

**Performance-Based Approaches to  
Agri-Environmental Water Quality Policy  
in Canada**

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## Abstract

Performance-based approaches to managing water quality on agricultural landscapes offer the potential to improve the effectiveness of water quality outcomes compared to current practice-based approaches. Performance-based approaches, however, require varying degrees of precise measures or modeling of water quality and differentiated payment structures to achieve these effective outcomes.

The potential to implement performance-based approaches for water quality management on agricultural landscapes was assessed through three broad objectives: 1) review and evaluate performance-based approaches used for a similar purpose in other jurisdictions; 2) assess the social context of the study region of southwest Alberta, with the intention that this region would serve as a test case for implementing performance-based approaches; and 3) determine the suitability of performance-based approaches for the study region based on social and institutional context.

Several performance-based approaches were identified through the review and evaluation of approaches that have been implemented elsewhere, these were: water quality trading, differentiated payments for ecological goods and services, cross-compliance, and emissions charges. The drivers and enabling conditions were evaluated and social and institutional factors were often important for the social, environmental, and/or economic successes of the approaches. The social context, or social norms and values, related to agriculture and water quality within the study region was assessed using interviews with watershed landowners and surveys with rural and urban residents. Respondents were generally in favour of a combination of polluter pays and beneficiary pays principles. Implementation of an environmental standard of care was a common suggestion; agricultural landowners who achieved water quality beyond the standard could be eligible for incremental payments based on water quality improvement. Suitability of performance-based approaches to the social and institutional context of the study region revealed that a suite of measures may be required to align with social norms and values. Cross-compliance and differentiated payments for ecological goods and services were two approaches that provided a suitable mix of polluter pays and beneficiary pays principles; however, institutional barriers exist to implementing these approaches.

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## **List of Abbreviations**

AAFC: Agriculture and Agri-Food Canada

AARD: Alberta Agriculture and Rural Development

AEIs: Agri-Environmental Indicators

ALSA: Alberta Land Stewardship Act

AUS: Australia

BMPs: Beneficial management practices

CESI: Canadian Environmental Sustainability Indicators

CEPA: Canadian Environmental Protection Act

CFO: Confined feeding operation

CRP: Conservation Reserve Program

Dr: Drivers

EBI: Environmental Benefits Index

EC: Enabling Conditions

EFP: Environmental Farm Plan

EG&S: Ecological goods and services

EPA: Environmental Protection Agency

ha: hectare

km: kilometre

L: litre

lb: pound

mg: milligram

MINAS: Minerals Accounting System

ml: millilitre

mpn: most probable number

N: Nitrogen

no: number

NVZ: Nitrate Vulnerable Zone

OECD: Organization for Economic Co-operation and Development

P: Phosphorus

PCA: Principal Components Analysis

PES: Payments for ecosystem services

PEP: Proof of Ecological Performance

PEPA: Performance-based Environmental Policies for Agriculture

TMDL: Total Maximum Daily Load

UK: United Kingdom

US: United States (of America)

USDA: United States Department of Agriculture

WEBS: Watershed Evaluation of Beneficial management practices

WQT: Water Quality Trading

# **CHAPTER 1: INTRODUCING PERFORMANCE-BASED APPROACHES FOR MANAGING WATER QUALITY ON AGRICULTURAL LANDSCAPES**

## **1.1 Introduction**

Canada is experiencing a time of potential change in the development of agri-environmental policy. Policy makers have recognized the importance of including ecological goods and services (EG&S) into policy decisions and a number of pilot projects are currently underway that encourage the production of EG&S through payments to landowners, the results of which are likely to guide future agri-environmental policy decisions at the federal and provincial levels (AAFC 2006, 2008). Ecological goods and services "represent the benefits human populations derive, directly or indirectly, from ecosystem functions" (Costanza et al. 1997). Ecological goods and services encompass both benefits valued by markets (such as food and fibre) and benefits that do not have a monetary value (such as nutrient cycling, water filtration, and aesthetic values) (Millennium Ecosystem Assessment 2005). Within this thesis, the discussion of EG&S will be limited to those goods and services that are not currently valued by markets.

The Canadian government has implemented and maintained a conventional, practice-based approach to agri-environmental policy to date, which pays landowners to adopt sustainable farming practices regardless of the environmental outcome, or provision of EG&S that actually occurs (AAFC 2011). This creates dissonance; there is government acknowledgement of the importance of EG&S, but program offerings for agricultural producers do not support a focus on the production EG&S as the basis for the level of payment or cost-sharing provided. An alternative to these current approaches that focus on inputs and practices is a performance-based approach to EG&S provision that pays or penalizes landowners based on environmental output.

Practice-based approaches have resulted in some small improvements to water quality; however, on agricultural landscapes, water pollutant levels often exceed guidelines for protection of

aquatic life and water quality overall in Canada has actually decreased over the past 25 years (Environment Canada 2010; Eilers et al. 2010). Events such as the Walkerton tragedy in Ontario where several deaths occurred<sup>1</sup> (Justice O'Connor 2002), and the large algal blooms that have spread over Lake Winnipeg<sup>2</sup> (Environment Canada 2010) have put a spotlight on the potential for serious harm from agricultural pollution. These major events, as well as the broader indications of inadequate water quality on agricultural landscapes, indicate that the current policy approach to agricultural water pollution is not effective. A new approach may be required - an approach that focuses on outcomes rather than on inputs - that has the capacity to address areas of particular concern.

Performance-based approaches, in the context of agri-environmental policy, can be broadly defined as approaches that pay or penalize agricultural producers based on some measure of environmental outcome and not on inputs or practices (Keeney and Boody 2005; Weinberg and Claassen 2006). Measurement of outcomes may be based on models or monitoring, and payments or penalties are conditional upon outcome delivery (Wunder et al. 2008; Lowell et al. 2007). Performance-based approaches have been implemented in several other regions, such as the United States and Europe, but have been left largely unexplored by Canadian policy makers. However, performance-based approaches hold the potential to provide greater environmental, social, and/or economic benefits than the practice-based approach (Winsten 2009; Weinberg and Claassen 2006), and warrant further investigation in the Canadian context.

## **1.2 Theoretical and conceptual perspective**

The role of environmental policy, broadly, is to achieve environmental objectives at the least cost (Horan and Ribaudo 1999). When placed within the context of EG&S and agriculture, the role of agri-environmental policy is to ensure the provision of EG&S where markets do not provide them. Current practice-based approaches for the provision of EG&S by agriculture are likely not

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<sup>1</sup> Seven deaths and over 2200 illnesses were reported in Walkerton, Ontario in 2000 as a result of inadequately treated drinking water that had been contaminated by agricultural pollutants via runoff.

<sup>2</sup> The algal blooms on Lake Winnipeg in Manitoba have been largely attributed to high levels of phosphorus from manure contamination. The conditions for aquatic life have been compromised in large areas of the lake (up to 13,000 km<sup>2</sup>).

the most efficient means to provide EG&S, as the link between practice adoption and outcomes is uncertain due to variations in climate, topography, land location, and other agricultural practices having an influence on EG&S outcomes.

Performance-based approaches are structured around payments or penalties based on environmental quality, that is, the focus of these approaches are on the outcomes provided by the changes to management practices, rather than on the management practices themselves (Claassen et al. 2001). This type of approach is generally touted as more flexible for program participants and potentially more efficient in terms of payments or penalties that are more closely related to actual or modeled environmental outcomes (Wätzold and Dreschler 2005; Claassen et al. 2001; Weinberg and Claassen 2006). For example, where the goal is to reduce agricultural pollutants travelling to a water body, some agricultural producers may enhance riparian buffer areas, while others may decide to alter timing or method of soil fertilization. Under a performance-based approach, all of these producers would be paid according to their individual impact on water quality, giving them the option to choose their practices with the knowledge of the expected outcome and resulting payment. However, performance-based approaches are prone to difficulties in measurement - particularly where non-point source pollution occurs - and there is resulting unpredictability in environmental outcomes, and associated risks to program providers and participants (Weinberg and Claassen 2006). Despite the challenges associated with implementing performance-based approaches, they offer the potential to improve efficiency of programs aiming to enhance the delivery of EG&S from agricultural landscapes (Weinberg and Claassen 2006), presenting a policy opportunity for Canada.

Performance-based approaches may provide more than double the environmental benefit than practice based approaches. A modeled comparison for water quality management on agricultural land in the United States was undertaken with \$1 billion allocated for each program (Weinberg and Claassen 2006). The same amount of environmental improvement for \$1 billion spent on practice-based approaches could be attained with \$200 million with performance-based approaches, although the costs of water quality data collection and model development were not included in the analysis. Weinberg and Claassen (2006) attribute the large difference in part to producer flexibility in choosing the least-cost and most effective management practice to achieve environmental goals. The implementation of performance-based approaches, however, requires



the development of mechanisms to measure or predict water quality impacts from agriculture, and payment or penalty schemes to reflect those impacts which can be very costly. Where performance-based approaches have been already developed, an opportunity exists to transfer them to a new jurisdiction thereby reducing the costs associated with policy development (Benson 2009). In the development and implementation of new performance-based policy, the process can be informed by understanding the nature and success of relevant policy applications in other jurisdictions. This process is broadly referred to as 'policy transfer' and it encompasses the transfer of policies, policy instruments, structures, and concepts (Dolowitz and Marsh 1996). Policy transfer allows policy-makers to learn and apply lessons from other regions.

The successful transfer of a policy approach from one jurisdiction to another is highly dependent upon the drivers and enabling conditions that constitute the relevant policy context (Dolowitz and Marsh 2000; Millennium Ecosystem Assessment 2005; Mossberger and Wolman 2003). The social and institutional context have a particularly important role in assessing policy fit (Dolowitz and Marsh 1996). The term 'institution' in the literature refers to both the formal and informal rules of society (e.g., North 1990; Roland 2004) and this definition is not disputed; however, within this thesis, the term 'institution' is used to describe the formal rules and organizations that govern society, while the term 'social context' refers to the informal rules of social norms and values to which society adheres. This distinction is used in order to separate the informal social context from the more formalized rules that govern society for analysis and discussion. With this distinction clear 'institutions', as defined for this thesis, provide the legislative and political framework for implementing and administering policy approaches. The prevailing social norms and values (social context) dictate how the policy approach will be perceived by society. Dwyer and Ellison (2009), in a review of recent policy transfer literature, emphasize the importance of understanding the context surrounding policies prior to policy transfer, and acknowledge that context is often undervalued in policy transfers. Given the importance of addressing context in policy transfers, and the potential for Canada to transfer performance-based approaches from other jurisdictions, an assessment of Canada's institutional and social context is required including (dis)similarity to other jurisdictions where performance-based approaches have been implemented. A review of the literature revealed that there is a lack of data available describing social norms and values in Canada. This gap in the literature will be addressed within this thesis.

### *Transformations and resilience*

The potential for change to occur in Canadian agri-environmental policy represents an opportunity for a policy transformation; that is, the opportunity for policy to move from a state where environmental performance (production of EG&S) is not taken into account in payment schemes to a state where EG&S production becomes the focus. Transformations are described as opportunities for a policy transformation when the current paradigm becomes untenable (Walker et al. 2004). Opportunities for transformations, such as the shift from practice-based approaches to performance-based approaches, is dependent in large part upon the resilience of the current system. Resilience can be defined as the degree of resistance to change within the current system configuration, while maintaining the ability to reorganize as a result of disturbance (Walker et al. 2002; Holling 2001). While resilience is a desirable quality in that it is a stable system that can manage shocks, a high level of resilience can be harmful where the current system is unsustainable, as it may reduce the potential to alter the system to a more sustainable configuration (Walker et al. 2002). For example, new policies that improve the sustainability of agriculture in terms of water quality may not be implemented as a result of the resilience of current policies demonstrated through strong support by the agricultural community and a resulting political unpalatability to change. The social context of a region may aid in identifying dissonance between social norms and values and the assumptions that underpin policy approaches. Where these are not aligned, social context may provide a good indicator of potential opportunities for policy transformation.

### **1.3 Research purpose**

To date, the Canadian government has focused on practice-based approaches to EG&S provision in the design of agri-environmental policy. However, performance-based approaches should be considered as an alternative that could provide more efficient means to promote the production of EG&S. The purpose of this thesis is to evaluate performance-based approaches to water quality policy for Alberta, Canada. This will be achieved using a policy transfer framework that follows the process of context assessment for fit including: recognition of a problem, source site selection, identification of key contextual factors involved, and finally evaluation of fit with the target region and recommendations (Hermans 2011).

## **1.4 Objectives**

The objectives of this research were to:

- i. Identify performance-based approaches to manage water quality on agricultural landscapes implemented in regions outside of the study region of southwest Alberta, and assess the drivers and enabling conditions of that implementation;
- ii. Assess the social norms and values of the study region related to agricultural landowners' rights and responsibilities for water quality; and
- iii. Synthesize the findings of objectives i and ii to evaluate the capacity of the study region to implement a performance-based approach, and provide recommendations based on contextual alignment of the study region to the host regions.

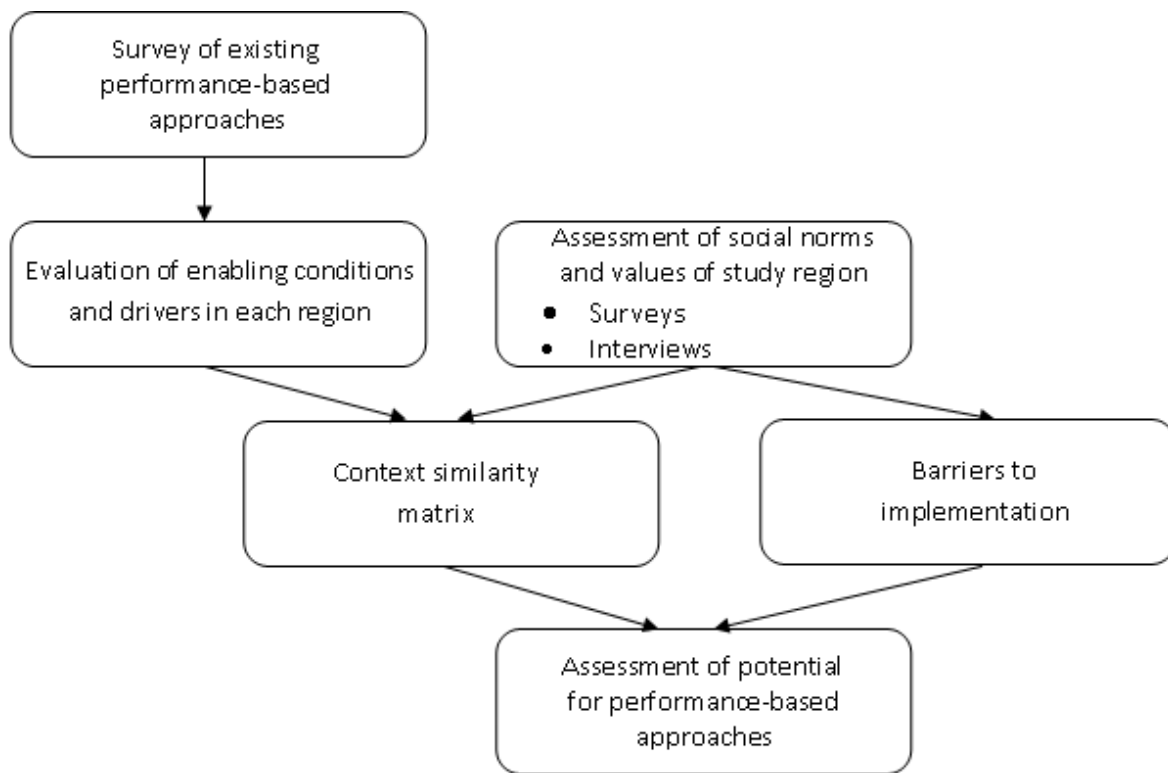
## **1.5 Research methods overview**

Several methods were used to fulfill the objectives of the research project. The research approach is described in the process diagram below (Figure 1-1). First, a survey of the relevant literature was conducted to identify and describe existing agri-environmental performance-based approaches for water quality management. This search was bounded by institutional and developmental congruencies with the study region in southwest Alberta (Mossberger and Wolman 2003). The approaches were organized by measurement and payment structure; this created an organizational tool to select performance-based approaches that are best-suited to a region's institutional capacity for implementation and social context for each approach.

An assessment of the social norms and values of the study region was conducted. This was a novel method to assess the potential to implement different policy approaches for the region. Semi-structured interviews were conducted within the study watershed, and surveys with corresponding questions were sent to several communities (rural and urban) downstream from the study watershed. The surveys and interviews used Likert scales that rated the degree of agreement or disagreement to statements to evaluate agricultural landowner and public perceptions of agricultural producers' rights and responsibilities around water quality on agricultural landscapes (Rea and Parker 2005). Additional open-ended questions provided

opportunities for respondents to make comments. Open-ended responses proved useful in rationalizing many of the answers provided from the Likert scales.

The responses to interviews and surveys were analyzed using NVivo 8 (QSR International, Inc.) for qualitative data and PASW Statistics 18 (SPSS, Inc) for quantitative data. Finally, a description of the social context of the study region (using the analyses from survey and interview responses) was created and compared to the contexts of other regions where performance-based approaches have been implemented. An assessment of similarity of contexts was conducted and a matrix was created to visually describe how closely the context of the study region and others were aligned (Sheate et al. 2008). Based on this assessment and a discussion of barriers to implementation for each performance-based approach, recommendations were provided for approaches that fit best within the social context of the study region.



**Figure 1-1.** Process diagram of research methods

### **1.5.1 Research quality and validity**

The survey and interview data were collected using an instrument that was approved by the University of Saskatchewan Ethics Review Board. Surveys and interview questions were largely carried out using Likert scales; this format is widely used for the purpose of eliciting values or attitudes (Rea and Parker 2005; Gillham 2008). Every effort was made to minimize personal bias; however, I acknowledge that some bias based on personal experience and background is likely in the framing of questions and the interpretation of results. Despite this acknowledgement, a strong effort has been made throughout the study to fairly represent the results in analysis, interpretation, and application to the broader literature.

Bounding the review of performance-based approaches was necessary to retain some degree of consistency in the purpose of the approach and institutional context between the study region and regions where these approaches were implemented. As a result, only those performance-based approaches implemented within the jurisdictional and institutional boundaries were reviewed. Bounding the review in this way presented a limitation in the type of literature available. Most of the performance-based approaches identified were implemented as a result of pilot projects or were relatively new and were not comprehensively represented within the peer-reviewed literature. Grey literature was also included in the review, and provided a good source of information about specific instances where performance-based approaches were implemented. Often, these literature sources described the enabling conditions and drivers for the programs and were deemed appropriate for the purpose of reviewing the specific instances where performance-based approaches were implemented.

### **1.6 Thesis organization**

This thesis is organized into four remaining chapters, each structured in a manuscript format. Chapter 2 addresses the first objective of the research study: that is, to identify performance-based approaches implemented in other regions to manage water quality on agricultural landscapes and assess the drivers and enabling conditions of that implementation. Chapter 3 addresses the second objective of the study and describes the assessment of social norms and values of the study region related to agricultural landowners' rights and responsibilities for water quality. Chapter 4 is informed by the previous two chapters and provides a synthesis of the results presented and evaluates the suitability of potential performance-based approaches for the

study region based on the degree of social contextual similarity. Finally, Chapter 5 concludes the thesis with a discussion of how this research informs the performance-based policy literature and the literature related to policy transfer.

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## **CHAPTER 2: PERFORMANCE-BASED APPROACHES TO AGRICULTURAL ENVIRONMENTAL WATER QUALITY POLICY**

### **2.1 Introduction**

There is growing public concern about the effects of agricultural activities on water quality (OECD 2003; Coote and Gregorich 2000). In Canada, several agricultural water contamination events and on-going boil water advisories in some areas have served to fuel this growing concern. An often-cited example is the contamination of drinking water in Walkerton, Ontario in 2000 by bacteria from livestock manure, which severe rain events washed into groundwater. Seven deaths and approximately 2300 illnesses occurred due to this contamination. While Walkerton received significant media attention due to the severity of the problem, there have been several other documented instances where contamination of drinking water by fecal coliform bacteria have caused disease outbreaks in Canada (Schuster et al. 2005). Agricultural water contamination can also have deleterious effects on aquatic life. Nutrient loading of Lake Winnipeg, thought to be from primarily livestock manure, is an example that has received much media and research attention. High levels of phosphorus have caused large algal blooms (up to 13,000 km<sup>2</sup>) that reduce the oxygen concentrations and produce toxins in large portions of the lake (Environment Canada 2010; Salki 2007).

Water quality concerns across Canada have been highlighted in recent national and provincial reports. For example, a report from the Canadian Environmental Sustainability Indicators initiative (Environment Canada 2010) rated 20% of sites tested as “marginal” or “poor” (water quality guidelines are exceeded often) in reference to the guidelines for the protection of aquatic life and testing a variety of minerals, nutrients and organic compounds. Similarly, a report on agricultural water quality using agri-environmental indicators developed by Agriculture and

Agri-Food Canada reported that water quality in Canada decreased between 1981 and 2006, primarily as a result of increasing applications of nitrogen and phosphorus (P) from fertilizers and manure (Eilers et al. 2010). Concerns over declining water quality as a result of agricultural practices are echoed in prairie provincial reports.

Many agricultural contaminants that affect water quality are non point-source; that is, they are diffuse, entering water bodies from a variety of sources and at several locations. Water quality, along with many other open access and public goods that are affected by land management have been described as 'ecological goods and services' (EG&S). Ecological goods and services are the benefits that humans obtain from ecosystems (Millennium Ecosystem Assessment 2005). Ecological goods and services are often undersupplied by markets, and this is the case with water quality. Water pollution from agricultural sources is usually an external cost (externality) and not incorporated into costs of production. This results in an undersupply of water quality to downstream users and the need for policy measures to increase EG&S provision. Measuring water quality from individual fields or farms is very difficult, which makes regulation and enforcement of water quality standards difficult. Therefore, policy makers have relied upon incentives and education or technical assistance to encourage agricultural producers to adopt practices that minimize contributions of non point-source contaminants to water bodies and ensure the production of water quality EG&S. These practices are referred to as 'beneficial management practices' (BMPs).

Performance-based approaches for agri-environmental policy may have an important role in managing water quality. The current approach to water quality policy in Canada and internationally has encouraged changes to management practices through some regulatory and often voluntary measures (Weersink et al. 1998). These efforts have resulted in some positive changes to water quality, but the changes have not been sufficient to ensure that water quality guidelines are being consistently met (Environment Canada 2010). Performance-based approaches may complement current efforts and enhance water quality management because they provide a means to ensure agri-environmental programs result in improvements, as measurement (or estimation) of outcomes is an intrinsic component of these instruments.

The objectives of this paper are: 1) to identify alternative, performance-based policy approaches that have been implemented elsewhere to manage water quality, 2) to assess the institutional and socio-cultural context that resulted in their adoption; and 3) to critically assess their relative success where literature is available.

## **2.2 Background**

### **2.2.1 Policy approaches to manage water quality**

Agri-environmental policy may be implemented based on inputs (i.e., adoption of management practices) or outputs (i.e., environmental performance), depending on the structure of the approach. The choice of approach is largely dependent on how the objective, or environmental goal, is defined. Where goals are related to inputs or management practices, policy approaches with a focus on inputs, such as cost-sharing measures to adopt practices, are appropriate. However, where goals are output-based, such as water quality objectives, a corresponding output-based approach to policy may be more appropriate. This is because there are a number of factors other than inputs that affect water quality, some beyond the control of the landowner, and input-based policy goals and corresponding approaches may not be the most effective way to ensure water quality improvements. Where the direct measurement of outputs is not possible, emission proxies or modeled approximations of water quality improvements through changes to practices may be feasible mechanisms to assess achievement of water quality objectives (Dunn and Shortle 1987; Shortle and Horan 2001).

### **2.2.2 Evaluation of effectiveness of regulations and voluntary programs**

The nature of the pollution source is very important from the policy perspective. Agricultural pollution is almost entirely non-point source; that is, emissions occur via seepage, erosion, and runoff and are extremely difficult to trace (Weersink et al. 1998). Examples include leaching and runoff from manure and fertilizer application, irrigation return flows, pesticide drift, and soil management practices causing wind and water erosion. Non-point source pollution is influenced in part by agricultural activities and management decisions, but can also be heavily influenced by weather and physical properties of the land, such as soil type. Because water quality is affected

by many agricultural activities and other stochastic influences, it is very difficult to measure the impact of a specific practice, regulation, or program on water quality. Most evaluation efforts have been general measures of changes to water quality over time, such as the water quality reports created by Environment Canada and AAFC, or else measures of adoption rates of BMPs with the assumption that an increased rate of adoption improves water quality (MacKay and Hewitt 2010).

### **2.2.3 Theoretical framework: Performance-based approaches to agri-environmental water quality policy**

Voluntary incentive or cost-sharing programs are the main tool used by governments and NGOs to manage agricultural activities that affect water quality (Weersink et al. 1998). These programs are often designed to encourage the adoption of BMPs by agricultural producers. The programs focus on inputs with the assumption that improvements to practices will result in improvements to environmental outcomes. However, the link between inputs and outputs is indirect and influenced by a number of factors, including location, topography, weather and specific farm traits. For example, fencing a stream to restrict cattle access (and providing off-site watering systems for cattle) can have a significant positive impact on water quality where stream banks are steeply sloped and cattle cause erosion and damage to riparian areas, and particularly where water ways are prone to erosion from severe runoff events. The fencing will have much less of an impact where the stream bank is only gently sloped or level and cattle cause little damage to the water way and riparian area. Further differences in impact of the fencing practice would be noticed if the number of cattle accessing the stream was high for the sloped land and low for the level land. Under a cost-sharing program available to all agricultural landowners, both could receive equal compensation despite an obvious discrepancy in water quality benefits between the two scenarios.

Performance-based approaches to agri-environmental policy can be defined, in the broadest sense, as approaches that are designed based on some measurement of environmental outcome, rather than on inputs or management practices. A common definition of performance-based incentives describes them as payments or charges tied to outcomes and *not* to particular practices, where producer flexibility is a key component (Winsten 2009; Weinberg and Claassen

2006; Keeney and Boody 2005). In addition, the environmental outcome must be well-defined and program responses must be conditional on outcome delivery (Wunder et al. 2008). This distinguishes performance-based approaches that target a *specific* environmental outcome from other input-based approaches directed toward general improvements to the environment. The expected performance of a particular practice can be estimated with models (Lowell et al. 2007), indicators (Weinberg and Claassen 2006), and remote sensing (Cohen and Goward 2004), while actual performance can be measured with direct inspections (Hanley et al. 2004). Often, more than one mechanism is used to estimate performance, such as models supplemented with local data for more accurate estimates of the effect of a management change (Lowell et al. 2007). Payments or charges incurred through performance-based approaches can be fixed and contingent on achieving an environmental standard, or incremental with each unit of environmental outcome (for example, payments for each unit reduction in a specific water pollutant).

The use of performance-based approaches has been shown to provide a cost-effective way for the landowner to provide EG&S because the landowner has the ability to adopt the least-cost strategy to meet a target (Wätzold and Dreschler 2005). Flexibility for the landowner is a key benefit of a performance-based approach (Claassen et al. 2001; Weinberg and Claassen 2006). For example, where the program goal is to reduce P contamination of a waterway, landowners may choose to exclude livestock from streams, alter timing of manure application to land, alter the method of manure application to land, increase water filtration by improving riparian buffer zones, or grow cover crops to reduce runoff. These practices have different adoption costs depending on location or management specific characteristics of the equipment capabilities and the agricultural activities of the landowner. Where modeling capabilities exist, the effects where the practice is implemented can be estimated and the landowner is given the opportunity to make the most economically viable decision for their individual operation based on the expected benefits and costs of the relevant BMPs.

A performance-based approach to agri-environmental policy has been shown to provide certain benefits to the program provider and to society as well. First, funds are directed toward practices that have a demonstrated positive effect on the environment, reducing the potential to pay for

practices that are ineffective in meeting the environmental objectives (Claassen et al. 2001). As previously mentioned, modeling impacts of specific practices creates the ability to assess the cost-effectiveness of each practice. Where the impact (and associated payment) is relatively small, agricultural producers are unlikely to adopt the practices that are economically unattractive. Agricultural producers are more likely to choose approaches that have a larger environmental benefit and potentially provide higher payments. This approach provides greater environmental benefit for tax dollars spent. A further benefit is that performance-based approaches can be targeted to specific locations (Weinberg and Claassen 2006), and spatially heterogeneous or targeted payments for EG&S may be more cost-effective than uniform payments (Wätzold and Dreschler 2005).

Performance-based approaches provide the opportunity for governments to demonstrate to the public, in a more concrete way, that tax dollars are funding actual improvements to environmental outcomes from agriculture. The ability to demonstrate environmental improvements at a site-specific scale may also have a positive impact on how society views government spending on agri-environmental programs (Latacz-Lohmann and Hodge 2003) and on the efforts of agricultural producers to make environmental improvements.

While there are significant advantages to using performance-based approaches for agricultural water quality policy, there are several drawbacks as well. Development and implementation of complex delivery systems and subsequent monitoring are required, and the high administrative cost of these activities is commonly cited as a major constraint to adopting a performance-based approach to agri-environmental policy (Hodge 2000; Weinberg and Claassen 2006). Information requirements to determine baseline levels of measurable attributes and model research and development would likely be very high, as much of the information needed is not currently available (Claassen et al. 2001).

The second major constraint to adoption of performance-based approaches in agri-environmental policy is the unpredictability of environmental gains (Jack et al. 2008); this is common to both performance-based and practice-based approaches, but more pronounced in the former. Environmental outcomes are subject to factors such as climate and ecological variability that are

outside the control of the landowner (Hodge 2000). These factors reduce the ability of the landowner to evaluate the outcome of a management strategy in advance and thus may impose a high degree of risk in providing EG&S where payments are contingent on EG&S delivery (Engel et al. 2008). Accordingly, landowners may be hesitant to commit to a program or may demand high payments to alleviate the risky nature of the program (Hodge 2000).

There are other potential issues that have been identified with performance-based programs. One concern is that in some situations non-compliance by one large polluter can reduce the effectiveness of the actions of many smaller polluters in a watershed (Keeney and Boody 2005). In addition, the lag time between a change in practices and the benefits of that change can be several years and the payment scheme can be complicated by this problem. Finally, physical process models that estimate the effect of a change in agricultural practice can be flawed and result in substantially less improvement than estimated, resulting in reduced cost-effectiveness (Keeney and Boody 2005). These are issues that require consideration when contemplating a performance-based approach to water quality management, particularly due to the nonpoint nature of the pollution in agricultural systems.

#### **2.2.4 The importance of context in implementing performance-based approaches**

Performance-based approaches are implemented within a specific context and as a result of a number of drivers and enabling conditions (Millennium Ecosystem Assessment 2005; Garrick et al. 2009). Drivers can be based on demand (environmental, social and/or economic), or drivers can be institutional where legislation and/or policy is put in place so that performance-based approaches may be implemented. Enabling conditions describe the history of legal and regulatory reforms, environmental conditions and social norms that allow the consideration of performance-based approaches as a viable option for water quality management on agricultural land. Enabling conditions include factors such as recognition by policy makers of water quality as an ecosystem good and well-defined property rights of agricultural landowners that create the potential to be paid for improvements to water quality (i.e., a 'right' to pollute). Recognition of EG&S is vital to the implementation of some performance-based approaches that are based on the premise that agricultural producers should be paid for the public (external) benefits they

supply, such as schemes that pay for EG&S. Well-defined property rights allow an understanding of who pays for what; that is, whether governments employ a ‘beneficiary pays’ principle or a ‘polluter pays’ principle for agricultural landowners (OECD 2010). When this is clearly defined, policy approaches that fit within the property rights framework are more easily identified. Factors that affect the ability of a government to implement performance-based approaches will be described for each approach identified in the selected cases where it has been implemented.

Together, the drivers and enabling conditions describe the relevant context surrounding performance-based approach implementation and are useful in assessing potential fit of the approach to another region (i.e., policy transfer). The successful transfer of a policy approach from one place to another depends, in large part, on the broader contextual factors that drive and enable it (Dolowitz and Marsh 2000; Mossberger and Wolman 2003; Millennium Ecosystem Assessment 2005). Policy transfer literature indicates that many policy transfers are performed with an unsystematic approach and rely on anecdotal evidence, paying inadequate heed to context (Wolman 1992). Dwyer and Ellison (2009), in a review of recent policy transfer literature, emphasize the importance of understanding the context surrounding policies prior to policy transfer, and state that there is currently a lack of consideration of policy context. This is also the case when focusing specifically on water policy (Pigram 2001).

