Agricultural Greenhouse Gases Program (AGGP2)

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Trees Store a Large Amount of Carbon in Three Agroforestry Systems in Central Alberta, Canada

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Introduction

Long-term carbon (C) storage in terrestrial ecosystems in both the vegetation and soil help to mitigate climate change. The ability to store C can be vastly different depending on factors such as the land-use system involved, the climatic condition, and the soil type, among others. One of the deficiencies in our study of agroforestry systems (AFS) is that C sequestration potentials are largely calculated from coarse estimates of overstory tree biomass and mineral soil C contents. Here, we studied ecosystem level C stocks across 36 sites (Fig. 1) in central Alberta, Canada, by assessing how they differ among three different AFS (hedgerow, shelterbelt, and silvopasture; 12 sites for each AFS) and their component land-uses (forested area and adjacent herbland).

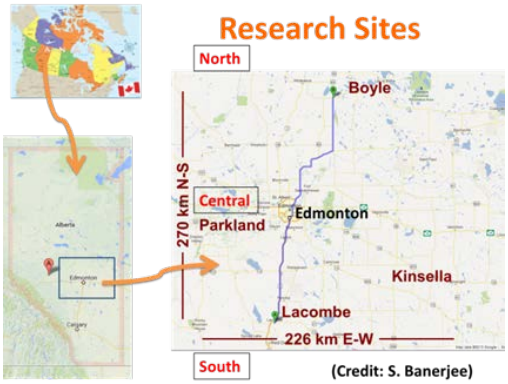


Fig. 1. Study site location.

Methods

At each of the hedgerow (aspen dominated), shelterbelt (white spruce dominated) and silvopasture (aspen dominated) sites, a rectangular plot (100 m^2) was established in each of the forested area and adjacent herbland. The vegetation was surveyed for the overstory, midstory, small shrub/large herb, and understory strata. The above- and belowground biomass of overstory and midstory trees was estimated using allometric equations from the literature or we established in this study. Other vegetation types were destructively sampled to determine aboveground biomass and their root biomass was estimated using known root to shot ratios. The C content in the vegetation, surface organic soils and mineral soils to a 75 cm depth were quantified.

The Result

Forested areas within each AFS stored 182 Mg ha^{-1} more C than the adjacent herbland; however, AFS type did not affect the ecosystem level C stock size. Carbon in forested areas of AFS was stored mostly in the mineral soil (61%), followed by overstory trees (28%) and surface organic layer (LFH, 10%), with the C stock in LFH in the forested area of AFS positively related to tree age (Fig. 2). A more detailed account of the C stock in the soil in the studied AFS can be found in Lim et al. (2018).

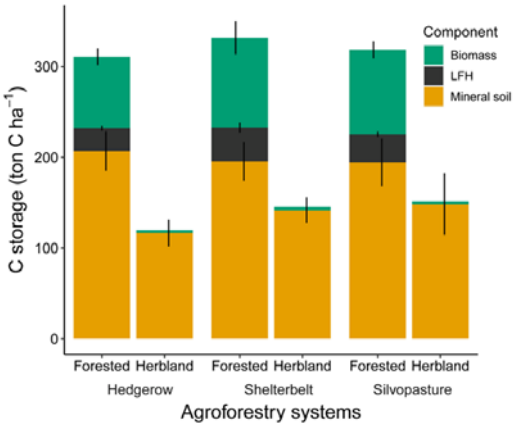
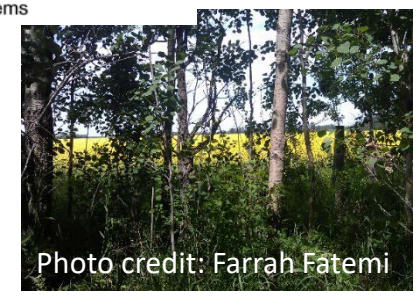


Fig. 2. Distribution of C stock in three agroforestry systems.



Implications

Trees make a large contribution to ecosystem level C storage in AFS and should be protected or promoted to realize their contribution for long-term C storage.

Further Reading

Lim, S.S. et al. 2018. Soil organic carbon stock in three Canadian agroforestry systems: from surface organic to deeper mineral soils. Forest Ecology and Management 417: 103–109.

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