Watershed Evaluation of Beneficial Management Practices (WEBs)

Program Overview

The **Watershed Evaluation of Beneficial Management Practices (WEBs)** program is assessing the environmental and economic performance of agricultural beneficial management practices (BMPs) at nine small watershed sites (approximately 300-2,500 hectares each) across Canada (Figure 1). A watershed is an area of land from which all runoff drains into the same water body, and BMPs are farming practices designed to minimize negative impacts on the environment. Water quality degradation caused by excessive sediment and nutrient runoff can be a critical environmental impact in agricultural watersheds.

Agriculture and Agri-Food Canada (AAFC) launched the WEBs program in 2004 and funding is currently provided under AAFC's *Growing Forward* initiative. Research is conducted in partnership with over 70 government, academic and other groups. The innovative work conducted within WEBs is only possible through the willingness of producers to allow research to be conducted on their farms. Local watershed conservation groups are working alongside producers and scientists to provide on-the-ground support for WEBs research. Ducks Unlimited Canada has been a key partner by contributing funding and expertise.

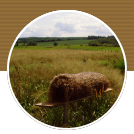
Much has been learned from WEBs research to date. This Program Overview highlights research and findings from the first eight years of the study.

What is WEBs studying?

WEBs is primarily focused on assessing the effect of BMPs on water quality. Other important indicators of environmental health—such as soil and air quality, biodiversity and greenhouse gas emissions—are also being examined at several WEBs watershed sites.

Figure 1. Location of the nine WEBs watershed sites

Canada



Each of the WEBs watershed studies includes the following components:

- ***Biophysical evaluations*** measure the environmental impact of BMPs.
- ***Economic evaluations*** examine the costs and benefits of implementing BMPs.
- ***Hydrologic modelling*** uses data from the biophysical component to assess the process by which nutrients and sediments are transported by water from agricultural land to receiving streams and the impact of these processes on BMP performance.
- ***Scaling up*** is being done using computer modelling to allow findings to be extrapolated to intermediate and regional watershed levels.

Integrated modelling activities underway within WEBs are combining hydrologic and economic variables into a decision-support tool for long-term watershed planning. Integrated modelling frameworks have been created for two pilot sites (Manitoba and Quebec), and several other WEBs sites are working on including this approach in their analyses.

WEBs BMPs implemented by watershed

BMPs studied in WEBs were selected to address specific watershed conditions and to reflect local and regional BMP interests. As a result, the suite of BMPs is different at each location (Figure 2). Much of the knowledge gained from the individual WEBs watershed projects can be applied to BMP performance in general.

		BC	AB	SK*	MB	ON	QC	NB	NS	PE*
	WEBs BMPs	Salmon River	Lower Little Bow River	Pipestone Creek	South Tobacco Creek/ Steppler	South Nation	Bras d'Henri/ Fourchette	Black Brook	Thomas Brook	Souris River
Riparian	Cattle exclusion fencing (and off-stream watering)	✓	✓			✓			✓	
	Off-stream watering without fencing		✓							
	Riparian vegetation management				✓					
In-field	Nutrient input / management (commercial fertilizer, manure)		✓	✓			✓		✓	✓
	Tillage / crop residue management				✓		✓			✓
	Crop rotation						✓			
	Perennial cover			✓	✓					
	Reduced herbicide use						✓			
	Winter bale-grazing			✓	✓					
	Irrigation efficiency	✓								
Runoff / discharge	Diversion terraces and grassed waterways							✓		
	Surface runoff control measures						✓			
	Buffer strips		✓					✓		
	Farmyard runoff management								✓	
	Runoff retention pond				✓				✓	
	Small reservoirs				✓					
	Wetland restoration			✓						
	Controlled tile drainage					✓				

*The Saskatchewan and Prince Edward Island WEBs projects have been operating since late 2009.

Figure 2. WEBs BMPs by category and the watershed where they are being tested

Why evaluate BMPs at the watershed scale?

