

This section provides an illustrative snapshot into the state of Canadian agri-environmental programing and associated research. A number of pilot initiatives have emerged in the last few years to demonstrate the value in the use of EGS-based incentives. Eight EGS pilots were developed with funding from Agriculture and Agri-Food Canada's (AAFC's) Advancing Canadian Agriculture and Agri-Food (ACAAF) program in 2007. These pilots solidified the linkages between land management practices and real environmental benefits to determine the most effective EGS program options. Pilot project results were presented at an EGS technical Meeting in Ottawa in April 2009. Presentations and discussions from this meeting are included in our synthesis of Canadian Programs and Canadian Research in the following sections of this document.

4.1 Canadian Programs

This section provides a synthesis of Canadian EGS programs. Some of these are longer-standing environmental incentive programs that have been designed to conserve and manage EGS from landscapes. Others have been specifically designed as EGS pilots under programs such as AAFC`s ACAAF call from 2007.

4.1.1 Conservation Easements

Motivation. Conservation easements provide a means for environmental conservation through an agreement between the landowner and a conservation organization. Under the agreements, the landowner voluntarily restricts the development of the land. The terms and conditions of the restrictions are pre-determined and the agreement prescribes whether the landowner can maintain agricultural productivity of the land and/or perform other specific activities. Agreements are tailored to meet the requirements of the landowner and the priorities of the conservation organization.

Execution/implementation. Conservation agreements are tied to land titles and are legally binding even if the land is sold or inherited. The land use and activities on a parcel of land under a conservation easement are determined by the clauses of the agreement. Conservation easements may be for a specified time period or in perpetuity. Easements are most often used to protect wetlands, wildlife habitat, watersheds, forests and so forth.

Treatment of co-benefits. Since conservation easements are based on tracts of land, as opposed to land features, there are often a number of co-benefits from such arrangements. The terms and conditions of land use and management determine the specific aspects of the land that are being conserved and managed.

Coordination with other programs. Conservations easements are used in Canada and the United States and administered by organizations such as The Nature Conservancy and Ducks Unlimited, as well as regional agencies such as the Manitoba Habitat Heritage Corporation (MHHC). Other programs such as the USDA's Natural Resource Conservation Service and the Wetland Reserve program, as well as the Grassland Reserve programs, use easement contracts to provide payments for the land, or its rehabilitation (USDA-NRCS, 2008; 2008a).

Investment/resource allocation decision process. Conservation easements are often based on the priorities of the organizations administering the easements. For example, Ducks Unlimited Canada (DUC) focuses first and foremost on conserving wetlands and associated nesting cover in areas of high wetland density. DUC targets land acquisition based on high priority waterfowl breeding areas and is also interested in the other natural features (grasslands and woodlands) important to a broad variety of wildlife.

Similarly, Natural Area Conservation Plans identify specific areas where the Nature Conservancy of Canada (NCC) will focus its work and the key actions (e.g., land securement, extension work, partnerships) necessary to conserve the biodiversity targets found within the natural areas. BMPs developed by NCC ensure that activities such as grazing and oil and gas exploration impact minimally on the biodiversity targets identified for NCC lands.

Environment Canada has developed specific categories of qualified lands based on national ecological sensitivity criteria. Some regions—Ontario, Quebec, New Brunswick and Prince Edward Island have their own criteria in addition to the federal one. See http://www.ec.gc.ca/pde-egp/default.asp?lang=En&n=75F19FC6-1 for detailed criteria developed for ecologically sensitive status for land.

Manitoba Habitat Heritage Corporation (MHHC) is the largest conservation easement holder in Manitoba, with a current holding of about 90,000 acres. Priorities for easement delivery are based on (a) wetland and associated habitat (through the North American Waterfowl Management Plan, or NAWMP, and the Wetland Restoration Incentive Program); (b) riparian habitats; (c) habitat for species at risk (HSP), with significant financial support from Environment Canada; (d) source water protection lands identified in Conservation District management plans; and (e) mitigation/compensation habitats in association with major developments (e.g., highway construction). With a conservation mandate, MHHC targets species and habitat -based programs on priority landscapes for priority species. As new data become available and species priorities shift, delivery priorities are adjusted. MHHC is also moving away from the species/habitat focus to support integrated watershed management planning through the Conservation Districts in

Manitoba. The focus now includes source water protection as well as earlier priorities around habitat, wetlands and headwater forest land protection.

Outcome/status/impacts. Conservation easements are popular means of conserving and managing ecological sensitive or critical lands. As a primary administrator of conservation easements, The Nature Conservancy of Canada indicates that it has helped to conserve more than 2 million acres of ecologically significant land nationwide. MHHC has secured close to 90,000 acres to date with 525 easements and currently secures an average of 70 easements per year.

4.1.2 *Lake Simcoe, Ontario*

Motivation. Lake Simcoe has experienced significant eutrophication, increase in algal blooms and aquatic weed, as well as a rapid decline in fish species.

Execution/implementation. The Lake integrated watershed management plan (IWMP) (2008) and the Lake Simcoe Protection Plan (2009) provide implementation guidelines and information. The IWMP describes the implementation steps beginning with a Lake Simcoe watershed assimilative capacity study (ACS). Assimilative capacity of a watercourse represents the environmentally sustainable threshold of the system. The Lake Simcoe ACS was designed to help the Lake management partners to determine the carrying capacity of the watershed and the management practices necessary to minimize future phosphorous loading from the watershed or to reduce current loadings to meet the target for Lake Simcoe. The series of studies within the ACS were conducted by various research and consulting groups, and can be found at http://www.lsrca.on.ca/reports/acs.php. A Lake Simcoe Basin Environmental Monitoring report is also available at http://www.lsrca.on.ca/pdf/reports/watershed_monitoring_2007.pdf.

To determine these thresholds, two water quality models were developed with private sector consultants, a watershed-based water quality model known as the Canadian Arcview Nutrient and Water Evaluation Tool (CANWET) and a hydrodynamic lake water quality model developed by the Danish Hydraulic institute and referred to as MIKE3/ECO Labs model.

Investment/resource allocation decision process. Sub-watershed hydrology and nutrient loading was modeled using CANWET. Cumulative load was checked against allowable lake load. Modelled loads were used along with local conditions and sources in each sub-watershed to identify a viable portfolio of BMPs to achieve the required reductions.

Outcome/status/impacts. The assimilative capacity study in the Lake Simcoe watershed aided in developing total maximum monthly loads (TMMLs) as targets, taking into account the provincial

water quality objectives for phosphorous as well as the overall phosphorous loading target (see Figure 4.1). Estimated annual nutrient loads were taken for the lake and with public consultation and the use of models, lake wide management efforts could be appropriately targeted. Data gaps were identified through the development of the models and targets and recommendations were quality, quantity and habitat monitoring were made. A detailed implementation plan was planned after this data modelling and targeting exercise. Specific agricultural BMPS were planned as nutrient management efforts based on the TMMLs.

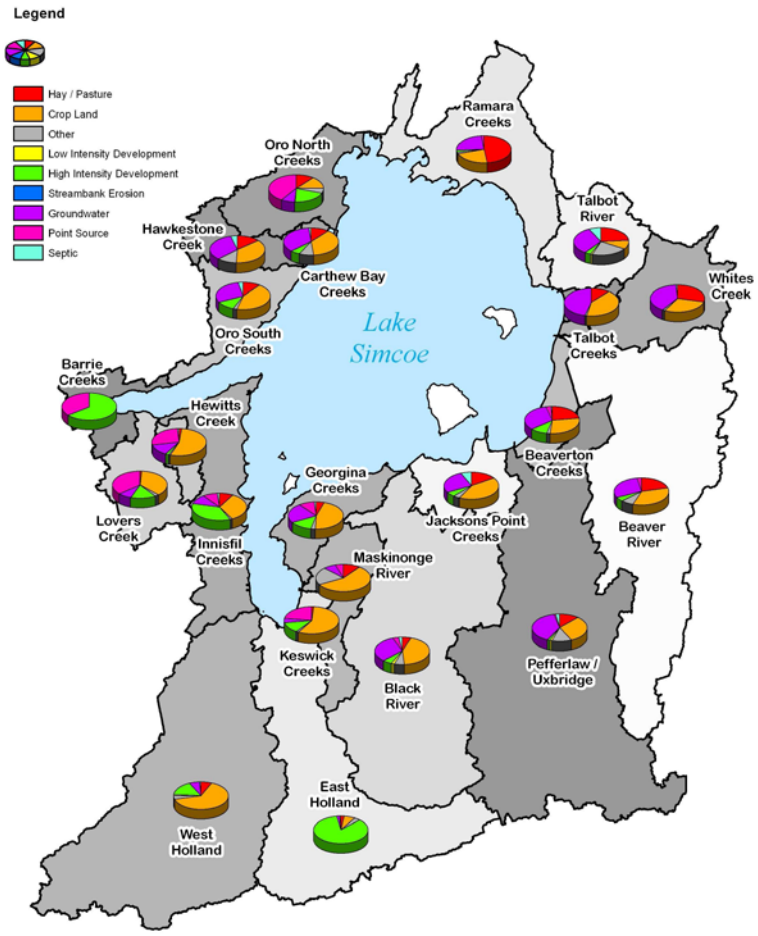

Figure 4.1: Phosphorous targets: Developing Total Maximum Monthly Loads (TMMLs).
Source: The Louis Berger Group Inc., 2006, with permission from Lake Simcoe Region Conservation Authority.

4.1.3 Pike River Watershed, Quebec

Motivation. Agricultural activities led to nutrient overloading and resulted in algal blooms in Missisquoi Bay in Lake Champlain. In 1995, the local office of the Quebec Department of

Agriculture, Fisheries and Food (MAPAQ), working in co-operation with the Institut de Recherche et de Développement en Agroenvironnement (IRDA), installed measuring instruments on Ruisseau-aux-Castors, a stream located in an intensively farmed area, and set out to document the agricultural practices of farmers in this watershed. In 1999, after three years of research and work with the farmers, a co-operative called the Coopérative de Solidarité du bassin-versant de la Rivière-aux-Brochets was established. The farmers who set up this non-profit organization wanted to work on improving water quality in watercourses that run across farmland. Since the monitoring showed significant phosphorous loads to streams in during runoff events, the cooperative suggested that the local farmers implement runoff control measures including the following: installation of inlet wells; planting of hedgerows on field margins along watercourses; and construction of rock chutes in strategic locations. The water quality monitoring subsequently showed a significant decrease of about 25 per cent in the mean phosphorous load.

Agriculture and Agri-Food Canada's Advancing Canadian Agriculture and Agri-Food program offered funding for EGS pilots in sub-basins of the Missisquoi Bay, Pike River watershed. This project was the site of a research-action project to determine EGS programing to reduce nutrient impacts on the Bay.

Execution/implementation. The first component provided incentive payments to farmers to establish 8-metre buffer zones planted with non-fertilized perennial crops, including runoff control structures to promote drainage while encouraging sedimentation of nutrient-rich suspended matter along five targeted streams in intensive agricultural areas.

The second component involved evaluating the new modelling and remote-sensing tools used to identify areas particularly vulnerable to erosion and exploring the willingness of farmers to change their agricultural practices in these plots.

The idea behind the project was to establish a continuous eight-metre-wide riparian buffer zone (exceeding the one-metre-wide buffer zone required by law) on either side of the five targeted watercourses in an intensively farmed region and to construct the requisite surface runoff control structures. The overarching goal was to establish a buffer zone to control runoff and reduce losses of nutrients, particularly phosphorus.

In the first year, a 51.4-hectare area of flood plains and grass buffer strips was established. Each farm business signed a written undertaking to maintain this area as such for a period of two years, as stipulated in the pilot project, in return for which the agreed-on financial compensation was paid out.

Each file includes the farm map for the area concerned, a description of the land for which compensation was paid, the measurements used to calculate the surface area, and the agreement signed by the farm business, along with a copy of the compensation cheque.

In the second year of the project, the infrastructure construction work continued and 602 interventions were completed, that is, 514 inlet wells and 88 other types of infrastructure (rock chutes, rip-rap, rock armouring and wellpoints).