Drivers and enabling conditions of a performance-based approach can be divided into economic, environmental, institutional, and social factors that have influenced the implementation and operation of performance-based approaches (Dolowitz and Marsh 2000). An analysis of drivers and enabling conditions across regions allows some generalizations to be made about those that facilitate implementation of performance-based approaches, and an identification of common contextual factors in successful and/or unsuccessful approaches within and between approaches. Social and institutional drivers and enabling conditions can be particularly important in assessing fit in water policy transfer (Dolowitz and Marsh 1996). Much of the policy transfer literature related to the transfer process discusses social and institutional context (e.g., Mossberger and Wolman 2003; Dolowitz and Marsh 1996; Rose 1993; de Jong 2009). Previous contextual analyses for potential water policy transfer have identified social and institutional capacity or



mismatch as significant barriers to a transfer (e.g., Hu 1999; Malano et al. 1999). Where policy transfers have been evaluated post-implementation, social and institutional mismatches have often been identified as a significant cause of substandard outcomes or outright policy failure (e.g., Wolman 1992; Barnes et al. 2009). This paper focuses specifically on social and institutional factors, but also acknowledges that other factors, such as economic or environmental factors, are important and relevant to the assessment of context for a particular approach.

### **2.2.5 Paper structure**

The remainder of the paper is organized into four sections. First, a brief introduction to performance-based approaches is provided to acquaint the reader with the concepts and definitions adopted by the author. Second, a review of performance-based approaches, with a focus on managing water quality on agricultural landscapes, is presented. This review is accompanied by a discussion of the relevant institutional and social drivers and enabling conditions for each approach. Within the bounds of what are considered 'performance-based' approaches, a range of methods to measure performance and payment structures exist. The third section develops an organizational framework for performance-based approaches based on the preceding discussion. This organizational framework provides a tool to rank approaches according to capacity to incorporate performance and to select appropriate approaches and policy instruments based on the measurement/estimation capacity and desired payment structure for regions where performance-based approaches are being considered. The framework is developed based on the assessment of individual programs using performance-based approaches, the policy instruments employed, and their approach to measurement and payment structure. The fourth and final section discusses applications of the organizational framework for policy ranking, selection, and transfer.

### **2.3 Introduction to performance-based approaches review**

Performance-based instruments and methods to implement policy instruments are described in this section, and are discussed jointly using the term 'performance-based approaches'.

Performance-based approaches were defined, for the purposes of this discussion, as those programs where there was some differentiation in payment/penalty level based on water quality

outcomes and some effort to measure or estimate those water quality outcomes. Performance-based approaches identified were briefly described, including a clear statement of the method used to measure water quality outcomes and the structure of the payment or penalty scheme. The enabling conditions and drivers for the program were discussed, and the outcomes evaluated where this information was available. Where there was more than one instance of implementation of a particular approach, the case where the most literature was available formed the main body of the discussion, with additional information supplied from other cases.

Three constraints were placed on this survey of the literature for performance-based approaches. All constraints were implemented to maintain a degree of consistency between the Canadian context and the contexts of other regions investigated, as well as to maintain a focus on agri-environmental policy and water quality (Mossberger and Wolman 2003). The constraints were as follows: 1) the review was limited to those approaches targeted specifically for agriculture; 2) the review was limited to approaches that focused on water quality, or else had water quality management as a component; and 3) the review was limited to the member countries of the Organization for Economic Co-operation and Development (OECD). Member countries of the OECD were chosen as a geographical limit to this discussion for the institutional characteristics to maintain a degree of contextual similarity between Canada and other member countries (Rose 1993). Specifically, in these countries, agriculture is practiced on private land, all have a system of democratic governance, and all are developed countries with market economies (OECD 2010).

### **2.3.1 Water quality trading/permits**

Water quality trading or permitting allows large emitters of water pollution to buy emission credits from low level emitters. This market-based approach establishes property rights for pollutant discharge and can be implemented where cap and trade regulations have been put in place, or where voluntary demand is great enough to warrant the policy instrument (Lal et al. 2009). There are several necessary conditions for water quality permit trading to occur: 1) a specific environmental objective ; 2) a clearly defined commodity; 3) appropriate level of

incentives to ensure trades; 4) appropriate and clear trading rules; and 5) measurement and monitoring (Weersink et al. 1998; Cantin et al. 2005).

Water quality trading uses an appropriate model or set of models to estimate water quality improvements and/or value transfer from other studies to estimate the effect of specific BMPs. In the case of water quality improvement, payments are made based on the magnitude of reduction in pollutants estimated from those models. I reviewed a number of cases where water quality trading was implemented in the United States and one in Canada (Table 2-1). These examples are generally based in small watersheds where there is a point source polluter (often industrial) that acts as a buyer of water quality permits from several non-point source polluters (often agricultural producers).

**Table 2-1.** Water quality trading programs

<b>South Nation River Watershed Phosphorus Trading Program, Ontario, Canada</b>			
This watershed-based water quality trading program is operated by the South Nation Conservation (SNC) community watershed organization. The SNC acts as a broker between water quality credit buyers and sellers. In this case, the sellers are farmers and the buyers are industrial wastewater emitters.			
Characteristics	Enabling conditions	Drivers	Outcomes
<p><u>Measurement:</u> Modeled based on measured performance of practices in other regions, calculated per hectare or per head for livestock.</p> <p><u>Payment:</u> The South Nation Conservation group retained the funds paid for P credits and used those funds for grants to agricultural producers to implement BMPs. Grant amounts were based on projects and not amount of P reduction</p>	<p><u>Institutional:</u> The Ontario Ministry of Environment created water quality guidelines with maximum allowable concentrations of pollutants.</p> <p>Regulatory measures for drinking water implemented under the <i>Safe Water Drinking Act</i></p> <p>South Nation Conservation community group established to manage natural resources in the watershed</p>	<p><u>Institutional:</u> Phosphorus concentration limit enforced in watershed</p> <p>Program viewed as an economical way to mitigate impacts of wastewater emissions</p> <p>Removal of legal liability for agricultural producers through "Statement of Roles and Responsibilities"</p> <p><u>Social:</u> Stakeholder buy-in achieved through the use of</p>	<p>Water quality in the watershed has improved, with an estimated reduction in emissions of approximately 10,000 kg per year</p> <p>More cost-effective than improving wastewater treatment</p> <p>Watershed residents perceived other benefits, including soil and livestock health benefits,</p>

	<p><u>Social:</u> Agricultural producers were well-organized and effective in lobbying for policies that affirm strong property rights</p>	<p>a locally-trusted organization, created a sense of security and trust</p> <p>Use of a trusted organization, the South Nation Conservation group, as a broker for credits</p>	<p>reduced risk to human health, improved opinions of the South Nation Conservation group, increased property values</p>
(O'Grady 2011; Allaway 2003; OMOE 1994; Driedger 2010; Justice O'Connor 2002; OFEC 2006; Selman et al. 2009; Boutz 2007)			
<b>United States water quality trading programs (several states)</b>			
Most US WQT programs are based on a point source buyer and non-point source sellers of pollution credits. Trades occur through clearinghouses (intermediaries between the buyer and seller); exchange marketplaces where buyers and sellers connect directly; and/or bilateral trades where buyers and sellers conduct single trades			
<b>Characteristics</b>	<b>Enabling conditions</b>	<b>Drivers</b>	<b>Outcomes</b>
<p><u>Measurement:</u> Either site-specific calculations to estimate nutrient losses or reductions using variables such as soil type, slope and other input rates; or pre-determined nutrient reductions for practices that assigns a nutrient reduction credit based on estimated average nutrient reductions</p> <p><u>Payment:</u> Credits based on an emission unit purchased through three mechanisms: 1) bilateral negotiations; 2) clearinghouses; or 3) exchange markets</p>	<p><u>Institutional:</u> Previous success of sulphur dioxide trading under <i>Clean Air Act</i></p> <p><i>Clean Water Act</i> gave individual states authority to regulate non-point source pollution</p> <p>US Environmental Protection Agency's <i>Watershed Protection Approach</i> created capacity to use unique approaches to achieve ecological goals</p>	<p><u>Institutional:</u> US Environmental Protection Agency and United States Department of Agriculture have promoted water quality trading through funding initiatives and policy provisions</p> <p>Several state-specific regulations to encourage trading</p> <p>Implementation, or imminent implementation, of nutrient caps for water bodies based on total maximum daily load (TMDL) for pollutants</p>	<p>Economic benefits, lower cost to reduce pollutant loads</p> <p>Where trades have not occurred, attributed to lack of institutional drivers</p>
(Selman et al. 2009; Woodward 2003; Woodward et al. 2002; McGinnis 2001; Abdalla et al. 2007; Fang et al. 2005)			

### **2.3.1.1 Common conditions among water quality trading programs**

There are several common enabling conditions identified from US and Canadian programs using water quality trading as a policy approach. The first enabling condition is a physical need for water quality control from agricultural landscapes; that is, water quality conditions have deteriorated to a level that is unacceptable. The second enabling condition is the legal capacity to implement a water quality trading program. There are two separate aspects to legal capacity. First, the water quality trading policy instrument must be recognized as an acceptable method of reducing non-point source pollution. In the South Nation case, this capacity was not explicit, but the institutional capacity was present and facilitated interpretation of the legislation in a way that created legal capacity. Second, there must be legal entitlement for the non-point source discharge. That is, there must be a “right to pollute” in place and this was the case for all programs reviewed. Finally, the policy instrument must be based on sound and socially-acceptable science. In cases where trading occurred, methods of estimating P emission reduction, calculating trading ratios, and monitoring for actual results were important factors in stakeholder buy-in and the long-term viability of the approach.

Common drivers were also evident among water quality trading programs. An institutional driver (i.e., agency endorsement and encouragement of using the specific policy instrument) was key to actually implementing the water quality trading program. Another important driver was the funding available to implement the program. In the South Nation watershed, it was the recognition that the cost to taxpayers for improving wastewater treatment was prohibitively high and this triggered the serious consideration of water quality trading. In the US programs, significant grants were provided for start-up of programs; this reduced financial risk for local agencies and created opportunities to implement water quality trading.

Several of the common enabling conditions and drivers identified among water quality trading programs were similar to those proposed by researchers. The success of the South Nation Watershed Phosphorus Trading Program was attributed by O’Grady (2011) to the following eight conditions: community consensus on the trading process; the legislative requirements to implement trading; reliable, science-based measurement; absence of economic risk to buyers and

sellers of credits; broker credibility; written instruments for trading and verification; and liability protection for buyers and sellers. Several of these conditions are similar to those identified by Selman et al (2009) in an assessment of several US water quality trading programs: demand for water quality must be driven by strong regulation and/or other non-regulatory drivers; minimization of agricultural landowner legal liability; strong science backing for water quality measurement; standardized processes and tools to minimize transaction costs; and, buy-in from stakeholders.

### 2.3.2 Differentiated payments for EG&S

Performance-based payments for EG&S encompass a range of payment types for the production of EG&S. This group of approaches relies on site-specific models and payments are structured to reflect degree of improvement in pollutant concentrations in water (Claassen et al. 2001). While there are a number of purported 'performance-based' PES programs being used in the US and abroad (Wunder et al. 2008), most have payments that are tied strictly to inputs or practices. The definition of performance-based PES used in this discussion requires that payments are differentiated, at least to some extent, based on estimated environmental outcomes. This means that payments can be based on estimated units of pollution reduction, or can be tiered to pay set amounts based on estimated outcomes. Programs that met the requirements of this definition were reviewed below (Table 2-2). Many of the PES programs implemented in OECD countries do not have this feature, and therefore are not within the scope of this review.

**Table 2-2.** Differentiated payments for ecosystem services (PES) programs

<b>Performance-based Environmental Policies for Agriculture (PEPA), Hewitt Creek Watershed, Iowa, United States</b>			
A series of pilot projects under the PEPA framework have been implemented since 2005. Most research findings in the literature relate to the Hewitt Creek Watershed in Iowa, so this watershed will be the focus. The watershed is considered to be one of the main contributors of nutrient, sediment, and fecal bacteria pollution of the Mississippi River. Interested stakeholders formed a watershed council that made decisions concerning the measurement method and payment structure for improvements to water quality at the farm level.			
Characteristics	Enabling conditions	Drivers	Outcomes
<u>Measurement:</u> Suite of indices to estimate nutrient and sediment losses. All of these indices are calculated for individual	<u>Institutional:</u> Listed as impaired watershed from <i>Clean Water Act</i>	<u>Institutional:</u> Impending regulation as a result of impaired watershed listing	Social successes were considered important. Stakeholders formed cohesive structure,

fields.	Financial support of local farm bureaus	shared knowledge and ideas.	
<u>Payment:</u> Variety of incentive payments; some are based on nutrient testing or fixed payments for specific practices, while others are incremental and increase based on degree of reduction in pollutants as estimated by indices.	<u>Social:</u> Fear of government intervention  Civic responsibility and peer pressure	Water quality improved, estimated reduction of 23% of nitrate pollution; phosphorus pollution was reduced by 14%	
(Morton 2008; Morton et al. 2006; Winsten 2009; PEPA 2011; Hewitt Creek Watershed Improvement Association Inc. 2008)			
<b>Privately-Sponsored PES, Vittel Company, France</b>			
Vittel is a water bottling-company that has been successful based on the 'natural mineral water' branding and purported health benefits associated with its source. To maintain water quality with increasing agricultural intensification around the source, the company developed a program for the farms within a set zone around the water source. The program provided long-term contracts for farmers to make extensive changes to their production systems based on the estimated impact of their specific land on the water quality of the bottling source.			
Characteristics	Enabling conditions	Drivers	Outcomes
<u>Measurement:</u> Estimated the total reduction of nitrogen emissions required to maintain an acceptable water quality standard, based on site-specific research. Management practices were identified that could achieve the nitrogen reduction requirement.		<u>Institutional:</u> Company required actions at the farm level to maintain viability  Political will to retain company in the region	Water quality maintained at an acceptable level for company to continue to operate, no jobs lost  Farmers negotiated contracts that have been satisfactory, no ill will.
<u>Payment:</u> Contracts negotiated based on actions required from each farmer		<u>Social:</u> Company employed many people in the region, this provided a strong incentive for farmers to work with the company; stakeholder buy-in	
(Perrot-Maître 2006)			
<b>Group PES, Cullers Run Watershed, West Virginia, United States</b>			
This particular watershed was chosen for a pilot project because it was small, had a history of water quality sampling, and a cropland distribution that facilitated measurement of effects of changes to practices relatively easily. Just over 50% of the agricultural households in the watershed participated in the project as a result of several informational meetings and the development of a farmer advisory			

committee.			
Characteristics	Enabling conditions	Drivers	Outcomes
<u>Measurement:</u> Measurement of water quality was direct, background levels of nitrogen were accounted for by measuring water quality in an additional "index watershed" that was similar in size and location but not impacted by agricultural activities.  <u>Payment:</u> Payments to whole group, distributed equally and based on water quality, volume.	<u>Institutional:</u> Impaired watershed listed under <i>Clean Water Act</i>	<u>Social:</u> Researcher interest in assessing feasibility of using a group-based PES approach to managing water quality	Social successes included increased interest in acquiring information about water quality, increased participation, and pressure to participate from other farmers. Trust among researchers and farmers developed throughout the project.
(Maille et al. 2009)			

### 2.3.2.1 Contextual similarities for differentiated PES programs

There are some important similarities in the differentiated PES programs presented for discussion. All were small-scale projects aimed at individual watersheds. The programs generally required a high degree of involvement by researchers or program proponents and a substantial amount of time to develop relationships and build trust with watershed landholders. Collection of water quality data and use of physical process models were common and necessary elements of all programs.

The most discussed successes of these programs in the literature related to the social capital creation and empowerment of local agricultural landowners who participated in the programs. All programs found that giving the landowners some authority in determining the payment terms and/or managing funding created a stronger program and a desire to learn more and to involve others.

### 2.3.3 Reverse Auctions

Reverse auctions have been applied where markets for the commodities of interest are not well established (Latacz-Lohmann and Van der Hamsvoort 1997). Reverse auctions are characterized



by multiple sellers of EG&S that participate in a competitive bidding system and a single buyer, usually a government agency. There are three ways to select successful bids from sellers in a reverse auction: 1) based on cost where bids are ranked and winning bids are funded from lowest to highest; 2) based on benefits where bids are ranked according to environmental outcomes and funded from greatest to least benefit; and 3) based on cost effectiveness where ranking occurs with both cost and benefit considerations (Selman et al. 2008). The latter two types of auctions can be considered performance-based, as there some measure of benefits and payment is based on the degree of benefit provided by the seller. Models are generally used to estimate the environmental outcomes and can be based on site-specific characteristics and practices. Payments are tied to degree of environmental outcomes in the sense that the most cost-effective, or the most beneficial, plans are paid out first. While the bid may not directly reflect the value of the outcome, it is sufficient payment for the landowner to achieve the outcome and therefore may actually be more cost-effective in some cases than differentiated payments. The reverse auction approach allows agricultural landowners to use their knowledge of the costs of implementing specific practices in order to create a bid price that makes the activity financially worthwhile for their business (Latacz-Lohmann and Van der Hamsvoort 1997). However, the participants must also be mindful of other sellers with the same intent and be strategic. Bids are constrained by the presence of multiple sellers and with the possibility of a rejected bid if the amount proposed exceeds the perceived value of expected environmental outcomes. This mechanism alleviates the problem of asymmetric information for funding agencies, as it reveals opportunity costs for landowners to provide EG&S (Ferraro 2008).

Reverse auctions have been implemented in the US through programs to manage highly erodible land and to reduce phosphorus runoff (Reichelderfer and Boggess 1988; Selman et al. 2008) and in Australia with widespread efforts to manage water quality along with other land management issues (Lowell et al. 2007; Eigenraam et al. 2007). The US program is the most well-established and incorporates water quality objectives, and therefore will form the basis for this discussion, with a summary discussion of programs implemented elsewhere (Table 2-3).

**Table 2-3. Reverse auctions**

<b>Conservation Reserve Program, United States</b>			
First introduced in 1986, the program aimed to achieve environmental benefits through land retirement, including improvements to water quality.			
Characteristics	Enabling conditions	Drivers	Outcomes
<p><u>Measurement:</u> Use of an Environmental Benefits Index (EBI) to estimate the site-specific environmental outcomes of retiring land, and weighted them according to the priorities of the program.</p> <p><u>Payment:</u> Bidding by landowners for land retirement payments. Bids selected based on EBI score. (Claassen et al. 2008; Reichelderfer and Boggess 1988)</p>	<p><u>Institutional:</u> History of land retirement programs during periods of low commodity prices; significant area of land designated as highly erodible</p> <p><u>Social:</u> Desire to support agricultural landowners</p>	<p><u>Institutional:</u> Enactment of the <i>Food Security Act</i> with a legislated land base target</p> <p>United States Congress authorized use of cost-benefit targeting to select bids</p>	<p>Estimated increase in environmental benefits but no measurement</p> <p>Criticisms of program for lack of objectivity, inflexibility to respond to changing environmental conditions</p>
<b>Conestoga Watershed, Pennsylvania, United States</b>			
A recent demonstration project implemented in the Conestoga Watershed in Pennsylvania is a more specific reverse auction for water quality.			
Characteristics	Enabling conditions	Drivers	Outcomes
<p><u>Measurement:</u> The expected reduction in phosphorus runoff was estimated using a combination of site-specific variables and along with research estimates of effectiveness of various BMPs</p> <p><u>Payment:</u> Used a cost-effectiveness strategy to select bids for specific BMPs agricultural producers were willing to implement on their land (Selman et al. 2008)</p>	<p><u>Institutional:</u> Watershed listed as impaired under the <i>Clean Water Act</i></p>	<p><u>Social:</u> Researcher interest in demonstrating the potential cost efficiencies using a performance-based approach as compared to a conventional input-based approach</p>	<p>The difference in phosphorus pollution reduction and costs were substantial: the conventional program required \$26.19 lb<sup>-1</sup>, while the reverse auction paid out an average of \$5.06 lb<sup>-1</sup></p>

<b>Great Barrier Reef, Australia</b>			
Water quality reverse auctions based on four one-year trials to assess opportunity costs of changing practices and to improve funding allocation (cost-effectiveness) for agri-environmental water quality programs offered by the Australian government			
Characteristics	Enabling conditions	Drivers	Outcomes
<u>Measurement:</u> Used models with site-specific data to estimate the amount of agricultural emissions reduced by each bid proposal, resulting in an environmental benefit index score  <u>Payment:</u> From the EBI and the proposed bid amount, cost-effectiveness was determined and bids were selected on this basis	<u>Institutional:</u> Previous successes of reverse auctions for conservation	<u>Institutional:</u> Governmental concern about misallocation of resources; these trial auctions were perceived as a method to better estimate opportunity costs for agricultural producers to make changes to practices and reduce potential of over-payment	These trials highlighted the variability in producers' costs and the importance of using a cost-effectiveness strategy in assessing bids.
(Rolfe and Windle 2011)			

### 2.3.3.1 Common context within reverse auction approaches

There are several similarities in the enabling conditions, drivers, and implementation strategies of programs utilizing the reverse auction policy approach. First, presence of an institutional driver is required. In all cases, there was a governmental or non-governmental agency with sufficient resources to promote the reverse auction approach to water quality management. Without support from these agencies, this policy approach would not be utilized, as the administrative and data-gathering costs can be very high and labour intensive (Weinberg and Claassen 2006). A common enabling condition was the failure of previous policy approaches to address water quality concerns. This similarity was particularly evident for the Australian and US pilot projects. Both studies made reference to previous programs that had failed to achieve desired outcomes, and the reverse auction was being trialled as an alternative, more cost-effective option (Keeney and Boody 2005; Rolfe and Windle 2011). Finally, an environmental benefit index is imperative to implementing the reverse auction in a performance-based manner. Though the link between practices and environmental outcomes was weak in the CRP, there was

an attempt to tie bid selection to expected outcomes and maximize cost-effectiveness. Site- or farm-specific environmental benefit indices were used in all programs, though the indices were based on models with varying capacities for accurately estimating environmental outcomes.

#### **2.3.4 Cross-compliance**

Cross-compliance imposes a minimum standard for environmental performance (i.e., production of EG&S) that is required of agricultural producers. The compliance instrument requires that agricultural producers undertake activities to achieve the minimum environmental standard to remain eligible for government support programs, loan programs, and voluntary agri-environmental programs. (Mann 2005; OECD 2010; Claassen et al. 2004). Where agricultural producers choose not to achieve the minimum standard, they are excluded from support programs and other forms of government assistance (Claassen et al. 2004). While the objective of programs that use cross-compliance is an environmental outcome, compliance is determined based on the adoption of practices (Baylis et al. 2008). As such, cross-compliance may be considered a 'hybrid' policy instrument, rather than strictly performance- or practice-based (Weinberg and Claassen 2006).

The EU has been implementing cross-compliance measures since the 1990's, and it has been a compulsory policy instrument in many of the member states since 2005 (OECD 2010). The following discussion of cross-compliance will focus on the United Kingdom experience with Nitrate Vulnerable Zones (Table 2-4).

##### **2.3.4.1 Important considerations for cross-compliance**

A main enabling condition of this type of instrument is existence of substantial agri-environmental payments and/or income support for agricultural producers. Creating conditions where agricultural producers must meet minimum environmental standards to remain eligible for income support provides an important incentive to comply. Likewise, where the economic benefits of agri-environmental payment programs outweigh costs, an incentive is created to comply with environmental standards. Without the conditionality of income support and other payment programs of significant value to the agricultural producer, this approach will fail.

**Table 2-4. Cross-compliance**

<b>Nitrate Vulnerable Zones, United Kingdom</b>			
These zones have been created under the EU Nitrates Directive where nitrate levels in watersheds exceed, or are likely to exceed 50 mg l <sup>-1</sup> . The entire watershed becomes an NVZ and all agricultural producers within the zone are expected to comply with nitrate pollution minimizing practices, thus taking on characteristics of a group-based approach.			
Characteristics	Enabling conditions	Drivers	Outcomes
<p><u>Measurement:</u> No measurement of individual farm contribution to water quality. However, beyond the initial assessment of a watershed as a NVZ, reviews must be undertaken every four years to assess water quality and revise the NVZ based on direct water quality monitoring</p> <p><u>Payment:</u> Where producers within these zones comply with required practices, income support payments are provided in full. Otherwise, reductions to, or denial of income support payments and agri-environmental payments occurs</p>	<p><u>Institutional:</u> Previous water quality directives and legislation</p> <p>Previous zonal designations for water protection (Nitrate Sensitive Areas) and implementation of the Common Agricultural Policy reforms of 1992 created institutional capacity</p> <p><u>Social:</u> Growing social belief that agricultural producers should not receive payments unless they comply with basic environmental requirements</p>	<p><u>Institutional:</u> World Trade Organization pressure to reduce income support payments and fit payments within 'green box' requirements (decoupled payments from production)</p>	<p>Mixed environmental outcomes: some NVZs (31%) showed improvement in surface water quality; some remained the same; and some (17%) became more polluted over a 12-year period</p> <p>Focus on inputs was not an effective strategy to reduce nitrate pollution</p> <p>Social outcomes showed a mismatch between farmers attitudes and public expectation of environmental benefits. Farmers were distrustful and felt penalized. However, considered an effective way to induce a change in practices and improved environmental outcomes in the face of a lack of interest by landowners</p>
(Macgregor and Warren 2006; DEFRA 2011; EC 2010; Baylis et al. 2008; Amin-Hanjani and Todd 2005; Osborn and Cook 1997; Worrall et al. 2009; Nielsen et al. 2009; Hall et al. 2004; McVittie et al. 2010; WTO 2008; Barnes et al. 2009)			

A second enabling condition of cross-compliance is an environmental standard, or else a practice-based set of standards linked to expected environmental outcomes. For NVZ scheme, the maximum concentration of nitrate in water provided that standard. However, environmental standards may not be socially acceptable by all sectors. A study of farmers' attitudes toward NVZs in Scotland showed that most felt penalized by being placed within a NVZ compared to those outside these areas (Barnes et al. 2009). Farmers were wary and wanted proof that the practices they were asked to implement actually had a positive impact on water quality. The productivist attitude of the farmers was not adequately accounted for in the introduction of the NVZ regulations, and this created an atmosphere of distrust and scepticism of the benefits of required actions. The lack of understanding of the dominant productivist culture of farmers in Scotland has led to very little change in behaviours and practices in NVZs (Barnes et al. 2009).

There are some issues to be aware of with the cross-compliance approach. One of the major shortfalls noted by Badertscher (2005) is that, once cross-compliance measures have been implemented, there are no further improvements to the production of EG&S beyond those required for compliance (i.e., this policy instrument does not foster innovation and continuous improvement). Evidence from studies of the impact of NVZ designations in the UK support this potential issue with cross-compliance, as an overall improvement in nitrate levels was not observed (Worrall et al. 2009). Another potential hazard of cross-compliance is level of subsidies and payments available to compliant agricultural producers. Where potential gain is less than the cost of compliance, compliance rates will be low (Claassen et al. 2004).

### **2.3.5 Emission charges**

Emissions charges are based on the polluter pays principle and result in increasing and incremental levies charged to agricultural producers who create more pollution than they are allotted based on individual operations. The only OECD country that has instituted a performance-based emission charge to manage water quality is the Netherlands (Table 2-5). In the case of the Netherlands, nutrient accounting - specifically for nitrogen and phosphorus inputs and outputs - was required of all farmers. This approach was mandatory and no payments were made for maintaining pollutant emissions below the limit, but levies were administered where emissions were exceeded (Peerlings and Polman 2008).

**Table 2-5. Emissions charges**

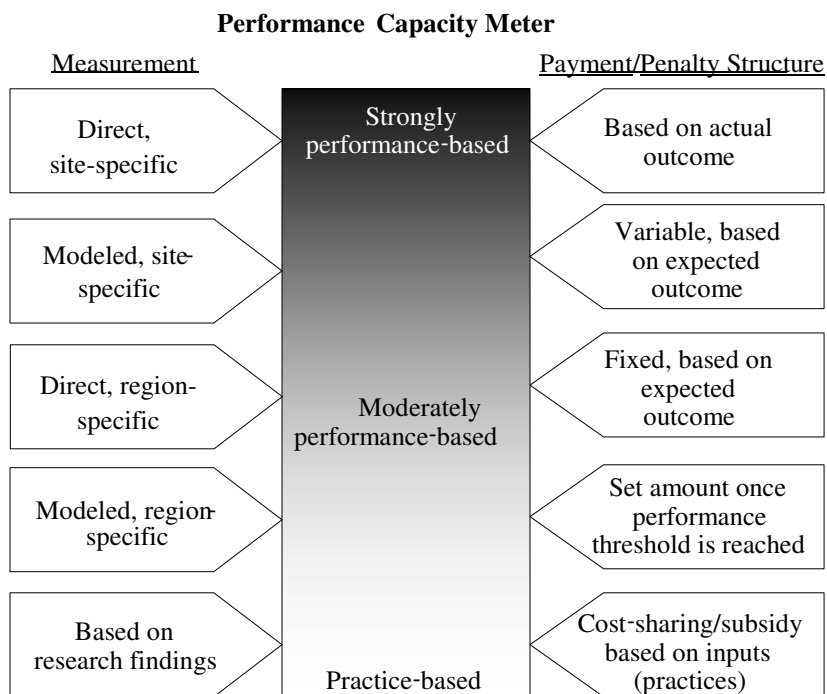
<b>MINAS program, The Netherlands</b>			
The Minerals Accounting System (MINAS) was introduced in 1998 for the highest risk farms, and then became compulsory for all farms in 2001 . The program was implemented as a result of the unsustainable quantities of manure being produced by intensive livestock operations with inadequate areas of land for manure distribution.			
Characteristics	Enabling conditions	Drivers	Outcomes
<u>Measurement:</u> Individual farm accounting of inputs and outputs related to phosphorus	Social: Intensive agriculture industry that maintains viability through livestock production, resulting in excess manure which contributed pollutants to water bodies	<u>Institutional:</u> Failed attempts to manage agricultural sources of water contamination through input-based regulations	Some water pollutants reduced (nitrates), but phosphorus remained a concern and actually increased. Program considered unsuccessful
<u>Payment:</u> Nutrient surpluses subject to incremental levy			Eventually discontinued as a result of incompatibility with European Union directives
(van Grinsven et al. 2005)			

## 2.4 Organizing performance-based approaches: The Performance Capacity Meter

The organizational tool developed from the review of performance-based approaches, called the Performance Capacity Meter, ranks reviewed programs and their approaches to provide an understanding of how approaches compare to one another. The meter uses methods of measurement of water quality and the structure of payments or penalties to rank approaches on a scale from strongly performance-based to weakly performance-based. Each approach, as well as individual programs, can be described as fitting within a ranking system for performance capacity. The strongest approach in terms of performance incorporates site-based direct measurements of performance and variable payments. In contrast, the weakest approach includes only a very weak measure of performance, and payments are based on inputs with no varying degree of incentive or disincentive based on the degree of outcome (Figure 2-1). The labelled arrows in Figure 2-1 represent benchmarks that reflect changes in measurement method and

payment structure along the ranking system. Measurement method and payment structure of the performance-based approaches are not necessarily linked, though they may occupy a similar rank.

Using water quality to demonstrate the performance capacity meter, a strongly performance-based approach is one that uses direct water quality measurements to evaluate the magnitude of the potential payment or levy. A key benefit to the program provider of a strongly performance-based approach is efficiency and effectiveness of payments/penalties; a high degree of accuracy is ensured and payments are made only for genuine improvements. However, there are several significant disadvantages to strongly performance-based approaches, including high administrative costs and potentially a high degree of risk assumed by the producer associated with, for example, variable and unpredictable weather events and other landowners, which has been shown by the programs reviewed to lead to stakeholder refusal to participate.



**Figure 2-1.** Performance Capacity Meter to rank effectiveness of potential of applicable performance-based approaches as indicated by measurement data availability/methods and payment/penalty structure capacity.



Moving to a less-strongly performance-based approach, as performance is estimated instead of measured directly, accuracy and cost-effectiveness decreases for the program provider but there is potential for increased landowner program adoption due to decreased risk. Water quality estimates that include site-specific conditions (e.g., slope, distance to surface water, crop grown, soil nutrient levels) are higher on the performance capacity meter than regional estimates, where only regional conditions are considered. Payment types can be variable and based on expected outcome from models or else fixed and based on model outcomes (e.g., reaching a set standard of water quality to be eligible for government funding). These types of approaches afford landowners greater security in receiving funding if actions are carried out, regardless of the effect of weather and other conditions beyond their control.

