Agroforestry Comes of Age:
Putting Science into Practice

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AROUND THE GLOBE AND ACROSS CANADA
THE AGRICULTURE AND AGRI-FOOD CANADA AGROFORESTRY DIVISION

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INTRODUCTION

The Agroforestry Division of the new Agri-Environment Services Branch of Agriculture and Agri-Food Canada is in transition from a predominantly regional focus to a national role in providing leadership and expertise in agroforestry research, development and delivery across Canada. In its expanded role, the Agroforestry Division seeks to enhance agroforestry practices through the development of partnerships with regional and local agroforestry interests. National coordination will assist to identify and prioritize research needs, develop and publish technical materials, and to establish demonstration sites to promote agroforestry as an economically viable and sustainable agricultural practice. However, many challenges exist in the expansion to a national role. This document will provide a history of the existing Division, its structure and the issues of functioning as a national organization.

Agricultural land is one of the key foundations in defining agricultural production. Agricultural production, while being environmentally and economically sustainable, must continually adapt to meet the challenges and opportunities provided by changing markets, environment and societal expectations. By integrating trees into agriculturally productive landscapes, agroforestry provides a science-based means of achieving key objectives in agricultural sustainability and natural resource management. Agriculture and Agri-Food Canada's Agroforestry Division has the knowledge, experience and mandate to bring agroforestry solutions and opportunities to Canadian agriculture.

Agroforestry practices have been identified as agricultural activities that can assist Agriculture and Agri-Food Canada's priority areas of Climate Change and Water Quality under the current Growing Forward initiative of the Government of Canada. Shelterbelts and other agroforestry practices are recognized as Beneficial Management Practices (BMPs) and are being applied across the country as part of Environmental Farm Plans (EFPs) which will use trees to achieve measurable and meaningful environmental goals.

By increasing the number of trees and shrubs established in Canada and enhancing agricultural production systems, agroforestry contributes to the environmental priorities for the sustainable use of and reduced impact on water, soil, and climate change by agricultural production.   The roots of trees act as nutrient filters and as such are able to reduce pesticides and other harmful contaminants found within farm run-off from reaching water reserves, either above or below ground.   In regards to water conservation, trees provide shade which can reduce water consumption and groups of trees (such as it has been shown for field shelterbelts) can retain

snow and therefore increase ground moisture levels. Field shelterbelts are widely recognized as an effective tool in the management of soil organic matter and soil erosion. As well, trees can contribute to improving the organic content of soil through the natural composting of shed leaves and roots. Trees and other plant materials remove air pollutants from the air and are essential tools in any response to global warming as they are able to sequester carbon and other greenhouse gases. AAFC, and others, have conducted recent research into the extent to which the management of trees and shrubs in agroforestry systems sequester carbon and reduce emissions.

Agroforestry contributes to the strategic outcomes for agriculture outlined by the Canadian Government and contributes to the profitability of the agricultural sector. The competitiveness and innovation within the sector is enhanced by agroforestry practices that provide new commercial opportunities in the bio-economy. Agroforestry contributes to society's priorities through research and development that provides insight into agricultural practices that can improve environmental performance implemented as best management practices.   Agroforestry practices also provide resilience in the landscape helping to mitigate productivity losses and manage production risks.

HISTORY OF THE AGROFORESTRY DIVISION

In the late 1800's, the Department of Agriculture began testing tree species in Brandon, Manitoba and Indian Head, Saskatchewan. In 1902 the Department of the Interior established the Forest Nursery Station at Indian Head, Saskatchewan. The nursery provided hardy tree seedlings to settlers of the Prairie region as a means of making the area more habitable and to help them meet building and fuel needs. Seedlings were provided free of charge in order to promote tree planting on public and private land.

