

EXECUTIVE SUMMARY OF:

Benefits from Agriculture and Agri-Food Canada's shelterbelt program: Economic valuation of public and private goods.

By: **Suren Kulshreshtha, Ph.D.** Professor of Agricultural Economics,
University of Saskatchewan, Saskatoon, SK, S7N 5A8

and

Edward Knopf, M.Sc. Northern Bounty Trading, 2251 McTavish Street,
Regina, Saskatchewan, S4T 3X3

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Agriculture and Agri-Food Canada's Agroforestry Division, Indian
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Executive Summary

The Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration (AAFC-PFRA) Shelterbelt Centre, located at Indian Head, Saskatchewan, was established in 1901. Since its inception the Centre has been involved in two major activities: One, Distribution of tree seedlings for planting as shelterbelts on farms as well in other non-farm environments (such as roads, parks, Indian Reservations, research stations, among others); Two, research, development and technology transfer activities. To a certain extent these two activities are complementary, since more technology transfer activities can be postulated to arouse interest among the landowners to the point they would decide to plant shelterbelts.

By the end of 2002, an estimated 576 million tree seedlings have been distributed to over half a million users / agencies, although some of them are repeat customers. In a typical year, number of tree seedlings distributed by the Centre has varied between 4 and 12 million, with the average for the entire period being 5.65 million. Much of this distribution has been concentrated in the provinces of Manitoba and Saskatchewan, with Alberta getting a relatively smaller share. Of the total number of tree seedlings distributed over the 1981-96 period, the largest share (88.6% of the total) was received by landowners for planting field and farmstead shelterbelts.

Shelterbelts are intimately related to many ecosystem functions, particularly those related to air, water, soil and biota. Through these, they bring forth many economic benefits to various members of the society. The research questions posed in this study are:

- What are the major benefits to the society from the shelterbelts;
- Who receives them?
- What is the magnitude of these benefits from shelterbelts?

In addition to these questions, there is the issue of feasibility of undertaking such estimations – do we have sufficient information and data to place an economic value to the changes in the ecosystem functions related to shelterbelts? This study was undertaken to answer the above questions. In particular, it was designed to identify and estimate (subject to data and information availability) various benefits from shelterbelts to the Canadian (including local) society. The scope of the investigation covers both distribution and the research, development and technology transfer activities undertaken by the Centre. Thus, this is a total of two sets of activities by the Centre – the Shelterbelt Program, which is the growing and distribution of tree seedlings, and the other activities undertaken by the Centre.

Total benefits of the AAFC-PFRA Shelterbelt Centre activities were postulated to be received by two major groups: Those who plant them, and those who do not plant them but still receive some benefits from them indirectly. The first group of benefits was labelled ‘Private benefits’ and the second one as ‘External Benefits’, often labelled as “Social Benefits”. The latter group of benefits are received by those members of the

society who have not planted the shelterbelts themselves. These, therefore, become externalities of the shelterbelt program.

External benefits were a sum of two sub-categories of benefits: those provided through generation of public goods (called public-goods-related externalities), and those provided by non-public goods (called non-public-goods-related externalities). Public goods are a special category of goods and must satisfy two characteristics; One, no one can be excluded from enjoying these benefits; and Two, just because someone has enjoyed these benefits, it should not diminish the level of benefits received by other users. Any external benefit that does not satisfy these two criteria is labelled as a non-public good-related externality.

Social benefits from the AAFC-PFRA Shelterbelt Centre were broadly divided into two sets: One set of activities pertained to distribution of tree seedlings to various parties leading to many social (private and external) benefits from planted shelterbelts. The second set of benefits was from research, development and technology transfer activities of the Centre. This latter set of benefit was somewhat more difficult to estimate since these activities also lead to a higher uptake rate by individuals to plant shelterbelts. Some double-counting of benefits thus could exist. On account of lack of data, these benefits were treated in a qualitative manner.

Various benefits from shelterbelts were hypothesized to be generated through economic and social changes or through ecosystem functions. It should be noted that that some of the ecosystem function-related changes result in social and economic changes / impacts, that lead to social benefits. Thus, some benefits are direct in nature, while others are indirect.