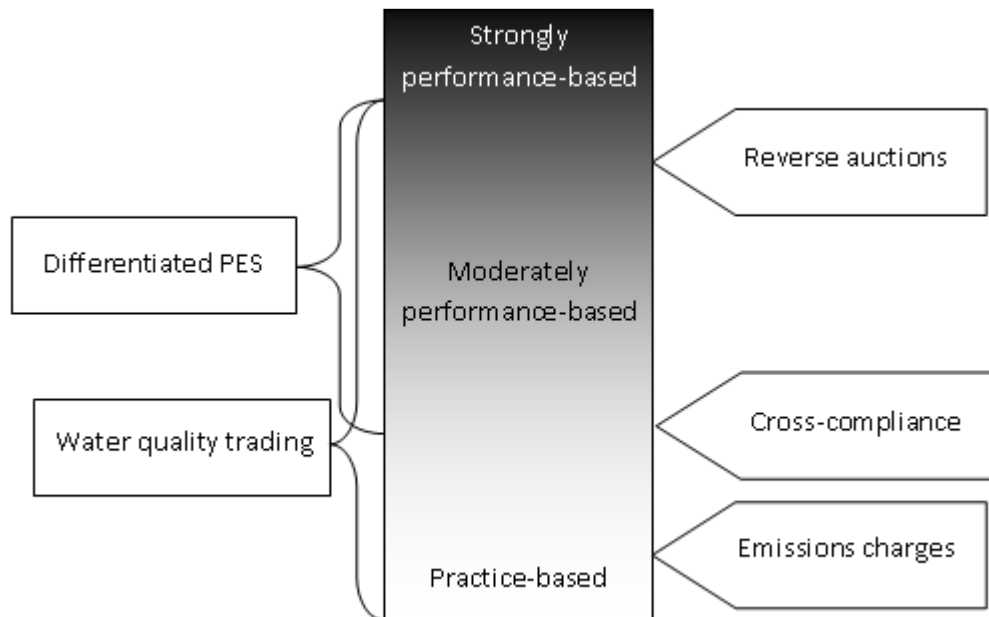
Finally, where approaches are only very weakly performance-based, outcomes are assessed based on research results that indicate average responses to a specific management practice. The programs that incorporate this type of approach are prescriptive and allow no flexibility for the landowner to adopt practices to his or her particular situation. While some attempt is made to assess whether there will be a positive environmental outcome, the attempt is weak and outcomes are assumed to be linked to inputs or management practices. Payment structures for these approaches are usually fixed, paid as a cost-share or subsidy for inputs, and measurement is not included. There are some benefits to these approaches: administrative costs are low, as there is no need to develop models or measure site-specific or regional conditions; this approach can be applied to a broad landbase; and, there is no risk to landowners as the receipt of payments is based entirely on inputs. However, there is only an indirect link between environmental performance and payment structure and the environmental outcomes are likely lower than with other approaches.

#### **2.4.1 Applying the performance capacity meter to policy examples**

Categories of performance-based approaches varied in the degree of performance incorporated within them. Further, programs using a particular policy approach implemented that approach differently, resulting in differing capacity for performance *within* policy approaches, as well as among them, shown in Figure 2-2. While the approaches varied in their performance capacity,

they can be qualitatively ranked using the two dimensions of performance - measurement and payment/penalty structure - for the relative degree of performance incorporated into them.

Depending on the context within which the performance-based approaches are implemented, rankings on the scale may differ (Figure 2-2). For example, if cross-compliance was based on achieving water quality standards, rather than the assumption of that achievement with the adoption of specific practices, then reliable, site-specific models would be required and payments could be based more strongly on performance. This change would alter the ranking of the cross-compliance approach from very weak to moderately performance-based. The context surrounding implementation of these approaches, which influences the capability for measurement of water quality and payment/penalty structure, is critical in the degree of cost-effectiveness achieved by performance-based approaches.



**Figure 2-2.** Variability in degree of performance applied to categories of performance-based approaches to manage water quality for agricultural landscapes. Variability is a result of the specific implementation strategies used.

## **2.4.2 Applications of the organizational framework**

Performance-based approaches can occupy more than one rank on the performance capacity meter. The methods used to measure performance and to pay or penalize agricultural producers can vary among programs using the same category of approach, creating a range of potential for performance capacity (Figure 2-2). This creates opportunities to improve the degree of performance of a policy instrument where drivers and enabling conditions are present (Rose 1993; Hospers and Beugelsdijk 2002). For example, in its current application in the UK, cross-compliance for NVZs is based almost entirely on agricultural producers adopting specific practices where their land falls within a designated zone, making it a very weakly performance-based approach when viewed as from an individual producer perspective, but stronger when viewed as a whole watershed-based approach. Basing compliance on flexible, site-specific practices where physical process models are available to provide reliable estimates of the environmental outcomes of those practices would create a stronger performance-based cross-compliance approach at the individual producer level. The performance capacity meter provides a useful tool to understand what is needed to achieve a stronger performance element in water quality programs for agriculture.

The tool has further potential to serve as a general approach to categorizing performance-based approaches and may be useful in other research or policy studies to enable the selection of appropriate instruments based on measurement or payment structure capabilities, or where a specific level of environmental performance is desired. Using the performance capacity meter, a region can assess its capacity to measure environmental outcomes and the social and institutional capacity to implement varying degrees of differentiation of payments. Based on these two measures of capacity, the region can determine where they rank on the capacity meter - and what policy approaches are associated with their ranking.

## **2.4.3 Success and the performance capacity meter**

In addition to the organizational framework provided by the performance capacity meter, an investigation was performed to assess the possibility of a linkage between a higher degree of capacity for performance in the usage of the approach with reported success of the specific

programs. The definition of 'success' and reports of success are based on available information from the literature and therefore no assertions can be made beyond the acknowledgement of a general trend. This potential relationship between degree of basis in performance and degree of success warrants further study with quantifiable metrics to measure reported successes.

Successes reported were largely encompassed within the social and environmental contexts. Social successes were often reported as stakeholder buy-in, development of trust, and high rates of participation by agricultural producers. Environmental successes were measured or estimated improvements to water quality as a result of the implementation of a program. The environmental outcomes often varied among pollutants; for example, in the MINAS program (an emissions charges instrument) nitrogen was reduced from water bodies, but phosphorus was not. In a few cases, economic successes were also noted. The Vittel water company PES program identified economic successes for the company (continued to operate with assurances of adequate water quality), for the program participants (payments to farmers were negotiated individually), and also to the broader community (many community members were employed by Vittel).

There appeared to be a weak correlation between perceived successes of programs implementing performance-based approaches and increasing capacity for performance. For example, the UK where a weakly performance-based cross-compliance approach was used reported mixed successes and failures while some of the more strongly performance-based approaches (particularly those that used differentiated PES) reported high levels of successes in several areas (economic, environmental, and social) and no failures. Further evidence of this weak trend was the MINAS program that failed to meaningfully reduce P emissions and was eventually discontinued.

An important consideration may be the temporal and physical scales of the programs when reporting successes. Many of the pilot and small watershed-based programs reported greater successes than larger, established regional or national programs. This may be due in part to the scale of the project, the amount of time available to assess program performance and success,

and also to the attention and time paid by researchers and governments to evaluate the successes and failures of the program.

#### **2.4.4 Risk and the performance capacity meter**

A common theme identified in the programs evaluated was the importance of the "conditionality" aspect of performance-based approaches (Wunder et al. 2008) and the associated distribution of risk. Approaches that tie payments or penalties to the achievement of water quality outcomes produces or increases the inherent risk of production, primarily as a result of variable weather and other factors that can directly or indirectly influence water quality beyond the participants' control. This risk must be borne either by the program participant(s), or by the program provider, or shared by these and other stakeholder groups. As performance capacity for payment/penalty structure increases, risk in receiving payments for water quality also increases for program participants. For example, a program low on the capacity meter, such as a practice-based payment program, will pay regardless of environmental outcome, so risk to the participant is limited. Conversely, payments for incremental improvements to water quality that are measured directly will have substantial risk associated with them; variables beyond the control of agricultural producers could have a significant impact on water quality and influence outcomes and associated payments. A high degree of risk was identified in several of the programs as an issue that had to be resolved in order to implement a performance-based approach (e.g., differentiated PES, water quality trading, cross-compliance).

Often, resolving the issue of risk resulted in transferring risk from the agricultural producer (participant) to the program provider or other bodies through guaranteed payments for actions in the programs reviewed. This created a substantial weakening effect on the performance-based aspect of the programs. For example, in the South Nation water quality trading program a "Statement of Roles and Responsibilities" was created that shifted the liability for achieving water quality outcomes from landowners to purchasers of water quality credits. This statement created the necessary stakeholder buy-in to proceed with the program (O'Grady 2011). This is a common theme with payments for ecosystem services; Wunder (2006) reported that most PES schemes in existence do not adhere to the 'conditionality' requirement in an attempt to maintain

relationships with farmers. The inference in Wunder's report is that conducting PES programs with non-payment for undelivered ecological goods and services would likely have negative impacts on relationships between governments and farmers.

Balancing risk assignment for stakeholder buy-in is an important consideration in implementing performance-based approaches: higher risk is inherent in cost-efficient payment structures; however, stakeholder buy-in has been shown through this review to be a key driver in the perceived success of programs. Tools to manage the effects of environmental variability on EG&S production have been proposed, including a combination of fixed and variable payments that reduces the payment risk borne by agricultural producers (Meijerink 2008). The assurance of a payment increases participation, and the variable payment provides added incentive to produce EG&S. Another tool to reduce the negative impact of risk on program participation is a relative performance evaluation, where the performance of agricultural producers are compared to one another, rather than actual measurements or estimates of EG&S production (Zabel and Roe 2009).

## **2.5 General lessons drawn from review of performance-based approaches**

The preceding review and assessment of performance-based approaches to agri-environmental policy indicates that they have not been well-developed for management of agricultural water quality. There are few examples of performance-based approaches available within OECD countries, and of those examples most are pilot projects or localized, watershed-based initiatives (particularly those that are more strongly performance-based). Despite this, there are contextual similarities among many of the described cases and some general lessons for successful implementation of performance-based approaches can be taken from them.

### **2.5.1 Social context matters**

There are two facets of social context that can play an important part in the capacity to implement performance-based approaches. First, the general social context of the region plays an important role in the success of implementing a program with these types of approaches. A general public acknowledgement of the importance of environmental outcomes from agriculture

created the appropriate social enabling conditions to implement a performance-based approach. Understanding the prevailing social context regarding agriculture and the environment at a broad scale will allow an assessment of the capacity of a region to implement a performance-based approach.

Second, understanding social values and norms provides an important benefit to program administrators in that programs (and policy approaches therein) can be tailored to the specific conditions of the region, leading to greater potential for success (Perrot-Maître 2006). Where performance-based approaches have been used to manage water quality successfully, social buy-in is essential (Selman et al. 2009). Researchers involved in pilot projects identified trust as the key factor in gaining stakeholder buy-in for the program region (O'Grady 2011; Perrot-Maître 2006). For example, O'Grady (2011) described a point in the process of developing a watershed-based water quality trading program in the South Nation Watershed where progress stalled as a result of stakeholder lack of trust. The issue was one of risk management and which party would shoulder the majority of the risk in achieving water quality outcomes. He reports that the program would not have been successfully implemented without developing social buy-in from the community by implementing the approach in a manner that was consistent with the social norms and values of the stakeholders. Selman et al. (2009) report that several water quality trading programs in the US have stalled short of implementation due to lack of support from key stakeholders. Lack of buy-in by agricultural producers in Scotland was described as a limiting factor on the success of cross-compliance measures there to reduce nitrate pollution to water bodies, and stakeholder reluctance to participate hindered all cross-compliance efforts reviewed here. The main problem was a mismatch of social values between agricultural producers who view agriculture as an activity to produce food and fibre, and the public at large with multi-functional expectations of agriculture (McVittie et al. 2010; Macgregor and Warren 2006). The effort to understand the social values of stakeholders and development of trust have been acknowledged as factors important to the success of watershed-based management (Perrot-Maître 2006; Global Water Partnership 2009; Mandarano 2009; Conley and Moote 2003).

### **2.5.2 Water quality standards facilitate the implementation of performance-based approaches**

Institutional capacity appears to be a common constraint to increased implementation of performance-based approaches. Researchers have called for specific language in legislation that creates capacity for these approaches (Selman et al. 2008; O'Grady 2011). Where the institutional capacity does exist, there are several examples of policy approaches implemented in other regions to draw from. For example, the total maximum daily load (TMDL) standards in the US, combined with specific mandates for cost-effective agri-environmental programming, have contributed to the implementation of a major reverse auction program along with over 50 smaller water quality trading programs and several examples of PES programs (Selman et al. 2009; Claassen et al. 2001).

Implementation, or forthcoming implementation of water quality standards has been an important factor in many of the US-based programs and pilot projects, as well as in the UK and the South Nation Watershed in Ontario (Selman et al. 2009). The introduction of TMDLs and local or regional pollution caps has driven interest in water quality trading, PES, and cross-compliance. The presence of standards is required to implement some of the more strongly performance-based approaches. Even where water quality standards have not been implemented or enforced, the fear of regulation on the basis of water quality standards has created social conditions conducive to the use of performance-based approaches. In some cases, agricultural producers recognized a potential for water quality regulation within their watershed and this spurred interest in alternative mechanisms to manage water quality (Winsten 2009).

### **2.5.3 Well-developed estimation methods are required for stronger performance-based approaches**

Standardized, consistent, and robust estimation methodologies are necessary for successful implementation of performance-based approaches (Selman et al. 2009; Selman et al. 2008; Guiling and St. John 2007). Guiling and St. John (2007) call for improved site-specific research to improve estimates of environmental outcomes (EG&S), a framework to monitor and ground-truth models and test accuracy, and a repository of estimation models and monitoring data for the



US. Current estimation tools are relatively simple and unlikely to be highly accurate (Winsten 2009). Improvements in accuracy and site specificity would result in an increase in cost-effectiveness of payments for EG&S (Ribaud et al. 2001). These needs likely extend to other regions as well, especially those with less experience in implementing performance-based approaches to agri-environmental policy, such as Canada.

## **2.6 Conclusions**

The vast majority of OECD member countries have not used performance-based policy approaches in the execution of agri-environmental policies related to water quality, based on available literature (Latacz-Lohmann and Van der Hamsvoort 1997; OECD 2008). The review is limited by the relative newness of the use of performance-based instruments for water quality and agriculture, as well as by the dearth of published literature related to these approaches. However, it is evident from OECD documents that all member countries have several agri-environmental regulations, policies, and programs to manage water pollution that are based on inputs or BMP adoption (OECD 2008). Where performance-based approaches have been used, they generally have been piloted but not implemented into longer-term programs. The US, Australia and Canada are the main countries that have applied instruments that use performance or outcomes rather than inputs as measures for improvements to water quality and to calculate payment levels. Other OECD countries have used market-based policy instruments for a number of other issues, but not specifically to manage water quality (OECD 2008).

The contextual conditions of regions where performance-based approaches have been implemented show some similarities, particularly in the need for a physical driver, institutional capacity, and favourable social conditions. There are also noticeable differences among regions with performance-based approaches; unique conditions such as data availability or private company initiatives create opportunities for specific approaches. However, general lessons can be drawn from the similarities among cases.

The contextual factors contribute to a ranking for each performance-based approach on the Performance Capacity Meter that describes their performance capacity using measurement

method and payment/penalty structure as the metrics. It is evident from the use of this tool that substantial variability exists in terms of the potential for incorporating performance into agri-environmental policy approaches. The Performance Capacity Meter may also be applied as a tool to identify a region's capacity to implement a performance-based approach based on the same metrics of measurement and payment/penalty structure.

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## **CHAPTER 3: EXAMINING THE SOCIAL CONTEXT FOR IMPLEMENTING PERFORMANCE-BASED POLICY APPROACHES TO MANAGE WATER QUALITY IN AGRICULTURAL AREAS**

### **3.1 Introduction**

Incentive-based programs have been the primary mechanism used by governments in Canada to encourage agricultural practices that produce ecological goods and services (EG&S), which are positive environmental outcomes from agricultural landscapes that are not valued by the market. Many of these programs have focused on reducing negative impacts on water quality, with good water quality as one of the desired EG&S outcomes. Incentive-based programs are based on the perception that agricultural landowners should be paid to reduce their negative impacts to water quality. These programs are not necessarily cost-effective means to provide payments for environmental outcomes: incentive-based programs focus on changing management practices (practice-based); however, the link between practices and environmental outcomes can be weak (Heimlich and Claassen 2004).

An alternative to practice-based environmental policy and programs is a performance-based approach (NRTEE 2005; Kennedy 2009; Weber 2001; Weinberg and Claassen 2006). In a performance-based approach, the landowner realizes some type of economic incentive (e.g., a payment or penalty) based on production of EG&S (ecosystem outputs, or performance) rather than on simply adopting a practice. Performance-based approaches focus on *outcomes* rather than particular practices, where producer flexibility is a key component of programs (Winsten 2009; Weinberg and Claassen 2006; Keeney and Boody 2005). Performance-based approaches require that environmental outcomes must be well-defined and program responses (payments or penalties) are conditional on outcome delivery (Wunder et al. 2008). The expected performance



of a particular practice can be estimated based on mechanisms such as simulation models (Lowell et al. 2007) and indicators (Weinberg and Claassen 2006), while actual performance can be measured through on-site or remote monitoring (Hanley et al. 2004; Cohen and Goward 2004). These performance-based approaches are considered to be a more efficient method of incentivizing agricultural landowners to reduce their negative impact on the environment (Weinberg and Claassen 2006).

The broad objective of this manuscript is to evaluate the potential, from a social context perspective, for performance-based approaches to be implemented in the study region of southwest Alberta. This objective supports the assumption that social norms and values change over time, and a discrepancy between the environmental reference level agricultural landowners are obligated to provide and the environmental target level expected by society may develop. This results in a situation where new policy approaches (such as performance-based approaches) may be implemented to better align policy with social norms and values.

### **3.1.1 Social perceptions of agricultural property rights**

The perceived rights and responsibilities of agricultural landowners by society (i.e., social norms and values) are often reflected in the agri-environmental policy approaches of a region (Hodge 2001). Property rights to agricultural land exist as a result of social acknowledgement of the legitimacy of an ownership claim (Bromley 1991). The historical view of property rights in Canada and elsewhere in developed nations was that agricultural producers had the right to do as they please on their land and should be given incentives to change (Hart and Latacz-Lohmann 2005; Hodge 2001, 2007). This historical view of society's willingness to rely on agricultural landowners to manage the land without interference was supported by Pond (2009) in a review of an Ontario land use policy. Conversely, Klintman (2010) stated that the public has always expected a level of environmental stewardship from agricultural landowners and suggested that increasing public distrust of the state to ensure the provision of environmental benefits from agriculture has been the reason for a perceived shift in social values. Regardless of whether or not there has been a shift in the public's perception of agriculture, a traditional view of property rights endures through many of Canada's agri-environmental programs and agricultural producers have often been compensated to some degree for costs associated with adopting

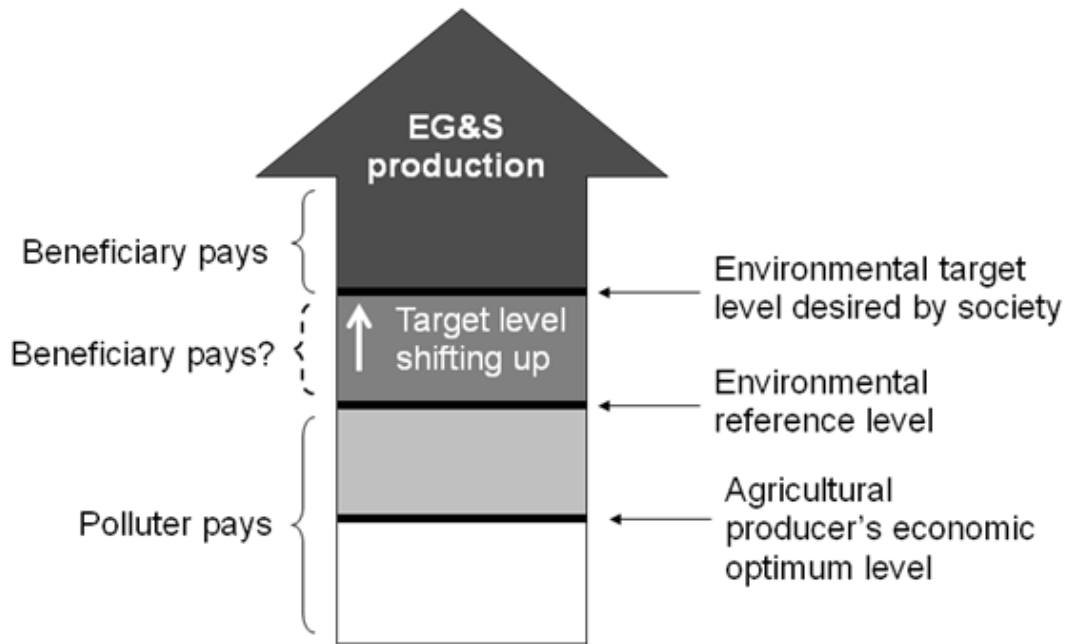
BMPs. For example, trees have been provided, free of charge, for agricultural landowners to construct shelterbelts to reduce soil erosion and enhance snow retention (AAFC 2008). These practices have been developed to improve environmental conditions on agricultural land. In addition, education and technical assistance are offered to agricultural producers free of charge. Agri-environmental incentive programs infer implicitly that landowners have a right to compensation for providing social benefits by changing their practices or adopting new technology (Tovey 2008); transferring resources from the public to private landowners (MacIntosh and Denniss 2004). This is equivalent to incentive programs implying that the public has the responsibility to ensure that agricultural operations produce environmental benefits and prevent environmental harm.

Social expectations of the rights and responsibilities of agricultural landowners are reflected in environmental reference levels, enforced or promoted through regulations and agri-environmental programs. The reference level is defined by the obligations agricultural producers have to provide environmental quality at their own expense (OECD 2010). The environmental reference level for water quality in Canada is low. There are some restrictions on practices that can impact water quality; for example, setback requirements for pesticide application and manure handling and storage, however water quality is managed through guidelines rather than standards and these are often exceeded (AAFC 2011; Environment Canada 2010).

Environmental reference levels may not accurately represent the social demand for the provision of EG&S; however, and the OECD (2010) describes an "environmental target level" that may be higher than the reference level and represents society's preferences for environmental quality. The environmental target level will change with shifting social norms and values and the corresponding demand for environmental benefits from agriculture (OECD 2010).

Two principles for responsibility emerge from environmental reference and target levels: the 'polluter pays' principle applies below the reference level; and the 'beneficiary pays' principle applies above it (Figure 3-1). The polluter pays principle was first articulated by the OECD in 1972 and in 1990 it was applied by the OECD as an important principle in agricultural policy (OECD 2010). The principle is based on the notion that polluters should bear the cost of preventing or mitigating environmental damage to ensure the environment is maintained in an

acceptable state (OECD 1972). The beneficiary pays principle is warranted where society desires environmental benefits from agriculture beyond the demand for reduction of harm caused by agricultural activities (Grossman 2007). This concept has also been described and further developed in a Canadian climate change adaptation report directed toward policy options for agricultural producers (Eco Resources and International Institute for Sustainable Development 2010).



**Figure 3-1.** The polluter pays and beneficiary pays principles for changing social expectations of EG&S production by agricultural producers. Adapted from the Organization for Economic Cooperation and Development (2010) .

This study is based on a “social process” view of property rights; that is, property rights change over time (Gosnell and Travis 2005; Macpherson 1978). Based on this view of property rights, agricultural landowners’ practices, and the agri-environmental policy that guides them, will need to adapt to society’s perceptions of acceptable practices. The success of a new agri-environmental policy approaches, including performance-based approaches, can be impacted by society’s perceptions of the scope of property rights of agricultural landowners, and whether the policies conform to society’s views (Davies and Hodge 2006). The perception of legitimacy of the new policy approaches by agricultural landowners will potentially increase adherence (or compliance) to the policy and motivation in relation to the aim of the policy.

### **3.1.2 Social norms and values in southwest Alberta**

Efforts have been made to understand the motivations of agricultural producers in adopting BMPs (Banack and Hvenegaard 2010), and barriers to their adoption in Alberta (Alberta Research Council 2006). While these studies are important for the advancement of practice-based programs, they do not provide the needed guidance in the development of a progressive, cost-effective performance-based policy. There appears to be no recent literature that provides an understanding of current perceptions of agricultural property rights in Alberta. Before new policy approaches are implemented that have the potential to alter agricultural property rights (e.g., limit the rights producers have to release pollutants into water bodies) the social norms and values of the region should be examined for compatibility with the principles of the policy approach (Davies and Hodge 2006; Lejano et al. 2007). This study examines if and how values differ between agricultural producers and the public, as well as how perceptions align with current policy and potential performance-based approaches.

The perception of property rights and responsibilities of agricultural landowners from the viewpoints of agricultural landowners, rural residents and urban residents in southwest Alberta was investigated. The objective was to assess the potential to implement performance-based agri-environmental policy instruments by evaluating the prevailing perspectives of water quality stakeholders related to: 1) responsibility for effects of agricultural activities on the environment; 2) agricultural property rights and responsibilities; and 3) preferences for policy approaches.

## **3.2 Methods**

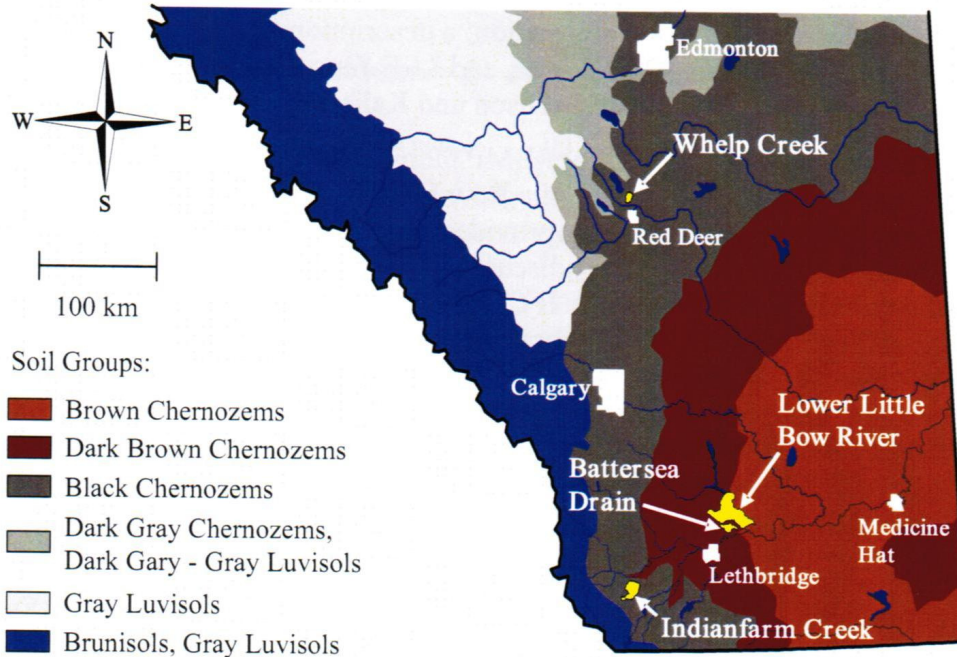
### **3.2.1 Study site description**

Opinions of agricultural landowners representing the range of agricultural activities in Alberta were solicited regarding water quality and agri-environmental policy. To obtain the perspectives of agricultural producers for a wide variety of management activities, three watersheds were included in this study. The main study site was the Indianfarm Creek Watershed in southwest Alberta, situated within the foothills fescue subregion in the Black Chernozem soil zone (Figure 3-2). The area of the watershed is approximately 14,500 ha (Olson and Kalischuk 2008) and all

land is privately owned except for 65 ha of leased Crown land. This watershed was chosen because it represents a range of agricultural activities: native and tame pasture, annual and perennial crops and livestock production. Though it is a relatively small watershed, there are two distinct regions where activities differ: the upper reaches of Indianfarm Creek are in the foothills of the Rocky Mountains where the area is used primarily for pasture and tame hay, along with some annual crops and one feedlot; the lower region is dominated by annual crops and livestock operations including beef cattle confined feeding operations, cow-calf production, and one dairy. The primary land uses in the watershed are annual crops (40%), pasture (44%) and confined feedlot operations (CFOs) (8%) (Olson and Kalischuk 2008).

Additionally, the Indianfarm Creek watershed was chosen because of existing water quality concerns. Water tends to flow heavily in spring from snowmelt, during and after rain events, and significant flows can also be triggered by releases from a dam built near the top of the watershed. These intermittent flows result in stream bank erosion, which results in sedimentation and reduction of water quality. Water quality monitoring data indicate that during particular times of the year fecal coliform, nitrogen, and phosphorus levels are substantially higher than water quality guidelines recommend (Olson and Kalischuk 2008). Alberta Agriculture and Rural Development (AARD) reported that total phosphorus and total nitrogen values in the creek in 2007 averaged  $0.16 \text{ mg L}^{-1}$  and  $1.68 \text{ mg L}^{-1}$ , respectively. These concentrations are 3 and 1.6 times higher than the provincial guidelines for the protection of aquatic life (Science and Standards Branch 1999). In addition, fecal coliform bacteria concentrations exceeded the recommendations for irrigation water quality during high flow periods after rain events, at snowmelt, and at a few monitoring sites during base flow (Olson and Kalischuk 2008). Average total coliforms were three times higher than the guideline of  $1000 \text{ cfu } 100 \text{ mL}^{-1}$  (Olson and Kalischuk 2009). Fecal coliforms, including *Escherichia coli* (*E. coli*), originate from manure sources and can cause disease in animals and humans.

Finally, the Indianfarm Creek watershed was a good fit for the current research since AARD is performing a study in the watershed to quantify the impacts of BMPs on water quality. The agency has developed relationships with many of the agricultural landowners in the watershed



**Figure 3-2.** Location of Indianfarm Creek, Batterssea Drain and Whelp Creek watersheds in Alberta (Source: Alberta Agriculture and Rural Development. Used with permission).

and provided access to them through advertising in their newsletter and attendance at field days and watershed meetings.

Two additional watersheds were included to obtain a more complete representation of agricultural landowner attitudes within this region. These watersheds, Batterssea Drain and Whelp Creek (Figure 3-2), were chosen for two reasons. First, they included agricultural activities not found in Indianfarm Creek watershed. Second, AARD was actively working within these watersheds on the same project as in Indianfarm Creek Watershed. AARD facilitated access to watershed residents with contact information where possible, and promoted this study through their watershed newsletters that were distributed to all landowners in all three watersheds.

The Batterssea Drain is part of an area of southern Alberta known as ‘Feedlot Alley’, with a high concentration of livestock (over 1 million) in a 500km<sup>2</sup> area (Environment Canada 2010). All

land in this watershed is privately owned. This watershed is situated 25 km north of the city of Lethbridge in the mixed grass subregion and has brown to Dark-Brown Chernozemic soils (Figure 3-2). The main agricultural activities within Battersea Drain are confined feeding operations for beef cattle and annual, irrigated cropping (Rodvang 2009). Fecal coliform concentrations are of particular concern in this watershed (Acharya et al. 2008), due in part to the high quantities of manure produced and applied to crop land and to the high incidence of gastroenteritis from fecal bacteria (Johnson et al. 2003). Fecal coliform concentrations in Battersea Drain were measured over three years from 1998-2000 and levels in surface water were found to be more than double the provincial guidelines for the protection of aquatic life in 30% of the samples (Hyland et al. 2003).

The Whelp Creek watershed has an area of approximately 4500 ha, with 1% of the area occupied by Crown land. It is located 6 km west of the town of Lacombe, in the black soil zone and the central parkland subregion of central Alberta (Figure 3-2). This watershed is approximately 400 km north of the Indianfarm Creek Watershed and the Battersea Drain. The watershed supports a variety of agricultural activities, but is also used by other industries. Land is used mainly for annual grain and forage crops, with some hog and dairy production. There is a strong oil and gas industry presence, and the eastern part of the watershed has been zoned for industrial development (Olson and Kalischuk 2009).

### **3.2.2 Data collection**

Interviews and surveys were used to collect the opinions of residents in the three watersheds, and other residents of southern Alberta regarding agricultural landowner rights and responsibilities for water quality. These instruments were approved by the University of Saskatchewan Ethics Review Board. Questions posed to respondents, whether through interview or survey, were identical. Interviews were used in the watersheds to gain additional information about agricultural practices, participation in agri-environmental programs, and motivations for participation or reasons for non-participation in those programs. For the broader societal opinions, interviews were not a feasible method to collect respondent views, so surveys were used in selected southern Alberta communities to obtain urban and rural perspectives. Stratified

sampling was used to select communities at varying distances from the Indianfarm Creek Watershed, and stratified random sampling (using a random number generator) was used to select postal codes within the city of Lethbridge to, as accurately as possible, represent the three main regions of the city.

Respondents were divided into three groups for comparisons: 1) agricultural producers (watershed residents plus survey respondents who identified themselves as producers); 2) rural residents (respondents from the five rural communities that did not identify themselves as producers); and 3) urban residents (all respondents from Lethbridge that did not identify themselves as producers). This approach was used to investigate potential differences between groups at varying social distances from agricultural activities (Boulanger et al. 2004; cited in Vera-Toscano et al. 2007), although Vera-Toscano et al. (2007) found that geography and dominance of agriculture in the region also played an important role in respondents' perceptions of agriculture, whether rural or urban.