For the first component, about 600 runoff control structures were installed for an area of 97 hectares and for the second component, the predictions of three tools were compared and it was the fine-scale tools that proved most effective at predicting erosion and drainage problems.

An amount of $675/hectare was paid to farmers as compensation for two years of lost income ($337.50/hectare per year) and the producers were allowed to harvest forage produced in the buffer strips.

Treatment of co-benefits. The program considers water quality and habitat. Soil erosion control was also managed through the program.

Outcome/status/impacts. The object of the second component was to verify the SWAT modelling results through on-site verification of the land parcels identified as being vulnerable to nutrient exports and to explore the practical implications in terms of the changes farmers should make to their farming practices.

The model designated land parcels as vulnerable when they met three criteria: steep slope, high soil fertility and annual crop. Aside from the bias associated with generalizing soil analysis results, if a crop rotation system is used for some parcels of land system, this creates an additional bias interfering with the software's identification of vulnerable land parcels. Fine-resolution relief maps of the area were produced using LIDAR and complementary data instead.

On the research and analysis front, focus groups of farmers were planned along with focus groups made up of citizens to promote discussion regarding various aspects: motivation of farmers to participate in such a project, relevance of a watershed-based approach, the concept and value of ecological goods and services (EGS), adjustment of the approach over time, citizen expectations, and so forth.

Finally, the analysis of this information and the project evaluation were entrusted to a multi-stakeholder group composed of participants and representatives from the agricultural and environmental sectors, as well as provincial and federal government analysts.

There was an 85 per cent participation rate among the targeted farm businesses, a similar percentage of the targeted total acreage planted to perennial crops (30 hectares of flood plain previously used for annual crops converted to perennial crops), and 85 kilometres of eight-metre-wide buffer strips planted to perennial crops, for a total of about 100 hectares. In addition, 602 runoff control structures were constructed.

Lessons:

- The participation rate was very high.
- It appears that when technical and financial support is available, farmers are ready to join in.
- They want to earn income comparable to that generated by the crops previously grown on the land concerned.
- Two years is much too short a time to assess the effect that the riparian buffer strips and the runoff control structures have on water quality.
- Growing hay in the strips may be viable for dairy producers, but the profitability of growing switch grass in the riparian buffer zone remains to be demonstrated and measured, and the profitability of such crops will be largely dependent on the existence of facilities for processing the biomass. Ideally, the acreages concerned should become profitable over the medium to long term.
- If a policy is put forward to promote the establishment of riparian buffer strips, sufficient flexibility should be accorded to allow for different widths of buffer to negotiate fields that parallel or perpendicular to a water course.
- A voluntary project allows producers to participate at their own comfort level.
- Collaboration between jurisdictions is important.
- High turnover of government representatives was challenging.

4.1.4 Lower Souris Watershed

Motivation. An understanding of the potential of landscapes to provide healthy EGS in balance with agricultural production is a major goal. The Lower Souris Watershed Committee Inc. (LS) is a group of rural municipalities, towns and conservation groups in the extreme corner of south eastern Saskatchewan. The vision of the LS is, "balancing the economic, environmental, and social values to sustain and improve the watershed for future generations."

Agriculture and Agri-Food Canada's national Advancing Canadian Agriculture and Agri-Food (ACAAF) program to develop pilot EGS projects enables LS to submit a proposal to develop a case study of how EGS tools could be used to achieve desired environmental endpoints in a working agricultural landscape.

Execution/implementation. Three objectives were developed for the ACAAF-funded project.

(1) To determine specific landscape goals for the quality and quantity of wildlife habitat in the Lower Souris Watershed (LSW);
(2) to determine the net costs (or lack thereof) borne by agricultural producers in the Lower Souris to provide the targeted quality and quantity of wildlife habitat in the LSW; and
(3) to conduct a policy analysis of the various EGS and non-EGS tools to achieve specific landscape targets for the quantity and quality of wildlife habitat in the LSW.

For the first objective, quantity and quality of wildlife was determined separately through a detailed inventory of the current landscape. DUC conducted an inventory analysis to quantify the abundance and distribution of aquatic and terrestrial habitats across the LSW.

To determine quality of wildlife habitat, rangeland health and riparian health assessments were conducted. These assessment protocols evolved out of range management science to assess the ability of ecosystems to perform essential ecosystem functions. These techniques use a variety of biotic and abiotic measurements to determine the extent to which a riparian area is performing filtration, sediment trapping, biomass production, erosion control and groundwater recharge (Adams et al., 2005). These assessments are generally performed by a walk-through assessment and ocular estimates of key site indicators. This is an efficient sampling method and is a good indicator of land management impacts on a site. Each indicator is given a score, and scores are summed to give a total per cent health. Based on this total, sites are described as healthy, healthy with problems or unhealthy.

For the second objective, local producers were surveyed regarding their historical land use practices (Entem et al., 2009) to collect information on the provision of wildlife habitat in many different farm settings. Producers were asked to provide management information regarding a piece of their land that is managed as a unit. The survey was divided into three primary sections: identifying wildlife habitat and costs of conversion; identifying inputs, operations and production from cropping enterprise; and identifying inputs, operations and production from grazing and haying enterprise. This information in conjunction with varying crop prices, beef prices and weather trends was used to simulate a representative mixed farm from the project area.

Three general scenarios were modelled in this study to estimate the benefits or costs to the farm. These scenarios were defined as follows:

- Landowner maintains habitat rather than converting this habitat to cropland, either by draining wetlands or clearing bush;
- Landowner converts cropland to tame grass, through converting a whole field that increases EGS;
- Landowner reduces grazing pressure on pasture lands, through a lower stocking rate or by adding cross fencing and off-stream watering.

For the final objective, economic incentives were taken as a preferred policy option over regulatory, market-based, institutional or advisory measures. The analysis focused on the costs and habitat benefits of converting annual cropland and, to a lesser extent, native grass and aspen, to perennial forage.

An analysis based on land cover data, at the quarter section scale, was performed on a sample of three rural municipalities within the Lower Souris watershed (Belcher, 2009). With recognition of information limitations such as variability of opportunity cost from farm to farm and even field to field, the local watershed representatives formulated final policy recommendations that would aid in achieving the determined landscape targets for wildlife habitat within the project area. To develop policy recommendations, the representatives considered the following criteria:

- Are the initial targets realistic?
- Is the recommended program achievable and practical?
- Will the program be socially acceptable?
- Is this recommendation fiscally responsible?
- Does this type of program promote unintentional actions?

Local stakeholders were involved in developing the quantity and quality of wildlife habitat in the watershed. Reports such as the one by White (2007) provided relevant background information. Collaboratively developed targets involved discussions around an appropriate balance of industry and environment to sustain quality of life and natural resources.

Based on presented information, watershed representatives developed locally appropriate targets for the portions of the watershed and placed them in the following categories: Lentic Riparian, Lotic Riparian, Perennial Forage, Native Grasslands, Aspen and Crop. Target quantity and quality for these categories were collectively decided.

Based on a producer survey, farms in the watershed were characterized and crops and land use were determined.

In order to understand the biophysical and economic results of implementing practices that promote EGS, a working simulation model (Dollevoet et al., 2009) was developed. The model predicted outcomes for the three defined EGS scenarios at the farm level.

Treatment of co-benefits. Wildlife habitat quantity and quality were primary goals in this program. Nutrient loading and soil erosion were also managed in the programing.

Outcome/status/impacts. For the purpose of this project, three representative rural municipalities within the Lower Souris Watershed (Silverwood, Reciprocity and Storthoaks) were studied. Project results show that, for an extensive program of converting approximately 350,000 acres of annual cropland, grass and aspen to perennial forage within the study area, will require in the range of $0.75 to $1.25 million in annual payments. A more moderate program of converting 95,000 acres of annual cropland to perennial forage will require from $240 to $390 thousand in annual payments. The analysis also shows that the conversion of annual cropland to perennial forage conserves significant areas of wetlands. To conserve equal areas of wetlands through a direct wetland payment would cost approximately $2 million and $778,000 for the extensive and moderate program, respectively. The policy analysis provides support for targeting lower value land in habitat programs, for both economic and EGS-related reasons.

4.1.5 Property Tax Credits, Ducks Unlimited Canada

Motivation. This program was administered by Ducks Unlimited Canada in the Province of Saskatchewan to test tax credits as a means to conserve natural capital: grasslands, woodlands, and wetlands. The intent was to ascertain if an existing program, its system and infrastructure could provide a delivery mechanism to pay for environmental stewardship and encourage the retention of natural capital.

Execution/implementation. This program was implemented as a three-year pilot project in two rural municipalities. The rural municipality of Emerald is in the parkland eco-region and has a high proportion of annual cropland. The rural municipality of Morse is in the Prairie Eco-region and has a high proportion of grassland and cattle production. Enrollment in the program was voluntary and conducted annually and participating landowners were asked not to clear, break or drains natural lands for the duration of the tax year. Compatible agricultural uses were allowed.

Treatment of co-benefits. Land-based activities with complementary soil and water quality and quantity outcomes were expected. The program targeted farmer outlook and the use of municipal tax credits as a delivery mechanism.

Coordination with other programs. The pilot built on programing around agricultural BMPs for wetland, grassland and woodland conservation.

Investment/resource allocation decision process. Overlaid GIS maps with the following information were used to facilitate program delivery:

- Cadastral data integrated with municipal ownership data;
- Soft copy photogrammetric wetland inventory captured from programed 1:40,000 scale aerial photography; and
- Upland habitat inventory developed from programed SPOTS 10m multi-spectral imagery.

The use of remote sensing for designing and monitoring is an interesting component of this case.
Outcome/status/impacts. This small project pilot surpassed uptake expectations. Approximately 50 per cent of ratepayers in Morse and 32 per cent in Emerald applied for the tax credit. DUC's goal was 25 per cent enrolment after three years.

4.1.6 Prince Edward Island EGS Pilot Project

Motivation. Changes in PEI agriculture from small-scale family farming to industrial agricultural production, impacts of agriculture on environmental health, erosion form large fields, degradation of stream habitat, impacts of agricultural pesticides, impacts on human health, nitrate concentrations in groundwater reserves.

Impacts and potential impacts of agricultural operations on environmental functions and health has long been understood and accepted in this region. A responsible producer group, well-informed public groups, and watershed -based environmental committee comprised of broad -based representation created the basis for this pilot project. This pilot was funded by AAFC's ACAAF project and was conducted to evaluate the effectiveness of implementing a set of financial incentives to agricultural producers for the provision of EGS through a comprehensive EGS Land Management Package (CLMP). This should address environmental priorities and should lead to improved water quality and biodiversity in each of the watersheds. The project would provide information around benefits/costs of various incentives in the CLMP and the level of adoption by producers.

Execution/implementation. This pilot project was implemented in two watersheds: the Souris and Founds watersheds in PEI.

Broad-based partnerships were established in implementing this project. The Souris and Area Branch of the PEI Wildlife Federation provided overall project management, administered and delivered the activities and objectives indentified in the project application. The Trout River Environmental Committee provided representation on project committees. The PEI Federation of Agriculture assisted in garnering producer support in the project, and became a strong advocate of the project. The PEI Department of Environment, Energy and Forestry conducted water quality monitoring in cooperation with Environment Canada. They also provided a hydrogeologist who performed the predictive water quality monitoring. The PEI Department of Agriculture provided technical support for soil conservation, nutrient management and pesticide risk reduction. They also performed lysimeter monitoring. The PEI Agricultural Insurance Corporation administered the payments to the producers. The University of New Brunswick provided the services of an economist who conducted the valuation of various EGS activities and provided the social and economic evaluation. In addition, AAFC's regional office provided representation on the various project committees and Ducks Unlimited Canada provided assistance with GIS mapping and representation on the committees. Syngenta provided some funding and recommendations around pesticide risk reduction strategies. Cavendish Agri-Services provided nutrient management recommendations for potatoes and determined the financial returns for split field nutrient management trials.

The pilot project was implemented over two years. In the first year, the signing of the contribution agreement was in the middle of the cropping season, but in year two, significant progress was demonstrated as producers incorporated many features of the project that applied to their farms. All measurements of soil erosion structures, retired land, grassed headlands, hedgerows, sensitive land adjacent to legislated buffers, and reduction of red land over winter were done by the agrology specialists utilizing the Global Plotting System. The agrology specialists were also involved with the nutrient management trials and data collection for the pesticide risk section.

