

**Agroforestry Comes of Age:
Putting Science into Practice**

Proceedings of the 11th North American Agroforestry Conference
May 31-June 3, 2009
Columbia, Missouri

MICHAEL A. GOLD & MICHELLE M. HALL, EDS.

COMMUNICATING THE ECONOMIC AND ENVIRONMENTAL IMPACTS OF AGROFORESTRY SYSTEMS

Laura Poppy¹, Janna Lutz¹, and Henry de Gooijer¹

¹Agriculture and Agri-Food Canada, Agroforestry Division, Indian Head, SK, Canada, S0G 2K0.
Contact: Laura.Poppy@agr.gc.ca

Abstract: The Agriculture and Agri-Food Canada Agroforestry Division conducts research, development and delivers technology tools, products and services including tree and shrub seedlings for the adoption and integration of agroforestry practices by producers. The Division works toward increasing the adoption of agroforestry by demonstrating that agroforestry practices can be both environmentally and economically beneficial if properly integrated as a management practice in the agricultural landscape. To do so, it is important to demonstrate the return on investment for the producer, highlighting private benefits, while also determining opportunities that recognize public benefits. Agricultural practices are constantly changing as producers adopt new technologies and adapt to changing markets, social concerns and changing physical environments. Some producers may no longer consider trees in the agricultural landscape necessary as they rely more on adopted technologies and machinery advancements to impact production and environmental issues traditionally addressed by shelterbelts and tree buffers. As farms become larger and demographics of the farm population change, there is less time and traditional labour for producers to plant and care for trees. Agroforestry specialists and development staff must be cognizant of agricultural trends and keep this in mind when developing agroforestry marketing strategies and programming that is directed at producers. Using the AAFC-PFRA Agroforestry Division's Prairie Shelterbelt Program as an example, this presentation will focus on government & producer investment in agroforestry systems and the economic and environmental impacts of agroforestry systems for the producer and on the agricultural landscape.

INTRODUCTION

The agricultural regions of the Canadian Prairie Provinces experience year-round extreme temperature variations, strong winds and snow build up, all of which can have huge impacts on quality of life. Everywhere on the continent, including the prairies, environmental issues such as water quality and quantity, habitat for preserving biodiversity and concerns about climate change have increased the focus of the roles that trees play on the landscape. Shelterbelts and other agroforestry systems have been used to address these issues and can positively impact agricultural production systems and the quality of life of rural people. Communicating these benefits, in terms of both economic and environmental impacts to agricultural producers, is the focus of the work of the Agriculture & Agri-Food Canada's (AAFC) Agroforestry Division which is based out of Indian Head, Saskatchewan.

INVESTMENT BY THE GOVERNMENT OF CANADA

Research conducted by AAFC's Agroforestry Division has identified many benefits to agroforestry, both environmental and economic. Agroforestry is a beneficial management practice (BMP) and is generally understood and recognized by most landowners on the prairies and across Canada. However, adoption by landowners has been limited and is not always at the level practitioners and program managers would like to see. In temperate areas, such as the Canadian prairies, highly mechanized, monocrop agriculture has marginalized woody plants on the landscape (Kort and Poppy 2009). As well, continuing technological and demographic changes are further challenges to the long-term, sustainable use of trees in agricultural landscapes. In western Canada, agroforestry practices are a voluntary action by the landowner. As a result, agroforestry adoption requires a certain level of buy-in from the landowner. Therefore, it is important for practitioners to stop and reflect on why adoption of agroforestry practices may not be occurring and to try to understand and address the reality producers are facing in regards to barriers.

Understanding adoption techniques and developing new ways to secure higher levels of adoption of conservation practices involving woody plants is critical to the future success of agroforestry programs (Brandle 2004). The role of woody plants, whether in shelterbelts, riparian buffers or other agroforestry plantings, continues to be the focus of the AAFC Agroforestry Division's research and information development. The Division uses several techniques to increase adoption of agroforestry practices by landowners, including targeted research & information development as well as supplying tree seedlings and technical services at no charge to rural landowners through the Prairie Shelterbelt Program.

In 1901, the Government of Canada established the AAFC Agroforestry Division tree nursery at Indian Head, Saskatchewan. The primary function of the facility was to produce and distribute hardy tree and shrub seedlings at no charge to settlers in western Canada. This service continues to this day and is accomplished through the Division's Prairie Shelterbelt Program (PSP) which is administered out of Indian Head, Saskatchewan. The PSP is one of the longest running government programs, with over 100 years of service to farmers and rural landowners in western Canada. By 2008, the AAFC Prairie Shelterbelt Program had distributed an estimated 600,000,000 tree and shrub seedlings. This is enough trees to circle the globe 27 times (at 6' spacings) and to sequester over 218 mega tonnes of CO₂ which is the equivalent to the weight of 95 million adult elephants!

