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2004-02-19

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Public and Private Benefits from Shelterbelt Centre Activities

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Key Words: shelterbelts, prairies, benefits, public goods, Shelterbelt Centre

Abstract

The Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration (AAFC-PFRA) Shelterbelt Centre was established at Indian Head in 1901 and since then has been a major source of tree seedlings to prairie farmers and to other eligible interested agencies. The Centre has distributed over 576 million tree seedlings. On farms, these shelterbelts have become an important resource, both to the producers as well as to the society as a whole. A survey of producers attending the Shelterbelt Centre Field Day in 2003, indicated that shelterbelts lived up to their expectations and that both society and producers derive benefits from them. They affect the producers and society in a variety of ways – some directly and others indirectly through ecosystem functions. Based on the study, this value to the society (other than land owners) of the shelterbelts established since 1981 could exceed \$150 million, and can even be as high as \$940 million. Major benefits accrue from carbon sequestration, wildlife habitats and related activities, and from energy conservation. These benefits, although apparent to most of us, are difficult to estimate precisely, and require better data and an interdisciplinary approach.

Introduction

The AAFC-PFRA Shelterbelt Centre, located at Indian Head, Saskatchewan, was established in 1901, even before the province was created. 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 improved technology (better variety of trees suitable to the prairie landscape) and more technology transfer activities (provision of information to those interested in planting shelterbelts) can be postulated to arouse interest among the landowners to the point they would decide to plant shelterbelts. Originally, the objective of tree distribution was to enhance quality of life for farmers and to serve as a major soil erosion mitigation measure. Currently, trees in an agricultural context are known to have additional environmental benefits while rural demographic trends and alternate production technologies have altered the aggregate impacts of original tree planting goals.

Need for the Study

A rigorous assessment of benefits from the AAFC-PFRA Shelterbelt Centre has not been undertaken. Although some aspects of these benefits are described, more emphasis of the past studies has been on benefits to landowners. Since a part of the expenditures are from public treasury, knowledge of benefits accruing from shelterbelts to other members of the society is necessary to achieve a proper balance for program activities. Information collected through the process of estimation of various benefits could also be used for (1) supporting funding decisions by the public agencies; (2) business planning with respect to setting priorities (research, development, technology transfer, programming, production); (3) public education to promote the merits of agroforestry; and (4) improving society's knowledge base (cataloging and categorizing impacts, understanding methodologies).

Objectives and Scope of the Study

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. Although it is recognized that benefits to the landowners could be significant, the research questions were posed in this study to estimate the level of major benefits to the society from the shelterbelts. The study is limited to the shelterbelt related activities of the AAFC-PFRA shelterbelt Centre. Other agencies that may be undertaking similar activities are not included here.

Selected Features of Shelterbelt Centre Activities

Since 1901 till the end of 2002, an estimated 576 million tree seedlings have been distributed by the AAFC-PFRA Shelterbelt Centre to over half a million users / agencies, although some of them are repeat customers. In a typical year, the number of tree seedlings distributed by the Centre has varied between 4 and 12 million, as shown in Figure 1, with the average for the entire period being 5.65 million. Further analysis of the distribution data for the 1981-96 period indicated that the largest share (88.6% of the total) of these seedlings was used by landowners for planting field and farmstead shelterbelts. Major type of seedlings distributed was deciduous shrubs.

Conceptualization of Benefits from Shelterbelts

Society benefits from the plantation of shelterbelts in several ways. Both activities of the Centre (Tree distribution, and Research and technology transfer) generate benefits to the society. Tree seedling distribution has a direct link to these benefits, but the research and technology transfer