A socio-economic survey was conducted to estimate the social benefits of seven environmental actions performed by agricultural producers in the Souris and Founds watersheds. The seven management practices included: erosion control, retirement of highly sloped lands, increase in hedgerows, pesticide risk reduction, reduction in winter tilled land, retirement of sensitive land adjacent to legislated buffers, and permanent grassed headlands. The survey presented producers with hypothetical government incentive programs that would encourage agricultural producers to perform specific environmental actions that improve EGS in the watersheds and asked them to choose between the programs. Through statistical analysis of the responses, an estimate of the

average willingness to pay for each environmental action in each watershed was derived. These values were aggregated to the local population for each watershed and converted into per acre social benefits in order to set the stage for a comparison with the costs.

A pesticide risk indicator model was developed to determine the environmental and health risks associated with the active ingredients per hectare on potatoes. Spray records were collected by the agrology specialists from the producers and they were entered into this model by staff of the PEI Department of Agriculture. In the Souris and Trout River watershed the sum of the ERI and HRI (E-ERI&HRI) was calculated in each year for each field and the mean overall value was determined. Fields with E-ERI&HRI below the mean value received EGS payments.

Treatment of co-benefits. Water quality, habitat, soil erosion and human health were considered in this programing.

Investment/resource allocation decision process. Prior research that shows the positive impacts of farm-level management practices. These include: retiring sensitive land in steeply sloping areas where soil erosion is high; straw mulching to reduce rain-induced soil erosion; nutrient management for improved yield and reduced impact on groundwater nitrate levels, etc.

Outcome/status/impacts. While water quality has been monitored during the pilot program, it has been suggested that such short-term data could not conclusively prove the impact of land practices on water quality. This data will provide important baseline for long-term monitoring.

This program allowed producers to get comfortable with practices and incentive structures. The percentage uptake increase from year one to year two reflected this and was upto 261 per cent for spring plough. LEACH-M modelling for nutrients and water quality indicated that N levels declined to above 4 mg N/l in earlier May, depending on fertilizer N rate, management, land use history and weather. Predicted effects of nutrient management on water quality in the Souris River were positive as well.

A cost-benefit analysis as calculated as part of this pilot was not available during reporting. Households' willingness to pay vs. social benefits of BMP was analysed and reported.

Another positive outcome of this project was the development of a PEI Alternative Land Use Services (ALUS) program. This provincial program was based on the payments developed for the PEI EGS Pilot Project, and it includes many of the Comprehensive EGS Land Management Package components. This will offer producers the opportunity to continue with some of the environmentally responsible practices implemented under EGS.

Lessons. A strong project manager and agrology specialists who are familiar with the producers, environmental issues, and who also have experience in agriculture is crucial to quick producer uptake. Producers who respect and trust these individuals are more willing to participate.

The timing of signing contribution agreements is crucial to ensure producer uptake in the first year. Having a contribution agreement signed (May 23) in the middle of cropping season is detrimental to producer uptake in year one, as it is too late to implement many of the practices at this time.

The partnerships required to deliver a successful project like EGS should include the following; Agriculture and Agri-Food Canada, Provincial Departments of Agriculture and Environment, municipal governments, local watershed groups, farm organizations, farm suppliers, agricultural processors, academic institutions, and local environmental groups.

4.2 Canadian Research

This section briefly summarizes EGS *research* conducted in the Canadian context. Some of this research was presented at the EGS technical meeting in Ottawa in April 2009. This research provides insights into different aspects of EGS motivation, design and implementation. Cost–benefit analyses and willingness to pay analyses provide motivation for the use of EGS incentives for the realization of environmental outcomes. Other research includes design aspects such as the use of specific delivery mechanisms in EGS programing. Some synthesis of research studies is provided in Appendix 1 of this document.

Included in the summary below are a number of these studies. Studies determining the most effective delivery mechanisms for EGS programing include Yang et al., 2009; Nolet, 2009; and Boxall et al., 2009b. Studies offering motivation for the use of EGS programs to policy designers, analysts and program managers include Boxall et al., 2009a; ÉcoRessources and IISD, 2009; and Nova Scotia Federation of Agriculture, 2009. In essence, all these studies span the motivation, design and implementation stages of our EGS continuum described by Hajkowicz (2009a) and validated through our review of more advanced EGS programs across the world. A summary of research and their highlights is provided in the Table 4 below.

Table 4: A summary of research findings presented at the EGS technical meeting, Ottawa, April 2009.

Source	Key role of research	Research Goal	Research Results
Yang et al. (2009)	Program design and targeting	A pilot wetland restoration project in the Broughton Creek watershed in Manitoba was used to develop an integrated economic and wetland-watershed model to examine the cost-effectiveness of wetland restoration scenarios. This model was calibrated and validated using existing data from South Tobacco Creek (STC). The model results were applied to prioritize locations for wetlands restoration in the STC watershed.	By setting a total phosphorous reduction target, researchers identified priority farms for wetland restoration and found corresponding costs. In addition, researchers ran a cost-minimized scenario and demonstrated the value of targeting wetland restoration on the basis of benefit to cost ratios.
Boxall et al. (2009a)	Motivation for EGS programing	Researchers used a stated preference survey to gauge Manitobans' willingness to pay for wetland restoration and retention. Information around benefits and costs associated with wetland restoration were provided.	Willingness to pay was estimated at $290/household/year for retaining existing wetlands up to $360/household/year for restoring wetlands to 1968 levels. Aggregated values were determined for the province based on these values.
Nolet (2009)	Program design	This study examined the benefits for farmers and social value from agro-forestry practices, as well as evaluated their benefits and costs for agricultural businesses. This study focused on two agro-forestry practices most likely to be established in Quebec (windbreaks and riparian agro-forestry systems) and nine EGS most relevant to these practices and the region in the Esturgeon watershed in a peri-urban agricultural region and the Fouquette River watershed representing a remote area with extensive agricultural production.	Agro-forestry practices were listed based on farmer's interest in them, as well as the benefit-cost ratio for their implementation. Monetary values were given for nine selected EGS. A classification of EGS based on monetary value showed that carbon sequestration falls in first place in both watersheds and represented 27 per cent and 64 per cent of the total benefits. Three scenarios were developed: regulatory scenario based on prioritization of provincial regulations, priority scenario based on watershed priorities and a high-level scenario based on maximizing EGS.

ÉcoRessources and IISD	Motivation for EGS programing	Research looked at the costs and benefits of several policies that could increase the supply of ecological goods and services (EGS) from agricultural lands. Delivery mechanisms selected for this study included annual payments, one-time payments, reverse auctions and water quality trading. Research looked at a range of BMPs including grassy and wooded riparian buffer zones, winter cover crops, conservation tillage, and conversion of marginal farmland to wetland, retirement of flood-prone land, conservation of existing forests and wetland, and manure storage.	The cost-efficiency analysis of the delivery mechanisms revealed that market-based instruments provided most cost-efficient solutions and water quality trading was the most cost-efficient of the options pursued in the research. Cover crops provided a cost-efficient option for phosphorous removal at $38/kg while wooded riparian zones were expensive at $897/kg.
Boxall et al. (2009b)	Motivation for EGS programing	This study developed estimates of the cost of wetland restoration activity in South Tobacco Creek in Manitoba. These costs consisted of opportunity cost of lost cropping areas, nuisance costs of maneuvering machinery around the wetlands, and the actual on the ground costs of restoration. Restoration costs were found to be heterogeneous within a watershed, individual producer's lands and among producers.	Two scenarios were examined based on maximizing acres restored and maximizing abatement of phosphorous, and two pricing rules: discriminant – where the winters are paid what they bid and uniform – where all winners are paid the lowest unsuccessful offer. Researchers found that uniform pricing rule allows more efficient use of limited funds for wetland restoration.
Nova Scotia Federation of Agriculture	Design and implementation of EGS programs	Two main elements of this research were: to consult with primary producers about the impacts of changing environmental standards and societal expectations on their farm businesses, and to develop a pilot program to support environmentally beneficial activities on farms that are in a designated watershed but that, for a variety of reasons, may not be able to take advantage of existing provincial programs.	The first component indicated that farmers are increasingly aware of the value of protecting the environment for themselves and for society at large. They make management and investment decisions that reflect their environmental attitudes and accept that these actions are necessary. Component two resulted in 15 projects on 6 farms in the St. Andrews watershed. Several

			lessons around design and implementations were gleaned. A minimum of three years is recommended for program delivery.

Essentially this research demonstrates that Canada is in the early days of EGS programing, with a bulk of the research focused on the motivation, design and implementation of EGS programing. While signals from auditors have indicated that we must progress to demonstrating environmental outcomes from such programing, the EGS programs and associated research is still in the process of debating the need and the ways in which EGS can be helpful to policy-makers. Acknowledging the value of EGS programing in priority areas of environmental concern, as well as moving ahead toward programing and research for performance measurement for better accountability of allocated resources would be a significant step in the Canadian EGS agenda.

Another insight from the Canadian programs as well as Canadian research is that most initiatives are still in the regional pilot stages. While these are necessary for a number of reasons, an effort to scale up and link to federal resources and programs would provide the necessary resources and high level direction that programs worldwide have benefitted from. Once again, lessons can be learned from the Chesapeake and Mississippi cases where large basin management efforts have initiated regional collaboration leading to federal leadership and resources. An emphasis on performance evaluation in these initiatives is also a significant lesson for the Manitoba context.

5.0 Synthesis of Best Practices (International and Canadian)

The review of best practices covered a large range of EGS policies and programs, from national-level, state/provincial-level programing to local pilots. These best practices demonstrate different levels of evolution in the use of financial incentives and market mechanisms in managing and enhancing EGS. This level of evolution, commitment and management is demonstrated in the various categories we used to characterize the case studies. Our synthesis uses the categorization to mine the most promising and appropriate features for Manitoba.

5.1 Motivation

While a variety of motivating factors were seen in our review of EGS best practices, a primary focus of many of the cases was water quality. Water quality was a primary motivating factor in Australian programs, Switzerland, US programs such as EQIP and in the Chesapeake Bay and Mississippi Basin programs, and Canadian programs such as the Lake Simcoe plan, the Pike River project in Nova Scotia, as well as the Souris and Founds watersheds in PEI. Soil erosion is often the most closely related co-benefit that is explicitly targeting in some of these programs and implicitly managed in a few more. The protection of wildlife habitat is sometimes the goal of incentives on agricultural and non-agricultural landscapes. This outcome is often a stand-alone goal of EGS programs and is sometime treated as a co-benefit in the programs that we reviewed. Only the EcoTender project looked explicitly at greenhouse gas mitigation as a means of climate change mitigation.

Many projects reviewed have attempted bundling co-benefits through agri-environmental management. While the emphasis has largely been on water quality, soil management, habitat, water flow and other benefits such as health have also been explored.

5.2 Implementation

Implementation of projects shows a vast range of processes and governance systems- many show local institutional capacity and regionalized implementation of payments for ecosystem services. While water quality remains a primary motivation, implemented has focused on land management with a direct impact on water quality. Others, like the Chesapeake Bay Initiative, show political will and direction from the federal level driving state and local level action. **Of particular relevance to nutrient management of a large basin are the Mississippi Basin and Chesapeake Bay Initiatives that demonstrate the melding of national programs with regional prioritization, targeting and additional resources.**

The lack of silver bullets related to EGS program implementation leads us to reinforce the idea that EGS programing, especially at the regional landscape level, is context specific. The UK EGS programing is targeted to practices: organic and non-organic but also at vulnerable areas identified as regions of significant cultural or natural heritage. Geospatial mapping of these areas has proved to be a useful tool for broader participation, communication and uptake. Australian EGS programing has used a wider variety of targeting. The EcoTender program, for example, used a catchment model to identify areas of high significance and investment value. Reverse auctions have been proven as cost-efficient means of programing for agri-environmental conservation.

