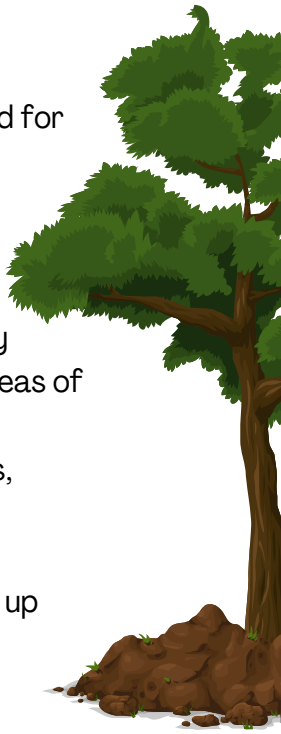
Forest Succession: What is in the soil, and why does it matter?

Study: Foote, R. L., and Grogan, P. (2010). Soil carbon accumulation during temperate forest succession on abandoned low productivity agricultural lands. Ecosystems, 13, 795-812.

What is the study about?



Carbon and nitrogen are stored in land, and more specifically, in soil. When this land is developed for agriculture, and thus experiences disturbances in the soil through ploughing, tilling, and crop harvesting, the amount of stored Carbon (C) and Nitrogen (N) decreases.

In Eastern North America, natural vegetation areas are mixed hardwood conifer forests, which settler Europeans encountered when more arrived here on Turtle Island in the early 1800s. They cleared these forests to establish their homes, farms and firewood stocks. Now, these huge areas of low productivity (marginal) farmlands in Eastern North America have been abandoned from agriculture over the past 70 years and have begun regenerating back to its most natural forms, which are forests.

This study explores the long term potential of abandoned farmland in Southern Ontario to take up and store carbon. The benefit of this is two-fold: it removes CO2 from the atmosphere, and it restores carbon content in soil to original levels before the impacts of agriculture.

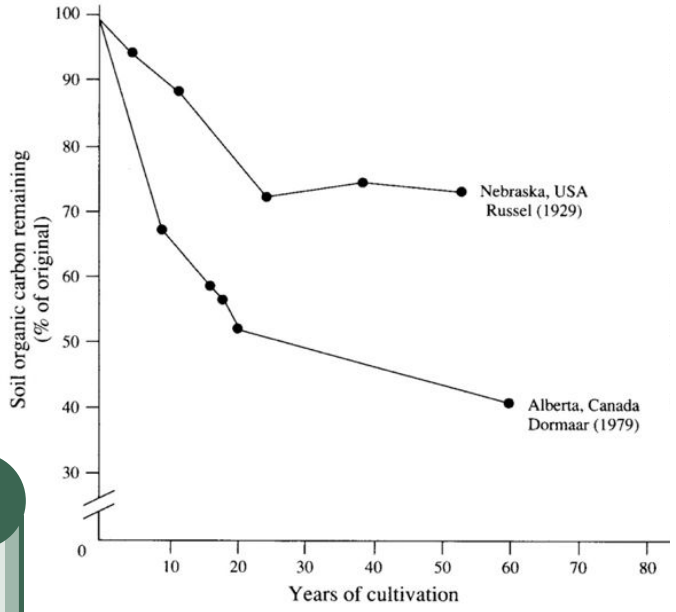
What did the researchers do?

The researchers looked at 3 different types of soil, and compared soil C and N levels in mature forests to farms that had been abandoned at various times over the past 100 years.

What did they find?

1

They found that abandoned farmland had 32% less carbon and 18% less nitrogen than their mature forest soil counterpart. Agricultural practices (primarily monocultures) reduce the amount of carbon and nitrogen in farmland soil (eg. Soil carbon is released after ploughing but little new carbon is added back because the crop planted is harvested and taken away. Also, Corn takes up N from soil and doesn't restore it.)



Foote, R. L. and Grogran, P. 2010.

2

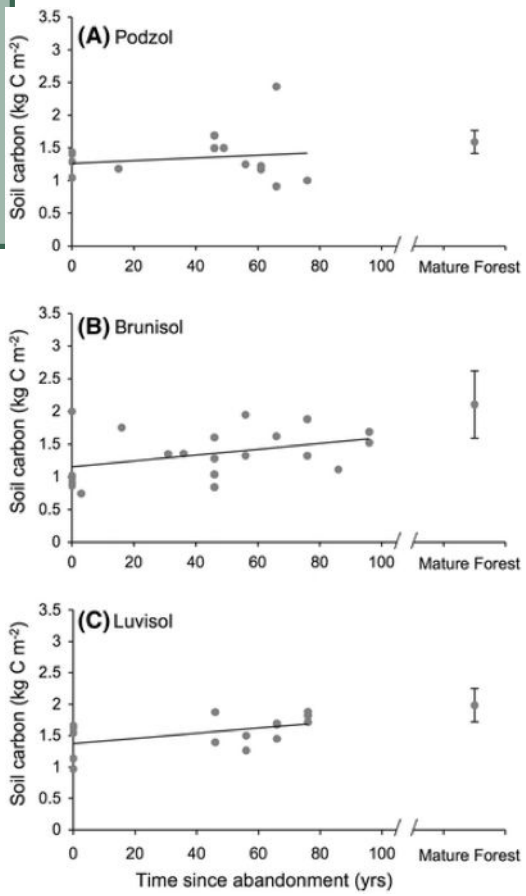
The most important factor in determining how much carbon and nitrogen could actually be taken up (sequestered) by the soil, was the time since abandonment. The soil type did not matter too much.

3

The data from this study were used to estimate that 8.95 teragrams (about 8,950,000,000 kg) of carbon may have been taken up into the soil since farmland abandonment began in the 1950s. Overall, this is a relatively small amount of carbon compared to what trees are capable of sequestering (taking up and holding), over that same period (12x more). That said, tree carbon sequestration ceases once the forest matures but soil carbon sequestration can continue for much longer.

4

It isn't the soil-type that's important in determining how much C and N are taken up; but instead, how long a farmland has been abandoned. The more time for vegetation succession toward a mature forest, the more soil and plant carbon is sequestered. Furthermore, the transition from agriculture crop monoculture to shrubland and then forest greatly increases the biodiversity of plant and animal species.



Soil carbon in different soil types. Foote, R. L. and Grogran, P. 2010.

5

Abandoned farmland will naturally undergo vegetation succession to forest in this region. Abandoned farmland becomes a carbon sink and accumulates increasing amounts of plant and soil carbon as it develops into forest.

Why does this matter?

Having carbon and nitrogen stored in soil is beneficial for soil and plant function and productivity, efficient water cycles, and overall ecosystem health and balance. Storing carbon in the soil also means that instead of carbon accumulating in the atmosphere as CO2, it can be stored as organic carbon in the soil, which then influences climate change. Therefore, mature forests accumulate CO2 from the atmosphere and restores carbon content in soil and are effective long-term carbon sinks.