Photo by D. Gouge

Natural Resources Canada
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Canadian Forest Service

CANADIAN WOOD FIBRE CENTRE

Fibre Facts nº 23

Climate Change and the Bioeconomy: Finding Silviculture Solutions for 21st Century Forests

Not all might be lost when a major natural disturbance strikes a forest. As climate change begins to intensify, Canada's forests will experience frequent disturbances. Such events equate to a loss of habitat and timber, and are often a large silvicultural expense.

Canada

Researchers with Natural Resources Canada (NRCAN), Canadian Wood Fibre Centre (CWFC) and Université Laval investigated if they could turn a "disaster" into an opportunity. After a spruce budworm outbreak within a boreal-conifer forest of eastern Canada, they concluded that utilizing the un-merchantable and dead standing timber for forest biomass could improve forest regeneration, decrease silviculture costs and help fight climate change.

Figure 1: A map of the study area located within the boreal forest of Quebec's North Shore Region.

Since 1948, Canada's mean temperature has increased by 1.7 °C, which is twice the rate of the corresponding increase in the global mean temperature. As this trend continues, Canadian forests will experience more extreme weather and environmental events. To deal with the consequences of such events, forest managers will need new silvicultural approaches to continue to manage forests sustainably. Forest biomass harvesting is an innovative silviculture technique currently used to supply Canada's growing bio-economy through the harvest of untraditional timber sizes and quality. Using this technique may also enable foresters to safely and economically renew forests that have been affected by natural disturbances.

Within the boreal forest of Quebec's North Shore Region, a spruce budworm outbreak caused severe mortality to most of the spruce and balsam fir trees. This outbreak created a forest condition with a large amount of dead woody material left standing and fallen on the forest floor. This resulted in a high fire hazard and a forest that is difficult to regenerate.

CWFC and Université Laval researchers used this forest to evaluate if a sustainable forest biomass harvest could have an effect on the:

1. density of natural regeneration
2. quantity and quality of suitable microsites for tree planting
3. financial cost of site preparation and tree planting
4. carbon balance of silviculture scenarios when forest biomass is used as a substitute for fossil fuel energy production

The study compared two timber utilization methods within a clearcut harvesting system:

1. Traditional utilization: harvest to the provincial timber utilization standards
2. Biomass utilization: harvest of degraded conifer trees and tree parts that do not meet lumber standards, as well as intolerant hardwoods

Data was collected post harvest and before any site preparation or tree planting occurred.

Figure 2: Salvaged timber from the areas devastated by the spruce budworm infestation.
(Photo by D. Gouge)

Figure 3. Possible planting location and regeneration occurring within a stand harvested for forest biomass material.
(Photo by D. Gouge)

Management Implications

1. Regeneration

One year after harvest, sites with biomass harvest had more of the desired commercial species naturally regenerating, more plantable microsites and an increase in the combined presence of desired regeneration and microsites. There was no difference between the harvesting treatments regarding the amount of competing vegetation on site.

2. Site Preparation

The cost of mechanical site preparation within the biomass harvested stands was estimated to be less ($182/ha) than within the stands that were harvested for traditional lumber use ($464/ha). This $282/ha reduction in costs was attributed to biomass harvested stands having less fallen and standing woody material left on site. Thus, these areas needed less effort to be properly scarified, and required less planting due to the increase in the desired natural regeneration.

Climate Change Implications

The integration of biomass harvesting with silviculture can have a positive ecological and financial impact on forest management. This silvicultural package may allow foresters to effectively deal with large-scale forest mortality induced by climate change. This will also supply renewable resources to Canada's green economy. Close collaboration between the forest industry, bio-economic industries and government can allow for synergies to be developed that would result in financial savings and green house gas emission reductions.

Carbon Sequestration

By modelling the carbon fluxes of various silviculture scenarios, the research team demonstrated that the scenarios that included site preparation and planting sequestered the most carbon over a 100-year period. The biomass harvest, site preparation and planting silvicultural package was the only scenario that became a carbon sink. This occurred after year 65.

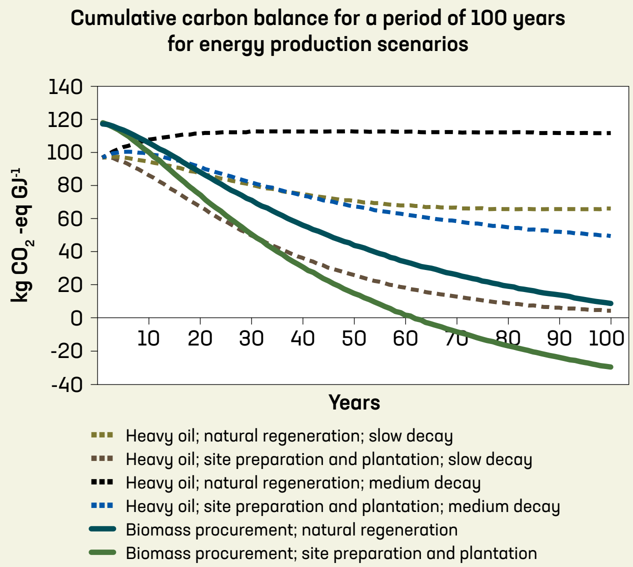

Figure 4. Cumulative carbon balance for a period of 100 years for energy production scenarios representing combinations of forest biomass harvest (with vs. without), regeneration methods (natural regeneration vs. site preparation and plantation), woody debris decay rate (slow vs. medium) and heat production energy systems (bioenergy from biomass vs. heavy oil) in northeastern Quebec. Positive values on Y axis represent greenhouse gas (GHG) emissions and negative values represent GHG sequestration. Simulations include processes of forest growth, debris decay, site preparation (when needed), energy production and use. It does not include emissions from timber harvesting and transport.

Acknowledgements:

This study was funded by the Natural Science and Engineering Research Council of Canada, the International Energy Agency Bioenergy – Task Force 43, and Natural Resources Canada.

For more information (reference):

Gouge, D., Thiffault, E., and Thiffault, N. 2021. Biomass procurement in boreal forests affected by spruce budworm: effects on regeneration, costs, and carbon balance. Can. J. For. Res. 51(12): 1939-1952

Available online at:
https://doi.org/10.1139/cjfr-2021-0060

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Aussi disponible en français sous le titre :
Les changements climatiques et la bioéconomie : trouver des solutions sylvicoles pour les forêts du XXIe siècle

Canadian Wood Fibre Centre – Fibre Fact: 023. ISSN 1918-2562-PDF-E