AGGP-Agroforestry

How Much Greenhouse Gases can be Mitigated in a Farm by Shelterbelt Plantings?

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To date, research on GHG mitigation potential of shelterbelts have focussed on single components within the farm system, i.e. either carbon storage in biomass and soil, or trace gas emissions in shelterbelts and cropped fields, without taking into account the complexity of interrelationships in these systems. Yet, two pertinent questions arise: (a) by how much do shelterbelts reduce GHG emissions from a whole farm during a given period of time? and (b) what shelterbelt tree species are more effective in mitigating GHG emissions? Indeed, a holistic quantitative assessment of the effect of planted shelterbelts on overall farm GHG emissions is needed for a more accurate estimation of the environmental and economic benefits of shelterbelt establishment, which in turn, will support policy and management decisions on shelterbelt systems.

Greenhouse Gas Mitigation by Shelterbelts

Using the Holos model (a Canadian farm-level GHG calculator developed by Agriculture and Agri-Food Canada), we estimated the potential of three shelterbelt tree species [hybrid poplar (*Populus spp*), white spruce (*Picea glauca*) and caragana (*Caragana arborescens*)], at five planting densities, for reducing net GHG emissions in a model farm (cereal – pulse rot ation) over a 60-year time frame. The planting densities of the shelterbelts represented 0%, 0.5%, 1.0%, 3.0% and 5.0% of the total farm area. The Holos model considered all significant sources and sinks of GHGs on the farm including: carbon (C) storage in tree biomass and soil, C loss due to microbial decomposition of plant residues and due to diesel fuel use, and the production of N_2O and CH_4 gases in the soil.

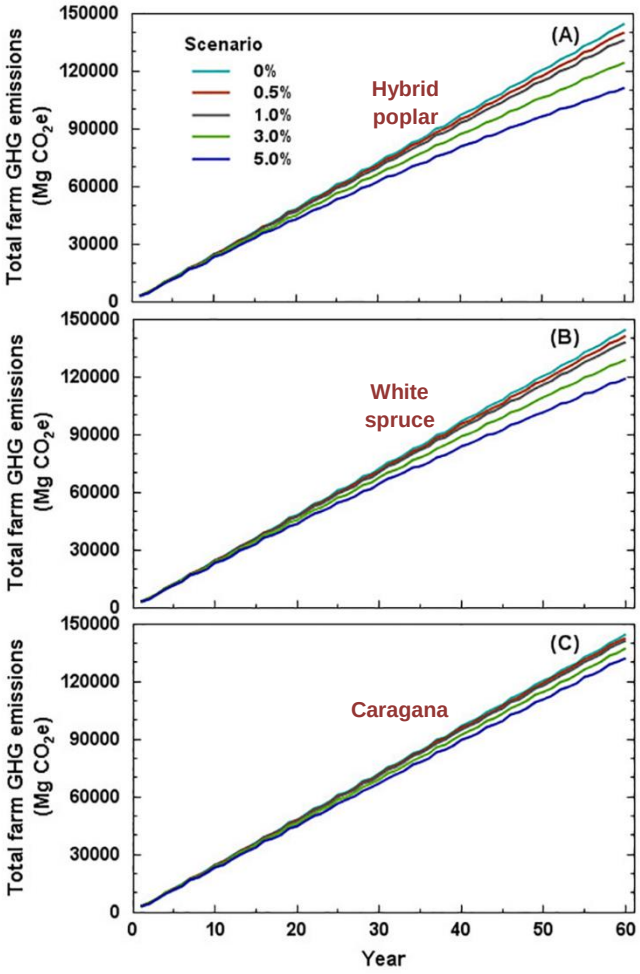

Fig. 1. Total farm GHG emissions across five scenarios of (A) hybrid poplar (B) white spruce and (C) caragana shelterbelt establishments in a 688 ha model farm across 60 years

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Major Findings

- The greatest reduction in farm GHG emissions was predicted when the planted shelterbelt species was hybrid poplar (33,226 Mg CO_2e; 23.0%) followed by white spruce (25,194 Mg CO_2e; 17.5%), and caragana (11,897 Mg CO_2e; 8.2%), at the highest planting density (see Fig. 1).
- The greater GHG mitigation potential estimated for hybrid poplar shelterbelts was attributed to greater biomass production and consequently, more rapid C input to soil through litter fall and root turnover compared to white spruce and caragana.
- Greenhouse gas estimates from Holos agree with data obtained from field measurements and suggest that species selection will be important for maximizing C sequestration and GHG mitigation potential from shelterbelt systems; conversely, shelterbelt removal from the agricultural landscape suggests an increase of net on-farm GHG emissions.

FURTHER READING

- Amadi, C. C. 2016. **Dynamics of carbon dioxide, methane and nitrous oxide fluxes in planted shelterbelts and adjacent cropped fields.** Ph.D. dissertation, University of Saskatchewan, Canada
- AGGP Fact Sheet(s): **SASK-17, SASK-18**

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