The US programs in the Chesapeake Bay, as well as the Mississippi Basin demonstrate the value of spatial targeting and prioritizing investments to target specific regions of high value benefit: cost ratio. While EGS policies and programs most frequently use economic incentive-based policy instruments, these are combined with education, institutional capacity building and sometimes regulatory policy instruments for program implementation. These cases are of especial significance to the Manitoba context due to the potential motivation around reducing nutrient loads to Lake Winnipeg. **It is critical to note that only through spatial modelling has targeting and effective prioritizing taken place in the two US cases. This provides an important lesson for the design and implementation of EGS policy and programing in the Manitoba context.**

Another key lesson from a review of EGS implementation is the prevalence of stakeholder participation and multi-stakeholder partnerships in EGS programs. These partnerships may be amongst various levels of government, non-governmental agencies and other relevant stakeholder groups. This creates a level of trust and uptake that programs without stakeholder input cannot compete with.

A critical insight derived from our study is the natural tendency of most reviewed programs to move from motivation, design and implementation to a need for performance measurement for better accountability. A corresponding lesson for programs in earlier stages of this continuum is to be forward compatible by incorporating performance measurement and accountability into EGS programing to get to effective and efficient programing in the most effective timeline.

5.3 Treatment of Co-benefits

Our analysis of the treatment of co-benefits is reflected in our review of the motivation for EGS programs. Most programs and projects that we reviewed explicitly targeted water quality and to some extent soil erosion. Wildlife habitat conservation was the other, relatively common outcome of EGS programing revealed in our review. This outcome is treated both as a co-benefit and as a stand-alone, primary benefit of EGS programing in the cases that we reviewed.

The EcoTender program in Australia can be highlighted as the one program successful in harnessing co-benefits. The Catchment Modelling Framework that formed the basis of this work provides the sophisticated targeting and decision-support mechanism that allows the monitoring of multiple co-benefits and enables the incorporation of multiple benefits into.

From a previous review (EnviroEconomics, 2009)[18] it can be ascertained that the bundling of more than one category of ecological services, has been proposed for long as being more efficient. Although merged bundles may reduce transaction costs that can be less effective since merging services makes it impossible to target payments to individual services. Results of payment for ecological services schemes indicate that selling bundled services increase revenues to land users, but that the scheme is more complex to set-up given the need to address separate EGS at the same time.

We did not find much information around the integration of EGS into existing programs. This is another gap, possibly in EGS programing, and potentially in the scope of this initial review.

5.4 Decision-Making Criteria in EGS Programing

A range of methodologies were uncovered in resource allocation/decision-making criteria in the reviewed EGS programs and policies. These range from simple criteria developed through participatory, multi-stakeholder processes, to sophisticated analytical and geo-spatial models that help target policies and programs sectorally, regionally or spatially. Spatial models are especially helpful in determining geographic and sectoral priorities and are deemed to be a high level priority in developing environmental management programs on the landscape such as those under an EGS agenda.

Since these decision criteria are a key lesson for use in the development of a Manitoba-based EGS policy, we analyse these in some detail in the section on final recommendations.

The Australian case reveals a number of different decision-support systems, as well as resource allocation models. These range from the INFFER tool for resource allocation and policy analysis to the catchment modelling framework to determine the best funding allocation from a spatial and ecological perspective. The US cases demonstrate the most advanced levels of modelling, supported by calibration based on years of monitored data. The Chesapeake Bay, for example, has developed total maximum daily loads at the sub-watershed levels and is using these to manage outcomes and

[18] Copyright Her Majesty The Queen in Right of Canada, Environment Canada, 31 March 2009. Reproduced with the permission of the Minister of Public Works and Government Services Canada.

resource allocation decisions. Canadian pilot initiatives are taking into account other socio-economic criteria such as equity.

A variety of multi-criteria decision analysis tools are applied in EGS programs across the world. The US Environmental Quality Incentives Program (EQIP) commenced in 1997 and developed an aggregate environmental index (AEI) at the federal level to allocate funding amongst the states. Each state employs a wide variety of AEI to direct funding internally. The US Wetlands Reserve Program (WRP) is a voluntary program providing financial assistance to landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns (NRCS, 2007). Like the EQIP, the funds under the WRP are allocated to the states using an AEI. This allocation is based on four criteria: ecological concerns (protecting bird migration and rate of wetland loss), state performance (program performance and easement closure), landowner interest (level of unfounded applications), and cost. The cost is the least important criterion.

5.5 Outcomes/Status

Most programs reviewed have significant uptake for EGS programing. Most programs are on agricultural landscapes and significant extension and outreach in program design, along with incentive payments for participation have been instrumental in improved uptake and program success. The programs reviewed in this research yielded a broad range of outcomes. Many of the programs reviews based performance evaluation on level of uptake and land under area covered by the program. While program goals are often EGS management related, evaluations often lack specific indicators and measures of program goals fulfillment.

In the review of the UK program, program uptake and some bird habitat -based outcomes have been measured and reported. In the case of Australia, the most significant outcome is the evolution of the programing itself. Australia has seen the development of a national, integrated EGS programs based on adaptive re-design of numerous regional programs and pilot initiatives. Within the regional programs too, an emphasis on multifunctional program design, monitoring and evaluation with some emphasis on feeding design and implementation lessons back into programs, as well as the use of multi-criteria tools such as the catchment modelling framework and indicator analyses for decision support and resource allocation are key lessons. In the case of Natura in France, a "Barometer" provides the state of program uptake, area under programing, status of programing as well as qualitative indication of progress. A commendable set of performance indicators is seen in the case of programing in Switzerland, where indicators have been developed for nutrients, energy/climate, water, soil as well as biodiversity. In the US, little has been recorded on the outcomes of the Chesapeake Bay and the Mississippi Basin initiatives. There is not much recorded evidence that the dead zone in the Gulf of Mexico and the nutrient loading of the Chesapeake Bay have actually seen improvements. However, significant progress in program design and the focus on

the development of measurable TMDLs is hoped to overcome some of these program shortfalls. An important outcome in the Canadian research is the absolute and measurable nutrient reduction demonstrated in the case of Pike River, Quebec. The water quality monitoring at the end of the two-year program period showed a significant decrease of about 25 per cent of the mean phosphorous load.

Other specific outcomes include the realized value of public consultation and decentralized implementation in programing. In addition the use of technical tools such as SWOT and CANWET models were explored and assessed.

6.0 Conclusions

Across the country, place -based approaches are gaining momentum. Cantin (2010) describes such approaches as a collaborative means to address complex socio-economic issues through interventions defined at a specific geographic scale. These could include watersheds, communities, forested areas, etc. and allow a means to grasp complex and sometimes unexpected connections. This is the opportunity we have in developing a provincial EGS policy- of grasping complex and possibly unexpected connections, not just between the most obvious, such as soil and water management, but perhaps between potential benefits in food production, water and health through EGS management.

Manitoba has articulated a number of provincial priorities through a range of policies, programs and legislation released in the past few years. An understanding of such articulated provincial priorities related to land and water management, greenhouse gas management, habitat management, and flood and drought management are seen as relevant to a Manitoba EGS program. It is anticipated that these priorities will form the building blocks of an EGS policy for Manitoba.

6.1 Manitoba's Priorities

Climate Change

Beyond Kyoto (2008) delineates Manitoba's greenhouse gas emissions reduction targets as 6 per cent below 1990 levels by the year 2012. Relevant to the EGS agenda, it identifies agriculture as a particularly relevant sector due to the fact that it contributed almost 30 per cent of the province's overall greenhouse gas emissions in 2005. Programing in agriculture, forestry and community-based resource management are expected to reduce emissions by 680,000 tonnes toward meeting the provincial targets, while agriculture alone is expected to contribute to 250,000 tonnes of emissions reduction to meet the provincial targets.

Highlights of emissions reductions from agriculture, forestry and community programs include afforestation and woodlot programs, Agricultural BMPs and support for municipal waste reduction including composting, water and energy efficiency, and transportation demand management.

In agriculture, BMPs have been identified to realize reductions in provincial greenhouse gas emissions. These include efficient use of nitrogen fertilizers, expanded soil surveys to provide landscape information and support environmentally sustainable decision-making, manure management technologies and practices, biofuel production and management, management of soils

through reduced tillage and other soil conservation practices, crop rotations, organic farming, as well as land management practices for carbon sequestration—including wetland restoration, permanent cover, afforestation, and riparian area improvement.

Water

In land and water management, Manitoba's *Water Protection Act* (2005) prescribes actions and limits to land and water management for maintaining water quality appropriate for ecological and life-support systems and food production. The act describes water quality management zones as designated areas that may be demarcated for the purpose of protecting water, aquatic ecosystems or drinking water sources, as well as regulating or prohibiting activities or uses in a water quality management zone.

This act provides guidance and regulatory background for the protection and stewardship of Manitoba's water resources based on watershed management planning, decentralized management through water planning authorities, an understanding of financial incentives for management water quality and habitat, as well as establishing standards, objectives and guidelines for water.

The act also enables the development of Integrated Watershed Management Plans through a participatory approach. These plans are intended to identify priority land and water-related issues in the watershed, determine projects or policies targeted to address the issues, and identify how land and water management programing can be cooperatively carried out throughout the watershed. Manitoba Water Stewardship provides a $25,000 grant to each watershed planning authority to offset expenses related to the development of the plans.

The Manitoba Water Strategy (2003) identifies six main policy areas as provincial priorities. These are:

- Water quality;
- Conservation;
- Use and allocation;
- Water supply;
- Flooding; and
- Drainage.

Agriculture

The federal program *Growing Forward* provides the foundation for coordinated federal-provincial-territorial government action over the next five years to help the agriculture and agri-food sectors

become more profitable, competitive and innovative. *Growing Forward* puts more emphasis on building a profitable sector through:

- More investment in innovation;
- Action on key regulatory priorities;
- Environment and food safety programs;
- Programs that better meet local needs; and
- Measures that enable farmers to be proactive in managing risk when faced with disasters.

Growing Forward's environmental suite provides guidance for EGS programing by providing environmental action and environmental information. Programs included in the Environment Action are:

- Environmental Farm Plan: This program is designed to help producers meet environmentally sustainable targets including stewardship of land, water air and biodiversity resources used in agriculture; increased Canadian and international confidence that the Canadian agriculture and agro-food sector is producing food that is safe and environmentally sustainable.
- Environmental Farm Action Plan: This program supports agricultural producers in reducing identified environmental risks and improving the management of Manitoba's agricultural land. The goal is to reduce identified risks and improve management of water resources, air quality, soil productivity and wildlife habitats.

In agriculture, Manitoba is the easternmost of the Canadian Prairie provinces and has a large agriculture land base. Despite receiving the highest precipitation of the Prairie Provinces, drought is a constant concern. There are nearly 20 million acres of farmland in production, 3 million hogs, and 1.5 million cattle. Manitoba has seen unprecedented growth in the intensive livestock industry, notably from large hog operations. Manitoba's climate change targets for the agricultural sector of 250,000 tonnes of greenhouse gas reduction to meet the Kyoto targets (STEM, 2008) as well as Lake Winnipeg nutrient load reduction goals of 13 per cent to 1970 levels (LWSB, 2006) provide some additional impetus to agri-environmental management.

Land Use and Land Management

While land and land-use is managed through this large variety of legislative and institutional policies and programs, a coherent land management strategy has not been developed for Manitoba. A provincial priority articulated in the *Green and Growing* document (2005) is to "protect our pristine

land and environmentally sensitive areas and increase access to our natural habitats through the responsible expansion of our network for biking and walking trails."

A significant piece of legislation for land management is provided through *The Planning Act* that outlines the framework for planning on private lands in the province. It governs through policies and regulations including *The Provincial Land Use Policies* that represent the provincial interest in land, resources, and sustainable development and provides policy direction for a comprehensive, integrated and coordinated approach to land use planning and serves as a guide to planning authorities in preparing, reviewing and amending development plans and regional strategies.

Apart from land under agriculture and held by landowners through title, provincial Crown lands are managed under *The Crown Lands Act*. This act gives the provincial government and the Minister responsible for administration of the Act discretionary power to issue permits, licenses and leases that grant a temporary or permanent right of interest to use, access or occupy crown lands. Government can also purchase, exchange, or dispose of (sell) Crown lands or 'designate' particular areas such that certain activities and/or uses are permitted or prohibited within the defined (designated) area. Resource extraction is regulated by other legislation, including *The Environment Act, The Mines Act* and *The Forestry Act*. Wildlife management is governed by *The Wildlife Act* and institutionalized through *The Habitat Heritage Act*.

