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CANADIAN FOREST SERVICE

Science HIGHLIGHTS

SOIL DISTURBANCE AND BIOENERGY

What role does soil play in providing forest biomass for bioenergy?

Classifying soils across Canada could help determine how much biomass forest ecosystems can provide for bioenergy projects

Biomass from sustainably managed forests offers a renewable source of energy. But if too much biomass is removed, the forest ecosystem may be compromised. For forest energy, biomass is living or recently dead biological matter from plants. Rich in carbon, biomass is essentially a stored form of solar energy.

Traditionally, much of the biomass left over from forestry operations was left on the land. In a 2010 study, the Forest Products Association of Canada (FPAC) estimates that the Canadian forest industry will be able to produce clean bioenergy on a scale equivalent to nine nuclear reactors or enough clean power to meet the energy needs of 2.5 million homes. But with the push for bioenergy as a way to reduce greenhouse gas emissions finding out how much biomass can be sustainably extracted is a priority. One important way to gauge a forest's capacity to produce biomass is to see what kind of soil it grows in.

Different soils can handle different levels of biomass removal

"Basically, forests with sandier soils are at higher risk of reduced productivity because they have less buffering capacity," says Doug Maynard, a research scientist with the Canadian Forest Service–Natural Resources Canada at the Pacific Forestry Centre in Victoria, B.C. Buffering is the soil's ability to resist changes in acidity (measured by its pH level) and available nutrients. This capacity is largely determined by presence of clay, organic matter and acid-neutralizing rocks like limestone. If a soil's pH changes too much or nutrients are removed, it can lose its ability to sustain trees and other vegetation. This can lead to erosion and related problems that get worse over time like declining water quality as more silt ends up in watersheds.

Soil types also affect an ecosystem's capacity to sustain biomass in other ways. Maynard has been researching how soil compaction can affect the regrowth of vegetation. Compaction happens during forest harvesting when roads are built or heavy equipment runs over the land. When it comes to compaction, sandier soils are more resilient than clay soils because they are drier. Maynard is part of a larger Long-Term Soil Productivity Study coordinated by the U.S. Forest Service that is studying compaction and loss of organic matter.

Overview

One important way to gauge a forest's capacity to produce biomass is to see what kind of soil it grows in.

Sandier soils are less able to withstand biomass removal than clay soils.

Most of Canada's forest soils are not classified.

Doug in his element

Canada

Systematically mapping Canada's soils could lead to biomass removal ratings

Maynard and his Canadian Forest Service colleagues are working to classify soils across Canada for suitability for biomass. Their work could give industries like bioenergy and forestry a scientific baseline for biomass removal ratings. Slope, elevation and soil properties like buffering capacity and susceptibility to compaction are the kinds of factors a classification system would consider.

"Can we use GIS and other remote sensing tools to map soil in detail? Right now most of the forest soils in Canada are not mapped," Maynard says. "Once soils are classified, we could come up with a risk-rating system for biomass removal."

Mud Creek soil profile