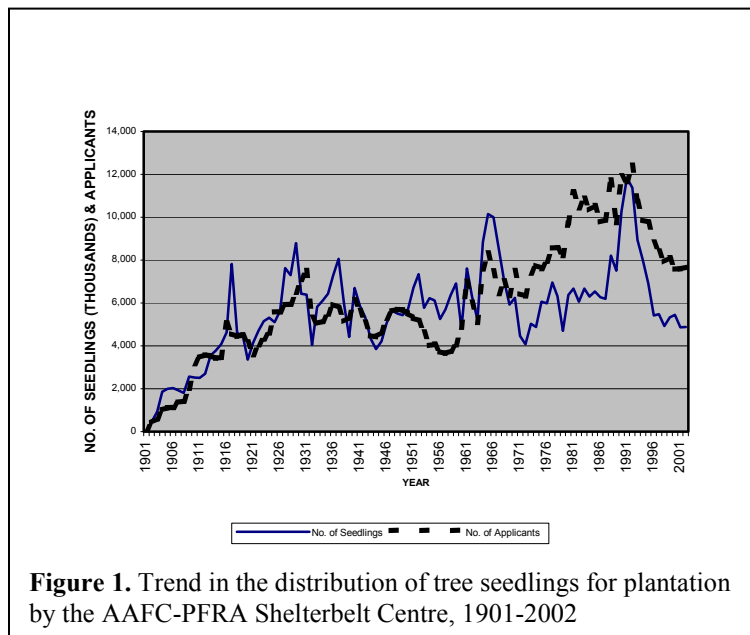


Figure 1. Trend in the distribution of tree seedlings for plantation by the AAFC-PFRA Shelterbelt Centre, 1901-2002

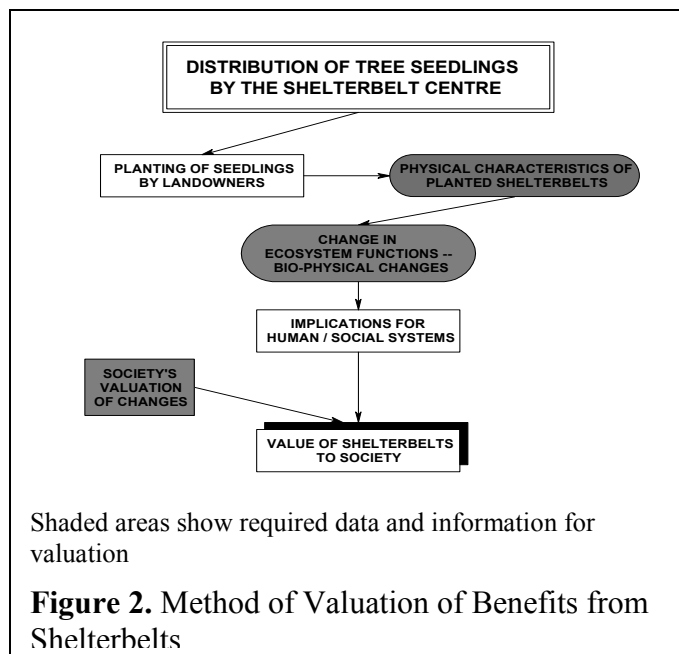
has an equally important, although indirect in nature, role to play. Better research and technology transfer (though the provision of proper information) leads to a higher acceptance of planting shelterbelts by landowners. Thus, the two sources of benefits are interrelated and a possible overlap may exist. To avoid this duplication, in this study emphasis is placed only on the tree seedling distribution activity.

If something promotes our well-being, it is seen as a benefit. For consumers it may be the quality of life; for business firms it may be their profits. Since there are multiple ways in which benefits can accrue to the members of the society, these need to be aggregated, which requires their conversion into monetary units. Benefits from shelterbelts could accrue to two parties: (1) Landowners, called Private benefits. Here benefits accrue to the individuals planting the shelterbelts. (2) Members of the Society, called Social Benefits. The latter category of benefits could come in two forms: (i) Some benefits may be available to all members of the society at no cost to them. These are called Public Goods-related benefits. (ii) Some benefits are realized by only a smaller section of the society, and are not available for free. These are called Non-Public Good-related benefits.

Method of Valuation

Let us ask the question "In what manner do shelterbelts generate any of the three types (Private, Public Goods-related, and Non-Public Goods-related) of benefits?" Shelterbelts can provide benefits directly to the landowners or to other members of the society, or alternatively benefits could be derived indirectly through various ecosystems functions that they provide. In this context, shelterbelts are seen as providing some value to the users, commonly called the Anthropocentric view of valuation.