The indirect benefits to society, generated though various pathways to ecosystem functions, included the following bio-physical changes induced by shelterbelts:

- **Soil**
 - Reduced soil erosion
 - Shoreline protection

- **Air**
 - Reduced odours from animal production sites
 - Reduced pesticide drift (also affecting water quality indirectly)
 - Reduced greenhouse gas accumulation in the atmosphere

- **Water**
 - Water quality through filtering function
 - Floodplain management
 - Wastewater management

- **Biota**

- Wildlife habitats
- Wildlife based recreation
- Increased biodiversity

In addition the following direct socio-economic changes were identified:

- **Economic**
 - Energy conservation
 - Aesthetic and related amenities
 - Improved farm level economic efficiency
 - Transportation infrastructure related and traffic related impacts
 - Health impacts

- **Social**
 - Quality of life

Readers should note that some of these economic impacts (resulting in benefits or costs) are a result of the ecosystem function changes. Similarly the social impacts (in terms of quality of life) are a culmination of various economic and environmental changes.

At least theoretically, each of the ecosystem changes and direct and indirect socio-economic changes could result in private benefits as well as social benefits (both public-goods-related and non-public-goods-related). However, certain types of benefits were hypothesized to be relevant but could not be estimated due to poor information available.

Total social benefits of an ecosystem can be approximated by the “Total Economic Value” framework where the total value is a sum of use-related and non-use-related values. The latter groups of values, although very relevant, are difficult to estimate and were excluded from this study.

A benefit received by a member of the society is the economic value of the impact (change) that is generated by the shelterbelt either directly or indirectly through ecosystem functions. How these values should be estimated is replete with problems. There are at least two schools of thought on this subject. One school, called the utilitarian school, believes that a change in ecosystem functions is relevant only if it affects the human well-being of members of society. This is the anthropocentric view of the ecosystems. They are here to serve the mankind, and only through that process have a value to them. This view is not shared by another school of thought, called the non-utilitarian (ecocentric) school, where an ecosystem has an intrinsic value by itself. Since these values are very culture and political system specific, they are difficult to estimate and therefore, not attempted in this study. This should not be interpreted to suggest that intrinsic values are not relevant to the society. In fact, these may be as, if not more, important than the anthropocentric values. However, a general lack of methodologies to estimate such values led to this decision. Examination of intrinsic values of shelterbelts is left for future studies in this area.

In this study, values were estimated using the anthropocentric school of valuation. Here the value was equated to the willingness-to-pay for a given good or service. Since many of the ecosystem generated goods are not traded in the marketplace, non-market valuation methods were applied. Even here, methodology was based on available studies on valuing a given change. If such studies were not found, no benefits were estimated, although addressed in a qualitative manner. As noted above, private benefits were identified but not estimated quantitatively (with some exceptions). Results are shown in Table A. Since most benefits were treated in a qualitative manner, the only observation that can be made is that shelterbelts generate large benefits to the producers. A survey of landowners supported this conclusion.

Social benefits (through public goods and non-public goods) were estimated to be significant. Results are shown in Tables B and C, respectively. Several of these benefits could not be estimated on account of poor data or lack of evidence on connection between shelterbelts and human well-being. However, all things considered, estimated social benefits from shelterbelts established during 1981 to 2001 under this program are in the range of \$105 million to \$601 million. Since some benefits could not be estimated, the real value of the AAFC-PFRA Shelterbelt Centre's program exceeds this level of benefits. In addition, several private benefits were identified as well.

This study has established a significant value of social benefits from various public-goods-related and non-public-goods-related benefits from shelterbelts. In final analysis, some of the benefits could not be estimated, primarily on account of many data and information gaps connecting shelterbelts with human well-being. In summary, many of the issues society faces in evaluating the social (private and external) benefits suffer from a lack of multi-disciplinary approach to research questions. To build a multi-disciplinary approach, researchers would require a joint effort in formulating the hypotheses to begin with. It is at this point that both the social and scientific information needs are identified and research design formulated accordingly. Shelterbelts are an important resource to the Canadian society; they benefit landowners as well as other members of the society either directly and/or indirectly. A multidisciplinary approach to generate hypotheses would in itself generate numerous interesting research areas.