In 1930, the Federal Forest Nursery Stations were transferred to the Dominion Experimental Farms Branch of the Department of Agriculture. At this time, there was an increase in seedling-production capacity and in efforts towards designing and promoting effective shelterbelts. The promotion of shelterbelts became the Nursery's primary focus during the 1930's and onwards as they were found to be a highly effective tool in reducing levels of soil erosion. While not transferred to the Prairie Farm Rehabilitation Administration (PFRA) until the 1960s, the nursery assisted rehabilitation of the Prairies through its promotion of shelterbelt plantings and provision of tree seedlings.
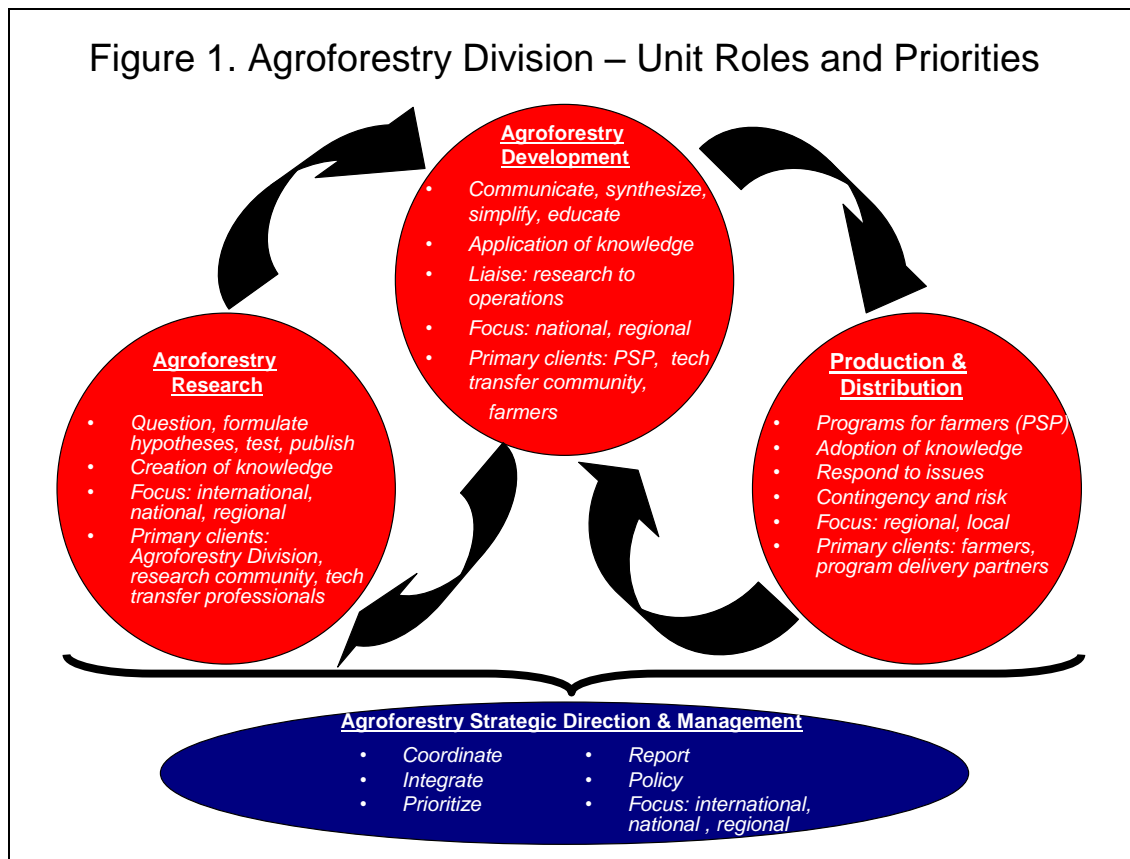
With the official transfer of the nursery to PFRA in 1963, the practice of shelterbelt planting was further supported by an increase in applied research capacity at the facility and expansion into new areas of tree breeding, insect and weed control, tree seedling viability, seedling processing and storage and soil related problems. The applied research had the dual role of assisting in increasing the quantity and quality of the nursery's seedlings as well as acquiring knowledge as to how best establish healthy tree and shrubs within the Prairie climate.