6.2 Manitoba's Programs

Manitoba also has a number of incentive programs in place to enable agri-environmental management and address other provincial priorities.

Manitoba Water Stewardship administers the Wetland Restoration Incentive Program (WRIP) to "provide incentives to landowners to restore wetlands on their land." The program, delivered in partnership with project partners Manitoba Habitat Heritage Corporation and Ducks Unlimited Canada, provides financial incentives, technical support, and advice to landowners. The program delivers multiple benefits including greenhouse gas emission reduction, improved nutrient retention, enhanced provision of wildlife habitat and protection of biodiversity.

The Riparian Tax Credit Program is administered by Manitoba Finance to encourage farm operators to upgrade their management of lakeshores and river and stream banks to reduce erosion, buffer the extremes of the flood and drought cycle, improve water quality downstream, and reduce emission of greenhouse gases. This program recognizes those who have already done so. The delivery mechanism for this program is through a property tax credit.

Manitoba Agriculture, Food and Rural Initiatives (MAFRI) administers The Environmental Farm Action Program (EFAP) to support agricultural producers in reducing identified environmental risks, including those to water resources, air quality, soil productivity and wildlife habitats, and improving the management of Manitoba's agricultural land. BMPs funded under this initiative cover a broad variety, and include waste management, site, management, nutrient management, livestock management, and precision agriculture applications.

MAFRI also administers The Manitoba Sustainable Agriculture Practices Program (MSAPP) to achieve greenhouse gas emission reductions in the agriculture sector, as well as improved water quality, enhanced profitability and great energy efficiency. Funding is provided in areas including fertilizer and nutrient management, manure management and treatment, composting, feeding and grazing strategies, cropping systems and others.

These are just a few relevant Manitoba incentive programs that provide insight and fodder for the development of a Manitoba EGS policy. A full synthesis of Manitoba's relevant programs is presently being compiled by the Provinceduring the time of the research.

6.3 Towards a Manitoba EGS Program Design

A Manitoba-based EGS policy will have to **incorporate and blend current and new programing** and resources, capacity and knowledge in order to be effective and efficient. Lessons learned from the design, implementation and monitoring of existing programs will provide the most relevant and context-specific inputs for the design of a Manitoba EGS program.

The need to monitor and adapt to attain not only cost-efficiency, but also environmental outcomes, is more and more urgent in today's climate of economic tightening and the need to produce more for less. This need is further heightened through our review where a trend can be seen in EGS programing toward a call from national auditors for greater accountability. Awareness of this need for performance measurement should drive any program design and implementation in the national and regional contexts in Canada.

Essentially this review of international EGS programing and Canadian EGS programs and research has revealed that Canada is in the early days of EGS programing, with a bulk of the research focused on the motivation, design and implementation of EGS programing. While signals from national auditors have indicated that we must progress to demonstrating environmental outcomes from such programing, the EGS programs and associated research in Canada is still in the process of debating the need and the ways in which EGS can be helpful to policy-makers. Acknowledging the value of EGS programing in priority areas of environmental concern, as well as moving ahead toward

programing and research including performance measurement for better accountability of allocated resources, would be a significant step in the Canadian EGS agenda.

Another insight from reviewing Canadian programs and research against a review of international programing is that while an international trend of compiling lessons from regional pilots to develop national level strategies for EGS has emerged, Canadian programs as well as Canadian research are still in the regional pilot stages. While pilots can continue to refine design and implementation techniques, an effort to scale up and link to federal resources and programs would provide the necessary resources and high level direction that programs worldwide have benefitted from. Important and relevant lessons can be learned from the Chesapeake and Mississippi cases where large basin management efforts have initiated regional collaboration leading to federal leadership and resources. Performance evaluation in these initiatives is also a significant lesson for the management of Lake Winnipeg priorities in the Manitoba context.

Some relevant guidance for the development of EGS policies and programs comes in the form of guidance principles for the design of agri-environmental programs given by the European Commission (2005). These principles provide some insight into the design and implementation of EGS programs in general. Of these, the principles relevant to EGS programing in general and in the Manitoba context specifically, are synthesized below:

a. The optional nature of agri-environmental programing tends to promote constructive operations and in this respect has an advantage over statutory environmental obligations.
b. Agri-environmental programing (and by extrapolation, any land and water based EGS programing) is a site-specific measure.
c. The diversity of measures and environmental situations, and the long lead-in time for some of the environmental effects to be perceivable, requires a structured and long term approach to monitoring and evaluation.
d. Agri-environmental contracts compete economically with the most profitable land use, so payment levels have to be set sufficiently high to attract farmers to join schemes while avoiding over-compensation.
e. Agri-environmental payments may only be made for actions farmers undertake above the reference level of mandatory requirements as currently defined by codes of "good farming practice" (GFP). This ensures the respect of the Polluter Pays Principle which requires that private actors have to bear the costs of rectifying or avoiding damage to the environment.
f. Wider contextual and institutional issues as well as attitudes have a great influence on agri-environmental measures' uptake and their environmental effectiveness.
g. Agri-environmental payments (and in all probability all EGS payments) are not considered to be trade-distorting subsidies.

Our primary insight into the development of a Manitoba EGS program is **to develop a simplified program targeting agricultural landscapes and the environment**. For example, a single program based on improving water quality, habitat conservation and reducing greenhouse gases would

potentially enhance the understanding of multi-functionality of landscapes and allow for better management and monitoring of multiple outcomes accordingly. Keeping in mind the risk of pilot program proliferation, attention should be given to **creating an over-arching framework articulating relevant regional priorities** analogous to the Australian experience with Caring for our Country and pilots leading up to it.

Targeting and Priority Setting

The need for accountability, as well as an increasing demand for demonstrating effectiveness in environmental programing (as opposed to simply uptake, for example) is leading policy-makers to adopt a variety of indices and multi-criteria decision criteria for monitoring, measuring and demonstrating progress in environmental stewardship. Hajkowicz et al. (2007) describe agri-environmental indices (AEI) used to quantify benefits and target investments in agri-environmental programs. They describe AEI as a set of measurable indicators that are combined to quantify the benefits of investing in a given location, project or region. The AEI is a unit of value that provides a relative, as opposed to absolute, measure of benefit arising from an investment option (e.g. farm, site, project, region) compared to another.

Policies to conserve, manage or enhance EGS need effective targeting and design. There are numerous studies to inform the ways in which EGS policies can be more effective, efficient, and potentially simple. As with most policies related to environmental management, the complexity of interlinked social and environmental systems does not allow for simplistic solutions. We have synthesized some keys studies to elaborate on the key decision support and policy analysis tools for EGS management and governance.

The World Resources Institute (2008) presents a range of policy options for sustaining ecosystem services where they weigh potential national and sub-national policies against potential value for sustaining EGS and challenges in design and implementation and give examples of each. They include national and sub-national policies such as mainstreaming EGS into economic and development planning, including investments in EGS in government budgeting and establishing protected areas. They also include economic and fiscal incentives such as the use of tax deductions and credits to encourage investment in and purchase of EGS, establishing fees for resource use or EGS management, using public funds to pay for maintenance of EGS, reducing perverse subsidies, setting limits and establishing trading systems for EGS etc.

Given all the choices for the selection of policy instruments for an identified policy goal, research identifies the criteria by which potential policy instruments might be chosen to fulfill an identified goal. One version of such instrument selection tool is in the form of a risk assessment tool developed in partnership with Environment Canada (Environment Canada and Marbek Resources

Consultants Ltd., 2006). This Qualitative Screening of Management Tools (QSMT) Methodology includes a number of criteria including environmental effectiveness, economic efficiency, distributional impact, political and public acceptability and jurisdictional compatibility and international obligations. Another framework applied for the evaluation of environmental tax proposals and relevant to the context of evaluation of financial incentives relevant to the stewardship of EGS is provided in an annex of a Government of Canada budget plan (Government of Canada, 2005). Annex 4 of this document provides some criteria for judging the efficiency and effectiveness of policies and policy instruments. These include environmental effectiveness, fiscal impact, economic efficiency, fairness and simplicity. The definitions of these criteria are given as follows and the annex indicates that decisions by government based on these criteria could be done by applying a relative weight to each criterion in making choices and establishing priorities.

Environmental effectiveness: whether, and to what extent, the proposal will contribute to achieving the environmental goal.
Fiscal impact: how the proposal will affect government expenditures or revenues.
Economic efficiency: how the proposal will affect the allocation of resources in the economy and Canada's global competitiveness.
Fairness: how the impacts of the proposal are distributed across sectors of the economy, regions or groups within the population.
Simplicity: how governments will administer the proposal and how affected individuals or parties will comply—and at what cost.

The INFFER tool described in the review of Australian EGS programing is another such tool enabling decision-making in the context of environmental stewardship and management. INFFER aims to get the most value from small environmental budgets and provides recommendations around when and where to apply specific policy instruments. INFFER creates a strong business case for public investment and enables more effective use of limited public finances. It goes against the current approach of offering equitable financial incentives fairly evenly by promoting more spatially targeted resourcing.

These decision support tools provide a variety of support structures for programing and policy-making toward identifying and implementing cost-efficient and environmentally effective means of programing for the conservation and management of EGS.

Designing for Multi-functionality

Many of the programs and projects reviewed as part of this study demonstrate significant 'bundling' of articulated program benefits or a multi-functionality of program goals. For example, the Australian EcoTender program is designed for reducing soil and water salinity, improving

biodiversity, as well as reducing greenhouse gas emissions from agricultural landscapes. Decision-support tools were also designed (catchment modelling framework) keeping this multi-functionality in mind. Programs on the Canadian landscape also targeted multiple outcomes such as biodiversity or habitat management while attempting nutrient reduction for water quality or soil conservation. While this sort of multi-functionality is most apparent at the design and priority setting stages, there is a need to carry these multifunctional components to program monitoring and performance measurement to ensure that agri-environmental programs consistently acknowledges the multiple benefits that EGS-based programing can release.

Economic Valuation of EGS

Finally, we'd like to highlight the role of strategic research in providing necessary motivation for EGS programing and enhancing the use of EGS programs to realize optimized public benefits. Economic valuation of EGS within identified geographical contexts is one example of such research that helps to steer the necessary discourse toward EGS-based programing. Valuation studies also provide the necessary justifications to cabinet committees and treasury board secretariats by providing an understanding of the scale and value of public benefits through proper management. These studies can also demonstrate the claimed EGS improvements, although not all measured and valued in existing markets, have tangible value in policy debates (say, in avoided cost of health care or benefits to tourism). Examples of regional valuation studies that have had demonstrated impact on political priorities and policies include: The Value of Natural Capital in Settled Areas of Canada (Olewiler, 2004); Natural Credit: Estimating the Value of Natural Capital in the Credit River Watershed (Kennedy and Wilson, 2009); An Ecosystem Services Assessment in the Lake Winnipeg Watershed: Phase I Report – Southern Manitoba Analysis (Voora and Venema, 2008) and Pimachiowin Aki World Heritage Project Area Ecosystem Services Valuation Assessment (Voora and Barg, 2008). These valuation studies have increased the motivation for programing to conserve and manage EGS for valuable and multiple public benefits.

7.0 Bibliography (General)

Alberta Environment. 2008. Environmental Tools Guide. Retrieved February 21, 2010, from http://environment.alberta.ca/1985.html.

Australian Bureau of Statistics (ABS). 1998. Year Book Australia, Catalogue No. 1301.0. Australian Bureau of Statistics, Canberra.

Australian Bureau of Statistics (ABS). 2007. Australian Farming in Brief, Catalogue No. 7106.0. Australian Bureau of Statistics, Canberra.

Australian National Audit Office (ANAO). 2008. Regional Delivery Model for the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality; Audit report 21, 2007-2008; Australian National Audit Office, Canberra.