Estimation of benefits from planting shelterbelts was undertaken using the methodology depicted in Figure 2. Three pieces of information are critical for this valuation exercise. One, physical characteristics of the planted shelterbelts; Two, changes in the bio-physical (related to ecological) functions of the shelterbelts; and Three, knowledge of values placed by the society on the impacts of the shelterbelts. These values are a result of a change in the individual's well-being.



Direct Benefits from Shelterbelts

Although a variety of direct benefits from shelterbelts can be identified, the major ones include: (1) Energy conservation, through savings in the cost of heating or cooling homes that are protected by the shelterbelts; (2) Improved aesthetic and related amenities provided by the

shelterbelts, which may lead to higher property values and / or quick sale of the property; (3) Improved farm level economic efficiency, resulting in higher profitability of crop and livestock enterprises; (4) Transportation infrastructure and traffic related impacts, often resulting in lower maintenance of roads and reduced traffic hazards; and (5) Health impacts, including improvement in both physical and mental health.

Indirect Benefits from Shelterbelts

The indirect benefits to society, generated through various pathways to ecosystem functions, could include the following bio-physical changes imparted by shelterbelts:

- (1) Soil:** These may include: (1) Reduced soil erosion, resulting in lower damages to homes and businesses, and reduced cost to municipalities to maintain drainage ditches. (2) Shoreline protection, resulting in reduced silting of reservoirs, as well as reduced treatment cost for water utilities.
- (2) Air:** These may include: (1) Reduced odours from animal production sites, which may result in improved air quality, improved health of workers and people residing in the neighbourhood, as well as in increased property values. (2) Reduced pesticide drift, which affects water quality, may result in reduced treatment cost for water (which may subsequently result in lower cost of water to the users). (3) Reduced greenhouse gas accumulation in the atmosphere, which may slow down the process of climate change resulting in reduced damage to nations world over.
- (3) Water:** These may include: (1) Water quality through filtering function, thereby improving the quality of groundwater resources in areas where needed. (2) Floodplain management, which in some regions could result in reduced property damage. (3) Wastewater management, where wastewater is used in the cultivation of shelterbelts, thereby reducing the cost of disposal (and treatment) to various municipalities.
- (4) Biota:** These could include: (1) General increase in various types of biodiversity; (2) Wildlife habitats, resulting in higher level of biodiversity. (3) Wildlife based recreation, such as bird watching, and hunting.

Each of these changes has a connection with the human well-being, and thus result in a benefit to the society as well as to the landowners.

Perceptions of the Visitors to the Shelterbelt Centre

What producers and other members of the society have to say about the benefits from the shelterbelts? To ascertain these, a survey of visitors to the Shelterbelt Centre Field Day in July 2003 was undertaken. Respondents included both Producers – those who had planted shelterbelts, and Non-producers – those who did not plant (but were familiar with them). Two questions (among others) that were asked in the survey included: (1) What benefits are provided by the shelterbelts and how important are they to you? And (2) How are these benefits distributed between the producers and society? Responses to these questions are presented in this section.

Ten benefits of the shelterbelts were identified and each respondent was asked to rank on a scale of 1 to 5, where 1 being not important, and 5 being very important. Importance of these benefits varied by type of respondent, as shown in Table 1.

Table 1. Ranking of Different Benefits from Shelterbelts as Identified by Producers (Those having planted them) and Non-Producers (Those who did not plant them)

No.	Description of Benefit	Producers		Non-producers	
		Av. Score	Rank	Av. Score	Rank
1	Beautify the agricultural landscape	4.616	2	4.352	
2	Provide wildlife habitats on agricultural lands	4.527	3	4.619	2
3	Protect other biodiversity (plants, insects, birds, etc.)	4.378		4.486	3
4	Remove carbon dioxide (greenhouse gases) from the air	4.464		4.405	
5	Stop soil erosion by wind	4.619	1	4.741	
6	Protect water quality in rivers and streams	4.203		4.696	1
7	Remove dust or odours from the air	4.125		4.180	
8	Improve public health	4.103		4.064	
9	Improve road safety	4.028		4.001	
10	Improve property values in the area	4.042		4.218	
Average Score		4.310		4.376	