In 1987, the nursery was re-named the Shelterbelt Centre to more accurately recognize the broader and more comprehensive scope of applied research and technology transfer performed at the facility beyond the growing and distribution of seedlings. The Centre, however, maintained the original operational objectives of the Forest Nursery Station (produce seedlings, conduct

research, collect statistics and information) under PFRA's mandate to "...secure the rehabilitation of drought and soil drifting areas in the Provinces of Manitoba, Saskatchewan and Alberta and to promote within those areas systems of farm practice, tree culture, water supply, land utilization and land settlement that will afford greater economic security."

DESIGN AND FUNCTION OF THE DIVISION

The Agroforestry Division is comprised of four separate units. Each of the units within the Agroforestry Division has roles and priorities particular to the scope of their activities (Figure 1). The Research Unit, the Agroforestry Development Unit, and the Tree Production and Distribution Unit work closely together to create knowledge, technology transfer tools and products, and high-quality plant material. Similarly, the Agroforestry Division operates in an integrated manner with the Directorate, Branch and Department to ensure agroforestry practices have a role in the sustainable management of Canada's agricultural land base.

Figure 1. Agroforestry Division – Unit Roles and Priorities

Agroforestry Development
- Communicate, synthesize, simplify, educate
- Application of knowledge
- Liaise: research to operations
- Focus: national, regional
- Primary clients: PSP, tech transfer community, farmers

Agroforestry Research
- Question, formulate hypotheses, test, publish
- Creation of knowledge
- Focus: international, national, regional
- Primary clients: Agroforestry Division, research community, tech transfer professionals

Production & Distribution
- Programs for farmers (PSP)
- Adoption of knowledge
- Respond to issues
- Contingency and risk
- Focus: regional, local
- Primary clients: farmers, program delivery partners

Agroforestry Strategic Direction & Management
- Coordinate
- Integrate
- Prioritize
- Report
- Policy
- Focus: international, national, regional

Agroforestry Strategic Direction and Management

The Agroforestry Strategic Direction and Management unit coordinates the Division activities, including financial and human resources. This unit, lead by the Agroforestry Division Manager, provides support and direction for the management of AAFC Agroforestry Division programs, inputs into the development and management of other branch and departmental agroforestry initiatives, and leads the development and implementation of management instruments for

Division programs. The Strategic Direction and Management Unit are responsible for determining the direction and overall mandate for the Division's activities.

Production and Distribution Unit

The Production and Distribution Unit's primary function is the physical production and distribution of the seedlings required to meet the demands of the Prairie Shelterbelt Program (PSP) and related programs supported by AAFC, focusing on high quality plants, client satisfaction and environmentally sustainable production. The Prairie Shelterbelt Program is an on-going program which provides technical services and tree and shrub seedlings at no charge for planting shelterbelts and for agricultural conservation and land reclamation projects in Manitoba, Saskatchewan, Alberta and northeastern British Columbia.

The Production and Distribution Unit builds on the genetic selections and assessments of the Agroforestry Research Unit to produce hardy tree and shrub seedlings suitable for desired agroforestry uses on prairie planting sites. The Unit is also responsible for the allocation and distribution of seedlings to clients of the PSP on an annual basis. This requires partnerships with other departments, agencies, and non-government organizations to deliver seedlings to clients.

Agroforestry Development Unit

The Agroforestry Development Unit's primary functions are to support and promote the adoption of agroforestry practices by Canadian farmers and to increase the visibility and understanding of agroforestry science. It also has direct responsibilities in support of both the Agroforestry Research Unit and the Production and Distribution Unit in the delivery of Prairie Shelterbelt Program (PSP).

The Agroforestry Development Unit develops and maintains current and factual information for the development and implementation of agroforestry practices. The information is regionally and locally relevant. It is targeted towards landowners, practitioners and decision makers. The Unit's work is designed to support sustainable agroforestry expansion.