### *Interviews*

All agricultural landowners in the three watersheds ( $N = 120$ ) were sent information about the study using the quarterly AARD watershed newsletter that provides watershed news and highlights upcoming events. Potential respondents were then contacted by mail with a letter outlining the study and requesting participation using comprehensive sampling (provided in Appendix A). Approximately two weeks after the letter was sent, phone requests were made for interviews. Thirty phone calls were answered or returned, and 19 interviews were conducted. Interviews were semi-structured allowing for specific questions to be asked of all respondents, but also providing opportunities for further discussion. Questions in the interview were focused primarily on eliciting attitudes towards participation in cost-sharing agri-environmental programs, experiences and attitudes toward these programs, measures undertaken to manage water quality without compensation, respondents' local knowledge of the watershed and water quality challenges, and individual farm characteristics (interview script provided in Appendix B).



### *Surveys*

The survey instrument was composed primarily of Likert scale questions, where respondents rated their degree of agreement with statements provided in the survey. Respondents were asked to provide their perceptions of local surface water quality, their concern for water quality, the responsibility that various groups held for water quality, their priorities regarding concerns that should be addressed by agri-environmental policy and preferences for policy instruments. Respondents were also asked to provide demographic information and voluntary additional comments (survey instrument provided in Appendix C). These questions were asked of all respondents. The questions were asked in interviews with watershed residents in Indianfarm Creek, Whelp Creek, and Battersea Drain watersheds, and asked by survey for all other respondents residing outside of the three watersheds. Surveys were mailed with a description of the research project, consent form and postage-paid return envelope by unaddressed mail using Canada Post for distribution to all potential participants.

The survey was pre-tested with a sample of ten individuals: five university students and five people from a variety of occupations, including agricultural production. The survey was modified to accommodate uncertainties in language, structure and instructions that were revealed during this piloting process.

### **3.2.3 Sampling**

Five communities were chosen at increasing distance from Indianfarm Creek Watershed, using stratified sampling of a list of communities between Indianfarm Creek Watershed and the city of Lethbridge in southern Alberta. These communities, in order of increasing distance from the watershed, were: Brocket, Granum, Nobleford, Monarch and Shaughnessy. They are all located in close proximity to the Oldman River, to which Indianfarm Creek is a tributary. Brocket is a hamlet situated within the Piikani First Nation reserve, located adjacent to the watershed. The rest of the communities surveyed are small rural towns with agricultural activities occurring around them. The main agricultural activities that occur in this region range from extensive livestock production (mostly cattle) on native and tame pasture and crop production in the west (Brocket, Granum) to intensive confined livestock operations and feed production in the east

(Nobleford, Monarch and Shaughnessy) (Table 3-1). This range of agricultural activities is consistent with a change in soil type from Black Chernozem in the west to Dark Brown Chernozem in the east (Figure 3-2) and average annual precipitation ranges from 515 mm in the west to 365 mm in the east (Environment Canada 2010).

**Table 3-1.** Characteristics of agricultural activities of municipalities where surveyed communities are located (data from 2006).

Municipality	Average farm size (ha)	Crops (% of total agricultural land)	Pasture	Irrigated land	Livestock (no. of head)
Pincher Creek (Brocket)	649	27	65	1	123,900
Willow Creek (Granum)	561	40	56	4	245,000
Lethbridge County (Nobleford, Monarch, Shaughnessy)	277	70	19	37	646,700
Source: Statistics Canada (2006)					

Each mailing address within selected communities received a survey to meet the research objective of collecting a broad range of rural opinions. The number of surveys sent to each community and response rates are reported in Table 3-2. No surveys were returned from Brockton. Canada Post confirmed distribution of the surveys to the community. Inquiries to a local authority regarding possible reasons for the lack of responses went unanswered.

Residents of the city of Lethbridge were included to provide a representative urban perspective, as Lethbridge draws water from the Oldman River for household use. Indianfarm Creek is a tributary of the Oldman River. Lethbridge is the largest urban centre in southern Alberta with a population of 95,200 (Statistics Canada 2006). Lethbridge developed as a coal-mining town in the mid-1800's; however, agriculture has become an important industry for the community since that time (Ellis 2001). Lethbridge has a university, a strong agricultural service sector and a federal agricultural research facility. Within Lethbridge, surveys were sent to each mailing address in a stratified random sample of postal codes that represented the three main districts in the city (north, south and west), representing approximately 7% of all households in the city.

### **3.2.4 Data analysis**

Principal components analysis was performed for exploratory data analysis to determine how respondents were grouped according to their priorities for water quality program outcomes; social, economic, and environmental. Principal components analysis was used to explain the variance in respondents' responses to a number of questions with a reduced number of components (Moran et al. 2007; Field 2005). Component coefficient scores, calculated for each respondent as part of the PCA, were plotted on axes that represented the two components to assess how priorities varied among and between groups at varying social distances from agriculture (Figure 3-7). The analysis was run using SPSS 18 (SPSS, Inc.) with a Varimax rotation with Kaiser Normalization and achieved convergence in three iterations (Field 2005; Moran et al. 2007). The Kaiser-Meyer-Olkin measure confirmed sampling adequacy with a reported statistic of 0.854. The PCA was run on non-normally distributed data; however, this analysis is considered acceptable for descriptive purposes (Jolliffe 2002).

The open-ended questions in the interviews and comments were evaluated to identify themes using content analysis (Gillham 2008). Comments provided by watershed residents in interviews and by survey respondents were queried and coded into categories describing commonalities called 'nodes'. Some of the nodes, such as reasons for and against participation in agri-environmental programs, were developed *a priori*. Others developed as content was reviewed. The software package NVivo 8 (QSR International, Inc.) was used for this analysis.

## **3.3 Results**

### **3.3.1 Response rates**

The response rate varied between 8 and 13% for most locations, with a total of 19 interviews conducted and 249 completed surveys returned (Table 3-2).

**Table 3-2.** Survey and interview response rates

Location	Number of surveys delivered	Number of responses	Response rate (%)	Proportion of total responses (%)
Watersheds <sup>1</sup>	120 <sup>2</sup>	19	16	6
Brocket	228	0	0	0
Granum	190	17	9	7
Monarch	156	20	13	8
Nobleford	293	27	9	10
Shaughnessy	134	11	8	4
Lethbridge	2260	174	8	66
<sup>1</sup> Includes interviewees from Indianfarm Creek ( <i>n</i> =15), Whelp Creek ( <i>n</i> =1) and Battersea Drain ( <i>n</i> =3) watersheds				
<sup>2</sup> Number of residents contacted by mail in all three watersheds				

There was a very low response rate from the Whelp Creek watershed (Table 3-2). The contact with this watershed was unavoidably delayed for three months between delivery of invitation letters and calling for interviews. When phone calls were made, many went unanswered and landowners who answered the phone often were unable to recall the letter sent out. The lone respondent from Whelp Creek stated, at the end of the interview, that there had been many inquiries from government, students and the oil and gas industry for information and that he was tired of being asked to take time to answer questions. The combination of interview fatigue and confusion around previous information sent out resulted in a decision that sufficient data were obtained from other watersheds at that point, and no further contact was made with Whelp Creek watershed residents.

Characteristics of the sample population were compared to characteristics of the provincial population based on the 2006 census of Alberta to determine how representative the study sample population was of the provincial population. The sample population had an underrepresentation of 18-45 year olds and overrepresentation of 46-75 year olds, with an average difference in proportion of 40%. The same comparison was made for occupations of respondents. General groups of occupations were created, as some occupation descriptions provided by respondents were difficult to assess and the proportion of Albertans that consider themselves retired is not provided by Statistics Canada. Given these limitations, the agriculture and resource-based industries were overrepresented, as were the health care and education industries.

When survey response demographic proportions were compared to the community census data<sup>3</sup>, 18-25 year olds were consistently under-represented and 46-65 year olds were over-represented. There were instances where occupations were highly over-represented, such as in health care in Monarch, education in Nobleford, and construction in Shaughnessy (more than quadruple the census proportion in all cases). In general, agricultural and natural-resource based occupations were over-represented by the highest margin (average of triple the census proportion across communities) (Statistics Canada 2006). The over-representation of agricultural producers may have created a bias in favour of the dominant agricultural perspective; however, respondent groups were divided by social distance from agriculture, so perspectives of rural and urban residents with no agricultural affiliation were represented.

**Table 3-3.** Survey questions and responses grouped by agricultural producers (n = 52), rural residents (n = 50) and urban residents (n = 166).

Question	Median response		
	Ag. producers	Rural	Urban
1. Rate surface water quality in your area (Scale: 1-7 <sup>1</sup> )	<b>5.5(±0.2)</b> <sup>7</sup>	<b>4(±0.4)</b>	<b>5(±0.1)</b>
2. Rate your concern for water quality (Scale: 1-7 <sup>2</sup> )	<b>6(±0.2)</b>	<b>6(±0.2)</b>	<b>6(±0.1)</b>
3. How much do groups benefit from changing agricultural practices to improve water quality? (Scale: 1-4 <sup>3</sup> )			
General public	<b>4(±0.2)</b>	<b>4(±0.2)</b>	<b>4(0)</b>
The producer that adopts the practice	<b>4(±0.2)</b>	<b>3.5(±0.2)</b>	<b>4(±0.1)</b>
Those downstream from the producer	<b>4(0)</b>	<b>4(0)</b>	<b>4(0)</b>
4. Who should be responsible for ensuring water quality is at an acceptable level on agricultural landscapes? (Scale: 1-4 <sup>4</sup> )			
Governments	<b>3 (±0.2)</b>	<b>4(0)</b>	<b>4(0)</b>
Agricultural landowners	<b>4(0)</b>	<b>4(0)</b>	<b>4(0)</b>
Non-governmental organizations	<b>2(±0.2)</b>	<b>3(±0.2)</b>	<b>3(0)</b>
General public	<b>3(±0.2)</b>	<b>3(±0.2)</b>	<b>3(0)</b>
5. Rate statements based on your feeling about them (Scale: 1-7 <sup>5</sup> )			
Governments should create water quality programs for agricultural producers	<b>6(±0.2)</b>	<b>6(±0.2)</b>	<b>6(±0.1)</b>
Producers are stewards of the land	<b>7(±0.2)</b>	<b>7(±0.2)</b>	<b>7(±0.1)</b>
Producers are responsible for the environmental effects of their practices	<b>6(±0.2)</b>	<b>7(±0.2)</b>	<b>7(0)</b>
Public should pay producers based on the degree of water quality improvement	<b>5(0)</b>	<b>5(±0.2)</b>	<b>5(±0.1)</b>

<sup>3</sup> Community census data were available for Granum, Nobleford, and Lethbridge. For the communities of Monarch and Shaughnessy, Lethbridge county census data were used.

Producers should be able to choose whether they participate in programs	5(±0.2)	3(±0.7)	3(±0.1)
Producers have the right to use any practice they want	2(±0.2)	2(±0.2)	2(0)
My taxes should not be increased to pay for EG&S	5(±0.4)	5(±0.4)	4(±0.1)
Public should pay more for food produced in a way where EG&S are also produced	5(±0.4)	4(±0.7)	4(±0.1)
Good actors should not be paid	5(±0.2)	4(±0.2)	4(±0.1)
Producers should be paid for EG&S, regardless of whether costs were incurred or not	5(±0.2)	5(±0.4)	4(0)
<b>6. Rate list of characteristics for their importance as a priority focus of agricultural programs (Scale: 0-10<sup>6</sup>)</b>			
Financial incentives	8(±0.7)	7(±0.7)	7(±0.4)
Survival of rural communities	8(±0.8)	8(±0.7)	8(±0.4)
Water quality for animals and aquatic life	9(±0.5)	10(±0.4)	10(±0.2)
Human health risk decreased	10(±0.2)	10(±0.2)	10(±0.1)
Lowest cost to taxpayers	6(±0.9)	6(±0.7)	7(±0.6)
No negative financial impact to producers	7.5(±1.1)	7(±0.9)	7(±0.5)
Most environmental benefit with least cost	9(±0.7)	10(±0.4)	9(±0.4)
All producers should be eligible	9(±0.4)	10(±0.7)	9(±0.4)
Water quality for recreation	8(±0.7)	8(±0.7)	8(±0.4)
Sustaining quality for future generations	9(±0.4)	10(±0.2)	10(0)
Explanation of rating scales:			
<sup>1</sup> 1 = Very poor ...7 = very good			
<sup>2</sup> 1 = Completely unconcerned ...7 = very concerned			
<sup>3</sup> 1 = No benefit, 2 = benefit somewhat, 3 = benefit moderately, 4 = benefit significantly			
<sup>4</sup> 1 = Not responsible at all, 2 = somewhat responsible, 3 = moderately responsible, 4 = very responsible			
<sup>5</sup> 1 = Strongly disagree... 7 = strongly agree			
<sup>6</sup> Number of points given to each item indicated its importance (0 = not important at all...10 = extremely important)			
<sup>7</sup> 95% confidence interval for the median. The 95% confidence interval for the median is a distribution free statistic. It is derived as follows using the difference between the 25th and 75th percentile, or Tukey's upper and lower hinges (H-spread): median +/- (1.58 x (H-spread)/sqrt n) (Velleman and Hoaglin 1981)			

### 3.3.2 Water quality perceptions

Agricultural producers and urban residents felt that surface water quality in the area was 'somewhat good', while rural residents gave water quality a lower 'neutral' rating (Table 3-3). A nonparametric independent samples Kruskal Wallis test (Chi square = 8.3, df = 2, sig = 0.016) confirmed a significant difference (at the 95% confidence level) among ratings of water quality. Further investigation of how individual communities rated water quality showed that respondents

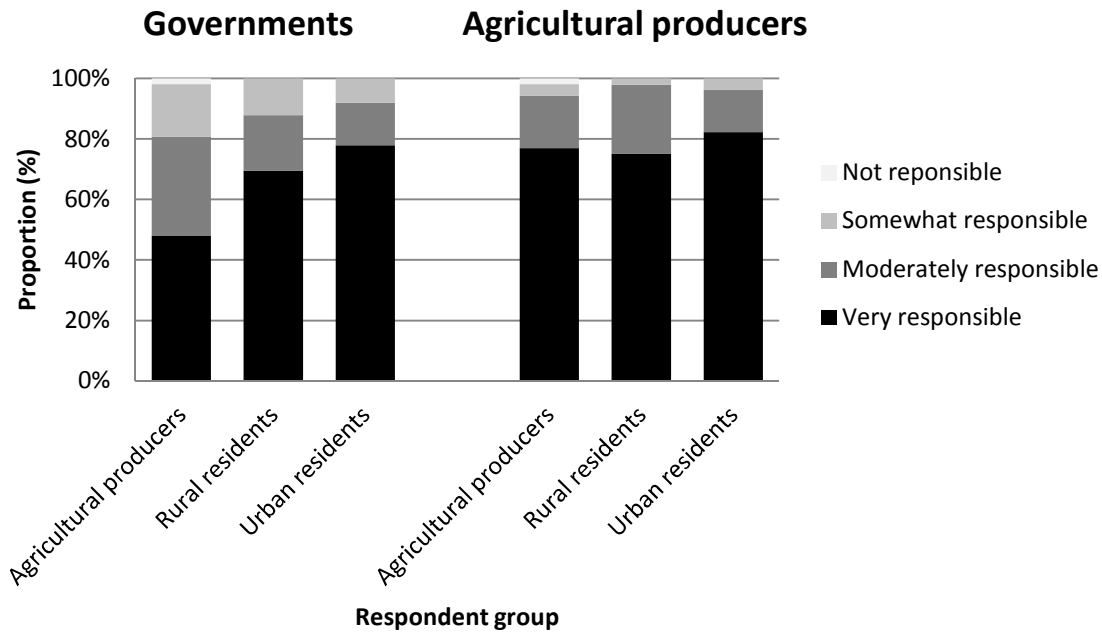
from the rural community of Shaughnessy rated water quality the poorest (median rating was ‘somewhat poor’, while the median rating at other locations was ‘good’).

Respondents made a number of additional comments related to agricultural practices and their effect on water quality. Some ( $n = 10$ ) thought that confined livestock operations (CLOs) were a major source of pollution, while others ( $n = 4$ ) made specific comments about extensive cattle grazing and stream contamination. The high degree of concern about CLOs may be related to the proximity of most respondents to ‘Feedlot Alley’. The comments related to cattle in streams were mostly first-hand accounts of events witnessed by the respondent. Though a few of the respondents relayed personal experiences, most comments related to CLOs and other industrial contaminants made reference to acquiring the information from second-hand sources (e.g., media sources). Ten respondents identified other industries as more significant sources of water contamination (e.g., the oil and gas industry, coal mining, golf courses and users of household chemicals).

### **3.3.3 Responsibility and property rights**

Many ratings related to perceptions about responsibility of ensuring adequate water quality were similar between groups. For example, all groups agreed that agricultural producers and governments hold the greatest responsibility for water quality on agricultural lands, followed by the public and non-governmental organizations (Table 3-3). However, agricultural producers were less willing to give governments a ‘very responsible’ rating than other groups (Figure 3-3) and indicated a lower expected degree of responsibility by governments than rural or urban residents (Table 3-3). Almost all (98%) agricultural producers acknowledged the need for government involvement at some level, and nearly 40% of interview respondents made a comment in support of governments acting as an authority to oversee water quality. Interview respondents identified establishing standards as important for controlling abuse of the watershed. Several survey and interview respondents (interview  $n = 5$ ; survey  $n = 13$ ) made comments that if governments expected improvements beyond a minimum standard, there should be a compensation mechanism. One producer noted that giving governments responsibility did not mean that they had the right to dictate management decisions for producers (what he termed

“over-legislating”). The reluctance to involve government in agri-environmental matters by agricultural producers was reinforced by respondent comments. For example, one producer commented that he made management decisions related to the environment that were “common sense”, and that he did not need the government to give him money for that purpose.



**Figure 3-3.** Perceived responsibility of governments and agricultural producers for water quality by respondent group. Agricultural producers  $n = 52$ ; Rural residents  $n = 50$ ; Urban residents  $n = 166$ .

Agricultural producers were generally willing to accept responsibility for the environmental effects of the management practices they use, but ranked their level of responsibility lower than other groups did (Table 3-3). Most also felt that they should not be able to use whatever management practice they want, preferring instead that a condition be placed on producers to adhere to a certain standard. This belief was shared among respondents from all groups where the suggestion was made that agricultural producers must use “appropriate” or “good” management practices and as long as that condition is satisfied, they can choose their practices. Approximately 50% of watershed interview respondents provided comments concerning using ‘proper’ management. Comments were made in the surveys (rural  $n = 3$  ; urban  $n = 10$ )



suggesting that bad practices be penalized and good practices rewarded, and that there should be standards in place to ensure water quality is not degraded by agricultural practices.

Statements made by interview respondents around property rights indicated that respondents were strongly in favour of maintaining the exclusive set of property rights currently upheld. One producer commented that "landowners should have the freedom to manage". Other statements related to property rights included: "farmers own the land", "farmers should be rewarded for good management", "ranchers should receive rewards for not polluting", and "if people like things a certain way, they should pay".

Society's willingness to recognize landowners' rights to manage the land as they see fit was addressed by asking respondents whether agricultural landowners should be able to use whatever management practice they want. No group felt that producers should be unrestricted in their management decisions, but rural and urban groups were neutral on the topic of whether agricultural programs should be voluntary, while agricultural producers were in greater favour (Table 3-3). There was a lot of variation around the rural response to this question, indicating a lack of consensus on the issue (Noble 2004). Some interview respondents ( $n = 3$ ) commented that regulations would not work, as enforcement would be too difficult, while others ( $n = 7$ ) thought 'bad' farmers should be regulated, but again, only to a reasonable standard. Several rural and urban respondents agreed that regulation was necessary; 48% of rural respondents and 42% of urban respondents indicated that they disagreed or strongly disagreed with environmental programs remaining voluntary for agricultural producers. Comments made by rural and urban respondents indicated stances in agreement and in opposition of the idea of increasing regulation in the interest of environmental quality. One respondent from the community of Monarch stated "no one has the 'right' to poison my water". Seven other comments were made that referenced regulation as acceptable. Many emotional written comments related to water quality were made within the surveys, demonstrating the importance of the water quality issue to southern Albertans:

"The water [is] being contaminated with no thought, other than profit!" (4L)

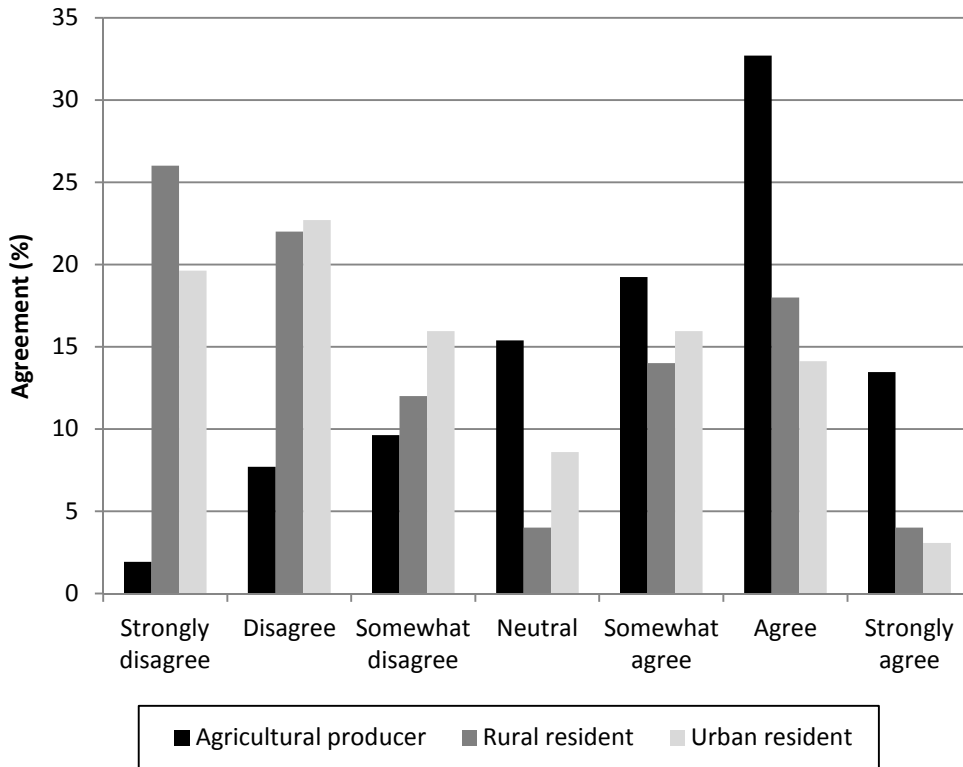
“The people on this planet right now who have the most influence on the water quality don’t care what condition they are leaving the water in for their grand children!” (5S)

“While I recognize there will be a financial cost in implementing any program, I do not feel programs and policies on something as essential as water should be limited or guided, first and foremost, by cost. The bigger cost would be the loss or contamination of vital resources for years or generations to come. We are ethically responsible for our planet’s health!” (23L)

“Water is one of our most important natural resources. Taking care of it should be top priority! It should not become a dumping ground for garbage and harmful chemicals. We have a new generation of children to inherit our earth and let’s hope it’s worth inheriting.” (53L)

Despite the high degree of concern expressed by some respondents, there was an equivalent number of responses that favoured voluntary measures (such as incentives and providing education to producers) to responses favouring regulation. Overall, agricultural producers rated maintaining voluntary participation in agri-environmental programs significantly more favourably than rural and urban respondents (Figure 3-4).

Several watershed residents ( $n = 7$ ) indicated in specific comments that they did not agree that the public should have the capacity to influence local agricultural policy. Two respondents commented that the public should not dictate or be consulted about agricultural policy. Another respondent stated that "if they are going to complain (be whistleblowers or police agriculture), then they have responsibility to ensure good water quality". There seemed to be a strong feeling of public misunderstanding about agricultural practices. Interview respondents equated giving the public responsibility for making policy decisions with giving them a right to demand how agriculture is practiced. All of these statements indicate that the watershed residents feel very strongly about their property rights and are unwilling to give up any of their perceived rights to manage the land.



**Figure 3-4.** Respondent ratings by group for maintaining the voluntary nature of agri-environmental programs. Agricultural producers  $n = 52$ ; Rural residents  $n = 50$ ; Urban residents  $n = 166$ .

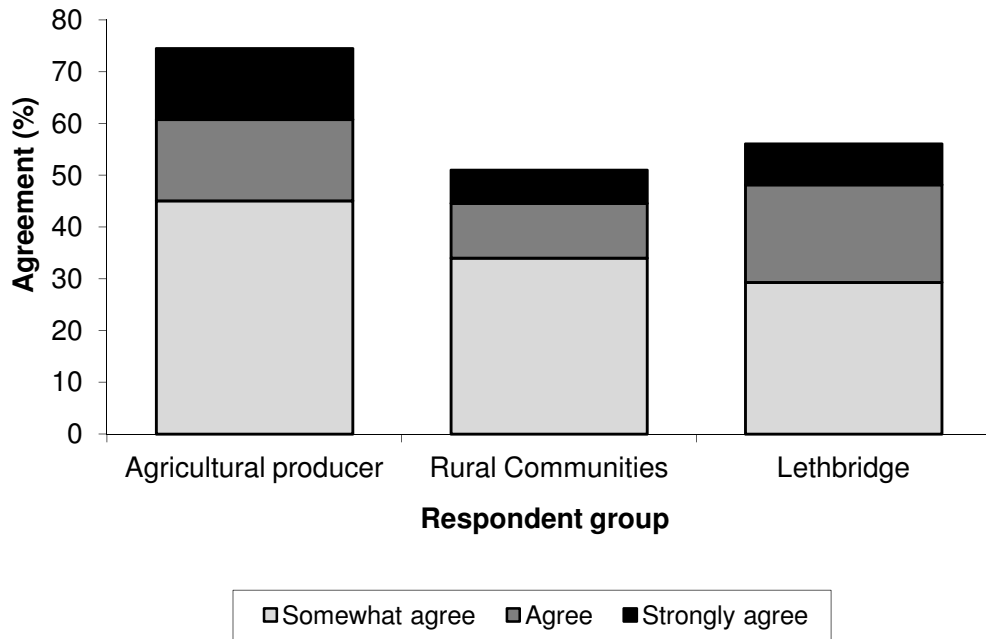
### 3.3.4 Policy and programs for agricultural producers

A number of options around payments for EG&S (particularly those pertaining to water quality) were proposed to respondents including higher food prices, increases in public taxes to pay for improvements and a range of questions about the structure of a payment program. Median responses were generally in the neutral range for several of these mechanisms, including tax increases and higher food prices (Table 3-3). This was an unexpected response, and further investigation revealed that the number of respondents who agreed and disagreed with tax increases was equivalent, with few ambivalent respondents. However, increased food prices generated little support or opposition, with most responses in the range of ‘somewhat disagree’ to ‘somewhat agree’. Urban respondents were less willing to pay more for food, and agricultural producers tended to agree with price increases, while rural residents showed more variation in

their responses as indicated by the larger confidence interval (Table 3-3). In comments provided by interviewees, watershed residents commented about food prices, stating that food prices do not reflect the true cost of food and that profit margins are small for small farms. Some specific comments were also made by survey respondents about the possibility of increased food prices. Most respondents that commented on this mechanism thought that food prices were already high, but a few suggested that we pay much less than many other countries for groceries.

There was support for a performance-based program, such as payments for EG&S. Agricultural producers were the group most in favour of this type of policy instrument, though their level of approval for it was less than for practice-based incentive programs (Table 3-3). The distribution of ratings for performance-based payments shows that 75% of agricultural producers agreed to some degree, while 55% of rural respondents and 60% of urban respondents agreed (Figure 3-5). Respondents from all groups commented that this type of payment structure was unlikely to work. This sentiment may have resulted in the cautious agreement to this mechanism. Many interviewees commented that this type of program would be nice, but was not feasible. The main concerns about this type of program were difficulty in measuring water quality output and monitoring and enforcement.

A final policy question focused on the problem of the good actor; that is, agricultural producers who have independently made improvements to their land and management practices that positively affect water quality without compensation. Overall, respondents felt neutral or somewhat agreed that good actors should not be paid for actions in the past, and surprisingly, agricultural producers agreed more strongly than other groups for not paying good actors (Table 3-3). Where additional comments were made, some suggested specific time periods for retroactive payments. Many of the watershed residents interviewed indicated that the cost of paying good actors was too great and therefore not feasible. This viewpoint from watershed residents is interesting, as approximately 80% of them reported that they have made changes to their operations without financial assistance (i.e., they are good actors).



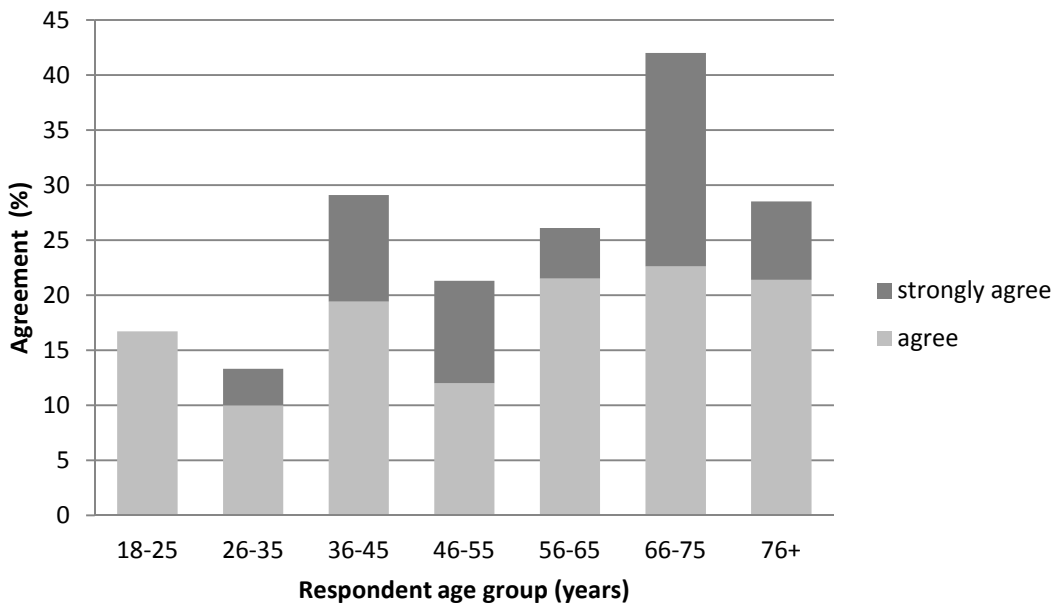
**Figure 3-5.** Response distribution related to whether performance-based payments should be provided for ecological goods and services, by respondent group.

In general, urban and rural residents did not display a strong opinion on most policy instruments proposed by the survey. This is unlikely a result of a lack of concern for water quality, as over 80% of both groups indicated they were at least ‘somewhat concerned’ about water quality.

### 3.3.5 Age trends

Frequency of responses were divided by age to gain some insight into how differing age groups perceive agricultural responsibility, rights, and water quality and potential trends in future social norms and values. The results show some important differences among groups. Respondents between the ages of 18 and 35 years were more likely than any other age group to strongly agree that governments should create environmental programs for agricultural producers, though the difference between young and older respondent groups diminished when ratings included ‘somewhat agree’ and ‘agree’. The same group of respondents were generally less likely than other age groups to agree that agricultural producers should be able to choose whether to participate in government programs, and were less likely than other age groups to rate agricultural producers as stewards of the land. Respondents between the ages of 18-35 also perceive the public to be less responsible for water quality on agricultural lands than older

respondents; however, government responsibility for the same was equivalent across age groups. This may indicate decreasing trust in agricultural producers to maintain an acceptable production level of EG&S by younger generations and an increasing acceptance of regulatory methods to manage water quality on agricultural landscapes by the same age group. This possibility is further strengthened by a decrease in the willingness to pay agricultural producers incremental payments for improving water quality by 18-35 year olds (Figure 3-6).



**Figure 3-6.** Proportion of each age group that agreed or strongly agreed with the notion of paying agricultural producers based on the degree of water quality improvement achieved (incremental payments).

### 3.3.6 Policy priorities

Respondents were asked to rate the importance of a variety of economic, ecological and social priorities for agri-environmental policy. Social priorities, such as sustaining rural communities and ensuring water quality for future generations, were ranked the most important by all groups, followed closely by cost-effectiveness of the program. Financial incentives were ranked higher by agricultural producers than other respondents (Table 3-3). All groups seemed to accept that some negative financial impact could occur to agricultural producers that participate in agri-environmental programs, as this characteristic was ranked near the bottom of the list of priorities.

Respondents from all groups also acknowledged that implementing programs at the lowest possible cost to the taxpayer was not an important priority in relation to the other characteristics presented (Table 3-3).

