Agricultural Greenhouse Gases Program (AGGP)

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Perennial Vegetation Cover Helps to Increase Soil Carbon Concentration and Stability in Agroforestry Systems

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The Motivation

Agriculture is a large source of greenhouse gases (GHGs) in the atmosphere. The increasing atmospheric GHG concentrations is the main cause of global climate change. The Paris climate agreement signed by world leaders in December 2015 set to limit global warming to 2 °C or lower in 2100. In order to achieve such an ambitious goal, we need to find a variety of means to reduce GHG emissions from different sources. Developing beneficial management practices and land use systems that reduce GHG emissions from agriculture has a large role to play to reduce GHG emissions from the agricultural landscape. This study thus evaluated the role of three agroforestry systems in increasing carbon sequestration and reducing GHG emissions in central Alberta.

Methods

We selected 35 sites of three agroforestry systems: 12 hedgerow, 11 shelterbelt and 12 silvopastoral sites. The sites were distributed across a 250 x 300 km area centered around Edmonton, spanning from the Dark Brown Chernozemic to the Dark Gray Chernozemic soil zones. In each site, plots were set up in the forested area and in the agriculture production area (herbland, including grazed pasture and annual crop production areas). Soil samples were collected from the 0-10 cm depth from the plots and were analyzed for their concentrations in the bulk soil and theirdistribution in different particle size fractions (<53, 53–250, 250–2000 μm).

The Result

Mean soil organic carbon concentrations (0-10 cm depth) in the whole soil was 62.5, 47.7 and 81.3 g kg^{-1} in hedgerow, shelterbelt and silvopasture systems, respectively, indicating that the soil organic carbon concentration was much higher in the silvopastoral system than in the other two systems. Soil carbon in the fine fraction (<53 μm) is more stable than that in the coarser fractions; its concentrations were 34.3, 28.8 and 29.3 g kg^{-1} in the hedgerow, shelterbelt and silvopasture systems, respectively, indicating that the soil organic carbon maybe more stable in the hedgerow system. Within each agroforestry system, the forested land use consistently had greater total soil organic carbon than in the herbland.

Implications

Integrating trees into annual cropping systems to form agroforestry systems within the agricultural landscape has the potential to store more soil carbon than monocultural agricultural land use. The existence of perennial grass species in the silvopastoral system likely helped to store more soil carbon as compared to shelterbelt and hedgerow systems.

Maintaining perennial vegetation cover should be encouraged to increase carbon sequestration in the agricultural landscape.

Further Reading

Baah-Acheamfour, M., Carlyle, C.N., Bork, E.W. and Chang, S.X. 2014. Trees increase soil carbon and its stability in three agroforestry systems in central Alberta, Canada . Forest Ecology and Management. 328: 131-139.

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