Australian National Audit Office (ANAO). 1997. Commonwealth Natural Resource Management and Environmental Programs; Audit report 36, 1996-1997; Australian National Audit Office, Canberra.

Belcher, K. 2009. Lower Souris Watershed Ecological Goods and Services Pilot Proposal Advancing Canadian Agriculture and Agri-Food Program, Agri-Environmental Policy Measure Analysis, Project Report. University of Saskatchewan

Boxall, P., Pattison, J.K., Gabor, S. 2009a. Estimates of Passive Use Values of Wetland Restoration and Retention in Southern Manitoba. Pages 30-52 in Proceedings of the Ecological Goods and Services Technical Meeting, Ottawa, Canada. Prairie Habitat Joint Venture (Edmonton).

Boxall, P., Packman, K., Weber, M., Samarawickrema, A. Yang, W. 2009b. Price discovery mechanisms for providing ecological goods & services from wetland restoration: An examination of reverse auctions. Pages 191-208 in Proceedings of the Ecological Goods and Services Technical Meeting, Ottawa, Canada. Prairie Habitat Joint Venture (Edmonton).

Cantin, B. 2010 Integrated Place-Based Approaches for Sustainable Development. *Horizons,* Vol. 10(4). Policy Research Initiative, Ottawa.

Dollevoet, B., Koeckhoven, S., Jeffrey, S., Unterschultz, J. 2009. Lower Souris Watershed Ecological Goods and Services Pilot Proposal Farm Level Economic Analysis. Project Report. Department of Rural Economy, Faculty of Agricultural, Life & Environmental Sciences, University of Alberta.

EnviroEconomics. 2009. Compensation for the Provision of Ecological Goods and Services: Policy Instruments and Practices within G8 and O5 Countries. A report for Environment Canada, Ottawa.

Environment Canada and Marbek Resource Consultants Ltd. 2006. Qualitative Screening of Management Tools (QSMT) Methodology. Unpublished report.

European Commission. 2005. Agri-Environment measures: overview on general principles, types of measures, and application. Directorate General for Agriculture and Rural Development, European Commission, Brussels. Available: http://ec.europa.eu/agriculture/publi/reports/agrienv/rep_en.pdf.

European Court of Auditors. 2006. Information note by the European Court of Auditors on Special Report No.7/2006 Concerning Rural Development Investments: Do they Effectively Address the Problems of Rural Areas? European Court of Auditors, Luxemburg.

Government Accountability Office. 2006. USDA Should Improve Its Process for Allocating Funds to States for the Environmental Quality Incentives Program. United States Government Accountability Office, Washington.

Government Accountability Office. 2002. State Advisory Committees' Views on How USDA Programs Could Better Address Environmental Concerns. United States Government Accountability Office, Washington.

Government of Canada. 2005. The Budget Plan 2005. Department of Finance, Canada. Retrieved September 22, 2009, from http://www.fin.gc.ca/budget05/pdf/bp2005e.pdf

Hajkowicz, S. 2009a. The evolution of Australia's natural resource management programs: Towards improved targeting and evaluation of programs; *Land Use Policy* 26:471-478.

Hajkowicz, S. 2009b. Cutting the cake: Supporting environmental fund allocation decisions; *Journal of Environmental Management* 90:2737-2745.

Hajkowicz, S. 2008. Supporting multi-stakeholder environmental decisions; *Journal of Environmental Management* 88:607-614.

Hajkowicz S, Collins C and Cattaneo A 2009. Review of Agri-Environment Indexes and Stewardship Payments; *Environmental Management* (2009) 43:221-236.

Kennedy, M., Wilson, J. 2009. Natural Credit: Estimating the Value of Natural Capital in the Credit River Watershed. The Pembina Institute and Credit Valley Conservation.

Louise Berger Group Inc. 2006. Pollutant Target Load Study: Lake Simcoe and Nottawasaga River watersheds. Prepared for the Lake Simcoe Region Conservation Authority. Available at http://www.lsrca.on.ca/reports/acs.php

Mann, S., Wüstemann, H. 2008. Multifunctionality and a new focus on externalities. Journal of Socio-Economics. 37(1), 293-307.

Miistakis Institute. 2009. Alberta Ecological Goods and Services Program Scan for Alberta NAWMP Partnership. Prepared for: Alberta North American Waterfowl Management Plan Management Committee.

Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Synthesis.* Retrieved 14 October 2009 from http://www.maweb.org/documents/document.356.aspx.pdf.

Mullinix, C., Phillips, S., Shenk, K., Hearn, P., Devereux, P. 2009. Facilitating Adaptive Management in the Chesapeake Bay Watershed through the use of online decision support tools. The third interagency conference on research in the watersheds, 8-11 September 2008, Estes Park, CO.

Natural Resources Conservation Service (NRCS) 2008. *Mississippi River Basin Gulf Hypoxia*; NRCS, Washington. Retrieved January 11, 2010, from http://wmc.ar.nrcs.usda.gov/partnerships/MSRB/index.html.

Natural Resources conservation Services (NRCS). 2007. Wetland reserve program: farm bill 2002, fact sheet. Natural Resource Conservation Service, US Department of Agriculture, Washington, DC.

Nolet, J. 2009. Ecological Goods and Services and Agroforestry (EGS): The Benefits for farmers and the interests for society. Pages 80-103 in Proceedings of the Ecological Goods and Services Technical Meeting, Ottawa, Canada. Prairie Habitat Joint Venture (Edmonton).

Office of the Auditor General of Canada. 2008. 2008 December Report of the Commissioner of the Environment and Sustainable Development, Chapter 3; Auditor General of Canada, Ottawa.

Olewiler, N. (2004). The Value of Natural Capital in Settled Areas of Canada. Published by Ducks Unlimited Canada and the Nature Conservancy of Canada. 36 pp.

Ribaudo MO, Hoag DL, Smith ME, Heimlich R. 2001. Environmental indices and the politics of the conservation reserve program; *Ecological Indicators* 1:11-20.

Rio Declaration on Environment and Development. 1992. Earth Summit Agenda 21 Chapter 14, final text of the agreements negotiated by Governments at the United Nations Conference on Environment and Development (UNCED), 3-14 June 1992, Rio de Janeiro, Brazil.

Soil and Water Conservation Society (SWCS) and Environmental Defence (ED) 2007. *Environmental Quality Incentives Program: Program Assessment*; Soil and Water Conservation and Environmental Defence, Ankeny, Iowa.

Stokstad, E. 2009. Obama moves to Revitalize Chesapeake Bay Restoration. *Science*. May 29, 2009. 324(5931). pp. 1138-1139.

Texas Parks and Wildlife. 2007. 2002 Farm Bill Program: Environmental Quality Incentive Program (EQIP). Retrieved Apr. 2, 2010 from: http://www.tpwd.state.tx.us/landwater/land/private/farmbill/eqip/.

United States Department of Agriculture (USDA) 2003. Conservation Reserve Program Sign-up 26 Environmental Benefits Index; Fact Sheet, USDA, Washington.

USDA-NRCS. 2008. Wetlands Reserve Program. Retrieved Mar. 22, 2010 from: http://www.nrcs.usda.gov/Programs/WRP/.

USDA-NRCS. 2008a. Grassland Reserve Program. Retrieved Mar. 22, 2010 from: http://www.nrcs.usda.gov/programs/GRP/.

Voora, V., Venema, H.D. 2008. An Ecosystem Services Assessment in the Lake Winnipeg Watershed: Phase I Report – Southern Manitoba Analysis. IISD, Canada.

Voora, V., Barg, S. 2008. Pimachiowin Aki World Heritage Project Area Ecosystem Services Valuation Assessment. IISD, Canada.

White, C. L., 2007. Lower Souris Watershed Ecological Good and Services Project Literature review of state of knowledge for landscape targets. The relationship between wildlife and habitat quality. Saskatchewan Watershed Authority.

WRI (World Resources Institute). 2008. Ecosystem Services: A Guide for Decision Makers. Washington DC. USA.

Yang, W., Liu, Y., Boxall, P.C., Packman, K., Weber, M., Gabor, S. 2009. Integration of watershed planning and the agricultural policy framework for the provision of ecological goods and services: A pilot watershed approach for wetland restoration and retention. Pages 13-29 in Proceedings of the Ecological Goods and Services Technical Meeting, Ottawa, Canada. Prairie Habitat Joint Venture (Edmonton)

7.1 Australia

Crowley, K. 2001. Effective environmental federalism? Australia's Natural Heritage Trust. Journal of policy and planning, vol. 3 (4). P 255-272.

Designer Carrots: Market-based instruments for NRM change [Website] http://www.marketbasedinstruments.gov.au/ [accessed February 26, 2010].

Eigenraam M, Strappazzon L, Lansdell N, Ha A, Beverly C and Todd J 2006. *EcoTender: Auction for multiple environmental outcomes*; Department of Primary Industries, Melbourne.

Hajkowicz S 2009a. The evolution of Australia's natural resource management programs: towards improved targeting and evaluation of investments; *Land Use Policy* 26(2009): 471-478.

Hajkowicz S 2009b. Cutting the cake: supporting environmental fund allocation decisions; *Journal of Environmental Management* (2009) 2737-2745.

Hajkowicz S 2008. Supporting multi-stakeholder environmental decisions; *Journal of Environmental Management* 88 (2008) 607-614.

Hajkowicz S and Collins K 2009. Measuring the benefits of environmental stewardship in rural landscapes; *Landscape and Urban Planning* 93 (2009) 93-102.

Investment Framework for Environmental Resources (INFFER) [Website] http://cyllene.uwa.edu.au/~dpannell/inffer.htm [Accessed March 22, 2010].

7.2 France

Barbut, L. & Baschet, J-F (2005). L'évaluation De La Politique De Soutien A L'agroenvironnement. Cabinet ASCA and DAF/SDEPE/BEPE ministère de l'Agriculture, de l'Alimentation, de la Pêche et de la Ruralité

Bonnieux, F. (2005). Agriculture et territoire : enjeux pour l'action publique et la recherche scientifique. Bilan critique de la politique agri-environnementale et perspectives d'évolution avec la nouvelle PAC. Séminaire INRA-DATAR, mai 2005

Boulanger, P. (2005). Les réalités de la distribution des subventions agricoles en France. Groupe d'Économie Mondiale de Science Po (GEM)
http://gem.sciences-po.fr/content/publications/pdf/subventions_agricoles.pdf

Centre National pour l'Aménagement des Structures des Exploitations Agricoles - CNASEA (2004). Évaluation à mi-parcours portant sur l'application en France du règlement CE n°1257/1999 du Conseil, concernant le soutien au développement rural.
http://agriculture.maapar1.agriculture.gouv.fr/spip/IMG/pdf/synthese-3.pdf

Centre National pour l'Aménagement des Structures des Exploitations Agricoles (CNASEA), (2009) 2008 Activity Report. http://www.asp-public.fr/sites/default/files//fichiers_attaches/pdf/RA_ cnasea_08_web.pdf

Desjeux, Y., Lepage, D., Arnaud, S. & Dupraz, P. (2006). Facteurs déterminant l'efficacité des Programs Agro-environnementaux: le cas de la Basse-Normandie. INRA UR0122 - Economie et Sociologie Rurale. Rennes

European Commission (1999). Regulation EC No. 1257/1999 of the Commission, May 17, 1999: http://www.arev.org/article/articleview/955/1/478/

European Commission (2002). Regulation EC No. 445/2002 of the Commission, February 26, 2002 http://www.arev.org/article/articleview/325/1/442/

European Commission (2005). Regulation EC No 1698/2005 of the Commission, 20 September 2005. On support for rural development by the European Agricultural Fund for Rural Development (EAFRD). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri= OJ:L:2005:277:0001:0040:EN:PDF

France's Senate [Website].http://www.senat.fr/rap/a04-076-3/a04-076-34.html [December 9, 2009]

Guihéneuf, P.-Y., Bonal, O. & Lierdeman, E. (2004) Les CTE en Languedoc-Roussillon. Les principaux effets d'une politique contractuelle innovante sur l'évolution des pratiques agricoles.

Matthews, A. (2008). European Rural Development Policy – Implications for Agri-Environment Schemes. European Agricultural Policy, Trinity College Dublin.