### **3.3.6.1 Respondent groupings based on policy priorities**

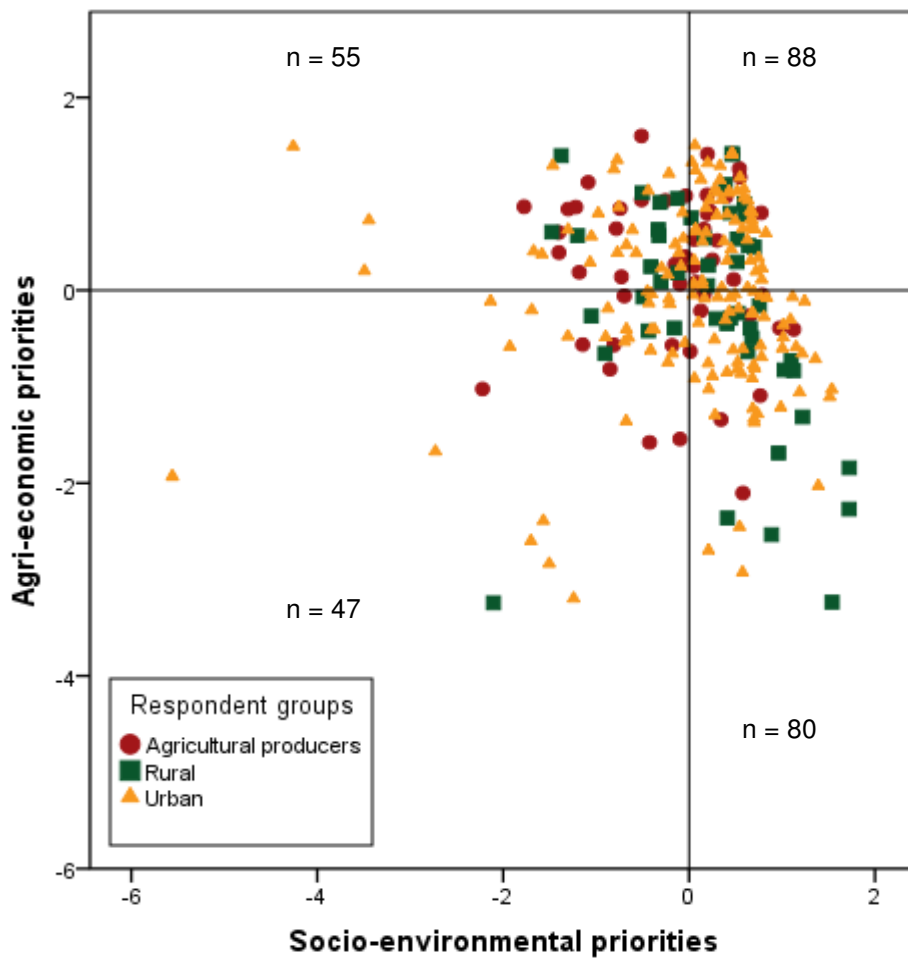
Social, economic and environmental priorities of respondents related to agri-environmental programs (variable  $n = 10$ ) given in Table 3-3 were used to create groups of respondents defined by their priorities using principal components analysis (PCA). A PCA reduces the number of variables needed to describe respondents using variance in variable values around theoretical means (components) applied to the data (Field 2005; Moran et al. 2007). In the present study the respondents could be described by two components: those who valued social and ecological priorities more highly (referred to as the socio-ecological group hereafter) and those who valued agricultural property rights and economic priorities more highly (referred to as the agri-economic group hereafter). The PCA was performed for two reasons: 1) to understand the balance of priorities of the respondents; and 2) to examine the demographics of each quadrant to identify trends in age, occupation, location and perspectives on water quality.

Two components were identified that explained 58% of the response variance. The addition of another component only improved the explained variance by nine percent and therefore was not included. The components, and the variance of each variable explained by each component (using a cut-off of 40% of variance) is shown in Table 3-4. Some variables, such as 'human health risk decreased' were strongly oriented within one component, while others, such as 'survival of rural communities', were described almost equally by both components.

When assessing individual scores for each component, the further from the mean in a positive direction, the more strongly the respondent felt about one or both sets of priorities. The further from the mean in a negative direction, the less strongly the respondent felt. More respondents fell within the upper right quadrant, which indicates that they felt strongly about both sets of priorities (Figure 3-7).

**Table 3-4.** Component matrix (rotated) for Principal Component Analysis using policy priority rankings

Variable	Socio-environmental component	Agri-economic component
Financial incentives		0.67
Survival of rural communities	0.40	0.55
Water quality for animals and aquatic life	0.83	
Human health risk decreased	0.84	
Lowest cost to taxpayers		0.68
No negative financial impact to producers		0.86
Most environmental benefit with least cost	0.49	0.55
All producers should be eligible	0.44	0.53
Water quality for recreation	0.66	
Sustaining quality for future generations	0.74	



**Figure 3-7.** Principal components analysis coefficient scores for respondents. The line of origin represents the mean coefficient score for each component.



The demographics of each quadrant are reported in Tables 3-5,3-6. For the upper right quadrant, where multiple priorities were important (n=88), the proportions of respondents from each community, age group and job type were similar to the demographic proportions of all respondents as a whole. However, the group had the lowest proportion of farmers and ranchers of any group identified (Table 3-5). The upper left quadrant (the agri-economic group) (n=55) had significantly higher proportions of farmers and ranchers and less urban residents than the total respondent population. A comparison of occupations showed that the proportion of retirees was somewhat lower for this group as well (Table 3-6). The lower right quadrant (the socio-environmental group) (n=80) was characterized by a lower proportion of farmers and ranchers, less respondents in the age group of 76+, more professionals and tradespeople and less respondents with jobs requiring no advanced training such as support roles. Finally, the lower left quadrant (n=47), where no priorities given were ranked highly (unidentified priorities), was characterized by more unemployed respondents (Table 3-6), and more respondents with children than for respondents as a whole (Table 3-5).

**Table 3-5.** Proportion of respondents in each priorities group and their family status

Group	Proportion of each group (%)				
	-----Respondent type-----			-----Family status-----	
	Farmer/Rancher	Rural resident	Urban resident	Has children	No children
Unidentified priorities	19	14	67	86	14
Agri-economic	33	20	47	67	33
Socio-environmental	12	22	65	78	23
Multiple priorities	18	16	66	76	24
<b>All respondents</b>	<b>19</b>	<b>19</b>	<b>62</b>	<b>76</b>	<b>24</b>

**Table 3-6.** Proportion of each priorities group by occupation

Group	Proportion of each group (%) by occupation						
	Retired	Student	Trades	Professional	Unemployed	Support position	Farmer/Rancher
Unidentified priorities	24	3	14	24	2	23	8
Agri-economic	10	4	11	24	0	24	17
Socio-environmental	21	4	24	33	0	12	7
Multiple priorities	23	3	14	27	1	30	4
<b>All respondents</b>	<b>22</b>	<b>3</b>	<b>16</b>	<b>28</b>	<b>1</b>	<b>22</b>	<b>8</b>

Further investigation of how concern for, and ratings of, water quality differed among groups also showed some differences (Table 3-7). The group with unidentified priorities were less likely than the overall sample population to rate water quality as 'good'. Interestingly, this group also had the highest proportion of respondents that were concerned about water quality in the region. Conversely, the group that ranked multiple priorities highly was more likely to rate water quality as 'good'. The socio-environmental group was significantly more likely to rate water quality as 'poor' than the overall sample population and had the highest proportion of any group to do so. The agri-economic group ratings of water quality reflected the overall sample population, but the level of concern about water quality expressed by this group was lower than the total sample (Table 3-7).

**Table 3-7.** Rating and concern about water quality by proportion of each priorities group

Group	Water quality rating		
	Poor <sup>1</sup>	Neutral	Good <sup>2</sup>
Unidentified priorities	29	15	48
Agri-economic	20	13	67
Socio-environmental	36	10	54
Multiple priorities	16	8	76
<b>All respondents</b>	<b>25</b>	<b>11</b>	<b>64</b>
Group	Concern for water quality		
	Unconcerned <sup>3</sup>	Neutral	Concerned <sup>4</sup>
Unidentified priorities	7	2	91
Agri-economic	19	11	70
Socio-environmental	8	4	89
Multiple priorities	10	5	85
<b>All respondents</b>	<b>11</b>	<b>5</b>	<b>84</b>
<sup>1</sup> Combined proportions of each group that rated water quality as very poor, poor, or somewhat poor			
<sup>2</sup> Combined proportions of each group that rated water quality as somewhat good, good, or very good			
<sup>3</sup> Combined proportions of each group that rated their concern for water quality as completely unconcerned, unconcerned, or somewhat unconcerned			
<sup>4</sup> Combined proportions of each group that rated their concern for water quality as somewhat concerned, concerned, or very concerned			

### **3.4 Discussion**

#### **3.4.1 Response rates**

The demographic differences between provincial statistical averages and respondents in the sample population for this study may have been a result of the method used in administering the survey. In addition, survey recipients who feel they have insufficient knowledge, or trouble reading the text are unlikely to return surveys (Rea and Parker 2005). This was expressed by three respondents who returned blank surveys with short notes explaining the reasons why the survey was not completed. Completion of surveys by those with strong opinion on the issue of water quality may have been more common.

Response rates for the survey portion of data collection were low. There are two potential reasons for these response rates: 1) the survey was sent as unaddressed mail, so it was a significant challenge to entice recipients to open the mail and read the contents; and 2) survey fatigue may have played a role, as the study region has been used by previous researchers. Unaddressed mail was the only viable option for the survey, as the quantity of surveys was large and there was strong concern that an internet-based survey would not be accessible to all targeted respondents. Several attempts were made to ensure survey recipients were aware of the nature of the survey from the envelope, including placing the University of Saskatchewan name and logo on the envelope and placing a short phrase in place of the address indicating that participation was requested for a short survey; however, the number of surveys that were undeliverable or delivered to vacant households cannot be determined. An additional consideration was made for the time of year the survey was administered; surveys and interviews were conducted during December and January when agricultural activities are less demanding compared to other times of the year.

Low response rates have been reported by other researchers in southern Alberta. Nicol et al. (2010) conducted telephone interviews with randomly selected farmers in southern Alberta in 2007 and achieved a response rate of 11.5%. Johnston et al. (2001) sent addressed mail surveys to irrigation districts in southern Alberta in 1998-99 and achieved a response rate of 36%. These

surveys, along with several government agencies and non-governmental organizations conducting research in the study area (Olson and Kalischuk 2008; AAFC 2008) may have led to survey respondent fatigue. Respondent fatigue leading to non-response is a documented survey research challenge. This problem may result from a number of potential sources: 1) past survey experiences where results were not shared (respondents felt that their opinions did not matter); 2) a large quantity of surveys requesting their participation in the past; and 3) past experiences with poorly-written surveys (Porter et al. 2004; Sinickas 2007). When non-respondents were questioned by researchers about their reason for not participating in a survey in the US targeted to college graduates from a variety of institutions, most indicated a lack of time or interest in the survey (Sosdian and Sharp 1980). Respondent fatigue was suggested by one interviewee and likely played a role in the low response rate achieved by this study. To reduce the risk of apathy for future survey attempts in the area, results were shared with all interview respondents and the survey respondents that provided contact information in order to receive a summary of findings. In addition, presentations were made to the government agency cooperating with this study and to the residents of the Indianfarm Creek Watershed, where most of the interviews were conducted at completion of data analysis in December 2010. Approximately one-third of the respondents attended the presentation in Indianfarm Creek Watershed.

Respondents rated water quality similarly, but when ratings were compared among rural communities, Shaughnessy residents rated water quality significantly lower than other communities did. When these results were presented to residents of the area, some suggested that this rating may have been related to a contaminated drinking water incident that occurred in the past and that residents of the area may be more inclined to rate water negatively for that reason. A media search confirmed a single contamination event in 1997 where residents of the town were advised to boil drinking water (Avram 1997). Stream water monitoring results show that bacterial contamination of the Oldman River, the source for drinking water in Shaughnessy, often exceeds water quality guidelines (Lorenz et al. 2008). The Oldman River receives return flow from irrigation water applied to the North Lethbridge Irrigation District and also receives runoff from surrounding fields which are high in phosphorus, a result of high manure application rates due to high density livestock production (Olson and Kalischuk 2008).

### **3.4.2 Balancing the polluter pays and beneficiary pays principles**

Willingness to pay for agricultural production of EG&S varied widely; however, a common theme identified in the results was a willingness to pay *only* for EG&S beyond an expected minimum standard of provision. There is an expectation that agricultural landowners will comply with providing the expected minimum standard of EG&S, and that the public will pay for EG&S produced beyond the minimum standard (OECD 2010). Thus, there are elements of the polluter pays principle, evident below the minimum standard, and of the beneficiary pays principle that applies above the standard.

The concept of a minimum standard of care, or reference level for good agricultural practices, is well-established in the literature (Claassen et al. 2001; OECD 1997). It has been applied through codes of practice in the European Union and through cross-compliance measures in the US (OECD 2010). Incorporating a minimum environmental standard or reference level may be socially acceptable, as respondents from all groups expressed a desire for this approach to agri-environmental policy. Further research is required to evaluate the appropriate level of EG&S provision, or specific practices, expected by the public to implement this approach to agri-environmental policy in Alberta.

The respondents generally adopted the polluter pays principle below the minimum standard, indicating that agricultural producers should internalize the costs of abating pollution to an acceptable level. This principle is widely applied in environmental policy, but is difficult to apply to agriculture due to the non-point source nature of agricultural impacts on water quality (Grossman 2007; OECD 2010).

The responses to questions related to rights and responsibilities indicate that agricultural producers, rural residents and urban residents share the opinion that producers do have a high degree of responsibility for the effects of their production methods on society and the environment. However, when changes to the perceived suite of property rights afforded to agricultural landowners was suggested, agricultural landowners exhibited strong opposition to any change that reduced these rights. Property rights are held in high regard by agricultural

landowners in this region, and challenges to those rights is strongly opposed by them (The Minister of Sustainable Resource Development 2011) . It may be that agricultural producers understood the question of ‘responsibility’ to indicate whether they were responsible landowners (i.e., good stewards). Whereas other respondents may have viewed the question to ask whether or not agricultural landowners should accept financial responsibility for the effects of production methods. The question of acceptability of regulation provides further evidence for this theory.

Regulation was generally considered acceptable to ensure minimum standards were maintained, and government involvement was recognized as being important to these program objectives. Calls for mandatory agricultural nonpoint source pollution have been made by researchers as well; Epp and Shortle (1985) criticize voluntary measures as inadequate and call for performance-based, mandatory programs based on modeling the impacts of practices on water quality. The use of regulatory standards compared to voluntary measures was modeled by Weaver et al. (1996), and the authors found that standards could be more efficient to promote improved environmental outputs; however, it was important to understand and account for differences in farm-level information. Agricultural producers however, were not enthusiastic about the possibility of regulatory measures to manage water quality. In their responses, agricultural producers tended to equate regulation with additional pressure, a loss of autonomy in their business and on their land, and further economic hardship. These findings are similar to findings from an assessment of Ontario farmers and participation in the Environmental Farm Plan program (Robinson 2006). Farmers from the study indicated that the threat of regulation spurred them to participate in the program in order to avoid further regulation

Respondents displayed ambivalence toward most policy instruments presented. A likely reason is that the public does not have well-formed opinions about, or knowledge of, water quality policy (Moran et al. 2007) and what their rights and responsibilities should be related to EG&S (Hall et al. 2004). Preferences however, can be inferred through the collective responses to the other questions posed in the surveys and interviews. Respondents’ opinions align with the foundations of some performance-based approaches. Cross-compliance and payment schemes for EG&S are potential policy approaches that have been implemented in other regions (Chapter 2) and that, in combination, may be appropriate for the area based on respondents' perceptions. Cross-

compliance sets an environmental standard that must be met in order to qualify for payments, and has been implemented in the United States to conserve highly erodible land (Claassen 2005). This approach is often used in combination with other instruments. Payments for EG&S can be administered in a variety of ways and most require that the public pay, in some capacity, based on environmental outcomes. This group of approaches may compliment cross-compliance when administered above the environmental standard. The views of respondents support these policy approaches as most expressed that payments to agricultural producers for the production of EG&S were acceptable. Water quality was a prominent concern for the majority of respondents from all groups, and particularly for those who reside near 'Feedlot Alley', indicating that payments for improvements to water quality in particular are warranted. Further research to assess the opportunities and barriers to implementing these policy approaches is required to fully understand the potential of cross-compliance and/or a payment scheme for the region.

### **3.4.3 Good actor dilemma**

The findings from the question about paying good actors were particularly unexpected. There was general agreement within the watershed, where all respondents were agricultural landowners, that good actors should not be paid for previous efforts. This finding minimizes a significant dilemma in making payments for EG&S to agricultural producers both efficient in terms of outcomes, and equitable in terms of effort. Some research has shown that paying good actors, or paying to maintain current water quality, could drastically reduce the cost-effectiveness of a performance-based policy (Weinberg and Claassen 2006). Alternatively, failing to pay good actors introduces a perverse incentive to reduce or halt BMPs that have a positive impact on water quality in order to become eligible for payments. In addition, failing to pay good actors can be perceived as a reward to those landowners who did not undertake any BMPs because they are often the landowners who can have the largest impact on water quality (Claassen et al. 2001). Targeted performance-based approaches that did not pay good actors might be successful in the study region as a result of the ambivalence from respondents towards payments for good actors. However, many of the respondents had taken measures to manage water quality without incentives and this could lead to a lack of 'additionality' (or payments for practices that would have been implemented anyway) in payment-based programs (Engel et al. 2008).

Interestingly, the minimum standard concept that emerged from the results of the study minimizes the good actor dilemma. Though there are other challenges associated with implementing a minimum environmental standard (e.g., water quality regulation, monitoring, measurement), it ensures all agricultural producers internalize the costs of achieving the standard and is potentially a more equitable option than other targeted performance-based approaches.

#### **3.4.4 Priorities for agri-environmental policies**

The responses to priorities for agri-environmental policy reinforced findings from many of the other questions; most indicated that social and environmental objectives were important, but that maintaining payments to agricultural producers was also an important factor to consider. The demographic breakdown of how groups ranked priorities was not surprising in many cases; agricultural producers were more likely to rank priorities related to payments and maintaining strong property rights more highly than respondents of other occupations, while respondents with a potentially higher level of education were more concerned with social and environmental priorities. It was surprising that, in a largely agricultural region, more respondents prioritized social and ecological goals above agricultural and economic goals for agri-environmental policy. This finding, together with those from questions related to agricultural producers' rights and responsibilities confirms that there is an understanding and high degree of concern for the environmental impacts of agricultural production. A shift in public opinion cannot be confirmed, as no previous studies assessing public opinion in the region could be found. However, there is a discrepancy between the assumptions of current agri-environmental approaches and respondents' perceptions of agricultural rights and responsibilities. The findings from the study region, both in terms of the discrepancy and the respondents' perceptions are similar to those reported by studies from the United Kingdom and the United States (Hall et al. 2004).

The range of priorities for agri-environmental policy presented were all ranked relatively high in importance (Table 3-3). The PCA allowed a stratification of respondents into groups that had similar priorities and another analysis of responses to selected survey and interview questions by age provide some insights into how social norms and values are distributed and potential changes based on perceptions of younger respondents. There were few surprises in the groups identified: those with agricultural and economic priorities were more often agricultural



producers; those with social and environmental priorities were more often urban residents and more highly educated. The majority of respondents (63%) valued social and environmental priorities highly (i.e., the socio-environmental group and the multiple priorities group, where socio-environmental priorities scores were positioned to the right of the mean line) (Figure 3-6). This dominant viewpoint that acknowledges the importance of sustaining water resources for the future and maintaining water quality for a variety of human and ecological health purposes. Those in the multiple priorities group also held financial considerations for agricultural producers and cost-effective policies as equally important.

These results are important to understand in assessing potential water quality policies; respondents want policies that ensure good water quality for the long term, but many respondents also placed importance of reducing the burden of this objective on agricultural producers. This is particularly important to recognize in light of the considerable lobbying power that agricultural producers have in the province of Alberta, and in Canada. Understandably, agricultural producers were more likely to be a part of the agri-economic group and prioritize financial incentives and reducing negative impacts of environmental programs on agricultural producers over social and environmental considerations. While these economic priorities may be important objectives for maintaining the status quo with agricultural producers, there is a significant proportion of respondents that perceive water quality and sustainability as the key priorities as well. Maintaining a balanced approach in acknowledging the interests of the majority and the interests of agricultural producers who wield political power is key in the development and implementation of future agri-environmental policies in the region.

#### **3.4.5 Future trends in social norms and values and implications for agri-environmental policy**

Theories related to stability in social values with age are numerous; a common theory is that social values follow an aging stability mode (Alwin 1994; Glenn 1980). Young people tend to have more malleable values that are subject to change based on both individual personality and on outside forces, such as historical events and the general paradigm of that period in time (Alwin 1994). Older people tend to be more entrenched in their values; they have surrounded themselves with like-minded people, have careers and families, and experience less change and

less exposure to alternative value systems (Kirkpatrick Johnson 2001). While there are certainly differences among individuals within a 'cohort' (or generation), there are also similarities based on the external forces that help shape values.

Social change often occurs with cohort succession, as different world views are represented between younger and older cohorts (Alwin 1994). As a result, it is useful to assess the responses of the youngest age groups to identify of potential changes to social norms and values in younger generations that will, in time, shape agri-environmental policies. Based on their responses to some of the survey and interview questions, younger respondents were generally more in favour of regulatory approaches to water quality management for agriculture and less likely to endorse incremental payments for improved water quality. These findings may indicate a shift in the perceptions of the rights and responsibilities of agricultural producers related to water quality. Indications are that there are somewhat greater expectations of younger respondents that agricultural producers ensure water quality is adequate without compensation and welcome government involvement in this matter.

Some caveats must be made in the interpretation of these data. First, while there does seem to be a trend, the number of young respondents was less than other groups (there were 42 respondents between the ages of 18 and 35). Second, young adults continue to develop their personal beliefs and are likely more prone to influence; their values are not as stable as those who are older (Alwin 1994; Alwin et al. 1992; cited in Kirkpatrick Johnson 2001; Glenn 1980).

### **3.5 Conclusion**

This study evaluated the perceptions of agricultural producers and rural and urban residents related to agri-environmental policy for water quality, and assessed whether those perceptions were aligned with the implementation of performance-based approaches. Based on the responses, a general program framework can be developed for agricultural water quality policy in southern Alberta. A summary of the findings indicates that all groups call for a water quality standard of care that is reasonable, and the continued financial support for agricultural producers who wish to improve water quality beyond the standard. This finding has been described by other social studies of environment and agriculture (OECD 2010; Grossman 2007), but contrasts with the

current policy approach where no water quality standard exists for agricultural landowners. Younger respondents were more likely to favour regulatory measures than older respondents, and this may have policy implications in the future.

This study was performed at a significant time in Alberta's land use policy development. Water quality is an important concern in the study area and the Alberta Land Use Framework is facilitating regional plans where consideration and development of new approaches for the provision of EG&S is explicitly incorporated into the framework (Government of Alberta 2008). Based on the responses to the surveys and interviews, respondents felt that incorporating payments for EG&S was an acceptable means to manage environmental quality on agricultural land. However, a recent amendment to the Framework (The Minister of Sustainable Resource Development 2011) limits the use of any approaches that might have a negative impact on property rights, and presents a potential barrier to the implementation of a water quality standard. Further investigation of possible barriers (and opportunities) to implementing performance-based approaches is required.

This study provides a basis for understanding how the public's perceptions compare with agricultural producers' views of agricultural property rights and how these views can be used to determine the potential for new policy approaches, and specifically performance-based approaches. As public knowledge and concerns change, and as generational cohort succession occurs, the expectations placed on agricultural producers will undoubtedly change as well. At present, the public are generally willing to provide aid to agricultural producers for the provision of EG&S, supporting a subset of performance-based agri-environmental policy approaches. Maintaining and incorporating a current understanding of how the public views agricultural and public rights and responsibilities into policy development and adaptive management will improve the alignment of public perceptions and policies, and may open windows of opportunity for new approaches.

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## **CHAPTER 4: ASSESSING INSTITUTIONAL CAPACITY FOR POLICY TRANSFER OF PERFORMANCE-BASED APPROACHES TO THE INDIANFARM CREEK WATERSHED IN SOUTHWEST ALBERTA**

### **4.1 Introduction**

Canadian federal and provincial governments have largely relied upon voluntary, practice-based policy approaches in agri-environmental programs to manage water quality. The most commonly used approaches include cost-sharing incentives, education, and moral suasion to encourage agricultural producers to adopt beneficial management practices (BMPs). The intent in adopting BMPs is to improve the environmental outcomes of agriculture, or reduce the negative environmental impacts of it. However, the link between practice adoption and environmental outcome is influenced by many variables and is often uncertain.

Performance-based approaches to water quality management on agricultural landscapes have the potential to improve the production of ecosystem services on agricultural land and have garnered significant interest in recent years (e.g., Weinberg and Claassen 2006; Selman et al. 2008; Morton et al. 2006; OECD 2010). These approaches link environmental outcomes (measured directly or estimated using models) directly to payments or charges. Performance-based approaches for agriculture have been implemented in other regions, but are rarely used in Canada and have not been used at all in Alberta.

A variety of performance-based approaches have been implemented outside of the province of Alberta to manage non-point source agricultural pollution and water quality. Approaches used for this purpose include water quality trading, differentiated payments for ecological goods and services, cross-compliance, and emissions charges (Chapter 2). These policy approaches have

potential to be implemented in Alberta, provided that the necessary contextual factors are in place (Rose 1993). Context - the enabling conditions and drivers for implementing the policy approach - is important for assessing fit when transferring an existing approach to a different jurisdiction.

Similarity of institutional and social context is especially important in assessing fit when considering a new policy approach. Rules imposed on society, both formal and informal, are an integral part of the policy context of a region (Roland 2004). The social norms and values of a region are generally slow to change over time, and thus require particular attention (Roland 2004). The dominant societal views of agriculture and the environment change incrementally over time and influence policy as they become incompatible with past policies (Roland 2004).

In the context of agri-environmental programs, social norms and values represent the environmental expectations that society places on agricultural producers. Past policies in Canada have, at times, reinforced the notion that agricultural producers should be paid to reduce environmental harms of their practices; these policies are indicative of a social belief in the 'beneficiary pays' principle and a tradition of agricultural exceptionalism where agricultural landowners are exempt from environmental regulations and standards that impact other industries (OECD 2010; Montpetit 2002). Few studies have attempted to assess whether more recent social norms and values in Canada are aligned with these principles. One Ontario study suggested that the province was moving away from these principles, as evidenced by the 'Greenbelt' policies implemented in Ontario<sup>4</sup> (Pond 2009). However, no attempt to assess social norms and values from a spectrum of public respondents had been undertaken in Canada until the study performed as a part of this thesis (Chapter 3).

The objective of this study was to synthesize a review of performance-based approaches, the focus of Chapter 2, with a field study evaluation of social norms and values in southwest Alberta

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<sup>4</sup> The *Greenbelt Act* was enacted in 2005 in Ontario as a protective measure taken by the province to ensure urbanization and development did not move into important agricultural land. It protects 1.8 million acres in southern Ontario that extend around the city of Toronto. The *Greenbelt Act* is considered by Pond (2009) to be a "formal embrace by Canada's largest province of a multifunctional paradigm for agriculture". Development rights have been expropriated from agricultural landowners within the Greenbelt, effectively reducing property values without compensation.

(Chapter 3) in order to evaluate institutional capacity in terms of the potential to transfer policy instruments from other regions to the study region. Context similarity was used as the indicator of relative probability of success, and barriers to the implementation of specific performance-based approaches were discussed.

## **4.2 Background**

Policy transfer allows policy-makers to learn and apply lessons from other regions to their own. The term 'policy transfer' encompasses the transfer of policies, policy instruments, structures, and concepts (Dolowitz and Marsh 1996). It can be described as a process where past or present policies, institutions, and ideas in one political system are used in the development of policies, institutions and ideas in another (Dolowitz and Marsh 2000). The region where the policy has been implemented is considered the 'exporter' and the region where the policy is transferred to is considered the 'importer'.

There are several degrees of policy transfer that may occur. The first is a complete transfer where a policy is taken from an exporting region and implemented in the importing region without alteration. This method is unlikely to be successful except in transfers within nations (Rose 1993). The second type of transfer is adaptation, where the policy is altered to fit the context of the importing region. Hybrid transfers combine two or more policies from separate regions to create a specialized policy for the importing region. Finally, ideas or inspiration for a policy in the importing region can be developed as a result of policies implemented elsewhere (Rose 1993).

Transferring and adapting policies from one region to another is common and has occurred throughout history (Benson 2009). Policy transfer literature indicates that many policy transfers are performed with an unsystematic approach and rely on anecdotal evidence, paying inadequate heed to the considerable complexity when conducting policy analyses (Wolman 1992). Where policy transfers have failed, importing regions may have neglected to adequately assess suitability. Dolowitz and Marsh (2000) list several specific reasons why policy instrument transfers may fail. First, the importing region may not have sufficient information about the instrument and its operation in the exporting region (uninformed transfer). The second reason

transfers may fail is incomplete transfer, where some of the important elements from the host region are not transferred. Finally, the importing region may not pay sufficient attention to the context of the exporting region which can result in an incomplete transfer. Many of these reasons for policy instrument transfer failure can be avoided with sufficient attention and evaluation of the instrument and to the broader contextual factors that drive and enable it (Dolowitz and Marsh 2000; Mossberger and Wolman 2003; Millennium Ecosystem Assessment 2005).

Contextual factors are the economic, environmental, economic, institutional, and social conditions and drivers surrounding policy approach implementation and operation (Dolowitz and Marsh 2000; Wolman 1992). Dwyer and Ellison (2009), in a review of recent policy transfer literature, emphasized the importance of understanding the context surrounding policies prior to policy transfer, and state that there is currently a lack of consideration of policy context. Where differences in context are substantial, policy transfers may be limited to the hybrid or inspiration transfer types. Where contextual differences are minimal, complete or adaptive policy transfers may be possible (Benson 2009).

### **4.3 Analysis framework**

#### **4.3.1 Institutional perspective**

The institutionalist view of policy transfer considers that goodness of policy fit depends on where, when and how it is adopted in a specific setting (Manning 2006). This perspective is summarized by Dwyer and Ellison (2009), who in a policy transfer review, stated that "'Context', then, is the thing". This approach is based on a belief that institutions, as a significant contributor to context shape preferences, transfer processes, and outcomes (Bulmer and Padgett 2004). 'Institutions' have been defined in several ways; however, for the purposes of this discussion, institutions are the formal and informal rules that guide society's actions (Roland 2004). As such, institutions include social norms and all other constraints that society imposes through rules, beliefs, and values (i.e., the social, legal and political contexts).

To further guide the analysis, the relative importance of specific institutions for successful policy transfer can be defined. Institutions have varying capacities to be altered, so it follows that it is

most important for the importing region to align with the exporting region on institutions that do not rapidly change and therefore hold a lower capacity for alteration. Political institutions are generally shorter term in nature and can change rapidly and discontinuously, and are referred to as 'fast-moving institutions' (Roland 2004). Conversely, social values tend to change slowly and continuously over time and are considered 'slow-moving institutions'. Legislative institutions are situated between these two ends of the spectrum, though they tend toward the slower side. There are always exceptions, but these classifications generally hold (Roland 2004).

Slow-moving and fast-moving institutions influence each other and create change over time. For example, a fast-moving institution such as a new political party in power can impact slower moving institutions such as legislation. Conversely, social pressure for change builds over time (due to the continuous nature of slow-moving institutions) and eventually causes a rapid change in a fast-moving institution (e.g., a new law is passed). Roland (2004) uses the analogy of pressure building along fault lines over time and suddenly causing an earthquake. The slow-moving institutions revealed by the Alberta study of social norms and values are not well-aligned with the faster-moving legislative and political institutions in Canada (Chapter 3). Past and present agri-environmental policies are indicative of a social context where society supports the 'beneficiary pays' principle; that is, the beneficiaries of public benefits (positive externalities) of agriculture are willing to pay for them. However, results from the Alberta study indicate that a combination of 'polluter pays' and 'beneficiary pays' is a more accurate portrayal of current social context. Briefly, respondents' general perceptions were that agricultural producers had a personal responsibility to achieve a minimum standard of care for water quality, below which no financial compensation or incentives should be applied ('polluter pays' principle). Above the standard; however, respondents were generally willing to continue to provide financial assistance or incentives to agricultural producers to improve water quality (Chapter 3). This presents an opportunity to investigate the potential contextual fit of new, performance-based policy approaches for the study region that were reviewed in Chapter 2.