Prior to WEBs, the costs and environmental benefits of BMPs were seldom measured beyond small plot and field experiments. By evaluating BMPs at the watershed scale, researchers can get a clearer picture of their performance by evaluating the combined effects of soils, topography, local climate and land use. To make the findings applicable to the agricultural landscape, WEBs studies are conducted on working farms where operational realities are taken into consideration in designing and conducting BMP experiments.

Figure 3: The primary focus in WEBs has been on water quality, although other environmental parameters—such as riparian health and greenhouse gases—are being considered at several sites.

Figure 4: The hog slurry management BMP uses spreaders adapted with trailing hoses in order to reduce nitrogen losses to the atmosphere.

What is WEBs learning?

WEBs has made significant progress in understanding the environmental and economic performance of BMPs. Progress has been made in validating hydrologic models using results from field-tested BMPs. And WEBs has successfully begun to integrate and extrapolate (scale up) biophysical and economic findings for broader planning purposes.

Environmental performance of BMPs

The BMPs studied in WEBs have varying environmental impacts. More than half of the BMP tests conducted to date have been found to reduce the contamination of surface waters by nutrients or sediment. WEBs researchers continue to study and quantify the nature of this reduction. Some BMPs were found to have both positive and negative environmental effects. Improvements to one parameter may come at the expense of degradation to another. For some BMPs, the impact on water quality was unclear but was positive for other environmental indicators such as riparian vegetative health or the health of aquatic invertebrate populations.

Much has been learned within WEBs about the interaction of landscape processes and BMP performance. For example, some BMPs are more effective during the growing season than during snowmelt runoff when the ground is still frozen, and BMP performance was found to vary with soil type.

Economic impact of BMPs

Most of the BMPs studied in WEBs have high implementation and/or maintenance costs, so it is important to study the economic impact of BMP adoption on farmers. WEBs research has shown that about 75 percent of the BMPs tested may contribute somewhat to improved financial returns—such as increased yields or cattle weight gain. The controlled tile drainage BMP (in Ontario) paid for itself through increased crop yields while improving off-farm water quality. Future research in WEBs will help to identify the on-farm and off-farm (public) benefits of other BMPs.

Hydrologic modelling results

The Soil and Water Assessment Tool (SWAT) is the primary hydrologic model used in most WEBs watersheds. Model calibration was initiated using field data or literature-derived values for initial input. Some modelling components were modified to better suit Canadian climatic conditions and to accommodate specific BMPs. Most model projections suggest a long-term reduction in sediment and nutrient loading. These initial results are being validated using WEBs field data.

Figure 5: Increased cattle weight gain and/or milk yields may partially offset the costs of exclusion fencing and off-stream watering.

Scaling up and integrated modelling results

Extensive hydrologic and economic assessments as well as socio-economic studies into the factors affecting farmers' willingness to adopt BMPs are being conducted on the two pilot sites. The resulting data are being incorporated into the WEBs integrated hydrologic-economic models to support the scaling up of findings and future decision-support activities.

Figure 6: The integrated modelling software for the South Tobacco Creek Watershed displays environmental effects and economic impacts on a map to assist in decision making.

Future of WEBs research

The WEBs program has created the infrastructure, data sets and partnerships needed to continue long-term watershed research. Such long-term studies are essential in evaluating ecological and water chemistry changes resulting from the implementation of BMPs. By gaining a more accurate picture of water and nutrient cycling in WEBs watersheds, the program is gathering consistent information to identify and assess environmental trends.

Information from WEBs studies will help farmers decide which practices work best on their farm and will help governments develop policies and programs to assist farmers in implementing effective BMPs. The end result will be improved water quality through better agricultural practices. Innovative, interdisciplinary research at the WEBs watershed sites will strengthen Canada's reputation as a leader in sustainable agriculture while contributing to a better quality of life for Canadians.

More information

Visit www.agr.gc.ca/webs or contact WEBs at webs@agr.gc.ca.

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