In the early years, the Division's PSP provided seedlings mainly for fuelwood and farmstead shelter. However, in the dirty thirties and 1980s more emphasis was placed on planting trees for soil and crop protection. On the Canadian prairies, shelterbelts and tree buffers are now planted for a variety of reasons such as farm, field and livestock protection, increased crop yields, beautification, energy reduction, diversification and biomass production. These and other private benefits are generally understood and recognized by landowners and many are scientifically documented (Kort and Brandle 1991). However, shelterbelts and other agroforestry practices are now also recognized for their many public ecological goods and services (Kulshreshtha and Kort 2009). These goods and services, or public goods, are linked to the protection of soil, water, air and biodiversity, however, they are not easily quantified.

The government of Canada has invested in agroforestry programs and practices through AAFC's Agroforestry Division. The investment includes personnel and operations of the Division including research and development and delivery of technology tools, products and services, along with providing tree and shrub seedlings through the Prairie Shelterbelt Program. The Division works toward increasing the adoption of environmentally beneficial management practices by agricultural producers for the management of land, water, air and biodiversity, specifically through the development and integration of agroforestry systems into the agricultural landscape.

BENEFITS OF AGROFORESTRY ON THE PRAIRIES

The government's investment in agroforestry is significant. However, it should be noted that the contribution of the landowner/producer is even more so. The joint investment by the producer includes the long-term allocation of land required for tree planting and the investment to prepare, plant and maintain tree plantings over time. Studies conducted by the AAFC Agroforestry Division (Kulshreshtha and Kort 2009 (Sharpe 2001) have found that producers in western Canada invest 1.5 dollars for every dollar invested by the government in agroforestry programs and services (i.e. Prairie Shelterbelt Program). The return on investment generates between 2 and 6 times the value in private and public benefits (Figure 1).

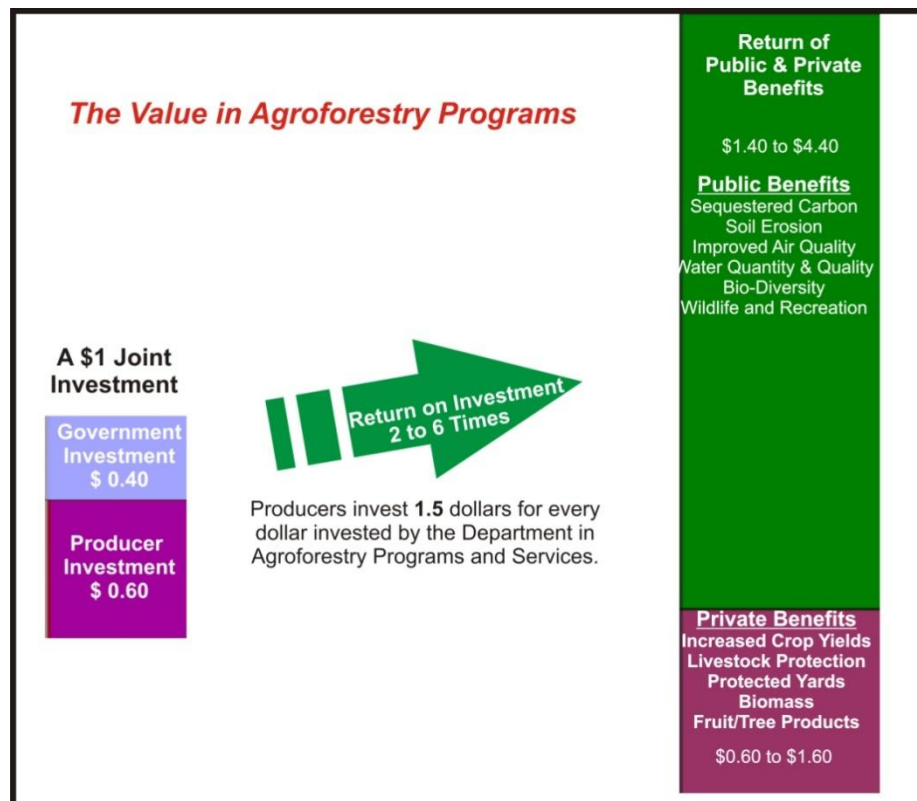


FIGURE 1 Public and Private Return on Investment

The Prairie Shelterbelt Program supplies approximately 4 million seedlings each year to over 7000 farm clients. The impacts of this service are varied (Figure 2). In 2007/2008, the following

public and private benefits and Farm Gate Impacts of 3.8 million PSP trees were found (Kulshreshtha and Kort 2009):