Ministère de l'agriculture et de la Pêche (2009). Plan de Développement Rural Hexagonal. 2007-2013 / La Nouvelle Programmation De Développement Rural.
http://agriculture.gouv.fr/IMG/pdf/comfeader_241006.pdf

Ministère de l'agriculture et de la Pêche (2009) [Website].
http://www.agriculture.gouv.fr/spip/ressources.themes.europeetinternational.plandedeveloppement ruralnational_r727.html [December 9, 2009]

Ministère de l'Agriculture, de l'Alimentation, de la Pêche et de la Ruralité (2003) Decree No. 2003-675 of July 22, 2003 regarding sustainable agriculture contracts and amending the rural code.
http://agriculture.maapar1.agriculture.gouv.fr/spip/IMG/pdf/decret2003_6745.pdf

Ministère de l'Agriculture, de l'Alimentation, de la Pêche et de la Ruralité (2005). Déclaration annuelle du respect des engagements CAD (DARE)
http://www.agriculture.gouv.fr/spip/IMG/pdf/2005_12476_01.pdf

Ministère de l'Agriculture, de l'Alimentation, de la Pêche et de la Ruralité (2005). Plan de Développement Rural National.

OECD (2008). OECD Country Trends of environmental conditions related to agriculture since 1990. France country section.

Polman, N. & Slangen, L. (2007). The design of Agri-environmental Schemes in EU: Lessons for the future. Sixth Framework program. Priority 8. Policy-Oriented research. Specific targeted research projet no. SSPE-CT-2003-502070

Thoyer, S. & Saïd, S. (2006), Mesures agri-environnementales : quels mécanismes d'allocation? ES 2007-01, ENSAM –LAMETA

Updated September 2005. 335 p.
http://www.agriculture.gouv.fr/spip/IMG/pdf/pdrn_maj_050901.pdf

Urbano, G. & Vollet, D. (2005). L'évaluation du Contrat Territorial d'Exploitation (CTE).

Vindel, B. & Gergely, N. (2005). Aperçus de l'évaluation à mi-parcours du plan de développement rural National. http://www.agriculture.gouv.fr/spip/IMG/pdf/vindel-nee22-tap.pdf

Zahm, F & Gassiat, A. (2009) Les Indicateurs D'évaluation Des Mesures Agro-Environnementales : Retour D'expérience Et Conséquences Du Nouveau Cadre Communautaire D'évaluation, CEMAGREF.

7.3 Switzerland

Loi fédérale sur la protection de la nature et du paysage of July 1, 1966:
http://www.admin.ch/ch/f/rs/451/index.html

Loi fédérale sur l'agriculture (Loi sur l'agriculture) of April 29, 1998.
http://www.admin.ch/ch/f/rs/910_1/index.html

Ordonnance sur les paiements directs versés dans l'agriculture (Ordonnance sur les paiements directs, OPD) of December 7, 1998 : http://www.admin.ch/ch/f/rs/910_13/index.html

Commission Européenne (2001). L'environnement, considération d'ordre non commercial. Conférence internationale sur les questions non commerciales dans le secteur agricole. Île Maurice, May 28-31, 2001. Deuxième document de travail Présenté par la Commission Européenne.
http://odin.dep.no/lmd/mf/news/020031-990205/dok-bn.html

Confédération helvétique (1996). Votation populaire du 9 juin 1996.
http://www.admin.ch/ch/f/pore/va/19960609/index.html

Diakosavvas, D. (2009). Switzerland : estimates of support to agriculture [Website]
http://www.oecd.org/dataoecd/55/32/35010986.htm [January 8, 2009]

European Environmental Agency (2005). Intégration de l'environnement dans la politique agricole de l'UE: Rapport d'évaluation basé sur les indicateurs IRENA.
http://reports.fr.eea.eu.int/eea_report_2006_2/fr/irena2006-FR.pdf

Flury, C. (2005). Rapport Agroécologique et bien-être animal. 1994-2005. http://www.blw.admin.ch/imperia/md/content/evaluationen/050920_agrokol_tierwohl_f.pdf?PHPSESSID=be7732bf896d77ceed6916321b58ff9a

FOAG (2002). Projet Développement des indicateurs agro-environnementaux et monitoring Phase I : Cadre et conception des indicateurs agro-environnementaux. http://www.blw.admin.ch/imperia/md/content/oekologie/concept_f.pdf

FOAG (2008). 2008 Report: Agri-environmental Monitoring

FOAG (2008). Les zones aux conditions agricoles difficiles de la Suisse.

FOAG (2008). Mesures définies en fonction des zones pour 2009

FOAG (2008). Rapport agricole 2009. http://www.blw.admin.ch/dokumentation/00018/00498/index.html?lang=fr

FOAG (2008). Résumé des paiements directs versés à l'agriculture en 2009. http://etat.geneve.ch/dt/SilverpeasWebFileServer/R%C3%A9sum%C3%A9_PD_2009.pdf?ComponentId=kmelia777&SourceFile=1231437163464.pdf&MimeType=application/pdf&Directory=Attachment/Images/

FOAG (2009). Recueil de bases. Projets lancés en vertu de l'art. 62a LEaux. Projets Nitrates

FOEN (2008). Objectifs environnementaux pour l'agriculture. A partir de bases légales existantes

OECD (2008). OECD Country Trends of environmental conditions related to agriculture since 1990. Switzerland country section.

Service romand de vulgarisation agricole – SRVA (2009) [Website] http://www.srva.ch/pages/ [January 8, 2009].

Station fédérale de recherches en agroécologie et agriculture de Zurich-Reckenholz – FAL (2009) [Website] http://www.agroscope.admin.ch/aktuell/index.html?lang=en [January 8, 2009]

Station fédérale de recherches en production végétale de Changins –RAC (2009) [Website] http://www.racchangins.ch/doc/fr/ [January 8, 2009].

Swiss Commission for Wild Plant Conservation – CPS (2009) [Website] http://www.cps-skew.ch/ [January 8, 2009]

7.4 Chesapeake Bay

Agriculture, CBP website. Available at http://www.chesapeakebay.net/agriculture.aspx?menuitem=14745 (accessed 13.01.10).

Brown, R.S. and Marshall, K. 1996. Ecosystem Management in State Governments. *Ecological Applications.* 6(3), 1996, pp 721-723.

Chesapeake Bay Program (CBP). 2010. New EPA Regulations Will Help Reduce Pollution from Stormwater, Animal Operations to Chesapeake Bay. News and Press Section. http://www.chesapeakebay.net/news_eparegulations.aspx?menuitem=48267 (accessed 13.01.10).

Chesapeake Bay Program (CBP) 2009. Bay Barometer: A Health and Restoration Assessment of the Chesapeake Bay and Watershed in 2008. http://www.chesapeakebay.net/content/publications/cbp_34915.pdf (accessed 08.01.10)

Chesapeake Bay Watershed Initiative, Pennsylvania. http://www.pa.nrcs.usda.gov/programs/CBWI/index.html (accessed 08.01.10)

Chesapeake Bay Watershed Initiative. 2009. CBWI brochure. Available at http://www.pa.nrcs.usda.gov/programs/CBWI/CBWI_Flyer.pdf (accessed 08.01.10)

Chesapeake Bay Watershed Conservation, USDA, NRCS. http://www.nrcs.usda.gov/feature/chesapeakebay/chesapeakebay.html (accessed 09.01.10)

Government Accountability Office (GAO) 2006. *USDA Should Improve its Process for Allocating Funds to States for the Environmental Quality Incentives Program*; United States Government Accountability Office, Washington.

Maps-Bay Watershed. Chesapeake Bay Program: A Watershed Partnership. http://www.chesapeakebay.net/maps.aspx?menuitem=16825 (accessed 09.01.10).

Mullinix, C., Phillips, S., Shenk, K., Hearn, P., Devereux, P. 2009. Facilitating Adaptive Management in the Chesapeake Bay Watershed through the use of online decision support tools. The third interagency conference on research in the watersheds, 8-11 September 2008, Estes Park, CO.

Stokstad, E. 2009. Obama moves to Revitalize Chesapeake Bay Restoration. *Science.* May 29, 2009. 324(5931). pp. 1138-1139.

USDA, 2009. AMA Ranking Tool Summary. ftp://ftp-fc.sc.egov.usda.gov/MD/web_documents/programs/ama/2009/AMA_Ranking_Tool.pdf (accessed 10.01.10).

USDA Briefing. 2009. Chesapeake Bay Protection and Restoration. USDA Briefing, November 10, 2009. http://www.nrcs.usda.gov/feature/chesapeakebay/Chesapeake%20Bay%20Strategy%20Presentation%2011-10-09.pdf (accessed 16.01.10).

USDA. 2009b. Interim Final Benefit-Cost Analysis for the Grassland Reserve Program (GRP). http://www.nrcs.usda.gov/programs/farmbill/2008/bca-cria/GRP_BCanalysisInterimFinal_01-13-2009.pdf (accessed 16.01.10).

USDA. 2009c. Maryland 2009 WHIP Field Handbook. ftp://ftp-fc.sc.egov.usda.gov/MD/web_documents/programs/whip/2009/WHIP_09_Field_Handbook_5_22_09.pdf (accessed 15.01.10)

Virginia Agricultural BMP Cost Share and Tax Credit Programs. Soil and Water Conservation. http://www.dcr.virginia.gov/soil_and_water/costshar.shtml (accessed, 19.01.10)

USDA. 2005. 2005 Maryland GRP Ranking Sheet. ftp://ftp-fc.sc.egov.usda.gov/MD/web_documents/programs/grp/2005_MD_GRP_Ranking_Sheet.pdf (accessed 18.01.10)

USEPA TMDL website. Available at http://www.epa.gov/chesapeakebaytmdl/ (accessed 15.01.10)
WRI. 2009. How Nutrient Trading Can Help Restore the Chesapeake Bay. WRI fact sheet.

7.5 Mississippi Basin

Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (MGMTF). 1998. *Charter of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force*. Washington, DC. Available: http://www.epa.gov/msbasin/pdf/tfcharter_revised.pdf [January 2010].

Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (MGMTF). 2001. *Action Plan for Reducing Mitigating and Controlling Hypoxia in the Northern Gulf of Mexico*. Washington, DC. Available: http://www.epa.gov/msbasin/pdf/actionplan2001.pdf [January 2010].

Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (MGMTF). 2008. *Gulf Hypoxia Action Plan 2008 for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin*. Washington, DC. Available: http://www.epa.gov/msbasin/pdf/ghap2008_update082608.pdf [January 2010].

National Science and Technology Council (NSTC) 2000. *Integrated Assessment of Hypoxia in the Northern Gulf of Mexico;* National Science and Technology Council Committee on Environment and Natural Resources. Available: http://oceanservice.noaa.gov/products/hypox_final.pdf [January 2010].

Natural Resources Conservation Service (NRCS) 2008. *Mississippi River Basin Gulf Hypoxia*; NRCS, Washington. Available: http://wmc.ar.nrcs.usda.gov/partnerships/MSRB/index.html [January 2010].

Natural Resources Conservation Service (NRCS) 2008b. *Mississippi River Basin Healthy Watersheds Initiative Fact Sheet*; USDA, Washington. Available: http://www.nrcs.usda.gov/programs/pdf_files/mrbi_factsheet.pdf [January 2010].

Hajkowicz S, Collins C and Cattaneo A 2009. Review of Agri-Environment Indexes and Stewardship Payments; *Environmental Management* (2009) 43:221-236.

Government Accountability Office (GAO) 2006. *USDA Should Improve its Process for Allocating Funds to States for the Environmental Quality Incentives Program*; United States Government Accountability Office, Washington.

Soil and Water Conservation Society (SWCS) and Environmental Defence (ED) 2007. *Environmental Quality Incentives Program: Program Assessment*; Soil and Water Conservation and Environmental Defence, Ankeny, Iowa.

United States Department of Agriculture (USDA) 2003. *Conservation Reserve Program Sign-up 26 Environmental Benefits Index*; Fact Sheet, USDA, Washington.

United States Environmental Protection Agency (USEPA) 2007. *Hypoxia in the Northern Gulf of Mexico: an Update by the EPA Science Advisory Board*; EPA Science advisory board, Washington. Available: http://www.epa.gov/msbasin/pdf/sab_report_2007.pdf [January 2010].