Table A: Private Benefits from Shelterbelts from Tree Seedlings Distributed by the AAFC-PFRA Shelterbelt Centre during 1981-2001

Pathway	Biophysical Impact	Level of Benefits (Million Dollars)	Level of Confidence
Soil	Reduced soil erosion	High (Affects farm level productivity)	High
	Shoreline stabilization	May be significant for some farmers (N.E.)*	
Air	Odour reduction	May be significant on livestock farms and Intensive Livestock operations (N.E.)	
	Air quality (non-odour related)	May be important (N.E.)	
	Improves air quality through reduced pesticide drift	None	
	Reduced greenhouse gas emissions	None (except if carbon credits are available)	High
Water	Water quality	N.E.	
	Salinity reduction	N.E.	
	Floodplain management	May be important for farms located in valleys (N.E.)	
	Wastewater management	None	
Biota	Biodiversity	None directly	
	Consumptive wildlife based recreation	May be important (Included under social benefits)	
	Bird watching	May be important (Included under social benefits)	
Socio-Economic	Energy conservation	\$46 - \$341	Medium
	Property values	Likely significant	Low
	Farm level production activities	Very highly significant	High
	Transportation activities	Likely low to medium (N.E.)	Low
	Health impacts	May be important (Included under social benefits)	
Research, Development & Tech Transfer		Medium (Through reduced cost of maintenance of shelterbelts on farms)	Low
Total of Estimated Benefits		\$46 - \$341 + unquantified benefits	

* N.E. = Not estimated

Table B: External Public-Goods-Related Benefits from Shelterbelts from Tree Seedlings Distributed by the AAFC-PFRA Shelterbelt Centre during 1981-2001

Pathway	Biophysical Impact	Level of Benefits (Million Dollars)	Level of Confidence
Soil	Reduced soil erosion	\$8 - \$122 (Includes non-public goods related benefits)	Low
	Shoreline stabilization	Likely low (N.E.)*	
Air	Odour reduction	Significant (N.E.)	
	Air quality (non-odour related)	\$4 (Likely duplication with reduced soil erosion) (Includes non-public goods related benefits)	Low
	Improves air quality through reduced pesticide drift	Captured under water quality (N.E.)	
	Reduced greenhouse gas emissions	\$56 - \$417	High
Water	Water quality	\$1.2	Low
	Floodplain management	Likely low (N.E.)	
	Wastewater management	Likely low (N.E.)	
Biota	Biodiversity	\$5 - \$16	Low
	Consumptive wildlife based recreation	None	
	Bird watching	None	
Socio-Economic	Energy conservation	\$0.2 - \$9.9	Medium
	Property values	None	
	Farm level production activities	None	
	Transportation activities	Likely low to medium (N.E.)	Low
	Health impacts	Likely of medium significance (N.E.)	
Research, Development & Tech Transfer		Significant	
Total of Estimated Benefits		\$74 - \$570	

* N.E. = Not estimated

Table C: External Non-Public-Goods-Related Benefits from Shelterbelts from Tree Seedlings Distributed by the AAFC-PFRA Shelterbelt Centre during 1981-2001

Pathway	Biophysical Impact	Level of Benefits (Million Dollars)	Level of Confidence
Soil	Reduced soil erosion	Included under public goods	
	Shoreline stabilization	None	
Air	Odour reduction	Significant (N.E.)*	
	Air quality (non-odour related)	Significant (N.E.)	
	Improves air quality through reduced pesticide drift	Included under public goods	
	Reduced greenhouse gas emissions	Included under public goods	
Water	Water quality	Included under public goods	
	Floodplain management	Likely low (N.E.)	
	Wastewater management	N.E.	
Biota	Biodiversity	N.E.	
	Consumptive wildlife based recreation	\$29	Medium
	Bird watching	\$2	Low
Socio-Economic	Energy conservation	Likely low (N.E.)	
	Property values	Likely low (N.E.)	
	Farm level production activities	None	
	Transportation activities	None	
	Health impacts	Significant (N.E.)	
Research, Development & Tech Transfer		Medium (N.E.)	
Total of Estimated Benefits		\$31	

* N.E. = Not estimated