### 4.3.2 Framework development

There are a number of frameworks for policy analysis. A well-known policy transfer framework created by Rose (2005) provides a broad and prescriptive 10-step guide to policy transfer. The guide covers a wide variety of issues when considering transferring a policy from another region, but dedicates only a brief section to the issue of context (Rose 2005) and only one page to cultural context. Policy transfer analysis, according to Rose (1993), should identify those factors that are significant to a policy's implementation and success, rather than listing all contextual factors for a given policy. Rose's minimization of the importance of culture and social context has been criticized as avoidance of necessary messiness in policy transfer (de Jong 2009) and overly rational in nature (Dwyer and Ellison 2009). However, rationalization in itself may not be undesirable. Runhaar and Driessen (2007), in developing a framework for strategic environmental assessment and policy making, describe rationalization as inclusive of both scientific knowledge and knowledge of the values of stakeholders. Other frameworks for assessing policy transfer suitability align with this notion and are less prescriptive and more inclusive of social context as a relevant consideration (e.g., Mossberger and Wolman 2003; Dolowitz and Marsh 2000).

The policy analysis framework developed by Mossberger and Wolman (2003) provides a set of criteria for assessing potential policy approaches and potential suitability for transfer, and will be used as a guide for the analysis in this paper. This framework draws from Rose's rational guide to transfer but is less prescriptive in its approach. The policy analysis includes three stages. The first is to build awareness; this stage of the analysis was completed in Chapter 2 for the exporting regions, where a review of approaches, and specific instances where the approaches were implemented, was performed and evidence of program evaluations and success were identified and discussed. This paper will focus on the second and third stages of the analysis framework. The second stage of the analysis is to perform an assessment of social and institutional context similarity between potential exporting regions and the importing region, focusing on enabling conditions and drivers. The third and final stage of the analysis is to assess the potential fit of policy approaches to the importing region, including an assessment of barriers to implementation and degree to which a policy approach could be transferred.

### **4.3.3 Policy approach transfer analysis**

#### 4.3.3.1 Assessment of study region context

The environmental, institutional, and social contexts of the study region as they relate to agriculture are described below. The environmental context is included to provide a brief description of the physical conditions and drivers that influenced the choice of the region for this study. This discussion provides an understanding of the conditions under which the policy instrument would be implemented.

##### *Environmental context*

The Indianfarm Creek Watershed is the focus of the study. This watershed is located in the southwest part of Alberta, in the foothills of the Rocky Mountains. Indianfarm Creek runs south to north through the watershed and flows into Pincher Creek, a tributary of the Oldman River and a primary source of drinking and irrigation water in the southern part of the province. Land-use in the watershed is almost exclusively agricultural (annual and perennial crop production and cow-calf operations). There are also four confined feeding operations. Alberta Agriculture and Rural Development (AARD) identified lack of access to pasture for cattle grazing as a main obstacle to healthy riparian areas and improved water quality (Olson and Kalischuk 2010); cattle are fenced into riparian areas to graze while flatter land is used for crop production to maximize productivity. A detailed description of the study site, including geography and agricultural activities, is given in Chapter 3.

The Indianfarm Creek watershed is prone to water quality problems as a result of agricultural management practices and seasonal flows. Water quality data collected by AARD in 2008 describe seasonal water quality (Table 4-1) (Olson and Kalischuk 2009). During snowmelt, phosphorus concentrations at times have exceeded the guidelines for the protection of aquatic life. These data indicate that water quality became substantially worse during runoff, often exceeding guidelines. During base flow, water quality guidelines were still exceeded at times.

AARD concluded, based on their measurements that water quality deteriorated from the headwaters to the outlet of Indianfarm Creek (Olson and Kalischuk 2009), and this pattern was exacerbated by rainfall events, where nutrient, sediment, and bacterial coliform loading of the creek was much higher (Table 4-1). As a result, management of the water quality impacts of seasonal and discrete weather events is a key focus for the watershed.

**Table 4-1.** Water quality parameter averages for seasonal flows in the Indianfarm Creek Watershed as measured by AARD in 2008

Timing	Total phosphorus <sup>1</sup> (mg L <sup>-1</sup> )	Total nitrogen <sup>2</sup> (mg L <sup>-1</sup> )	Suspended solids (mg L <sup>-1</sup> )	Bacterial coliforms (MPN <sup>3</sup> 100 mL <sup>-1</sup> )
Snowmelt (6 samples)	0.01-0.30 <sup>4</sup> (0.15) <sup>5</sup>	0.39-2.98 (1.25) <sup>5</sup>	2-125	50-800 (1,000) <sup>6</sup>
Rainfall (2 samples)	0.06-1.39	1.10-5.72	20-1600	10,000-56,000
Base flow (2 samples)	0.03-0.08	0.55-0.85	2-23	250-3,300
<sup>1</sup> Sum of particulate phosphorus and total dissolved phosphorus <sup>2</sup> Sum of organic nitrogen and dissolved inorganic nitrogen <sup>3</sup> Most Probable Number <sup>4</sup> Represents the range of averages for each monitoring station <sup>5</sup> Guideline for the protection of aquatic life <sup>6</sup> Guideline for the protection of agriculture				

*Institutional response to water quality concerns*

Alberta Agriculture and Rural Development is working within the watershed on a project that attempts to quantify the impacts of beneficial management practices (BMPs) on water quality (Olson and Kalischuk 2009). As part of this project, several BMPs have been implemented at sites that may have been contributing to poor water quality. Six sites were originally established where BMPs have been used including providing off-stream watering to improve riparian zones and reduce fecal coliforms in the creek; improved manure application timing and incorporation, as well as the development of setbacks from the creek for application; improved pasture management to avoid overgrazing and erosion; movement of overwintering sites for livestock out of a floodplain to reduce water contamination during high flows; and manure storage



capacity for livestock production to reduce the need to apply large amounts of manure to the land at inopportune times.

The most recent progress report from AARD stated that there was a "tendency of improved water quality" at two of the sites after one year of monitoring (Olson and Kalischuk 2010). Some improvements were noted, such as cattle preferring off-stream watering stations to direct creek access which suggest water quality improvement. A comparison of Nutrient Water Quality Index scores (an index that accounts for nutrient and bacterial coliform loading in water bodies) from 2007 to 2009 indicated that water quality had improved slightly, though not at all monitoring stations and seemed to be heavily influenced by water flows (Olson and Kalischuk 2010).

AARD is developing a model to simulate the site-specific effects of agricultural practices on water quality in southern Alberta. This model combines physical and economic models to estimate impacts of BMPs on water quality. The model is still under development; recent efforts to calibrate the model resulted in large differences between simulation output of water quality and actual water quality (Olson and Kalischuk 2010). There have been efforts at the federal level as well to estimate impacts of BMPs on water quality using an integrated economic-hydrologic model under the Watershed Evaluation of BMPs (WEBs) project in Canada (Boxall et al. 2007). It assesses the potential impacts of adoption of BMPs on water quality at a farm-specific level and also can be scaled up to model an entire watershed. In most cases, the provincial government has jurisdiction over private land management; however, the federal government sets broad policies and provides financial and research assistance for the benefit of provincial government departments.

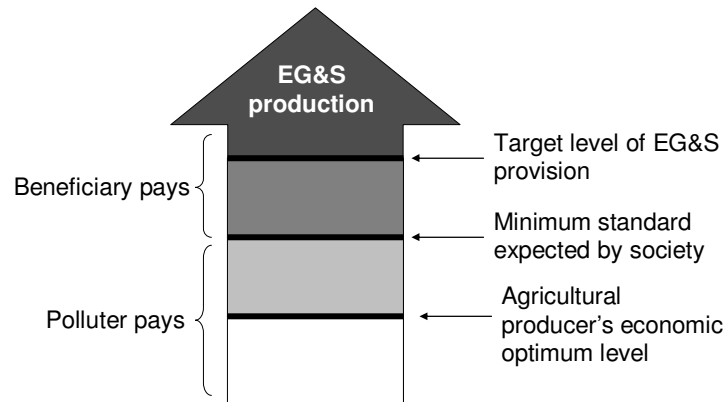
At the local level, AARD formed a watershed group comprised of several landowners in the watershed. This group has no formal decision-making authority, but serves as a means to maintain connections between AARD and the local landowners for the duration of their research project and to provide information and access to experts regarding possible changes to management practices (Olson and Kalischuk 2009). Organizations with services available to the watershed landowners include the Alberta Environmentally Sustainable Agriculture Program, which provides local field representatives for extension and awareness related to environmental

sustainability. Non-governmental organizations such as "Cows and Fish" also provide education and assistance in managing and improving environmental impacts from agricultural landscapes at the request of landowners or groups, and are particularly concerned with water quality (Alberta Riparian Habitat Management Society 2011).

### *Social context of study area*

The social context of the study area was evaluated and described in detail in Chapter 3. Briefly, perceptions of agricultural producers in the Indianfarm Creek Watershed as well as those of stakeholders beyond the borders of the watershed were assessed by interview and survey. Perspectives of agricultural landowners' rights and responsibilities in relation to water quality were sought, as well as respondents' degree of concern for water quality in their region. Finally, respondents' priorities (social, economic, and/or environmental) were assessed using the surveys and interviews.

The findings from the study indicate that the respondents were generally willing to pay for improvements to water quality beyond a minimum standard of provision that they thought should be provided by all agricultural landowners (Figure 4-1). This finding describes a shift from traditional property rights perspectives where society believed that agricultural landowners were the best stewards possible given their circumstances and demands upon them. The traditional property rights perspective endorsed the beneficiary pays principle, where the public pays for provision of EG&S from agricultural land. While this traditional view still exists, it is tempered by an expectation from many respondents that agricultural landowners hold a responsibility to manage their land in a way where environmental damage is reduced and ecosystem goods and services (EG&S) are provided. This perspective endorses a limited polluter pays principle, where agricultural producers are expected to pay the costs of providing a level of water quality expected by the public (Grossman 2007; OECD 2010).



**Figure 4-1.** Use of the polluter pays and beneficiary pays principles for societal expectations of EG&S production by agricultural producers. Adapted from the Organization for Economic Cooperation and Development (OECD) (2010) .

Agricultural producers, rural residents and urban residents who participated in the study share the opinion that producers do have a high degree of responsibility for the effects of their production methods on others. However, when changes to the perceived suite of property rights of agricultural landowners was suggested, agricultural landowners exhibited strong opposition to any change that reduced these rights. Property rights are held in high regard by agricultural landowners and challenges to those rights are strongly opposed (Bromley and Hodge 1990). A recent amendment<sup>5</sup> to the *Alberta Land Stewardship Act*, based on public pressure to ensure landowner property rights were not at risk, provides a good example in support of this finding (The Minister of Sustainable Resource Development 2011).

Agricultural producers were very apprehensive about both government involvement in farm management and the possibility of regulatory measures to manage water quality, though many watershed respondents acknowledged that establishing standards was important to control abuse of the watershed. Respondents who identified themselves as agricultural producers tended to favour lower responsibility for governments for water quality on agricultural lands than other respondent groups. One respondent expressed the opinion that giving governments responsibility did not mean that they had the right to dictate (or "over-legislate") management decision for

<sup>5</sup> The *Alberta Land Stewardship Amendment Act* ensures that private property rights are protected and provides a mechanism for challenging actions taken as a result of the *Alberta Land Stewardship Act* that may have a negative impact on property rights.

agricultural producers. In general, younger respondents (18 to 35 years old) were the most open to using regulation as a mechanism to ensure adequate water quality was maintained on agricultural landscapes.

When asked about agri-environmental policy outcomes, ecological and social priorities were ranked as superior in importance, or of equal importance, to agricultural rights and economic priorities by approximately two thirds of respondents (Chapter 3). These findings support a series of Alberta surveys that ranked a range of issues in order of importance to residents. In 2007, the environment ranked second in importance (below health care, but above education, the economy and oil sands/royalties), but that ranking was reduced to least important of all issues presented by late 2009, and was most recently ranked second-to-last in January, 2011 (Environics 2011). Rankings tended to fluctuate with confidence in the general health of the economy.

#### *Canadian context*

The importance of the environment to Canadians tends to fluctuate over time, and demand for EG&S may follow. The Strategic Council administered national surveys on a semi-yearly basis from 2005-2009 to obtain an understanding of the issues the public cares most about. The environment, as one topic among others such as taxes, gas prices and economic issues, moved from the third most important issue in 2005 with 9% of votes, to the most important in early 2007 with 26% of votes, and back to third with 9% of votes in 2009 (The Strategic Council 2009). From the data presented, the environment becomes an important issue to Canadians when the economy is strong, as the drop in votes for the environment corresponds closely with a dramatic increase in votes for economic issues (The Strategic Council 2009).

Canadian agricultural policy supports a productivist model of agriculture where intensive production is encouraged (Robinson 2006). The productivist model ideology sees agriculture (i.e., the production of food and fibre) as the primary function and ideal rural land use. Stewardship is considered a function of the continued production of food and fibre. The model is supported by strong farm lobby groups and generally marginalized conservation 'fringe' groups. Productivist agriculture is focused on the intensification and industrialization of production. Finally, the policies under a productivist agricultural model are focused on financial support and

the maintenance of strong property rights for agricultural producers (Wilson 2001). A tradition of agricultural exceptionalism exists, where agricultural producers are exempt from many of the regulatory measures imposed on other industries (Skogstad 1998). The environmental impacts of productivist agriculture are strongly negative; intensification of production and greater use of biochemical inputs result in erosion, pollution and other negative effects (Brundtland Commission 1987).

The federal government sets a general policy direction for agriculture that is renewed every four years (the current policy framework is titled "Growing Forward") (AAFC 2009). Within the framework, areas of focus are identified; some federal programs are administered as a result, but the majority of actions are taken by provincial governments and funded by the federal government.

There are a few key federal and provincial acts that create opportunities for implementing performance-based approaches. These are summarized in Table 4-2. Further discussion of the legislative context of Canada and the province of Alberta is provided in Appendix D.

The OECD has criticized Canada for not using market-based instruments to incorporate environmental concerns into policies. The organization stated that too much emphasis was given to voluntary measures (Appendix D). Transaction costs for deviation from the norm of voluntary measures can be very high in this type of system (Adamowicz 2007) and this may be a limiting factor in Canada because there are several levels of government competing for expertise in economic and market-based policy analysis which spreads resources thinly.

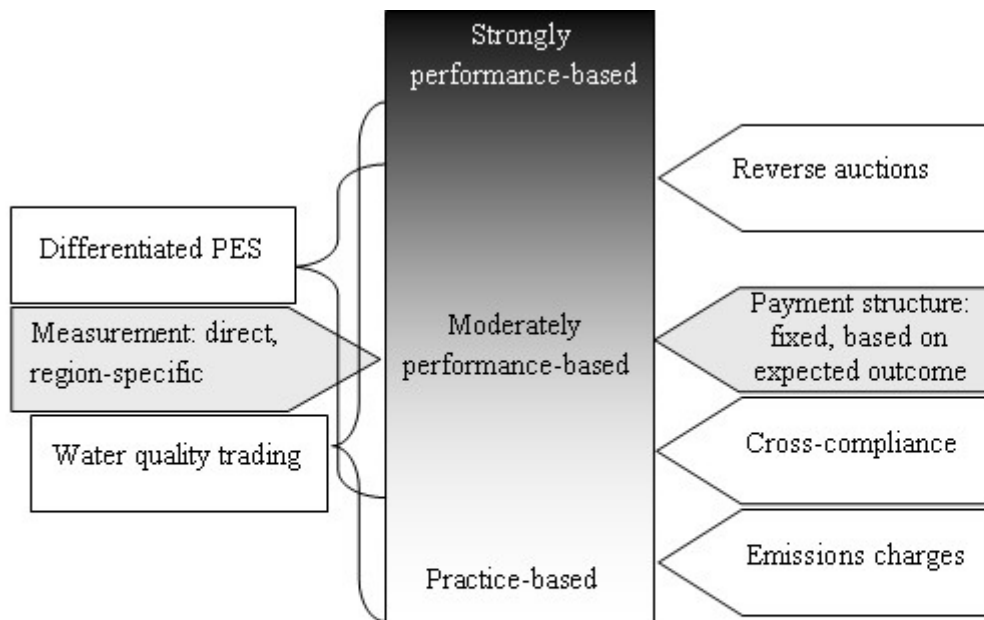
**Table 4-2.** Summary of Canadian and Alberta legislative context that enables the use of performance-based approaches

Act	Capacity created	Scope
<i>Canadian Environmental Protection Act (CEPA)</i>	<ul style="list-style-type: none"> <li>•Created capacity to regulate land-based sources of pollution, including diffuse pollution, into water bodies</li> </ul>	<ul style="list-style-type: none"> <li>•Substances deposited into water bodies</li> </ul>
<i>Canadian Water Act</i>	<ul style="list-style-type: none"> <li>•Created capacity for intergovernmental committees to manage water quality                             <ul style="list-style-type: none"> <li>-research</li> <li>-management plans</li> <li>-monitoring</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>•National waters or other water bodies where there is an "urgent national concern"</li> </ul>
<i>Water Act (Alberta)</i>	<ul style="list-style-type: none"> <li>•Created the necessary legislation for water management planning at the watershed scale</li> <li>•Created legislative capacity for <i>Water For Life</i> provincial water management strategy</li> </ul>	<ul style="list-style-type: none"> <li>•Water allocation and conservation in Alberta</li> </ul>
<i>Alberta Land Stewardship Act</i>	<ul style="list-style-type: none"> <li>•Created the necessary legislation for the Alberta Land Use Framework</li> <li>•Each of seven regions must institute a land use plan that may include market-based instruments and actions on private lands to achieve conservation and stewardship goals</li> </ul>	<ul style="list-style-type: none"> <li>•Province of Alberta with the seven regions delineated by watershed boundaries</li> <li>•Manages economic, environmental and social goals</li> </ul>

#### 4.4 Application of the Performance Capacity Meter to the study region

Given that the social and institutional context of the study region is known, the capacity to implement performance-based approaches can be assessed. The Performance Capacity Meter, developed in Chapter 2, may be used for this purpose (Figure 4-2). The Performance Capacity Meter provides rankings in terms of the capacity of a region to implement a performance-based approach, using measurement method and payment/penalty structure as ranking variables. Performance-based approaches reviewed in Chapter 2 have also been ranked using the Meter, which provides the additional potential to choose appropriate approaches based on similarity in rank with the capacity of the region. The ranking of the study region and the performance-based approaches that fit within the region's capacity are shown in Figure 4-2. The ranking for measurement method is based on the current capacity of the study region to measure water

quality at various points within the watershed, including the headwaters and the outlet, but not to evaluate the impacts of individual parcels of land throughout. The ranking for payment/penalty structure is based on social context findings from Chapter 3 summarized above. Fixed payments based on expected outcomes minimizes the economic risk to agricultural landowners and does not threaten their property rights, which were preferred by agricultural respondents. This ranking indicates that all performance-based approaches that occur at or below the ranking level for the study region may be suitable for it, as they correspond to the performance capacity exhibited by the study region. The performance-based approaches that occur at or below the performance capacity ranking on the Performance Capacity Meter will be assessed for similarity of social and institutional context. This includes all performance-based approaches reviewed, except reverse auctions.



**Figure 4-2.** Performance Capacity Meter ranking for the study region in southwest Alberta (denoted by shaded arrows), and the performance-based approaches that match the performance capacity.

#### **4.5 Performance-based approaches in other regions**

The context surrounding performance-based approaches to agri-environmental policy for water quality from member countries of the OECD was discussed in Chapter 2. Several common factors emerged around each instrument and are presented in Tables 4-3 through 4-6. The discussion in Chapter 2 was constrained by availability of literature related to context; it follows that the data in Tables 4-3 through 4-6 are not exhaustive but provide an overview of selected examples where literature was available. The tables also briefly identify the successes and failures of each program within an approach where more than one example is reviewed. Successes are identified where there were reports of environmental, economic, and/or social improvements as a result of the approach. Failures are identified where the literature has described the inability to attain goals set out for a program or reasons why a program was not implemented or was discontinued. These factors are only identified where they have been explicitly stated in the literature. While there are a number of policy items that may be transferred, including policy goals, instruments, institutions, ideologies, and others (Dolowitz and Marsh 2000), this discussion will focus on program transfer.



**Table 4-3.** Context for implementation of water quality trading as a performance-based policy approach in selected regions to manage agricultural water quality

	Institutional context	Social context
Main program reviewed: Ontario - South Nation Watershed	<u>Conditions:</u> Regulatory measures for drinking water; maximum allowable concentration of P established; Regulations established as a result of Walkerton tragedy, pressures	<u>Condition:</u> Well-organized farm groups that support maintaining strong property rights
<u>Successes:</u> environmental, social, economic	<u>Driver:</u> Stoppage of permits to deviate from exceeding maximum concentrations; removal of legal liability of agricultural producers through formal "Statement of Roles and Responsibilities"	<u>Driver:</u> Stakeholder buy-in through mediator; absence of risk for stakeholders; use of trusted organization as credit broker
United States - many examples	<u>Condition:</u> Previous success with other emissions trading; Federal government impetus to promote 'unique approaches' to watershed goals; individual state authority to regulate non-point source pollution	
<u>Successes:</u> environmental, economic	<u>Drivers:</u> Trading policy approved by EPA <sup>1</sup> and well-funded; individual state regulations to encourage trading; existing or imminent nutrient caps	
<u>Failures:</u> programs not implemented in some watersheds due to lack of drivers		
<sup>1</sup> Environmental Protection Agency		

**Table 4-4.** Context for implementation of differentiated payments for ecological goods and services (PES) as a performance-based policy approach in selected regions to manage agricultural water quality.

	Institutional context	Social context
Main program reviewed: United States - Performance-based Policies for Agriculture <u>Successes</u> : social, environmental	<u>Condition</u> : Listed as an impaired watershed under the <i>Clean Water Act</i> <u>Drivers</u> : Watershed ranked high on list of impaired watershed - scheduled for regulation; financial support of local farm bureaus	<u>Driver</u> : Threat of regulation, fear of government intervention, and peer pressure all drove participation
United States - Cullers Run (group-based program) <u>Successes</u> : Social, environmental	<u>Conditions</u> : Impaired watershed, listed under <i>Clean Water Act</i>	<u>Driver</u> : Stakeholder buy-in; researcher interest
France - Vittel water company <u>Successes</u> : Social, environmental, economic	<u>Driver</u> : Political will - potential loss of major employer; company required actions at the farm level to maintain viability	<u>Driver</u> : Stakeholder buy-in; fear of job losses in region

**Table 4-5.** Context for implementation of cross-compliance as a performance-based policy approach to manage agricultural water quality.

	Institutional context	Social context
United Kingdom - Nitrate Vulnerable Zones	<u>Conditions:</u> history of zonal water protection; inclusion in European Commission directives	<u>Condition:</u> belief in agricultural compliance with environmental standards
<u>Success:</u> Some environmental	<u>Driver:</u> pressure to conform to subsidy types	
<u>Failure:</u> Stakeholder buy-in not attained	approved by World Trade Organization	

**Table 4-6.** Context for implementation of emissions charges as a performance-based policy approach to manage agricultural water quality

	Institutional context	Social context
The Netherlands - Mineral Accounting System		<u>Condition:</u> agriculture focused heavily on livestock production where excess manure results in water pollution
<u>Success:</u> some environmental	<u>Driver:</u> failed attempts to manage pollution with	
<u>Failure:</u> largely unsuccessful in reducing P pollution	input-based regulations	

The information in Tables 4-3 through 4-6 show a range of social and institutional enabling conditions and drivers that contribute to selection and implementation of performance-based approaches to manage agricultural water quality. Each factor is specific to the region, though regions may share similar contexts, or similar contexts may emerge in relation to the use of a specific approach. When assessing programs outlined in Tables 4-3 through 4-6, there were some shared contexts within approaches. Common contextual factors are discussed below.

#### *Water Quality Trading*

Agri-environmental programs using water quality trading exhibited one necessary common factor: a water quality standard (or the threat thereof) (Table 4-3). The policy instrument also tended to be implemented more readily where there was a point source polluter and several agricultural non-point source polluters. Many of the failed attempts to set up water quality trading programs resulted from a lack of one of these two factors (Selman et al. 2009).

#### *Differentiated payments for ecological goods and services*

A main contextual factor indicated by literature related to the implementation of differentiated payments for ecological goods and services (PES) as a performance-based approach was the recognition of an environmental problem. All programs reviewed identified the deterioration of water quality as an important factor (Table 4-4). This type of policy instrument has been used by the example cases as a watershed-based program. Stakeholder buy-in within the watershed was another important factor in the successful implementation of the programs. In fact, program administrators for the two US programs reviewed considered the pilots to be successful enough to share their frameworks in other parts of the country (Winsten 2009; Maille et al. 2009).

#### *Cross-compliance*

Where cross-compliance was used, legislation and previous policies to support the compliance component were important contextual factors. To implement cross-compliance, some standard of water quality, or of acceptable practices must be established in the policy framework of the region. In the UK, this was through the Nitrates Directive which sets nitrogen concentration standards (Table 4-5). Another enabling condition was a response by the government to public

awareness and increasing demand for environmental outcomes from agricultural practices. However, the social successes of the program were negligible; it became clear in the review of the UK scheme that there was a lack of stakeholder buy-in and a sense of distrust among agricultural producers. There was a disconnect between the demands of the public at large for multifunctional agriculture and the agricultural producers who maintained a productivist view of their role (Barnes et al. 2009; Nielsen et al. 2009).

#### *Emissions charges*

Emissions charges reviewed in Chapter 2 and described in Table 4-6 have not been successful. The one example from a member country of the OECD identified was a Dutch program that penalized agricultural producers for surplus production of manure. The program did not achieve the objectives set out and will not be discussed further, as conditions where success occurs are not available.

#### **4.6 Comparison of social and institutional drivers and enabling conditions**

Fitting a performance-based approach to the study region requires some understanding of how the contextual factors create opportunities or limit the transfer of performance-based approaches. The assessment stage of the analysis calls for an evaluation of the similarity of enabling conditions and drivers between individual cases and the study region. The conditions and drivers do not have to coincide entirely, but must show some degree of similarity based on researcher judgment (Table 4-7). Close similarity was marked as (++)); some similarity was marked as (+); and dissimilarity, or incompatibility was marked as (-).

**Table 4-7.** Contextual similarity between performance-based approaches in other regions and the study region in Alberta.

Approach/case	Social context		Institutional context	
	Drivers	Enabling conditions	Drivers	Enabling conditions
<b>Water quality trading</b>				
Ontario - South Nation	*	+	-	
US - many examples			-	+
<b>Differentiated PES</b>				
US - PEPA	+		-	
US - Cullers Run	+			
France - Vittel company	-		+	
<b>Cross-compliance</b>				
UK - Nitrate Vulnerable Zones		++	+	-
* Cannot be determined from the literature				

#### 4.6.1 Social context similarity

The assessment of contextual similarity begins with the similarity of social context among the study region and regions where performance-based approaches have been implemented. Where social context was mentioned in the literature describing performance-based approaches, most have at least some similarity to the study region. The one exception is the Vittel, France case (Table 4-7) where the approach was based on a private water bottling company buying water quality through changes in practices from farmers within the watershed feeding the water source. This was an unusual case where governments did not play a significant role in the program and a social context misalignment was expected for this particular case.

The closest alignment in social context between regions with existing approaches and the study region was with cross-compliance (Table 4-7). The main enabling conditions for using cross-compliance as a policy approach were social awareness of the environmental impacts of agriculture and the belief that agriculture should comply with environmental standards (Table 4-5). Environmental standards have been specifically called for by respondents of a study we conducted in the study region. Many respondents were also at least somewhat in favour of regulating agriculture to maintain the minimum environmental standard for water quality. Many expressed an unwillingness to pay for agricultural producers to achieve the minimum standard

(Chapter 3). These expectations by society align well with the enabling conditions of the approaches using a cross-compliance policy instrument.

#### **4.6.2 Institutional context similarity**

Much of the discussion around context in the literature was related to institutional capacity: social factors and also political and legislative factors. The cross-compliance based program reviewed in Chapter 2 described political pressure from an intergovernmental body and the public as a driver for the use of this approach (Table 4-5). These political pressures are likely weaker in Canada; provincial governments, rather than federal or international bodies, manage most environmental issues (Montpetit 2002). In addition, Alberta agricultural producers have been successful in maintaining strong property rights; agri-environmental programs to date have been voluntary and have provided cost-sharing incentives to provide EG&S in agricultural landscapes. The most recent legislation enacted in Alberta was the *Alberta Land Stewardship Act* (ALSA), which had provisions within it to explore the use of new policy instruments to manage agricultural land. However, changes to the ALSA since its enactment were required to emphasize that property rights will not be affected by the Act and to make provisions for alternative actions where proposed land use plans may affect property rights (The Minister of Sustainable Resource Development 2011).

#### **4.6.3 Barriers to implementing cross-compliance**

Several contextual factors from the study region correspond well to performance-based programs that have been implemented using a cross-compliance approach. However, there are some potential barriers to implementing this policy instrument in the study region of southern Alberta. First, cross-compliance operates as an approach that requires achievement of a standard to access government income support programs and/or agri-environmental payments. These programs and payments are generally currently available to agricultural producers without the achievement of a standard. Some agri-environmental cost-sharing programs do require the completion of an Environmental Farm Plan, such as the Grazing and Winter Feeding Management Plan and the Manure Management Plan offered in Alberta (AAFC 2011). The Environmental Farm Plan, however, is a whole-farm environmental assessment completed by the agricultural producer with

guaranteed confidentiality and with no requirement to take any action as a result of completion of the assessment (Alberta EFP 2011).

Another potential barrier to implementing cross-compliance as part of a performance-based approach in the study area is the absence of a water quality standard. The UK NVZ program had water quality standards for specific agricultural pollutants. In contrast, Alberta does not adhere to a water quality standard (Montpetit 2002). Water quality guidelines exist for many pollutants, and may serve as a measure for compliance in the study area. However, an agricultural producer who participated in the field study to assess social norms and values indicated that the water quality guidelines were sometimes unachievable due to flow volumes and uncontrollable weather events, and should be tailored to individual watershed conditions (Respondent 3W).

The alternative to holding all agricultural producers to a water quality standard is to use the approach of the UK NVZ scheme and assess individual watersheds for water quality. Where pollutant levels are exceeded, all watershed landowners must adhere to a set of management practices that are designed to reduce pollutant levels. This approach reduces the amount of 'performance' incorporated into it, and it also creates an obligation for all watershed landowners to participate. As stated earlier, the literature available for the UK NVZ scheme indicate that the watershed approach to cross-compliance has not been effective in reducing agricultural pollution in a consistent manner, nor has it been accepted by landowners within the watersheds (Barnes et al. 2009). Where perceptions of legitimacy of a policy approach are absent, uptake and adherence to it are likely to be low (Davies and Hodge 2006). Macgregor and Warren (2006) report that Scottish agricultural producers maintain a productivist view of agriculture (i.e., agriculture should maximize production of food and fibre and environmental benefits are not prioritized) and many fail to acknowledge agricultural contributions to water quality. This view was echoed by respondents to the study described in Chapter 3; evidence that there are some parallels in social norms and values between the Scottish agricultural producers and those within the study region. Several respondents in the study region noted that there were other sources of contamination that deserved study more than agriculture. Viewpoints toward agriculture were dominantly productivist, though respondents, including agricultural producers, rural residents and urban residents had a range of perspectives regarding the role of agriculture in environmental



sustainability (Chapter 3). Davies and Hodge (2006) state that how the approach is presented to agricultural producers may have a significant impact on how it is perceived. For example, if cross-compliance is presented as a 'contract with society' and a way to continue to provide payments to agricultural producers, rather than a limitation on their 'right to farm', producers may be more accepting.

The final barrier to implementing cross-compliance is that the incentives to comply must exceed the benefits of failing to comply. That is, government income support and environmental payment programs must provide enough of an incentive to, at least, offset the costs of achieving a set water quality standard for agricultural producers to act (Claassen et al. 2004). Canada has a relatively low level of income support compared to other OECD countries (OECD 2007), and payments for agri-environmental programs are being reduced over time (AAFC 2010). Ensuring agricultural producers comply with water quality standards would require an economic assessment of the required compliance terms to adequately incentivize producers.

#### **4.6.4 Context comparison for other performance-based approaches**

The assessment of social norms and values of the study region in southern Alberta identified a general willingness among respondents to pay agricultural producers to improve water quality beyond a minimum environmental standard (Chapter 3). Water quality trading and differentiated PES pay agricultural producers for water quality improvements, though the mechanisms for payment are different. Payments for water quality improvements are 'beneficiary pays' instruments and align with the general social willingness to pay for water quality beyond a minimum standard indicated by field study respondents (Chapter 3).

##### 4.6.4.1 Water quality trading

The social context of water quality trading in the South Nation Watershed of Ontario acknowledged the importance of stakeholder buy-in for the success of the program, as well as organized farm groups that lobbied to maintain voluntary programs with payments for EG&S (Table 4-3). The programs from the US were assessed together and social context was not mentioned in the literature. The programs were generally considered successful (especially the

South Nation program), but several programs were not implemented in the US, though frameworks were in place, due to a lack of drivers (Table 4-3).

