

# Practices and Models for Agricultural Water Conservation

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## EXECUTIVE SUMMARY

Agricultural industry has played an important role in Canada's economic activities since Canada first became a country. Such importance to the economy, as well as the special reverence in which family farms are held, suggest that agriculture's continued vitality is essential for Canada's prosperous future. However, it is widely recognized that the development of agricultural industry is primarily constrained by water availability and faced with producing more food with less water. This is especially true in Canada where agriculture currently accounts for major water demand and is competing for limited water with domestic and industrial needs. Besides, conventional agricultural production practices are potentially harmful to the environment directly or indirectly, especially directly to the quality of water body, such as crop residue burning or deep soil inversion by tilling to control weeds and to prepare the seed bed. These practices considerably increase river contamination with sediments, fertilizers and pesticides. In addition, emission of greenhouse gas (GHG) associated with conventional agriculture practices is significant, which contributes to global warming and reduces the sustainability of agriculture by lowering soil organic matter and fertility, along with further negative environmental effects (e.g. a decrease in biodiversity).

To support sustainable development of agricultural industry, the protection of environment and mitigate and adapt to changing climate, an effective management of water consumption and conservation is desired. The management deals with using the water in more efficient, economical or sustainable manner. It not only entails the development of traditional water supply projects such as reservoirs and new pipeline connections, as well as the retrofitting of water supply infrastructure with more efficient distribution technologies but also explore new technologies and policies that encourage to use water in conservative manner. In brief, the management of agricultural water use is not an isolated activity but is related to economic, political and social acceptability, technical feasibility, and environmental sensibility. Hence, it would be a big challenge for researchers to have a thorough understanding of various practices for agricultural water conservation.

Previously, a number of researches were developed to explore the effective practice for using water in a conservative manner. For example, drip irrigation is one of such techniques consisting of a network of porous or perforated piping, usually installed on the surface or below ground, which delivers water directly to the root zones of crops. However, research on the development and applications of these practices and techniques is only the half way of for supporting the effective management of agricultural water consumption. The other part is the extensive research on the modeling approach that would provide the in-depth analysis of the generation, transportation, distribution, consumption and other related activities of contaminants' transportation and fate associated with agricultural water using process. Such modeling results could be effectively used for guiding and evaluating the development and applications of various water conservation practices.

Nevertheless, all water conservation practices determined by site-specific information would vary in different countries. A practice that is capable of reducing agricultural water demand in one country might not have the same effectiveness of its application in Canada. This could be partly due to the specific features plant type and growing manner. In addition, the Canadian topography, climate conditions and social system would also affect the application of practices. Similarly, models that were originally developed for guiding and analyzing those conservation practices in other country might not be effective when they are applied in Canada.

Therefore, based on the evaluation of agricultural water conservation practices that are utilized in the world and various typical models that were developed for supporting the management of agricultural water conservation, the objective of this report is to present an overview of the current practices and models for agricultural water conservation at the watershed scale to highlight some of the water conservation practices that could be potentially utilized in Canada and proactive modeling tools that would support the in-depth analysis of those practices in a Canada's climatic, topographic, plant type's and producing manner's context.

In this report, a variety of issues of water quantity, water quality and soil loss related to agricultural activities were identified, such as low efficient irrigation system; poorly drained irrigation water waterlogs and drowns crops, contamination of nutrients and pesticides from agricultural land, soil erosion that could threat the sustainability and productive capacity of conventional agriculture. Effective improvements and strategies in dealing with these issues were examined. Various water conservation practices that could be or potentially be used for agricultural water management in Canada were then explored. Furthermore, agricultural practices for water quality protection and soil erosion controlling are also investigated. In addition, a number of modeling tools that currently used to model agricultural water conservation practice were evaluated in regards characteristics, validation and simulation capabilities. Such evaluation can provide a guideline for potential user in choosing an appropriate model for supporting effective policy initiation and analysis of water conservation practices.

This report is presented in five chapters. Chapter 1 is an introduction. Chapter 2 provides background information and literature review on the agricultural water conservation practices and modeling research. This chapter equips the reader with a comprehensive understanding of the technical information that follows. Chapter 3 describes the management and practices of agricultural water conservation currently known. Chapter 4 presents a number of modeling researches to various issues of water quantity, water quality and soil loss relating the water conservation of agriculture. Chapter 5 provides the concluding remarks and some recommendations based on this study effort.

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