The goals of the Development Unit are to increase the overall awareness of benefits of Agroforestry, develop information products based on research results and expert knowledge in conjunction with the Agroforestry Research unit, develop technology and information transfer tools and methods to assist in the adoption of agroforestry practices, provide technical support to AAFC programs related to Agroforestry, provide guidance to the Agroforestry Research unit and the Production and Distribution units based on interaction and feedback from knowledge and information transfer programs and technical support functions, and develop collaborative delivery mechanisms to promote agroforestry.

Agroforestry Research Unit

The Agroforestry Division's Research Unit concentrates on advancing agroforestry science, technology and development of genetic materials. The goal of the unit is to address identified knowledge gaps in agroforestry science and increase the understanding of agroforestry practices

in a way that contributes to the scientific knowledge on tree health, growth and function; agroforestry design; and the environmental, social and economic effects of agroforestry.

The unit conducts a mixture of applied and basic research which involves systematic investigation and discovery to develop, verify and scientifically test the validity of a hypothesis, or theory related to Agroforestry. The Research unit includes researchers at the Shelterbelt Centre. The unit has built research relationships with AAFC Research Branch which also extends to Universities and other institutions. The unit is also internationally recognized and actively involved in cooperative international research projects.

The Agroforestry Division Research Unit has been performing tree improvement breeding for over 60 years and has one of the longest running tree research programs in North America. When the Tree Improvement Program began, emphasis was placed on screening different species for hardiness and adaptability. Today, the program's focus is on developing genetically improved trees and the research has a national scope which is advancing through partnerships.

The goal of the Agroforestry Research Unit is to develop agroforestry science, technology and genetic materials for the improvement of agro-ecosystems. The Unit's activities are managed through two research streams: Improved Tree Performance and Health, and Improved Knowledge of Agroforestry Practices.

Research in the Improved Tree Performance and Health stream includes research in three main areas:
- *Tree Genetics:* Develop improved trees and shrubs that are adaptable to current and future environmental and biological stresses to ensure long term viability and function of agroforestry systems. Improvement strategies concentrate on developing genetically diverse seed strains that are well adapted to local ecosystems.
- *Tree Biology:* Create a better understanding of how trees grow and respond to the environment and identify and improve key characteristics such as cold hardiness, nutrient uptake, drought tolerance and water use efficiency that allow trees to resist environmental and biological stresses.
- *Tree Culture:* Develop innovative, environmentally sound management strategies and practices for healthy agroforestry systems by researching cultural factors that impact health, growth and function of trees and shrubs. This includes nursery management, nutrition, pests and diseases and weed competition.

Research in the Improved Knowledge of Agroforestry Practices area includes:
- *Impact and Function:* Studies to increase understanding of how agroforestry practices protect water and soil, sequester carbon, affect biodiversity and crop productivity.
- *Agroforestry Design:* Development of optimal designs and management systems so that agroforestry practices provide desired environmental, social and production benefits and are efficiently integrated into agricultural production systems.
- *Landscape Integration*: Development of knowledge and tools to improve decision making and better predict and quantify the benefits of agroforestry within agro-ecosystems, to determine where agroforestry practices are most effective and will have the greatest impact.

A NATIONAL ROLE IN AGROFORESTRY

Agroforestry is not new to Canadian agriculture. Agroforestry has uniquely evolved with a significant amount of research, development and extension occurring in all agricultural regions. Certain practices, such as shelterbelts, are well known and have been supported by AAFC. Other agroforestry practices, such as silvopasture, alley cropping and riparian buffer systems are less common in Canada but have potential to improve agriculture's economic and environmental sustainability.

The Agroforestry Division set its roots in Indian Head, Saskatchewan as the Shelterbelt Centre for regional tree production and distribution. Over the past century, it has grown and is now, as a Division, branching out across Canada focusing on providing service and expertise nationally. The transition is from a predominantly regional focus to a national role in providing leadership and expertise in agroforestry research, development and delivery across Canada. This transition brings with it many challenges including the need to build and enhance partnerships across the country, an expansion of the current knowledge base around Agroforestry design and practices, national coordination and leadership, research coordination, fiscal and human resources, integrating with existing regional activities, and policy development.