A study of the potential to use water quality trading to manage agricultural non-point source pollution in Canada found that there were no strong political or legislative barriers to using the policy instrument (Cantin et al. 2005). The study highlighted the increasing establishment of watershed-based organizations that could facilitate use of the instrument.

#### *Barriers to implementing water quality trading*

Common contextual factors for existing performance-based approaches to water quality trading included the implementation of a water quality standard, or threat thereof, and the presence of point source and non-point source polluters in the watershed. The water quality standard served as an important driver for agricultural producers to participate in the programs. Regulation, or the threat of regulation, appeared to be an effective motivator for agricultural producers to accept alternative and voluntary performance-based approaches, as they seemed preferable to further regulation in the cases reviewed. Water quality standards do not exist for the study region in southern Alberta and there is no indication that standards are being considered. As a result, it may be difficult in the study region to motivate agricultural producers to participate in a water quality trading scheme, as was demonstrated in several US states where the framework for water quality trading was put in place, but the lack of enforceable standards resulted in inadequate drivers to implement the approach (Selman et al. 2009). Water quality in the study watershed exceeds federal guidelines for the protection of aquatic life, sometimes by a large margin (Table 4-1). However, exceeding current water quality guidelines does not carry any penalty.

The presence of at least one point-source polluter in each watershed where water quality trading was implemented was an important enabling condition. These point source polluters were usually wastewater emitters with a high cost of pollution emission reduction. Where water quality was compromised, it was less costly for the wastewater emitters, through transactions in an emission permit market, to pay agricultural producers to reduce pollution emissions than to implement the technology needed for equivalent emission prevention (even where pollution reduction estimation uncertainty resulted in payments of four times the likely actual emission

reduction, as in the South Nation watershed). The study region in southern Alberta is not home to any wastewater point source polluters; however, there are four CFOs within the watershed boundaries: three house beef cattle and one is a dairy operation. While CFOs are considered point source polluters (the emissions can be traced more easily from a CFO than from diffuse pollution from more extensive activities) (Ribaudo and Nickerson 2009), there is currently no requirement for the CFO owners to adhere to a maximum pollutant load entering waterways.

Several additional constraints have been identified for Canadian implementation of water quality trading. A study published in 2005 found that the capacity to estimate site-specific water quality impacts of beneficial management practices was not strong, and the water quality data needed for start-up and on-going monitoring were often not available. Social acceptance of the approach, willingness to pay and demand for improved water quality outcomes from agriculture were also questioned (Cantin et al. 2005). The study region of southern Alberta lacks some of the important enabling conditions and drivers that were demonstrated to be necessary for implementation of water quality trading in existing programs, including the presence of a water quality standard and regulations such as total maximum daily load (TMDL) limits for specific water pollutants from point source emitters. As a result, this instrument is unlikely to achieve any level of buy-in from agricultural producers. This has been demonstrated in several cases in the US where TMDL limits were not enforced and therefore the threat of regulation of agricultural sources of water pollution was low (Selman et al. 2009).

#### 4.6.4.2 Differentiated PES

Existing approaches using differentiated PES as a policy instrument shared some common context. Stakeholder buy-in was important, as the instrument has been implemented as a voluntary program in all reviewed cases. To achieve stakeholder buy-in, the major social drivers were the interest and time devoted to the programs by researchers and fear of worse outcomes from a lack of participation (Table 4-4). The cases in the US were both pilot projects where researchers were actively involved in the process of implementing a performance-based approach, and where funding was available to pay for water quality improvements (Winsten 2009; Morton 2008; Perrot-Maître 2006). The potential for time dedication and funding

availability are unknown for the study region. Alberta Agriculture and Rural Development is currently conducting a research study in the study region titled "Nutrient Beneficial Management Practices Evaluation Project" that assesses the water quality outcomes from BMPs (Olson and Kalischuk 2010). Future plans to supply further funding for the region have not been indicated by AARD.

Stakeholder buy-in was also influenced by the amount of 'ownership' of the program given to agricultural producers. In all three cases, agricultural producers were an important part of the development of the program structure. In the Cullers Run and PEPA programs, agricultural producers formed advisory committees and were given decision-making power. If the type of resources (time and financial) provided in these cases were provided to the study region, a differentiated PES program may work. Indications of this are provided from the results of the field study that assessed social norms and values of the region (Chapter 3). Agricultural producers in the study region were cautiously interested in performance-based approaches, and particularly differentiated PES (Chapter 3). Further, for the duration of the AARD research project in the region, a watershed stewardship group has been formed (Olson and Kalischuk 2011). The purpose of the group is to disseminate information to watershed landowners and to match agricultural producers and funding for environmental improvements they wish to make to their operation (mostly through government-funded cost-sharing opportunities) (Olson and Kalischuk 2011). At the conclusion of the study AARD will no longer organize watershed group meetings and the fate of this group is unclear.

As with most performance-based approaches, water quality monitoring data and models that provide reasonable site-specific estimates of water quality changes are important. For the cases reviewed using differentiated PES as a policy instrument, these factors helped create the necessary enabling conditions for the success of the programs (Chapter 2; Table 2-2). These are conditions that the study region meets, as AARD has actively monitored water flow and quality over several years at many locations in the region and the agency is also adapting an economic and physical process model to the region to be able to assess the impacts of individual BMPs on water quality (Olson and Kalischuk 2011).

### *Barriers to implementing differentiated PES*

Fitting the policy to the social norms and values of respondents from the study region to the extent possible is important for the improved chance of success of transfer of an existing approach elsewhere (Mossberger and Wolman 2003; Dolowitz and Marsh 2000). Often, when approaches were successful, there was a recognition of the importance of stakeholder buy-in, and where approaches were not effective, lack of stakeholder buy-in was noted as a key factor (Chapter 2).

The pressure on agricultural producers to participate in voluntary programs in order to avoid regulatory measures (as was the case for PEPA in the US) or economic difficulties (the case for Vittel in France) were important drivers for the approach (Morton 2008; Perrot-Maître 2006). As discussed with previous approaches, these drivers do not exist within the study region of southern Alberta. However, the Cullers Run Watershed in the US did not describe this situation as a driver for the approach and was still regarded as highly successful; researchers cited the pilot project as a model for further efforts nation-wide (Maille et al. 2009). The unique group approach to this program may be feasible within the study region, as a watershed stewardship group exists; however, the group's formation resulted from an AARD study and meetings are scheduled and run by AARD staff. The group's continued operation is unclear after the conclusion of AARD's work in the region in 2012 (Olson and Kalischuk 2011). If the group were to maintain its cohesion and form a viable self-governance structure, the potential for a group PES approach to water quality management in the watershed may be possible.

### **4.6.5 Suite of instruments**

Many researchers have acknowledged that there is no 'silver bullet', or single instrument, for managing agri-environmental issues (e.g., Engel et al. 2008; Claassen et al. 2008; OECD 2006; Weersink et al. 1998). Rather, a suite of instruments is needed depending on the nature of the environmental concern and the institutional, economic, social, and knowledge contexts of a region. Indications from the field study that assessed social norms and values of respondents in the study region are that there is an expectation that agricultural producers will adhere to a minimum water quality standard where no payments are provided to achieve the standard, but

payments for water quality improvements above the standard are acceptable. Therefore, two types of policy approaches are required to meet the expectations of the respondents: first, an approach that supports a minimum environmental standard requirement; and second, an approach that encourages further environmental improvements beyond the standard through a system of payments.

The two performance-based approaches reviewed where payments were conditional on environmental quality were cross-compliance and water quality trading. Both of these are successful where a water quality standard has been implemented. Water quality trading has the additional constraint for success of a threat of enforcement of the standard. As noted in the previous discussion, the institutional capacity to implement water quality trading does not exist at present; that is, a water quality standard does not exist for the study region, and social norms and values assessed from agricultural producers in and beyond the study region do not strongly support a water quality standard (Chapter 3). The willingness and ability of farmers to take on the role of steward where productivism is the dominant paradigm is also identified by Latacz-Lohmann and Hodge (2003) as an impediment to implementing an environmental reference level as a policy approach. Should this capacity be created in the future, the conditions would be suited to utilizing cross-compliance or water quality trading. However, at present, the lack of institutional capacity is a substantial constraint to implementing these approaches.

Implementation of the water quality trading instrument has the additional constraint of a need to identify the most significant source(s) of water pollution within the watershed. The instrument works on the premise that the costs of adhering to a water quality standard by point source polluters are high, and that the purchase of credits is a cost-effective alternative for point source polluters to meet the standard. There are some point source polluters (CFOs) in the watershed, and although water quality is monitored at 21 stations throughout the watershed (Olson and Kalischuk 2008), none of these stations are set up to assess CFO contributions to water pollution.

There was a performance-based approach reviewed that could be used to pay agricultural producers. Differentiated PES was used in other cases for this purpose, is subject to only a few barriers to implementation. This approach requires the measurement or modeling capacity to

estimate water quality outcomes from BMPs. This is being addressed by AARD in the development of a model appropriate for the study region (Olson and Kalischuk 2011). The economic capacity to implement this approach is uncertain; funding availability for payments is likely subject to change over time with yearly budgets, agricultural policy frameworks, and with changes in the governing political party.

#### **4.7 Future potential**

Chapter 3 described the prevailing perceptions of respondents to the field study conducted in southern Alberta in terms of four groups: agri-economic priorities, socio-environmental priorities, multiple priorities, and unidentified priorities. A dominant social perspective of balance among agricultural, economic, social, and environmental concerns emerged from the study in southern Alberta. The results related to social norms and values around agricultural property rights and water quality reflected this finding. Differences based on the age of the respondents were slight and there were few indications of a shift in thinking, save a lesser willingness to make incremental payments for water quality improvements from younger respondents (ages 18-35 years) and a greater acceptance of regulatory measures (Chapter 3). The current perceptions seem to be fairly evenly distributed among age groups and, based on the field study data, will be maintained unless events occur that motivate a change, including legislative changes (Roland 2004; O'Grady 2011). The recent implementation of the Alberta Land Use Framework could create change among agricultural landowners. The *Alberta Land Stewardship Act (ALSA)* created the legal capacity to implement the Framework. When the ALSA was first enacted, it created a sense of fear around possible losses of property rights as a result of new policy approaches to land management. However, this was soon tempered by an amendment that assured landowners of no reduction in property rights as a result of the ALSA (The Minister of Sustainable Resource Development 2011). The fear of reduced property rights may still exist and this could potentially create a driver similar to those described in some of the performance-based approaches where agricultural producers participated in programs to avoid further government intervention related to water quality. This is an observation that warrants further investigation, as an opportunity to implement performance-based approaches may exist as a result of the circumstances around property rights and the *Land Use Framework*.

The South Saskatchewan Regional Profile (wherein the study region is located), an informational document preceding the development of a Regional Plan through the Land Use Framework, has cited increasing land use pressures, including rural and urban residential development, oil and gas extraction activities, increasing recreational demand, intensive livestock production facilities, and other industrial uses as competing for land currently used for agriculture, resulting in further fragmentation and reduction in rangeland and crop land (Government of Alberta 2009).

Balancing increasing pressures from human activities and the maintenance of quality water supplies will become more of a challenge as these land use pressures are predicted to grow over time (Government of Alberta 2009). The Regional Profile also stated that within the Oldman River Basin (where the study region is located) agricultural activities are responsible for the water quality concerns along smaller tributaries, such as Indianfarm Creek. Increasing pressure to produce crops on all available agricultural land has been cited as a major reason for direct cattle access to, and deterioration of, streambanks and riparian areas (Olson and Kalischuk 2011). As agricultural land becomes increasingly fragmented and unavailable over time due to increasing land demands from other activities, there may be increasing pressure on agricultural producers to use marginal lands around streams for livestock production. This could cause a decrease in water quality over time and should be taken into consideration in policy planning under the Regional Plan.

#### **4.8 Limitation to the policy transfer assessment**

Capacity to assess the suitability of performance-based approaches for the study region was constrained by the availability of literature describing and analyzing the approaches. Many of the performance-based approaches are relatively new in their application to water quality and agriculture. As these approaches become more widely used, and as existing approaches are studied over time, literature related to these approaches will likely become more abundant and allow for a more thorough assessment.



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## **CHAPTER 5: CONCLUSIONS FOR INTRODUCING PERFORMANCE-BASED APPROACHES FOR MANAGING WATER QUALITY ON AGRICULTURAL LANDSCAPES: USING INSTITUTIONAL CONTEXT AS A GUIDE FOR POLICY TRANSFER**

### **5.1 Introduction**

Performance-based approaches have the potential to be efficient and effective in the provision of EG&S (Weinberg and Claassen 2006), and more specifically in the provision of adequate water quality, as compared to practice-based approaches, which represent the current policy approach used in Canada. However, performance-based approaches require greater information about water quality and the capability to model or directly measure the impacts of individual BMPs on water quality.

In addition to technical and informational requirements, social acceptance of performance-based approaches is an important consideration when assessing the feasibility of implementation (Chapter 3). In fact, policy alignment with the prevailing social norms and values, and/or with strongly held perceptions of well-organized interest groups is important for its success (Wolman 1992; Dolowitz and Marsh 1996; Barnes et al. 2009). Social norms and values, or social context, are often under-examined in policy implementation, and more specifically in the policy transfer literature (Wolman 1992; Dwyer and Ellison 2009). Policy transfer is a mechanism to take existing policies, parts of policies, or lessons drawn from them and apply them to another location. Policy transfer provides a way to avoid 're-inventing the wheel' or creating an entirely new policy, where an existing one might serve the purpose.

The purpose of this thesis was to address the lack of consideration given to context in policy transfer, with a focus on social context, and to assess the transferability of performance-based agri-environmental approaches to water quality management implemented elsewhere. To achieve this, three objectives were set out:

- i. Identify performance-based approaches implemented in other regions to manage water quality on agricultural landscapes and assess the drivers and enabling conditions of that implementation;
- ii. Assess the social norms and values of the study region related to agricultural landowners' rights and responsibilities for water quality; and
- iii. Synthesize the findings of objectives i and ii to evaluate the capacity of the study region to implement a performance-based approach, and provide recommendations based on contextual alignment of the study region to the host regions.

While all three of these objectives were achieved to some extent, the scope of the analysis must be considered when evaluating the results. First, the objectives were addressed from a social science perspective. Contextual factors important in policy transfer range from social to biophysical to economic; social context is an important, and insufficiently-studied factor in context, but limiting the analysis to social factors does result in a less than comprehensive assessment for a policy transfer. Second, the research budget limited the quantity of data collected. Significant efforts were made to insure that the highest possible response rate was achieved within the budget constraints; however, surveys were sent by unaddressed mail and this may have reduced the response rate and potentially created a greater bias in the participant demographics than might otherwise have been the case with personally-addressed mail. Finally, upon conducting the literature review for performance-based approaches, it became evident that there was a dearth of peer-reviewed literature that was focused on these approaches in applications that were relevant to the study. The review was expanded to include 'grey' (non-peer reviewed) literature in order to be able to draw from sufficient resources for the discussion. This lack of peer-reviewed resources is the direct result of the novelty of applying performance-based approaches to agricultural management of water quality. Despite these limitations, I believe that the thesis is successful in achieving the objectives set out and makes a meaningful contribution to the policy planning literature.

## **5.2 Systematic assessment of applicability of performance-based approaches for water quality management**

Performance-based approaches differ from practice-based approaches in that they focus on outcomes rather than on inputs. The structure of these approaches can vary markedly and this represents a challenge in classifying an approach as clearly 'performance-based'. Further, a single performance-based approach can, in some cases, be implemented in a variety of ways that results in a more or less performance-based implementation. As a result of these characteristics of performance-based approaches as a group, and the implications in choosing an appropriate approach for a given region, a systematic characterization of performance-based approaches was undertaken. The approaches varied around two key factors: measurement capability (or preference) and payment/penalty structure (Chapter 2). The types of measurement and payment structures that characterize the range of performance-based approaches represent a spectrum from very weakly performance-based to strongly performance-based approaches.

The organizational model created, called the 'Performance Capacity Meter', identifies benchmarks for increasing measurement and payment/penalty structure capabilities as the approaches become more focused on outcomes and less focused on inputs. The Meter provides a useful tool to classify policy approaches and assess not only whether they are performance-based, but also by relative degree. As a result, it contributes to the literature related to performance-based approaches and their use for non-point source pollution in agricultural settings specifically, but also contributes to the understanding and application of these approaches in broader EG&S applications.

The Performance Capacity Meter has an additional application as a tool to select appropriate approaches for a region where the measurement capacity and desired payment/penalty structure is known. The literature review and assessment of current performance-based approaches in use provided the necessary data to rank the approaches on the Meter (Chapter 2). The Meter creates a simple organizational structure for a complex mix of approaches that facilitates the classification and selection of appropriate approaches where the regional capacity is known. Measurement capacity is a relatively straightforward metric; however, payment/penalty structure must be informed by social norms and values that will influence the acceptability of the structure chosen.

As payment/penalty structure becomes more strongly performance-based, it becomes more strongly targeted to those landowners that affect the greatest improvement in water quality and thus may have implications in terms of perceptions of fairness and equity. The literature related to good actors in agri-environmental policy acknowledges that an unfortunate trade off exists between cost-effectiveness and fairness (Claassen et al. 2001). That is, paying only those actors who can affect the greatest change (usually 'bad actors', or those that do not adopt BMPs) results in inequity and unfairness for those who have been good stewards in the past; however, ensuring fairness and equity by paying all actors, including early adopter of BMPs (the good stewards, or 'good actors'), results in reduced cost-effectiveness and lesser environmental outcomes for a given budget (Engel et al. 2008). Additional social concerns of validity of the science used to measure water quality and the risk involved in payments only where outcomes are realized are significant considerations when choosing a payment/penalty structure .

### **5.3 Social norms and values: informing policy decisions**

The social norms and values of the study region were assessed by interview and survey to understand how agricultural producers, rural residents and urban residents perceived the rights and responsibilities of agricultural landowners in relation to water quality. This line of questioning was used as an indirect approach to identify whether performance-based approaches would fit within the social context of the study region, and if so, which approach(es) would best align with the norms and values of the region. However, public preferences for particular policies or programs are not necessarily well-formed. The methodology used to extract preferences relied on perceptions of the rights and responsibilities of agricultural landowners; this was communicated by rating degree of (dis)agreement statements and by answers to multiple-choice questions. This method allowed at least partial circumvention of the problem of poorly-formed opinions about policies and programs and assessed the underlying social norms and values, or social context, that inform those opinions.

There has been much discussion in the agricultural policy literature about the paradigm in which we are currently situated. Several researchers suggest that there is a divide between North American agriculture, which is productivist and focused primarily on food and fibre production;



and European agricultural practices, considered post-productivist (or multi-functional) (e.g., Burton 2004; Burton and Wilson 2006; Pond 2009; Wilson 2001). Based on the results of the social context evaluation in Chapter 3, I conclude that, from the respondents' perspective, agricultural landowners have a responsibility not only to provide food and fibre, but also to provide a socially-acceptable level of EG&S. This indicates a misalignment with the productivist perspective of agriculture where the primary objective is to produce the greatest yield possible from the land (Robinson 2006), and the tradition of agricultural exceptionalism that has dominated policy decisions in the past and persists in the present (e.g., *Alberta Land Stewardship Amendment Act*). While the results of this study cannot conclusively prove that a paradigm change is occurring, it is evident that social norms and values do not entirely coincide with the social context assumptions implicit in current agri-environmental policy approaches. The respondents rejected the notion that agricultural landowners should be offered financial incentives to make changes to agricultural practices without regard for an environmental standard of care (Chapter 3).

There were indications of a shift in norms and values in younger respondents (Chapter 3). There was increased acceptance of agricultural water quality regulation and decreased willingness to pay agricultural producers for EG&S for respondents who were 18-35 years old. The groups identified with the principal components analysis showed that a majority of respondents ranked social and environmental priorities more highly than agricultural and economic ones when developing agri-environmental policy. Multiple perspectives (relative closeness to agriculture, demographic patterns and priorities groups) all demonstrated a misalignment between reported norms and values and the norms and values assumptions current agri-environmental policies support. The analyses described a respondent population that demands a standard of care for water quality on agricultural landscapes, a population that is sensitive to the production economics of agriculture and therefore willing to provide positive incentives for improvements to water management; but also a population that will increasingly expect (as younger respondents become politically influential) that agricultural producers will provide a standard of water quality and are willing to penalize those producers who fail to meet this expectation.

This study provides a snapshot in time of the social norms and values of respondents in southern Alberta, a largely agricultural region, and further assessment of a broader range of Canadians would provide an understanding of whether current policies are indeed misaligned with social norms and values, or whether we as a country are still firmly situated within the agricultural productivist paradigm.

A broad application of the survey format used within this thesis (for example, at the provincial or federal scale) could provide policy makers with the social context information required to shift policy development toward performance-based approaches. The application of public funds for the provision of EG&S from agriculture could be enhanced with a given budget using performance-based approaches (Weinberg and Claassen 2006). This may provide a sufficient incentive for policy makers to consider a paradigm shift in policy. Information about water quality and potential models under development in Canada provide much of the institutional context for the implementation of performance-based approaches. An appropriate first step may be to implement performance-based approaches where water quality monitoring has been ongoing for several years as a result of federal and/or provincial research efforts, such as the federal Watershed Evaluation of Beneficial Management Practices project (AAFC 2011) and the Alberta Nutrient Beneficial Management Practices Evaluation Project (Olson and Kalischuk 2011). Alberta is particularly well-situated for the development and implementation of performance-based approaches as a result of previous and ongoing efforts to increase institutional capacity to manage water resource in the province through the *Water For Life* strategy (AENV 2008), and more recently the *Land Use Framework* (Government of Alberta 2008).

#### **5.4 Social context as an indicator of potential for implementing performance-based approaches**

As emphasized in the previous section, social context is an important factor to consider when implementing a performance-based approach. When the social norms and values of a region are known, there is an opportunity to use social context as an indicator of the potential for implementing performance-based approaches. The final analysis of the study combined the identification of existing performance-based approaches to manage water quality on agricultural

land, the drivers and enabling conditions that were common to each approach, and the social context of the study region (informed by evaluation of social norms and values) to assess the potential to implement the existing performance-based approaches. I approached this assessment from a social context perspective because social norms and values are slow to change as compared to other contextual factors, such as economic and physical factors (Roland 2004). Allowing social context to guide the selection of potential performance-based approaches ensured alignment with norms and values of the region. Respondents in the study region generally agreed that a minimum standard of environmental care should be required of agricultural landowners and that, above and beyond that standard, financial incentives for water quality improvements should still apply. From a performance-based approaches perspective, this finding created an opportunity to implement a suite of policy instruments to satisfy the expectations of respondents.

## **5.5 Conclusions and future directions for research**

This thesis seeks to improve the understanding of how social context can serve as a useful and appropriate indicator of potential to implement performance-based approaches, and also to advance the literature and methodology related to the assessment of social context. Previous studies focused on agri-environmental policy in Alberta, and in Canada, have questioned barriers and motives to adopt BMPs, or more generally to participate in government-administered programs. However, there have been few efforts to assess the (mis)alignment of current and future policies with the existing social context. This thesis contributes to that void in the policy planning process in Canada.

Internationally, evaluations of social acceptability for policies have directly queried preferences for policies and/or policy instruments while acknowledging that often these preferences are not well formed. This thesis presented a novel approach to understanding social context through an indirect line of questioning around agricultural landowners' environmental rights and responsibilities. Using this approach, the issue of poorly-formed preferences was circumvented and the responses provided were directly applicable and comparable to the enabling conditions

and drivers in regions where performance-based approaches had been implemented. This approach provides a unique, social context approach to studies of policy transfer feasibility.

The use of social context as an indicator of policy preference and for the development of policy requires an adaptive management approach. Responses to surveys and interviews may not fully reflect the population's true norms and values as a result of a number of factors including question format, question misinterpretation, discrepancy between responses and practices, and through the characteristics of the sample population. Individual responses and the broader interpretation of results must account for these issues of clarity, discrepancy, and bias possible in this type of research. In addition, social norms and values change over time, so policies must remain responsive to these changes. Adaptive management, or "gradual institutional reform", provides a framework for policy development using social context as an indicator (Roland 2004). Adaptive management acknowledges the complexity of social and ecological systems and encourages action despite uncertainty about the outcomes of policy decisions, with a continual process of monitoring and re-assessment (Noble 2004). The capacity for adaptive management is largely a function of social context, as it is the human-developed institutions that guide actions that impact the environment (Walker et al. 2004). An adaptive, or gradual institutional reform, process for performance-based policy development will acknowledge the uncertainty associated with social context and provide a mechanism for critical reflection on the impacts of new policies from social and ecological perspectives.

Agricultural non-point source impacts on water quality in the study region was approached from two perspectives: the social context where norms and values at the local and regional scales were assessed; and the biophysical effects of BMPs where water quality was assessed by Alberta Agriculture and Rural Development (AARD). The two perspectives were complimentary. Although water quality studies and AARD are ongoing, preliminary results from a short term assessment of BMP impacts on water quality highlights the challenges associated with performance-based approaches. Water quality was not uniformly impacted by BMPs; often water quality did not improve, or showed improvement in one year but not in another (Olson and Kalischuk 2011). The findings highlight the important role that landscape variability and climate play in the link between agricultural practices and environmental outcomes. Modeling the

potential influence of factors that are not accounted for in current policies and programs and using that information to guide future policy and program development could improve funding efficiency in terms of environmental outcomes (Weinberg and Claassen 2006). The improved efficiency occurs as a result of accounting for some of the uncertainties associated with landscape and climate variability and incorporating those uncertainties into payment or penalty structures. The Performance Capacity Meter developed within the thesis (Chapter 2) explicitly recognizes the importance of both the capacity to measure environmental (specifically water quality) outcomes from practices and the payment or penalty structure used to deliver the programs as key determinants of the capacity to incorporate performance into policy approaches.

### **5.5.1 Future research directions**

A possible avenue of research extending from the findings in this thesis is further development of the Performance Capacity Meter to improve the robustness of the tool. The tool is currently based on a relatively small subset of performance-based policy approaches as they have been applied within OECD member countries for the purpose of managing water quality on agricultural landscapes. The tool has potential usefulness for selecting policy approaches for other environmental issues, in other institutional and social contexts, at variable scales, and for a broad range of sectors. The current body of literature related to performance-based approaches for water quality management has not been systematically organized and the Performance Capacity Meter is a potential tool for that purpose. Further testing of the tool framework to ensure the ranking factors chosen (measurement and payment/penalty structure) are satisfactory for other applications of the tool is necessary for broader use.

A second direction for further research acknowledges the challenges of implementing a performance-based policy approach at the watershed scale. Issues raised in the review of existing approaches included balancing risk management for both program providers and participants and the potential to use a group approach instead of targeting individual landowners for watershed scale concerns (Chapter 2). These issues were briefly described within this thesis; however, they represent important and highly relevant concerns in development and implementation of policy approaches and warrant further study through the lens of performance-based approaches.

Development of a socially-acceptable risk management approach between program providers and participants clearly was a strong driver where performance-based approaches were socially successful. However, the result was often a transfer of the majority, or all, of the risk to the program provider. Accordingly, payments were made with little regard for actual environmental outcomes and performance capacity of these programs was severely diminished. While beyond the scope of this study, a potential solution to this problem may be a slow introduction of risk, rather than an abrupt change to current program structures. Drawing from the institutional change literature, Roland (2004) suggests that gradual, experimental institutional changes (discussed briefly in terms of adaptive management above) can have an impact on social norms and values, just as social norms and values influence formal institutions. Using incremental increases in risk, allowing for water quality model development to improve in accuracy over time, may have two advantages: 1) improved potential to gain public support; and 2) improved accuracy of models to predict impacts of agricultural practices, which has the additional advantage of reducing perceived risk.

The group approach to performance-based water quality policy has immediately recognizable benefits over individual actions. First, agricultural water pollution is largely diffuse, and therefore many landowners' management practices impact a single water body and these individual impacts cannot be easily distinguished. Second, there has been a trend towards watershed-based governance, rather than the traditional, top-down government approach to environmental management (Rogers and Hall 2003; Nowlan and Bakker 2010), and a group, or collaborative watershed-based, approach provides a fitting structure. Finally, an individual effort to reduce pollutant loading within a watershed generally has a negligible effect on water quality (with the caveat that major emitters may have a substantial impact). A group, or watershed, approach, however, ensures that many landowners within a watershed are reducing pollutant loads and is more likely to have a positive impact on water quality. There are less obvious benefits as well, such as the peer pressure mechanisms that can work to increase program uptake, as was demonstrated in a payment program in Cullers Run Watershed in the United States where the group received incentives for increased participation within the watershed (Maille et al. 2009). There are also potential disadvantages, such as the incidence of moral hazard where

watershed landowners do not participate but share in the benefits created by the rest of the group (Vossler et al. 2007). However, the structure of group, or collaborative watershed-based, programs are well-suited to water quality concerns in terms of dealing with the problem at an appropriate (watershed) scale. There are further measurement and monitoring efficiencies that could be realized as a result of a watershed scale program. In fact, this issue is not entirely separate from risk management, and may reduce the risk borne by individuals and distribute it among the group. There is the potential to use current watershed stewardship groups in agricultural areas that have been developed as a result of common interests or as a product of the *Water For Life* and *Land Use Framework* in Alberta to initiate this type of program structure.

Finally, there are some interesting intersections between findings and theoretical concepts that emerge from discussions within this thesis and provide opportunities for additional research trajectories. Specifically, concepts of path dependence and transformation (discussed in greater detail below) have potential application to some of the findings from the study region and from the review of performance-based approaches. Both of these concepts are embedded within the social-ecological systems resilience literature, but are not exclusive to it. The social-ecological systems concept embraces the notion that social systems are inextricably linked to ecological systems; therefore, they cannot be considered separately. For the purposes of this thesis, the social ecological system of the study region would encompass the range of actors, institutions, and water quality and management issues. Social-ecological systems are considered to move through adaptive cycles over time (Holling 2001). Adaptive cycles can be visualized as a loop that has two general parts: a forward and back loop. These two sections of the adaptive cycle manage for production and sustainability, respectively (Walker et al. 2002). Social ecological systems move through these cycles repeatedly over time. The forward, or production, phase of the cycle is more highly controlled and regulations for increases to efficiency are often implemented. The forward loop is representative of a period of relative stability in terms of policy. The back loop, or sustainability, phase of the cycle represents times of greater turbulence where novel approaches may be introduced. It is a time of greater susceptibility and rapid change (Holling 2001) and presents opportunities for new policies. There are many adaptive cycles occurring within a region at different scales that interact with one another (Walker et al. 2002). How the social-ecological systems move through these cycles is influenced by many factors and

is complex. However, two of these factors - path dependence (and the associated phenomenon of "lock-in traps") and transformations - are particularly applicable to the findings discussed within this thesis.

Path dependence occurs during the stable phase of the adaptive cycle and describes the tendency for policies and society to maintain the status quo and resist divergence or change from the current path as a result of positive feedback (where each successive decision makes the current path more attractive and harder to diverge from) (Pierson 2004). Self-reinforcing factors (such as historical decisions and high costs to change) maintain a specific, unchanging institutional trajectory that may not adequately adapt to changing external conditions (Burch 2011; Pierson 2004). Eventually, a failure to respond to changing conditions can result in a phenomenon called a "lock-in trap" where sustainability of the social-ecological system continues to decline. Lock-in traps are characterized by high connectivity, high resilience and low adaptability, and may occur in agricultural landscapes where economic welfare is dependent on the state (Allison and Hobbs 2004; Walker et al. 2004). The role that path dependency has played in the policy context of the study region is clear, governments have continuously supported a model of practice-based policy approaches for water quality management on agricultural landscapes. Change that was put forward by governments, such as the creation of legal capacity to use new (and potentially performance-based) approaches in Alberta was quashed - with a return to only marginal changes to the status quo - by concerns about eroding property rights as a result of the change (The Minister of Sustainable Resource Development 2011; Government of Alberta 2008). Further investigation of the roles of path dependence, the factors that have created lock-in traps, and how these factors interact within the study region would provide a complementary perspective to the findings in this thesis. An investigation of the intersection of policy planning and social norms and values within the study region would enrich discussions of social and policy context in the policy transfer literature and contribute to the resilience literature as well. This thesis contributes an illustrative example of that interaction, and provides a reference point for further investigation.

The concept of transformation is the act of movement from one social-ecological system configuration to another (i.e., changing a trajectory of a social-ecological system) that may



occur during a phase of rapid change in the adaptive cycle (Walker et al. 2004).

Transformational change can be based on choice, and therefore deliberate, or else it can be forced by shifting ecological, social, institutional, or economic factors (Folke et al. 2010).

Implementation of performance-based approaches to managing water quality on agricultural landscapes is constrained by several institutional and social barriers. Some of these barriers may be removed as a result of the emergence of a 'window of opportunity' for transformation.