Appendix 1: Summary of Research Studies Presented in EGS Technical Meeting, April 2009

This appendix provides a compilation of the summaries of research presented and compiled for the EGS technical meeting held in Ottawa in April 2009. It provides an insight into the state of Canadian research in the field of EGS policy motivation and programing.

Integration of Watershed Planning and the Agricultural Policy Framework for the Provision of Ecological Goods and Services: A Pilot Watershed Approach for Wetland Restoration & Retention

A pilot watershed approach for wetland restoration and retention has been reported on by Yang et al. (2009) for the Broughton Creek Watershed. The authors developed an integrated economic and wetland-watershed modelling system for examining cost effectiveness of wetland restoration scenarios. Specifically, the component had three interrelated objectives: 1) Develop an integrated economic and wetland-watershed hydrologic modelling system to estimate wetland restoration costs and water quality benefits in the South Tobacco Creek (STC) watershed; 2) Calibrate and validate the integrated modelling system to fit into the conditions of the STC watershed; 3) Apply the integrated modelling system to prioritize locations for wetlands restoration in the STC watershed. Modelling applied by the authors showed considerable spatial variations of economic costs and water quality benefits from wetland restoration. These costs ranged from $225 to 1,094/ha/year with an average of $438/ha/year. Total Nitrogen abatement benefits range from 14.7 to 218.2 kg/ha/year with an average of 48.8 kg/ha/year. Total Phosphorous reduction benefits have a minimum of 1.7 kg/ha/year and a maximum of 20.1 kg/ha/yr with an average of 5.0 kg/ha/year.

By setting a total Phosphorous reduction target, the authors identified 24 producers that need to restore wetlands with a total of 28.5 hectares and a corresponding cost of $10,874/year. In a simulated cost-minimized scenario, 7 producers needed to restore 60.2 hectares of wetlands at $17,642/year. This demonstrated the value of targeting wetland restoration based on benefit to cost ratios in order to achieve cost effectiveness in wetland restoration programing.

Estimates of Passive Use Values of Wetland Restoration and Retention in Southern Manitoba

A study by Boxall et al. (2009a) surveyed a willingness to pay for wetland restoration and retention in the Province of Manitoba. A stated preference survey instrument was designed to provide information on benefits and costs associated with wetland restoration along with a referendum

where survey takers were asked to vote for one or more restoration programs that would increase wetland areas or the current situation in which wetland loss would continue. 1980 responses were received to the survey conducted in 2009 where results indicated that conservative willingness to pay estimated from $290/household/year for retaining existing wetlands to $360/household/year for restoring wetlands to 1968 levels. Aggregated to the entire province over a five year period (discounted) the values were about $600 and $ 730 million respectively.

Ecological Goods & Services and Agro-forestry (EGS): The Benefits for Farmers and the Interests for Society

In a study examining EGS and agro-forestry, Nolet (2009) examined the benefits for farmers and social value from agro-forestry practices, as well as evaluated their benefits and costs for agricultural businesses. This study focused on two agro-forestry practices most likely to be established in Quebec (windbreaks and riparian agro-forestry systems). They also focused on nine EGS most relevant to these practices and the region. The researchers selected two watershed representing two different Quebec contexts: the Esturgeon watershed in a peri-urban agricultural region and the Fouquette River watershed representing a remote area with extensive agricultural production. For each of these watersheds, three scenarios were developed to examine agro-forestry practices: a regulatory-level scenario with Quebec's riparian buffers regulations applied, a priority-level scenario developed with members of watershed committees who seek to implement installations to protect watercourses and problematic road segments, and to reduce odours from livestock barns; and lastly a high-level scenario to maximize EGS.

The comparison of agro-forestry systems in the two watersheds demonstrated that windbreaks along roads were less interesting to farmers (benefit-cost ratio was below 0.12), as shown in Table A1.

Table A1. Agro-forestry practices: benefits for and interest to farmers.

Of interest to farmers	Agro-forestry practice	Benefit-cost ratio
Least	Windbreaks along roads	0.12
	Riparian buffers	0.2
	Windbreaks that protect crops	Approaching 1
Most	Windbreaks along buildings	Above 4

The following table, from Nolet (2009), presents a classification of EGS with current monetary value. The value of the nine selected EGS was generated by the implementation agro-forestry installations in the two watersheds, using four economic evaluation methods: hedonic methods, experimental economics, benefit transfer method and productivity method as applicable. The results related to the monetary value of EGS, evaluated over a 40-year period and discounted accordingly. These are organized according to monetary order of importance and presented in Table A2 below.

Table A2: Classification of EGS and current monetary value (in million $, 2008).

Order	Environmental goods and services	Scenario	Monetary value	
			Fouquette	Châteauguay
1	Carbon sequestration	Regulatory-level	0.224	7.317
		Priority-level	0.689	4.080
		High-level	2.057	56.081
2	Terrestrial biodiversity	Regulatory-level	0.540	2.422
		Priority-level	0.358	1.830
		High-level	1.351	50.308
3	Reduction in costs for clearing snow from roads	Regulatory-level	Not applicable in the case of riparian buffers	
		Priority-level	0.088	4.229
		High-level	0.142	12.147
4	Improvement in the quality of surface water	Regulatory-level	0.068	3.618
		Priority-level	0.068	2.763
		High-level	0.070	3.618
5	Improvement of the landscape	Regulatory-level	0	1.770
		Priority-level	0	1.145
		High-level	0	3.437
6	Increase in the number of wild pollinating insects	Regulatory-level	0.0001	0.533
		Priority-level	0.0005	0.590
		High-level	0.002	3.442
7	Decrease in treatment costs of potable water	Regulatory-level	Not applicable: sub-terranean source of potable water in this watershed	0.393
		Priority-level		0.085
		High-level		0.393
8	Reduction in agriculture-related odours	Regulatory-level	Not applicable—there are no windbreaks adjacent to buildings in these scenarios	
		Priority-level		
		High-level	0	0
9	Reduction in the gravity of road accidents	Regulatory-level	Not applicable in the case of riparian buffers	
		Priority-level	Indeterminable	Indeterminable
		High-level	Indeterminable	Indeterminable
Total		**Regulatory-level**	**0.347**	**16.056**
		Priority-level	**1.205**	**14.725**
		High-level	**3.623**	**129.430**

Source: Model developed by ÉcoRessources Consultants.

The important learning here was that carbon sequestration provides a considerable benefit in both selected watersheds. The differences in benefit values between the two watersheds are related to the differences in implementation areas. Biodiversity values remained comparable to other values quoted in literature. See Tables A3 and A4 for additional analysis.

Table A3: Private net costs and public benefits for the two watersheds (millions of dollars) (NPV = Net Present Value; B/C = Benefit/Cost Ratio).

		Private net costs		Public benefits	
Scenario		**Fouquette**	**Châteauguay**	**Fouquette**	**Châteauguay**
Regulatory-level	NPV (M$)	-0.474	-15.658	0.347	16.056
	B/C	0.14	0.14	N/A	N/A
Priority-level	NPV (M$)	-1.293	-1.441	1.205	14.725
	B/C	0.21	0.17	N/A	N/A
High-level	NPV (M$)	-2.508	-73.310	3.623	129.430
	B/C	0.38	0.42	N/A	N/A

Source: CEPAF and ÉcoRessources Consultants.

Table A4: Overview of the cost-benefit analysis for the two watersheds (millions of dollars) (NPV = Net Present Value; B/C = Benefit/Cost Ratio).

		Public benefits – Private net costs		Ratio of public benefits / private net costs	
Scenario		**Fouquette**	**Châteauguay**	**Fouquette**	**Châteauguay**
Regulatory-level	NPV (M$)	-0.1	0.4	N/A	N/A
	B/C	N/A	N/A	0.73	1.03
Priority-level	NPV (M$)	-0.09	3	N/A	N/A
	B/C	N/A	N/A	0.93	1.29
High-level	NPV (M$)	1.1	56	N/A	N/A
	B/C	N/A	N/A	1.44	1.77

Source: CEPAF and ÉcoRessources Consultants.

Cost Efficiency Analysis of Possible EGS Policy Options

Another cost-efficiency analysis conducted by ÉcoRessources and IISD estimated the costs and benefits of several policies that could increase the supply of ecological goods and services (EGS) from agricultural land in Canada. The following options were analyzed: annual payments, one-time payments, reverse auctions, and water quality trading. The research looked at selected BMPs, including grassy and wooded riparian buffer zones, winter cover crops, conservation tillage, conversion of marginal farmland to wetland, retirement of flood-prone land, conservation of

existing forests and wetland, and manure storage. With some assumptions and methodological cautions, the following results were presented. Improvement water quality worth approximately $900 million would costs between $500 million and $2.5 billion. The differences in costs were associated with policy delivery mechanisms. While annual payments were found to be least cost-effective at about $2.5 billion, reverse auctions and water quality trading were considered most cost-efficient at $600 million and $ 500 million, respectively.

This study looked into the possibility of harnessing co-benefits from agricultural BMPs and determined that an EGS program that improves both wildlife habitat and water quality would provide at least $3.3 billion in benefits and would cost between $1 billion and $2.8 billion. Again, the policy delivery mechanisms determined the cost-effectiveness. Annual payment cost close to $2.8 billion and reverse auctions cost about $1 billion to deliver the same set of EGS benefits.

Final recommendations of this study were around the use of policy instruments for maximizing cost-efficiency of BMP application on agricultural lands. Market-based instruments provided most cost-efficient solutions and water quality trading was the most cost-efficient of the options pursued in the research. Cover crops provided a cost-efficient option for phosphorous removal at $38/kg while wooded riparian zones were expensive at $897/kg.

Price Discovery Mechanisms for Providing EGS from Wetland Restoration: An Examination of Reverse Auctions

A study by Boxall et al., (2009b) developed estimates of the cost of wetland restoration activity in South Tobacco Creek in Manitoba. These costs consisted of opportunity cost of lost cropping areas, nuisance costs of maneuvering machinery around the wetlands, and the actual on the ground costs of restoration. Restoration costs were found to be heterogeneous within a watershed, individual producer's lands and among producers.

Knowledge of these costs allowed the researchers to examine the policies most suited for adopting wetland restoration practices. Reverse auctions were examined as a means to induce competition among eligible landowners. Reverse auctions were chosen for their potential cost-efficiency, as well as for their ability to reveal the actual costs of restoration.

Two selection strategies were then examined: maximize acres restored and maximize abatement of phosphorous; and two pricing rules: discriminant where winners are paid what they offered to be paid, and uniform in which all winners are paid the lowest unsuccessful offer. Using experimental economic procedures, researchers found that counter to current practices in which the discriminant pricing approach is typically employed, the uniform pricing rule may allow more efficient use of limited funds for wetland restoration.

Identification and Assessment of the Provision of EGS by the Primary Agriculture Sector and Determining Societal Expectations of the Farm Community

A study by the Nova Scotia Federation of Agriculture was designed to better understand the agricultural sector's interface with the environment and how EGS benefits from farmland could be enhanced. The two main components of this research project were:

1. Conducting in-depth consultations with primary producers who are members of the NSFA about the impacts of changing environmental standards and societal expectations on their farm businesses.
2. Developing a pilot program to support environmentally beneficial activities on farms that are in a designated watershed but that, for a variety of reasons, may not be able to take advantage of existing provincial programs.

The results of component one indicated that farmers have reacted in many positive ways to changes in expectations around their relationship with the environment. Farmers are increasingly aware of the value of protecting the environment for themselves as rural residents, for their industry, their community and society as a whole. They make management and investment decisions that reflect their environmental attitudes and accept that these actions are necessary.

The results of component two were fifteen projects on six farms in the St. Andrews Watershed. Several lessons were learned on designing and delivering an effective program to small, non-traditional farming operations. A minimum of three years is recommended as appropriate to allow a program to reach maturity and meet its goals. Effective communications is a key part of program delivery as many lifestyle farmers do not consider themselves part of the agricultural sector, and issues with the potential to create barriers to program acceptance by agricultural landowners in the watershed need to be identified and mitigated.