It should be noted that the Agroforestry Division is not currently devoid of national roles in agroforestry, and in fact, units such as the Strategic Management and Research Units already play a significant role in shaping and promoting Agroforestry across Canada. The Research Unit conducts research projects and has built partnerships, not only nationally but internationally as well. National research programs managed by the Agroforestry Division Research Unit have impacted agroforestry practice in all provinces by involving universities and Research Branch. Research projects on riparian buffers, tree genetics, livestock operations, and biomass production are examples of some of the current activities in collaboration at the national level. The integration of tree related best management practices into farm level environmental farm programs is also supported for all regions of the country.

Agroforestry practices are particular to farming systems, the physical and ecological environment, and the regional and social cultures. Agroforestry in the prairie region has evolved from the need for shelterbelts to provide protection to prairie farms and fields. Ecologically, much of this area is considered arid to semi-arid grasslands, mixed grassland and Aspen parkland environments. The species of trees introduced into the landscape, and the growth and function of those trees are very much limited by the grassland environment. In contrast, many of the agricultural regions in eastern Canada are based in boreal, mixedwood plains and Atlantic Maritime ecological regions where trees and tree culture are very much part of the landscape and local knowledge. The need for riparian buffers is much more prominent in agricultural landscapes dissected by numerous streams, rivers and riparian zones. Interest in Silvopasture systems in many areas of British Columbia is being driven by the need to develop economic and environmentally sound agricultural practices on forested lands affected by the Mountain Pine Beetle. Downturns in the forest industry and the need to create new economic products have also increased interest in integrated uses of once strictly forested lands. In its expanded national role, the Agroforestry Division must not only recognize this diversity in practice, but also the diversity in client and partner in its effort to promote sustainable practices.

The evolution of the Agroforestry Division from a regionally based Division to a fully national entity requires an increased level of knowledge and understanding of the potential benefits that agroforestry represents to Canadian farmers and the environment in all agricultural regions of the country. Agricultural production systems and land unit values vary across agricultural regions and are continually evolving. Agroforestry practices conducted and Agroforestry designs implemented in one region of the country may be unsuitable in other regions due to high land costs, machinery size or current production systems. As an example, many traditional prairie shelterbelts are being removed as machinery size increases and minimum till production systems replace conventional tillage systems. The challenge is to design Agroforestry systems that not only integrate well with current production systems, but also integrate well with evolving production systems while enhancing economic and environmental sustainability. Agriculture is also a shared jurisdiction between provincial governments and the federal government; therefore activities within each province may have to be adapted to federal-provincial agreements.

The Agroforestry Division can provide many functions in a national agroforestry role. Fundamentally, the Division can provide national ownership, leadership and direction to an area of science and land management practice that is often caught between agricultural practice and forestry. The Division can provide a broader and more inclusive environment for research and extension programs that support the development and implementation of regionally unique agroforestry practices and systems.

Continued leadership and coordination in research by the Agroforestry Research Unit into agroforestry systems, design, tree genetics, products and impacts will have a significant role in guiding agroforestry practice and implementation at the national level. Working with regional partners, coordinated research programs can reduce regional duplication while still providing answers to fundamental questions of design, impact and function. A national body can also provide scientific and limited financial support for specific regional research programs.

The development of innovative information resources that are current, factual and local relevant and the coordinated delivery of those resources are additional roles the National Agroforestry Division. Again, working with regional partners, national and regional workshops, field days and tours can be delivered to landowners and land use decision makers. A national agroforestry website, national and regional newsletters, the development of agroforestry planning materials, and economic evaluations of agroforestry practices are examples of some of the functions of the national centre.

Constructive and innovative Agroforestry policy development is also required at the national level. While agriculture is a shared jurisdiction between the federal government and the provinces, it is useful to develop and define acceptable Agroforestry practice and design, backed by science, before regulations that may constrict Agroforestry practice and benefits are imposed based on other standards. The National Division will work to develop science based policy and practice for adoption by producers in all provinces of the country.

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