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Case Study: Soil health assessment for land conversion from boreal forest to agricultural land - Thunder Bay Ontario – Canada

Paúl Benalcázar[1], Amanda Diochon[2], Randy Kolka[3], Robert Schindelbeckd[4], Tarlok Sahota[1], Brian E. McLaren[1]

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[1] Lakehead University, Faculty of Natural Resources Management. Thunder Bay, Ontario, Canadá
[2] Lakehead University, Department of Geology. Thunder Bay, Ontario, Canadá
[3] United States Department of Agriculture, Forest Services Northern Research Station. Grand Rapid, Minnesota 55744, USA
[4] Cornell University. 1005 Bradfield Hall, Ithaca, New York 14853, USA

* *Correspondence:* benalcap@uoguelph.ca

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Abstract

Scientific advances in soil science, the study of soil formation and evolution processes, and advances in modeling of biophysical-chemical soil processes have allowed a better understanding of the complexity, composition, and development of soil for maintaining life on Earth thanks to the ecosystem services it provides, including providing food for humanity; caring for it means guaranteeing our food and nutritional security. However, these ecosystem services provided by soil are being threatened by anthropogenic disturbances (climate change) that have been exacerbated by biophysical and chemical processes causing losses of organic matter [OM] content, one of the main components of soil fertility. As a result of the reduction of the OM content, the weakening of its structure is causing the soil to be more susceptible to erosion and degradation processes. The expansion of desertification also directly affects soil health [SS], which is its capacity to maintain the life of plants, animals, and microorganisms, and their diversity, as well as the environmental services it provides in terrestrial ecosystems. Recent advances in SS analysis are driving understanding of the factors that support this health, and the development of strategies that support a more regenerative agricultural production system. SS is a result of three factors: intrinsic properties, land use system and management practices. It is assessed through the measurement of indicators that consider physical, chemical and biological functions of the soil. In northern Canada, the need to produce more food has exacerbated SS due to climate change, and due to the change in land use: from boreal forest to agricultural production areas. The conversion of forest lands to agricultural lands often leads to significant losses of OM, affecting SS. The following study aimed to evaluate the effects of land conversion on SS indicators using the Comprehensive Assessment of Soil Health [CASH] framework, which defines a scale between 0 -100 with 80-100 being the best SS. Soils (0–5 and 5–15 cm) were collected from six dairy farms near Thunder Bay, Ontario, Canada, which included a mature forest, a field converted from forest to agriculture <10 years ago, and a field converted from forest to agriculture >50 years ago. Soil conversion resulted in significant declines in permanganate-oxidizable carbon, aggregate stability, soil respiration, and concentrations of OM, autoclaved citrate-extractable protein, nitrogen, and total carbon. The lower CASH

scores in soils converted to agriculture are interpreted as decreased SS, but the scores, along with soil organic matter [SOM] concentrations, remain high (CASH = 80; OM = 6%). No effect of time since conversion was observed, suggesting that any SS degradation occurs rapidly and is closely linked to decreased SOM.

Keywords: Soil functions, Organic matter, Soil health