- Crop benefits: \$ 0.9 Million (Net Present Value),
- Livestock benefits: 28 % reduction in energy requirements for beef cows, 10 % increase in rate of gain of feeder cattle,
- Protection of 1482 farm yards: snow clearing and home heating (\$ 0.4 Million reduction in home heating costs),
- Increase crop yields and decrease soil erosion on 12610 ha of crop land: \$11.35 Million in the value of topsoil conserved,
- Bio-energy and bio-fuels from woody biomass,
- \$8.8 Million in annual harvestable biomass in shelterbelts,
- Provide 198 ha of wildlife habitat and protect 270 km of riparian areas: \$2.1 million in enhanced water resource protection through riparian plantings, and
- Sequester 1.4 mega tonnes of CO₂ by 2057.

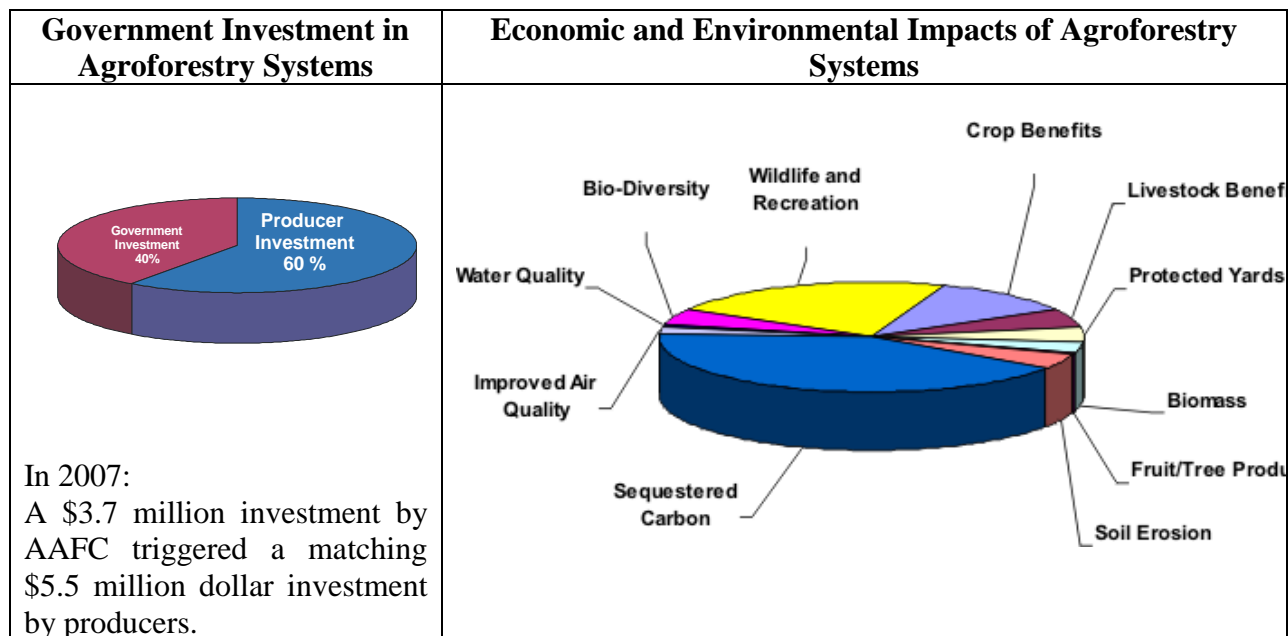


Figure 2 Economic and Environmental Impacts of Agroforestry Systems

ADOPTION BARRIERS

Private and public benefits of agroforestry are scientifically documented (Kort and Brandle 1991) and many are recognized and acknowledged by landowners, researchers and practitioners. There is value in incorporating agroforestry into agricultural production systems. However, adoption continues to be at a lower than expected rate. Having discussed the benefits of agroforestry to producers, we have to stop and reflect on why adoption doesn't automatically occur. We need to have an understanding of the reality producers are facing and what the barriers to adoption of agroforestry practices are in order to determine how to target our communication efforts.

Producers at this time face many pressures and realities. Agricultural production is a business where productivity must be maximized, markets are volatile, input costs are increasing, time and labour are in short supply, and societal scrutiny regarding environmental practices is increasing. Adopting any new practice on the landscape that may impact production and the economic bottom line involves risk and uncertainties.