Transformations may occur at different scales which means that the opportunities for transformation may occur at the watershed scale, or arise from a broader scale (e.g. regional, national, or even global) (Folke et al. 2010). The current paradigm of productivist agriculture that is supported by agri-environmental policies in Alberta, and more broadly in Canada, may be challenged. The reported social context from the field study is not well-aligned with the underlying assumptions of social norms and values that these policies represent. Following Roland's (2004) description of building tension as slow-moving institutions (social norms and values) become increasingly misaligned with those supported by policies, eventually a threshold, or opportunity for transformation, is reached and policy change occurs that may lead to a new paradigm, such as (but not necessarily) post-productivist agriculture. Policies are modified or new policies are implemented that create a better alignment between social context and policy. The degree of dissonance between social norms and values and policy that is required to reach the threshold is unclear. Also unclear is the potential for ecological and economic thresholds that may create transformational opportunities. Application of other cases where thresholds were reached and transformations occurred, including the thresholds database maintained by the Resilience Alliance (Walker and Meyers 2004), would provide a clearer picture of how important current barriers in the study region are to implementing performance-based approaches and where thresholds may exist within the social-ecological system of the region.

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**Appendix A: Pre-interview letter sent to watershed landowners in the  
Indianfarm Creek Watershed, Battersea Drain, and Whelp Creek  
Watershed**



January 21, 2010

Dear \_\_\_\_\_;

My name is Julia Baird; I am a graduate student at the University of Saskatchewan. As a part of my PhD thesis, I am working on a project titled “A performance-based approach to agri-environmental policy: Development and comparative assessment”. As a part of this project, I invite your participation in a short interview that will be administered by me at your convenience.

Your opinions and attitudes toward water quality issues and agriculture will be an important part of the project. The responses you provide will guide the development of an effective approach to environmental policy for agriculture that will be compared to the current programs available to agricultural producers.

You have been chosen as a participant based on your location. There are three sub-watersheds that will be studied: Indianfarm Creek and Battersea Drain in southern Alberta and Whelp Creek near Lacombe, AB. I am interested in understanding how your opinions may compare to those in other watersheds and to rural and urban residents that do not reside in any of the three sub-watersheds.

I have attached a standard University of Saskatchewan ‘participant consent form’ for your review. **I will call you to follow up in a week to determine your interest in participating in this research and to schedule a time and place to complete the interview.** If you have any questions at any time, please feel free to contact me by phone at (403) 454-6556 or by e-mail at [julia.baird@usask.ca](mailto:julia.baird@usask.ca).

Sincerely,

Julia Baird

## Appendix B: Consent form and interview script

### Consent Form for Researcher-Administered Survey

#### “A performance-based approach to agri-environmental policy: Development and comparative assessment”

Please read this letter carefully, and feel free to ask any questions you might have. I will review this information with you at the time of survey administration.

**Researcher:** Julia Baird, School of Environment and Sustainability, University of Saskatchewan, Saskatoon, SK. Phone: 403-454-6556, E-mail: julia.baird@usask.ca

**Supervisors:** Dr. Ken Belcher, School of Environment and Sustainability, University of Saskatchewan. Phone: 306-966-4019, E-mail: ken.belcher@usask.ca

Dr. Mike Quinn, Faculty of Environmental Design, University of Calgary, Calgary, AB. Phone: 403-220-7013, E-mail: quinn@ucalgary.ca

**Purpose and Procedure:** The purpose of this study is to understand and evaluate the viewpoints of residents of southern Alberta regarding water quality and environmental policies for agriculture. You are invited to participate in an interview to convey your opinions on the importance you place on water quality, your perception of how agriculture contributes to water quality, and how you think environmental policy can be best designed to manage water in agricultural regions.

The survey will take approximately 30 minutes to complete, and will be audio taped as a secondary source of information where clarification is needed. Results of the interview will be aggregated and be used to evaluate similarities or dissimilarities between direct stakeholders, rural and urban residents. Overall, the results will guide the development of an alternative approach to environmental policy for agriculture with the Indianfarm Creek sub-watershed as the case study, and will be scaled up to a whole watershed level. Your participation in this survey will provide valuable insight into how stakeholders and the public can participate in the development of public policy. This research is funded federally by the Social Sciences and Humanities Research Council and also by the University of Saskatchewan.

**Potential Risks:** There are no potential risks in participating in this study. Your name will not be used and results will be aggregated so that individual responses cannot be identified.

**Potential Benefits:** There are no direct benefits in participating in this study to you as an individual. The results in aggregate form will be shared with other respondents, federal and provincial agencies, academics and in thesis form for the School of Environment and Sustainability at the University of Saskatchewan in order to advance the sustainability of agricultural environmental policy.

**Storage of Data:** Completed interviews, researcher notes and results saved on a dedicated hard drive will be stored in the researcher's office during data analysis. Once complete, these data will be stored in a locked cabinet in the researcher's possession for a minimum of five years and until all reports, presentations, publications and the thesis have been produced and distributed. Only the researcher and supervisors will have access to this data.

**Confidentiality:** The responses you provide will be aggregated with others and used only in aggregate form. Your identity will be kept confidential at all times. If direct quotations are to be used, you will be asked to verify the quotation and give consent for the researcher to use it. No names will be used at any time.

**Right to Withdraw:** Your participation in this survey is completely voluntary and you may withdraw from this study for any reason, at any time. If you withdraw, any information provided to that point will be used unless you request that all information provided be removed.

**Questions:** You may contact the researcher with questions at any time using the contact information listed above. This study has been approved on ethical grounds by the University of Saskatchewan Behavioural Research Ethics Board on November 10, 2009. Any questions regarding your rights as a participant can be directed to the Board through the Ethics office (306-966-2084). You may call collect. All participants will receive a summary of the results once the study is complete and results will be presented at watershed meetings by the researcher.

**Consent to Participate:** I have read and understood the description provided above. I have been provided with an opportunity to ask questions and my questions have been answered satisfactorily. By completion of this interview, I consent to participate in the study described above; understanding that I may withdraw this consent under the terms outlined above.

## Researcher-Administered Survey for Watershed Residents

Name \_\_\_\_\_ Audio record? Yes No

1) Tell me a bit about your farm/ranch (what crops do you grow, what type of livestock do you raise, how much land do you farm, do you farm with family)

**READ:** I'm going to give you some background information before we go on. Agriculture has been credited with producing "ecological goods and services" in addition to crops or livestock. Ecological goods and services are environmental and social benefits that are either by-products of agricultural activities, or else they are purposely produced on agricultural land. Some examples of ecological goods and services are things like carbon storage (from zero tillage or pasture management), wildlife habitat (from conserving natural areas) and water filtration (from grassed waterways and wetlands). Some believe that farmers and ranchers should be compensated for producing ecological goods and services, including compensation for water quality improvements.

We'll use water quality as a focus for our discussion.

2) How would you rate surface water quality in your area? Examples of surface water are creeks, rivers, ponds and lakes. (Choose one)

- very bad
- bad
- somewhat bad
- neutral
- somewhat good
- good
- very good

3) I'm going to read a list of activities that use surface water. Which of the following activities do you personally use surface water for? (choose all that apply)

- recreation (examples are fishing, swimming, boating)
- water source for livestock
- visual enjoyment
- irrigation of crops
- drinking water for human consumption
- other: (please specify): \_\_\_\_\_
- do not use surface water

**\*Give scale for question 4\***

4) How important is it to have good surface water quality for each of the activities you chose?

Please use the scale I gave you to rate the importance of good water quality for each use that I read.

Scale:

- 1 = not important at all
- 2 = somewhat important
- 3 = moderately important
- 4 = very important

- recreation (examples are fishing, swimming, boating)
- water source for livestock
- visual enjoyment
- irrigation of crops
- drinking water for human consumption
- other: (please specify) \_\_\_\_\_

5) How concerned are you about surface water quality in your area? (Check one)

- completely unconcerned
- unconcerned
- somewhat unconcerned
- neutral
- somewhat concerned
- concerned
- very concerned

**READ:** Now I have a few questions about changes in management practices that you've made to your operation for improving water quality. There will be separate opportunities to discuss changes supported by financial incentives and changes that were voluntary.

(An example if needed to clarify: spring fertilizer/manure application rather than fall application)

6) Have you participated in any government cost-sharing programs WHERE YOU WERE REIMBURSED to improve water quality? (Some examples are the Shelterbelt Program, Greencover Canada and the Canada-Alberta Farm Stewardship Program)

Yes            No

7) If so, what changes have you made (please list/briefly explain)?

If not, why not?

8) Have you noticed any differences because of those changes (yes/no for each change and brief description)?

(Some examples of differences might be lower fertilizer costs or less topsoil erosion)



9) Have you made changes to your management practices to improve water quality WITHOUT receiving any compensation (for example, based on information from government or from non-profit groups like the nature conservancy or ducks unlimited, by participating in an environmental farm plan, or on your own)?

Yes

No

a) IF YES, what were the changes (list)? Why did you decide to make these changes (brief explanation for each one, or if there are many, an overall sense)?

b) IF NOT, would you make changes that would improve water quality even if no compensation were offered (briefly explain answer)?

Yes

No

10) If the respondent HAS participated in programs:

a) In your opinion, what was the best program you participated in? Why was it the best?

b) What was the worst program you participated in? What made it the worst?

11) If the respondent HAS NOT participated in any programs:

a) Are there any programs that you've heard about that sounded like good programs? Why did they sound good?

b) Are there any programs that you've heard about that you think were poorly designed? Why?

**\*Give scale for question 12\***

12) When farmers and ranchers use practices that improve water quality, how much do different groups benefit, in your opinion? I'll give you a list of different groups, please rate each group with a number from the scale given to you:

Scale:

1 = does not benefit at all

2 = benefits somewhat

3 = benefits moderately

4 = benefits significantly

\_\_\_ the general public

\_\_\_ the farmer or rancher that adopts the practice

\_\_\_ those downstream that use the water

\_\_\_ other, specify: \_\_\_\_\_

**\*give scale for question 13\***

13) Who should be responsible for making sure that water quality is maintained at an acceptable level on agricultural land? (Please rate each group with a number from the scale given to you):

Scale:

- 1 = not responsible at all
- 2 = somewhat responsible
- 3 = moderately responsible
- 4 = very responsible

- \_\_\_ government
- \_\_\_ agricultural landowners
- \_\_\_ those downstream that use the water
- \_\_\_ non-profit organizations that are concerned about water quality
- \_\_\_ general public
- \_\_\_ other: (please specify) \_\_\_\_\_

**\*Give scale for question 14\***

14) People have a range of different opinions about agriculture and the environment. I am going to read some statements to you that represent these different opinions. I'd like you to rate how you feel about the statements on a scale of 1-7 given to you. (Provide the respondent with a description of the scale on a separate paper so that they have a reference) I am also interested to hear the reasoning behind your answer.

Scale:

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Somewhat disagree
- 4 = Neutral
- 5 = Somewhat agree
- 6 = Agree
- 7 = Strongly agree

\_\_\_ The government should create policy and programs for farmers and ranchers to make sure that water quality is maintained at an acceptable level

\_\_\_ Farmers and ranchers are stewards (or, put another way, caretakers) of the land

\_\_\_ Farmers and ranchers are responsible for the environmental effects of their production methods

\_\_\_ When the public benefits from ecological goods and services produced by farmers and ranchers, the public should pay for these benefits. (For example, if a farmer or rancher makes a change to improve water quality, the public should pay the producer based on how much water quality is improved.)

\_\_\_ Farmers and ranchers should be able to choose whether or not they participate in programs that aim to increase ecological goods and services.

\_\_\_ Farmers and ranchers have the right to use any management practice they choose on their land

\_\_\_ My taxes should not be increased to pay for ecological goods and services produced by agriculture

\_\_\_ The public should pay more for food that is produced using methods where ecological goods and services are also produced

\_\_\_ Payments should be made for ecological goods and services produced in the future, not those produced in the past.

\_\_\_ Farmers and ranchers should be paid for the ecological goods and services they produce, regardless of whether or not they incur additional expenses in producing them.

**READ:** In the past, the government has provided some incentive programs for farmers and ranchers to improve environmental conditions. These have mainly taken the form of payments to offset the costs associated with adopting management practices that are more environmentally beneficial or less environmentally damaging. There are, however, many different ways that environmental improvements can be encouraged.

15) Let's say a government program was introduced for farmers and ranchers that encouraged improvements to water quality. In your opinion, what characteristics would be important to have as a part of the program?

**Instructions:** Rate the following list of characteristics for their importance in being included in an environmental program. You have up to 10 points to give each characteristic. The number of points you give each characteristic will indicate its importance to you (more important characteristics should receive more points). If you feel some characteristics are not important at all, give them 0 points.

\_\_\_\_\_ provides financial incentives for farmers and ranchers

\_\_\_\_\_ helps ensure survival of rural communities

\_\_\_\_\_ improves water quality to meet safety guidelines for animals and aquatic life

\_\_\_\_\_ reduces health risk to humans from water contamination

\_\_\_\_\_ lowest possible cost to taxpayers

\_\_\_\_\_ no negative financial impact to farmers and ranchers

\_\_\_\_\_ provides the most environmental benefits possible with the least cost

\_\_\_\_\_ all farmers and ranchers should be eligible for program

\_\_\_\_\_ improves water quality for recreation (examples: swimming, fishing, boating)

\_\_\_\_\_ sustains water resources for future generations

\_\_\_\_\_ other: (please specify) \_\_\_\_\_

\_\_\_\_\_ other: (please specify) \_\_\_\_\_

## Demographics

I have just a few more questions about you and your household.

16) Watershed respondent resides in: (Check one)

- a) Indianfarm Creek
- b) Battersea Drain
- c) Whelp Creek

17)What is your age? (Check one)

- a) 18-25
- b) 26-35
- c) 36-45
- d) 46-55
- e) 56-65
- f) 66-75
- e) 76+

18)Main occupation (if more than one, the occupation that provides the majority of your income):

19) What is the percentage of total household income that comes from agricultural production?

20)Do you have children?

Yes

No

If so, what are their ages (please list)?

21) Do you think that someone from your family (children or grandchildren) will eventually take over the farm/ranch?

Are there any other comments you would like to make?

Thank you for your time!

## Appendix C: Consent form and survey instrument



### Letter of Invitation

I am a graduate student at the University of Saskatchewan. As a part of my PhD thesis, I am working on a project titled “A performance-based approach to agri-environmental policy: Development and comparative assessment”. As a part of this project, I invite your participation in a short questionnaire.

Your opinions and attitudes toward water quality issues and agriculture will be an important part of the project. The responses you provide will guide the development of an effective approach to environmental policy for agriculture that will be compared to the current programs available to agricultural producers.

You have been chosen as a participant based on your location. This research study will focus on three watersheds in Alberta: Indianfarm Creek and Battersea Drain in the south, and Whelp Creek in central Alberta. These watersheds represent the range of agricultural activities that take place in Alberta and together will provide a good understanding of the views of agricultural producers in the province.

I have attached a standard University of Saskatchewan ‘participant consent form’ below for your review. Please read the form carefully before proceeding with the questionnaire. A self-addressed, stamped envelope has been provided for you to return the questionnaire at no cost to you.

### Participant Consent Form

Please read this letter carefully, and feel free to ask any questions you might have.

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**Purpose and Procedure:** The purpose of this study is to understand and evaluate the viewpoints of residents of southern Alberta regarding water quality and environmental policies for agriculture. You are invited to participate in a questionnaire to convey your opinions on the importance you place on water quality, your perception of how agriculture contributes to water quality, and how you think environmental policy can be best designed to manage water in agricultural regions.

The questionnaire will take approximately 20 minutes to complete. Results will be aggregated and be used to evaluate similarities or dissimilarities between agricultural producers, and rural and urban residents. Overall, the results will guide the development of an alternative approach to environmental policy for agriculture. Your participation in this survey will provide valuable insight into how stakeholders and the public can participate in the development of public policy. This research is funded federally by the Social Sciences and Humanities Research Council, the Agriculture-Environment Policy Research Network and also by the University of Saskatchewan.

**Potential Risks:** There are no potential risks in participating in this study. Your name will not be used and results will be aggregated so that individual responses cannot be identified.

**Potential Benefits:** There are no direct benefits in participating in this study to you as an individual. The results in aggregate form will be shared with other respondents, federal and provincial agencies, academics and in thesis form for the School of Environment and Sustainability at the University of Saskatchewan in order to advance the sustainability of agricultural environmental policy.

**Storage of Data:** Questionnaires and results on a dedicated hard drive will be stored in the researcher's office during data analysis. These data will be stored in a locked cabinet in the researcher's possession for at least five years until all publications have been distributed. Only the researcher and supervisors will have access to this data.

**Confidentiality:** The responses you provide will be aggregated with others and used only in aggregate form. Your identity will be kept confidential at all times.

**Right to Withdraw:** Your participation in this questionnaire is completely voluntary and you may withdraw from this study for any reason, at any time.

**Questions:** You may contact the researcher with questions at any time using the contact information listed above. This study has been approved on ethical grounds by the University of Saskatchewan Behavioural Research Ethics Board on November 10, 2009. Any questions regarding your rights as a participant can be directed to the Board through the Ethics office (306-966-2084). You may call collect. All participants may receive a summary of the results once the study is complete.

**Consent to Participate:** I have read and understood the description provided above. I have been provided with an opportunity to ask questions and my questions have been answered satisfactorily. By completing this questionnaire, I consent to participate in the study described above; understanding that I may withdraw this consent under the terms outlined above.

## Survey

Water quality can be a concern in agricultural areas. The first few questions of this survey will focus on surface water quality. Examples of surface water include creeks, rivers, ponds and lakes.

Surface water quality can be negatively affected by agricultural fertilizers and animal manure. For example, fertilizers can increase concentrations of nitrogen and phosphorus in surface water, which can affect the survival of aquatic life and increase the growth of algae. Manure can contribute bacteria to surface water that is harmful to human health if ingested.

1. How would you rate surface water quality in your area (water that you see or use regularly)?  
(Check one)

- very bad
- bad
- somewhat bad
- neutral
- somewhat good
- good
- very good

2. What do you use surface water for? (check all that apply)

- recreation (examples are fishing, swimming, boating)
- water source for livestock
- visual enjoyment
- irrigation of crops
- drinking water for human consumption
- other: (please specify) \_\_\_\_\_
- I do not use surface water

3. How important is it to have good surface water quality for each of the following uses?  
Please use the scale in the grey box on the right to rate the importance of good water quality for each use. Write the number from the scale that corresponds to the importance you place on water quality for each use.

- recreation (examples: fishing, swimming, boating)
- water source for livestock
- visual enjoyment
- irrigation of crops
- drinking water for human consumption
- other: (please specify) \_\_\_\_\_

Scale:

- 1 = completely unimportant
- 2 = unimportant
- 3 = somewhat unimportant
- 4 = neutral
- 5 = somewhat important
- 6 = important
- 7 = very important

4. How concerned are you about surface water quality in your area? (Check one)

- completely unconcerned
- unconcerned
- somewhat unconcerned
- neutral
- somewhat concerned
- concerned
- very concerned

**Please read before answering questions below:** Agriculture has been credited with producing “ecological goods and services” in addition to crops or livestock. Ecological goods and services are environmental and social benefits that are by-products of agricultural practices, or else benefits purposely produced on agricultural land. Some examples of ecological goods and services are things like carbon storage (from zero tillage or pasture conservation), wildlife habitat (from conserving natural areas) and water filtration (from grassed waterways and wetlands). Often, the production of ecological goods and services has benefits that extend beyond the farm that produces them to the general public.

5. Different groups may benefit when agricultural producers adopt management practices that improve surface water quality. In your opinion, how much do the groups below benefit? Please rate each group with a number from the scale in the grey box on the right.

- the general public
- the farmer that adopts the practice
- those downstream of the farmer
- other: (please specify) \_\_\_\_\_

Scale: 1 = does not benefit at all 2 = benefits somewhat 3 = benefits moderately 4 = benefit significantly
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6. Who should be responsible for ensuring that water quality is maintained at an acceptable level in agricultural landscapes? (Please rate each group with a number from the scale in the grey box on the right)

- governments
- agricultural landowners
- those that use the water directly
- non-profit organizations focused on water quality
- general public
- other: (please specify) \_\_\_\_\_

Scale: 1 = not responsible at all 2 = somewhat responsible 3 = moderately responsible 4 = very responsible
--



7. People have different perspectives about agriculture and the environment. Some statements that represent these different perspectives are presented below. I'd like you to rate how you feel about the statements using the scale in the grey box below.

Scale:	
1 = strongly disagree	5 = somewhat agree
2 = disagree	6 = agree
3 = somewhat disagree	7 = strongly agree
4 = neutral	

Please read each statement carefully and put the number corresponding to your feeling next to each statement.

\_\_\_ The government should create policy and programs for farmers and ranchers to make sure that water quality is maintained at an acceptable level

\_\_\_ Farmers and ranchers are stewards (or, put another way, caretakers) of the land

\_\_\_ Farmers and ranchers are responsible for the environmental effects of their production methods

\_\_\_ When the public benefits from ecological goods and services produced by farmers and ranchers, the public should pay for these benefits. (For example, if a farmer or rancher makes a change to improve water quality, the public should pay the producer based on how much water quality is improved.)

\_\_\_ Farmers and ranchers should be able to choose whether or not they participate in programs that aim to increase ecological goods and services.

\_\_\_ Farmers and ranchers have the right to use any management practice they choose on their land

\_\_\_ My taxes should not be increased to pay for ecological goods and services produced by agriculture

\_\_\_ The public should pay more for food that is produced using methods where ecological goods and services are also produced

\_\_\_ Payments should be made for ecological goods and services produced in the future, not those produced in the past.

\_\_\_ Farmers and ranchers should be paid for the ecological goods and services they produce, regardless of whether or not they incur additional expenses in producing them.

**Read before answering question:** Federal and provincial governments have provided some programs to agricultural producers to improve environmental conditions. These have mainly taken the form of payments to offset the costs associated with adopting management practices that are more environmentally beneficial or less environmentally damaging. There are, however, many different ways that environmental improvements can be encouraged.

8. Let's say a government program was introduced for agricultural producers that encouraged improvements to surface water quality. In your opinion, what characteristics would be important to have as a part of the program? Please read the directions below before answering this question.

*Directions to answer this question:*

Rate the following list of characteristics for their importance in being included in an environmental program. You have up to 10 points to give each characteristic. The number of points you give each characteristic will indicate its importance to you (more important characteristics should receive more points). If you feel some characteristics are not important at all, give them 0 points.

- \_\_\_\_\_ provides financial incentives for farmers and ranchers
- \_\_\_\_\_ helps ensure survival of rural communities
- \_\_\_\_\_ improves water quality to meet safety guidelines for animals and aquatic life
- \_\_\_\_\_ reduces health risk to humans from water contamination
- \_\_\_\_\_ lowest possible cost to taxpayers
- \_\_\_\_\_ no negative financial impact to farmers and ranchers
- \_\_\_\_\_ provides the most environmental benefits possible with the least cost
- \_\_\_\_\_ all farmers and ranchers should be eligible for program
- \_\_\_\_\_ improves water quality for recreation (examples: swimming, fishing, boating)
- \_\_\_\_\_ sustains water resources for future generations
- \_\_\_\_\_ other: (please specify) \_\_\_\_\_
- \_\_\_\_\_ other: (please specify) \_\_\_\_\_
- \_\_\_\_\_ other: (please specify) \_\_\_\_\_

Finally, a few questions about you and your household:

9. What is your age? (Check one)

- \_\_ 18-25
- \_\_ 26-35
- \_\_ 36-45
- \_\_ 46-55
- \_\_ 56-65
- \_\_ 66-75
- \_\_ 76+

10. What is your main occupation (if more than one, the occupation that provides the majority of your income):

\_\_\_\_\_

11. If you are an agricultural producer, what activities occur on your land (both leased and owned)? Please write the approximate percentage of your total household income that each activity listed below provides.

(If you are not an agricultural producer, you may skip to question 13)

- \_\_\_\_\_ Annual crop production
- \_\_\_\_\_ Perennial crop production
- \_\_\_\_\_ Feedlot operation
- \_\_\_\_\_ Cow/calf operation
- \_\_\_\_\_ Dairy operation
- \_\_\_\_\_ Hog operation
- \_\_\_\_\_ Chicken production
- \_\_\_\_\_ Other (please specify): \_\_\_\_\_

12. If you are an agricultural producer, what is the approximate percentage of total household income that comes from agricultural production?

\_\_\_\_\_

13. Do you have children? (Check one)

- \_\_\_ Yes
- \_\_\_ No

If so, what are their ages? (Please list)

\_\_\_\_\_

\_\_\_\_\_

14. Please provide any additional comments you wish to make. These comments can be general or about a specific response you gave in the survey:

Thank you for taking the time to complete this survey!

**Please fill out the address card in the return envelope if you wish to receive a report summarizing the results of this survey.**

## Appendix D: Legislated and voluntary measures in Alberta to manage water quality on agricultural landscapes

**Table D-1.** Summary of Alberta legislative context related to agriculture and water quality

Act	Potential impact on agriculture	Scope
<b>Agricultural Operations Practices Act</b>	<ul style="list-style-type: none"> <li>-new large livestock operations require approvals</li> <li>-sets out a standard of 'generally accepted agricultural practices' but does not define them</li> </ul>	<ul style="list-style-type: none"> <li>-Agricultural nuisance claims</li> <li>-Manure management</li> </ul>
<b>Alberta Land Stewardship Act</b>	<ul style="list-style-type: none"> <li>-Created the necessary legislation for the Alberta Land Use Framework</li> <li>-Each of seven regions must institute a land use plan that may include market-based instruments and actions on private lands to achieve conservation and stewardship goals</li> </ul>	<ul style="list-style-type: none"> <li>-Province of Alberta with the seven regions delineated by watershed boundaries</li> <li>-Manages economic, environmental and social goals</li> </ul>
<b>Environmental Protection and Enhancement Act (EPEA)</b>	<ul style="list-style-type: none"> <li>- Restricts release of pesticides and manure into water bodies</li> <li>-Codes of practice around pesticide handling</li> <li>-Requirement to obtain approval for new confined feeding operations</li> </ul>	<ul style="list-style-type: none"> <li>-Potentially harmful substances in water bodies</li> </ul>
<b>Water Act</b>	<ul style="list-style-type: none"> <li>-Created the necessary legislation for water management planning at the watershed scale</li> <li>-Created legislative capacity for <i>Water For Life</i> provincial water management strategy</li> </ul>	<ul style="list-style-type: none"> <li>-Water allocation and conservation in Alberta</li> </ul>
<b>Wildlife Act</b>	<ul style="list-style-type: none"> <li>-Requires recovery plans for specific species</li> <li>-Restricts activities on critical habitat for species at risk</li> </ul>	<ul style="list-style-type: none"> <li>-Critical habitat lands where recovery plans have been created for species at risk</li> </ul>

**Table D-2.** Voluntary agri-environmental programs related to water quality currently provided by Canadian and Alberta governments and non-governmental organizations<sup>1</sup>

<b>Program</b>			
<b>Agency</b>	<b>Name</b>	<b>Characteristics</b>	<b>Length</b>
<b>Funded by federal government under “Growing Forward” policy framework</b>			
Government of Alberta	Stewardship Plans: Integrated Crop Management (ICM); Grazing and Winter Feeding Management; and Manure Management	<p><u>Objective:</u> Demonstrate environmental practices and make operational improvements that reduce environmental impacts (including water quality impacts)</p> <p><u>Structure:</u> Develop a work plan based on approved practices (for example, off-site watering system purchase or groundwater monitoring near manure storage). An Environmental Farm Plan must be completed prior to applying for these plans</p> <p><u>Payment:</u> 50/50 cost share up to a maximum from \$15,000-\$50,000 depending on plan</p> <p><u>Follow-up:</u> Information not available</p>	2009-2013 (or until funds have been exhausted)
Agri-Environment Services Branch (federal)	Prairie Shelterbelt Program	<p><u>Objective:</u> Conserve water and, more broadly, to promote environmental stewardship and BMPs</p> <p><u>Structure:</u> Trees are provided for all landowners with the completion of a shelterbelt plan</p> <p><u>Payment:</u> Trees are free; labour and all other costs are the responsibility of the landowner</p> <p><u>Follow-up:</u> Applicant agrees to on-site inspection</p>	Ongoing since 1901
Government of Alberta	Water Management Program	<p><u>Objective:</u> Create long-term water management plans to ensure water quality and quantity in the future</p> <p><u>Structure:</u> Agricultural landowners must create a plan (proposed improvements to meet quantity and quality goals). Landowners with approved plans are eligible to apply for grants for specific projects outlined in the plan</p> <p><u>Payment:</u> 1/3 cost share up to \$5,000</p> <p><u>Follow-up:</u> Inspections may occur; if non-</p>	2009-2013

		compliant, funding forfeiture and prosecution	
Agriculture and Agri-Food Canada	Sustainable Agriculture Environment Systems	<p><u>Objective:</u> To accelerate development of BMPs to manage water and climate adaptation</p> <p><u>Structure:</u> Funding for researchers to develop BMPs</p> <p><u>Payment:</u> No payments for agricultural producers, this program creates new BMPs</p>	2009-2013
Agricultural Research and Extension Council of Alberta	Sustainable Grazing Mentorship	<p><u>Objective:</u> Match agricultural producers with mentors to improve profitability and health of pastures and manage environmental issues on pasture land</p> <p><u>Structure:</u> For a fee, producers are matched with a mentor and a grazing plan is developed together</p> <p><u>Payment:</u> Producers pay \$100 for up to 16 hours of consultation</p>	Information not available
Alberta Agriculture and Rural Development	Environmental Farm Plan (EFP)	<p><u>Objective:</u> Develop whole farm plans that identify environmental risks and mitigate them, as well as find opportunities to improve operations</p> <p><u>Structure:</u> Agricultural producers create an EFP by working through a guided process including facilitated workshops and a workbook. Once a plan to alleviate environment risks is in place, agricultural producers can apply for federal programs that provide cost-sharing funding.</p> <p><u>Payment:</u> None. Process is voluntary and provided at no cost to the producer. An EFP is required for some cost-sharing programs</p> <p><u>Follow-up:</u> None. Participants are not required to complete any tasks set out in EFP. Proof of completion of the plan is required to apply for some government programs</p>	Since 2003 in Alberta
<b>Many funding partners (Public and private)<sup>2</sup></b>			
Alberta Riparian Habitat Management	Cows and Fish Program	<p><u>Objective:</u> Manage riparian areas through awareness and education</p> <p><u>Structure:</u> Provide baseline assessments of</p>	Since 1992

Society		<p>riparian areas, monitoring services, and provide educational and technical assistance for implementing measures to improve riparian zones. Work generally occurs at the watershed scale.</p> <p><u>Payment:</u> None. Provide educational material and technical assistance at no charge to the landowner</p>	
Alberta Fish and Game Association	Parkland Stewardship Program	<p><u>Objective:</u> Educate rural landowners to improve wildlife habitat and ecological values of rural land</p> <p><u>Structure:</u> Provides air photos, natural resource inventories, surface water quality monitoring tools, conservation plans and site-specific best management practices.</p> <p><u>Payment:</u> None. Offers assistance at no charge.</p>	Information not available
Southern Alberta Land Trust Society	Conservation Easements	<p><u>Objective:</u> Conserve ecologically sensitive rangeland in southern Alberta</p> <p><u>Structure:</u> Offers conservation easements that maintain important ecological, social, agricultural, scenic and historic functions of the land by restricting activities on it in perpetuity or outright purchases of land from agricultural landowners</p> <p><u>Payment:</u> Variable, depending on the agreement, but up to the full market value of a parcel of land. In the case of conservation easements, the value of the easement (forgone income) becomes a tax credit</p> <p><u>Follow-up:</u> Participants must ensure donations meet requirements for tax credits</p>	Since 1998
Ducks Unlimited Canada (DUC)	Conserving Your Agricultural Land	<p><u>Objective:</u> To create suitable habitat for waterfowl (these activities also have a positive impact on water quality, even though this is not the explicit focus)</p> <p><u>Structure:</u> Offers a number of options for landowners, including transitioning from cropland to perennial cover, planting native and</p>	Since 1938

		<p>tame grasses, and land-use exchange</p> <p><u>Payment:</u> There are incentive payments for the transition to perennial cover, a discounted price for grass seed, and the land-use exchange is a straight trade between conservation of the landowner's sensitive lands and suitable agricultural land owned by DUC</p> <p><u>Follow-up:</u> Information not available</p>	
<p><sup>1</sup> Current as of April, 2011</p> <p><sup>2</sup>This list is not exhaustive, but provides examples of the types of programs offered to agricultural producers by NGOs</p>			

(AAFC 2011; DUC 2011; AARD 2011; Alberta Riparian Habitat Management Society 2011; AFGA 2011; SALTS 2011)

### Literature cited

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