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Canadian Forest Service – Great Lakes Forestry Centre

Fast-growing tree plantations as alternative crops

INTRODUCTION

Afforestation, defined as the establishment of forests on lands that have not been recently forested, can have multiple environmental and social benefits. In addition to the improvement or conservation of: wildlife habitat, recreational potential, visual aesthetics, and soil, water and air quality, tree planting can also mitigate climate change. Income can be generated from wood fibre or pulp or through the supply of various forest bioproducts, such as nutritional and medicinal biochemicals, energy from biomass and carbon sequestration credits within an offset trading system or exchange. Purpose-grown woody biomass for bioenergy through the establishment of fast growing plantations has received heightened attention of late, particularly in light of increasing prices of fossil fuel and the Ontario Government's plan to replace coal-fired power with, in part, biomass sources.

GREAT LAKES FORESTRY CENTRE (GLFC) RESEARCH

Overview

Initiatives such as the Forest 2020 Plantation Demonstration and Assessment initiative have resulted in the establishment of 6000 ha of fast-growing demonstration plantations, mainly on underutilized agricultural land across Canada, in cooperation with provinces, communities, forest industry, associations and rural landowners. Plantations have expected harvest dates 15-50 years hence, depending on the species and site characteristics, and were aimed primarily at wood fibre production. Plantation density ranged from 1,100 to 2,500 trees per hectare. Purposes of Forest 2020 included testing and improving biological information on both coniferous and deciduous species, demonstrating the potential contribution of fast-growing trees to help offset greenhouse gas emissions, and analyzing the potential to attract large scale private investment in future plantations. GLFC staff developed a summary of best practices for afforestation in Ontario and created models to assess the economic feasibility of these plantations in various landscapes and geographic locations. Under current market conditions, fast growing plantations for biofibre alone are not lucrative investments; however the picture can change when co-products such as carbon credits at sufficient price points or biofuels are added.

Modeling Economic Feasibility

Evaluations of the economic feasibility of afforestation for bioenergy, fibre production for wood or paper products, carbon sequestration and other potential environmental benefits were completed with the aid of models developed by GLFC researchers: the Canadian Forest Service Afforestation Feasibility Model (CFS-AFM), and the more advanced Forest Bioeconomic Model (CFS-FBM), which uses specified forecast horizons and an improved, more sophisticated carbon sequestration model.

The CFS-FBM model has been used to help assess the potential of major communities across Canada to host bioenergy facilities. In one set of analyses, five levels of biomass processing capacities were examined (90, 230, 450, 1500 and 3000 ktonnes per year). Much depends on the various assumptions but the results suggested three broad geographic regions have the most promise: the northern Prairies, central Ontario and parts of Quebec, and the Maritime Provinces. The Prairie Provinces were most suited for larger facilities, whereas other regions were more suited to smaller-scale projects.

The economic attractiveness of a bioenergy plantation (shorter rotation length and higher density) is influenced by the interaction between many factors, including site conditions, establishment and management costs, growth rates, harvesting and delivery costs and relative proximity of bioenergy facilities and markets. Land opportunity costs can also be a significant consideration if landowners are converting agricultural land to forest.

Short-rotation plantations for bioenergy

In Northern Ontario four short-rotation woody plantations, each 2 ha in size, were recently established on unused or underutilized agricultural land in New Liskeard, Hearst, Sault Ste. Marie and Thunder Bay to assess the potential for the purpose-grown hybrids to be used for bioenergy. This project builds upon experience gained in similar plantations established in southern Ontario and across Canada.

Short-rotation coppice (SRC), also known as "concentrated woody biomass for energy", is a form of silviculture that uses fast-growing hybrids of willow or poplar. It typically involves planting cuttings (portions of the stems) at high density (approximately 10,000-20,000 cuttings/ha), on a very short rotation (3-4 years) and results in high post-harvest stump sprout density (50,000-80,000/ha). Plantations can be harvested repeatedly (coppiced) for up to seven rotations before replanting. Various hybrids can be used, depending on site characteristics and local climate.

The key assessment activities in Ontario and the rest of Canada are: field testing of several hybrids of willow and poplar; chemical and physical analysis of woody biomass; determining cost of establishment, maintenance and harvesting practices; yield expectations; and conducting bio-economic analyses. Development of harvesting and processing systems is also underway. This work will be monitored over at least

1) Site preparation/cultivation using discs

2) Planting cuttings with modified vegetable planter

3) Sampling to determine plantation yield after 3 years' growth

4) A coppice plantation during the first growing season after harvest, with 4th growing season plantation (poplar on right, willow on left) in background

one full rotation. Collaboration is planned with various partners and end-users of the biofibre with ongoing technical support to ensure that the crops are properly maintained.

CONCLUSION

GLFC's afforestation projects help demonstrate the potential benefits of fast-growing plantations. GLFC researchers, through plantation establishment, data collection and modeling, have supported the assessment of the feasibility of afforestation on regional to Canada-wide scales. The economic models also examine issues such as the potential of woody biomass as an energy source and a fossil fuel substitute, the most influential factors that change the economic feasibility of tree plantations and the break-even costs of woody biomass supply. They are also being used to investigate co-benefits such as carbon sequestration by tree biomass and eventually the potential for other co-products. The results of these studies will be integral in the future success of fast-growing plantations in Canada.

Principal Collaborators

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