A ground-truthing survey to determine diversification and adaptation was carried out by AAFC's Prairie Farm Rehabilitation Administration (PFRA) in East Central Saskatchewan in 2000. Producers noted in the survey that a lack of finances was the highest ranked reason that they were not making changes to their current operation. When asked what they would need in order to make changes to their current operation, the responses included need for a program, other (labour pool, commodity prices, initiatives, and time), technical support and education and training.

Barriers to adoption of agroforestry beneficial management practices (BMP's) include economics, demographics, land tenure, policy, research & information, skills and training, compatibility and delivery barriers.

Economics – In many cases there is not a direct correlation to the economic returns on agroforestry activities. As well, there is a lack of market information. Many, if not most, agricultural innovations that have occurred, have been based on economics and profitability with a clear understanding of the consequences which decreases the risk factor. In many cases, establishing any form of agroforestry practice does have a high initial establishment and maintenance cost and a long term commitment before any economic gains are apparent. During difficult financial times, the adoption of environmentally based practices is lower than adoption of economically based ones.

Demographics – StatsCanada has recorded that the average age of a Canadian farmer is 52 years (StatsCanada Census of Agriculture, 2006). This may have an impact on agroforestry adoption. With many producers nearing retirement, this long-term horizon may not be attractive. Besides the aging farm population, the current state of farming has seen many producers take on off-farm jobs as they look for stable and profitable income which reduces their time available to pursue other on-farm innovations and activities. There is also a real labour pool shortage, especially for seasonal work, to assist producers and allow for them to expand their operations.

Land Tenure – A change has been noted in land ownership trends with a slight drop in owned land and a 9.9% increase in rented or leased lands (StatsCanada Census of Agriculture, 2006). StatsCanada results indicate that of Canada's agricultural land, 61-66% is farmed by the private owner. The remainder is under some form of rental agreement. In some cases, farmers who are retiring or wanting to downsize see renting as a way of retaining ownership of their land. In other cases, investor groups or others not actively farming are buying land as they consider it to be a relatively safe investment. Some farmers may not have the means to invest in land and they see land rental as a way to increase the size of their operation without large capital investments. When farmers are working and maintaining the land for others, there may not be the same desire to improve the land with agroforestry practices, especially since the benefits may take years to be appreciated and the land tenure agreement may well be expired before these benefits are realized.

Policy – The message coming from the policy makers must be very consistent and has to be delivered at the grass roots level. There is a lack of or insufficient programs, policy support and incentives for agroforestry practices. Programs appear and disappear, but it is the good practices that we must promote and that will be effective and enduring on the landscape. In a study of graziers (Greiner et al., 2009), BMP's were adopted by those who were intrinsically motivated to do so by their lifestyle and conservation goals while others that were motivated by economic and social goals, required external incentives.

Research & Information – Research as well as extension activities, education and demonstrations are very important in promoting adoption of agroforestry practices. Producers need decision support to make changes on their land. Regional demonstrations, technical support and improved information and understanding are integral to adoption of innovative practices. A Center for Subtropical Agroforestry (CSTAF) survey of professionals stated one of the main reasons for the lack of adoption of practices in some areas was due to a lack of familiarity with the practice and a lack of demos (Workman, Allen, 2004).

Skills and Training - Agroforestry practices are not widely recognized as there is a lack of knowledge including lack of management skills, lack of access to technical information or lack of its existence, lack of decision making tools and sustainability of different systems.

Compatibility – Whether this is a real or perceived barrier, compatibility or conflict between BMP practices may challenge landowners. Timing of the highest labour requirements may overlap with other farming practices. There may be a perceived incompatibility between the various outputs of a system such as competition between crops, livestock and trees. Agroforestry is not always viewed as a practical, profitable or low cost option for producers. In some cases, agroforestry is not even viewed as a land management tool.

Delivery Barriers – Program/project success is often based on economic results, however quantifying environmental performance is far more difficult. There is a definite need for involvement by extension professionals, policy makers and stakeholders to spread the word to landowners. In many cases the research conducted is not regional and site specific, which can reduce the uptake and reliability of the research and initiates the need for local demonstrations. In the CSTAF study, a major limitation to adoption in some areas was due to a lack of well documented local agroforestry experiments and positive experiences. In many of the programs we have worked within, delivery is enhanced by the positive experiences that are communicated amongst producers giving the practices credibility at the local level.