Responses were averaged for producers and non-producers. An average score of 3 shows a neutral position (neither important nor not unimportant). Any score higher than 3 shows that the benefit is important. All benefits were considered to be important by the respondents regardless of the type. In all cases a score of 4 or higher was obtained. Producers ranked reduced wind erosion as the top benefit, followed by aesthetic amenities and wildlife habitats. These benefits are derived directly by the producers, and thus important to them. The non-producers ranked benefits slightly higher than the producers (score of 4.38 vs. 4.31 for producers). They also ranked public goods higher. Their top choice was protection of water quality, followed by wildlife habitats and biodiversity.

Society's Share	% of total producers	% of total non-producers
100%	21	18
75%	9	18
50%	29	32
25%	20	18
0%	21	14
Total	100	100

With respect to the second issue – who receives the benefits from shelterbelts, respondents were asked if the society or the landowners receive these benefits. Five choices were given to them: all benefits to society, society's share 75% of total benefits, society's share 50% of total benefits, society's share 25% of the total benefits, and all the benefits to the producers. Results are shown in Table 2. One feature of this data set is that producers felt that more benefits of shelterbelts accrue to producers, whereas the non-producers thought a higher share of benefits is received by the society. Proportion of producers indicating the society's share being higher than half was 30% as against 36% for the non-producers.

A majority of landowners (84% of total) indicated that benefits of field shelterbelts outweigh the costs. Similarly a larger majority (91% of the total) of producers agreed that the shelterbelts had lived up to their expectations. In summary, the survey respondents appear to be consistent with differences in viewpoints based on private and social (external) costs and benefits. Producers pay more attention to private costs and benefits when asked to evaluate shelterbelt values in comparison to urban residents who evaluate shelterbelt value more from a social (spin-off impacts) perspective.

Magnitude of Estimated Benefits

On account of poor data on various aspects of shelterbelt benefits, an accurate value of all benefits to the society and to the landowners could not be estimated. Table 3 shows the estimated benefits. Although a large majority of benefits from shelterbelts are realized for crop and livestock production, these were not estimated since the major focus of the study was on the benefits to society. In this context, carbon sequestration benefits top the list. These can be as high as \$417 million, depending upon the value of carbon selected. Since carbon is not traded, it remains to be an uncertain area. Wildlife habitats and related recreational benefits are the next major benefits, followed by those from reduced soil erosion.

Table 3. Estimated Benefits from Shelterbelts Planted during 1981-2001, by Type of Benefit

Pathway to Benefit	Estimated Level in Million \$	Type of Benefit
Savings in heating and cooling costs	\$46 - \$341	Private
Reduced soil erosion	\$8 - \$122	Public goods-related
Improved air quality	\$4	Public goods-related
Carbon sequestration	\$56 - \$417	Public goods-related
Water quality	\$1.2	Public goods-related
Biodiversity	\$0.2 - \$9.9	Public goods-related
Wildlife based recreation	\$29	Non-Public goods-related
Bird watching	\$2	Non-Public goods-related
Estimated Total	\$151 - \$942	

Summary and Conclusions

This study has established a significant value of social benefits from shelterbelts -- from various public-goods-related and non-public-goods-related benefits. In addition, there are significant private benefits to landowners. Although in the 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, the estimated value of benefits is very significant. 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. 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. For, example the breakdown in knowledge occurs when scientist study certain aspects of changes in the bio-physical (related to ecological) functions of the shelterbelts that dose not allow economists to link this knowledge to values placed by the society on the impacts of the shelterbelts. Often a slight change in perspective by both research groups is required. To build a multi-disciplinary approach, researchers would require a joint effort in formulating the hypotheses to begin with. Such an approach would in itself generate numerous interesting research areas for further study.

Acknowledgements

Project was carried out under a contract from Agriculture and Agri-Food Canada – Shelterbelt Centre, Indian Head. This financial assistance is gratefully acknowledged.