Recent research suggests that we must first understand the motivations and risk attitudes of the producer in order understand their willingness to adopt various BMP's on their land (Greiner et al., 2009). Obviously motivations and risk attitudes vary by individual and are related to their personal beliefs, attitudes, circumstances and personal goals. This would lead us to believe that communication and the extension work we do cannot be a “one size fits all” solution, but must rather involve a variety of choices and methods so that we can tailor to suit individual personalities. Simple signage to communicate the producer's commitment or simply letting them know they have done something positive for the next generation is enough of a motivator, however others require more for adoption to occur.

ADOPTION OF AGROFORESTRY

There are a number of techniques and tools the AAFC Agroforestry Division is using to address barriers, increase adoption of agroforestry by landowners and to advance agroforestry on the Canadian Agriculture landscape.

Agroforestry Technical Service Delivery, Support and Development of Products

The AAFC Agroforestry Division is focused on increasing the overall awareness of the benefits of agroforestry practices and systems. This is done through the development and delivery of information and technology tools and products for producers, partners and the general public.

The Division also focuses on producing high quality, prairie hardy tree and shrub seedlings for distribution through the Prairie Shelterbelt Program (PSP) to eligible landowners. In partnership with research, PSP is continually evaluated and refined and processes are monitored to improve stock, increase survival and advance nursery function.

The following are examples of the Agroforestry Division's service delivery, support and development of products:

- Development and maintenance of the PSP, TREES database, tree delivery system and partner network. Accomplished through associations with staff and partners and routinely adapted to meet client and partner needs,
- Availability of a toll free number, and walk-in technical support with direct one-on-one access to technicians, researchers and program developers who can provide information and answer technical questions relating to the PSP, agroforestry practices, research and tree planning, planting and care,
- Maintenance and support one of AAFC's most widely accessed and utilized web pages,
- Development of agroforestry related information for clients, partners and staff. Distribution and provision of agroforestry and Program information for the web, agricultural offices, trade shows, producer meetings, partner workshops, tours, newspaper and magazines,
- Development and support of agroforestry demonstration sites to apply new research and technical information on a practical landscape level,
- Conduct ground-truthing surveys on existing tree planting sites to monitor survival, site management and fate and function of PSP trees, and
- Specialized programs, such as the Shelterbelt Enhancement Program (SEP), were initiated to overcome maintenance issues, increase the adoption of agroforestry practices, and meet environmental targets.

Agroforestry Research

The AAFC agroforestry research unit focuses on the development of agroforestry science, technology and genetic material for the improvement of the agroecosystem and support of agroforestry practices in Canada and abroad. The following are the main AAFC agroforestry research goals and outcomes:

- Improving technology for enhanced tree performance and health through a long-term, viable tree breeding and tree improvement program,
- Evaluating tree culture and understanding tree biology,
- Improving knowledge and understanding of agroforestry practices and their impact, function and integration on the landscape,
- Tree adaptation work to address current and future environmental and biological stresses,
- Developing agroforestry tools to assist in planning agroforestry systems and predicting impacts, and
- Developing and maintaining National and International research projects and partnerships.

CONCLUSION

Agroforestry continues to be high on Agriculture & Agri-Food Canada's national agenda. Agroforestry continues to play an integral role in improving the competitive position of the agricultural sector in Canada and contributing to the future sustainability of the agricultural land resource base. The success of agroforestry adoption will lie in the ability of practitioners and researchers to address adoption barriers and continue to support and promote agroforestry research, development and programs and services for the benefit of all Canadians.

LITERATURE CITED

- Brandle JR, Hodges L, Zhou XH (2004) Windbreaks in North American agricultural systems. *Agroforestry Systems* 61:65–78
- Kort J, Brandle JR (1991) WBECON: a windbreak evaluation model: 2. Economic returns from a windbreak investment in the Great Plains. In: *The third windbreak and agroforestry symposium proceedings*. Ridgetown Agricultural College, Ridgetown, pp 129-134
- Kort J, Poppy L, Gordon A, Caron L (2009) Preface. *Temperate agroforestry: When trees and crops get together*. *Agric Ecosyst Environ* 131:1-3
- Kulshreshtha SN, Kort J (2009) External economic benefits and social goods from prairie shelterbelts. *Agroforestry Systems* 75:39-47
- Sharpe J. (2001) *Activities and Costs for Planting and Maintaining One Mile of Shelterbelts*. AAFC- PFRA Agroforestry Division Shelterbelt Centre, Indian Head, SK.
- StatsCanada Census of Agriculture (1991 – 2006) www.statscan.gc.ca. (Accessed April 9, 2009)
- Workman, SW, Allen S (June 2004). *The Practice and Potential of Agroforestry in the Southeastern United States*. University of Florida, Circular 1446.