AGGP-Agroforestry

CARBON LIFE CYCLE ASSESSMENT OF SHELTERBELTS IN SASKATCHEWAN

No. Sask-44

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Shelterbelts, also known a windbreaks, provide a variety of environmental services. For example, they provide protection against soil erosion, habitat for wildlife and contribute to biodiversity as well as sequestering carbon in biomass and soils. With changes in crop production technology and increasing size of field operations equipment shelterbelts are being perceived as providing fewer benefits and imposing larger costs to farm managers, resulting in a trend towards shelterbelt removal. A more comprehensive estimate of shelterbelt benefits, such as net carbon sequestration, could be used to inform farm scale decisions on shelterbelt retention, as well as an important instrument in mitigating greenhouse gases.

SCOPE OF THE STUDY

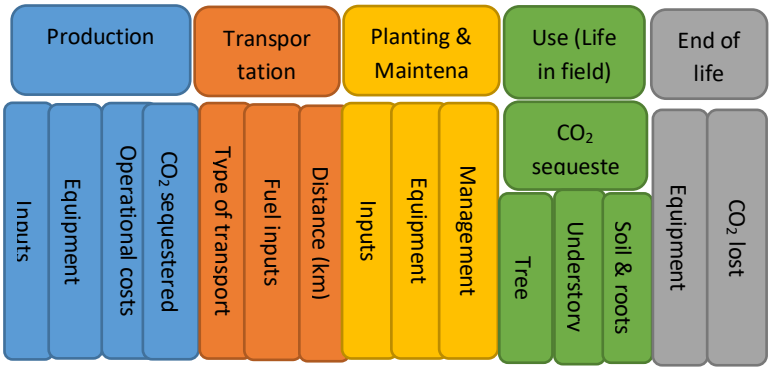

Figure 1. System components of life cycle stages for the Saskatchewan shelterbelt LCA

IN THIS STUDY, A LIFE CYCLE ANALYSIS WAS UNDERTAKEN FOR FARM SHELTERBELTS IN THREE SOIL ZONES OF SASKATCHEWAN.

SHELTERBELTS AND CARBON SEQUESTRATION

- Farm shelterbelts are one of a variety of management practices that can help mitigate greenhouse gas emissions from economic activities.
- Shelterbelt tree species grow at different rates under different climate conditions and as a result careful selection of tree species is required to meet sequestration objectives.

A Life Cycle Assessment (LCA) is a tool that observes and analyzes the entire life of a phenomenon from 'cradle to grave'. Applied to farm shelterbelts the LCA consists of four growth stages and one end of the life stage if a shelterbelt dies or removed. The initial stage is production of seedlings, followed by their transportation to the users (landowner). They are then planted either as farmstead shelterbelts, field shelterbelts, around livestock corrals, as well as around water bodies (wetlands, or on the bank of the river and other water bodies). During this initial 4-5 years period the shelterbelt trees require maintenance.

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Manitoba maple and green ash can build up carbon sinks at a relatively young age while hybrid poplar attain the largest estimated carbon stocks, in all three soil zones, over 60-year time horizon.

Table 1. Total Ecosystem Carbon (as carbon dioxide equivalent) sequestered by type of shelterbelt and location in tonnes for a km long shelterbelt at an age of 60 years.

Location (Soil Zone)	Caragana	Green ash	Hybrid poplar	Manitoba maple	Scots pine	White spruce
Brown	454.88	424.71	1500.49	565.82	477.14	495.79
Dark Brown	436.92	415.70	1482.80	556.01	470.29	572.01
Black	410.71	407.51	1461.39	544.80	483.67	510.58

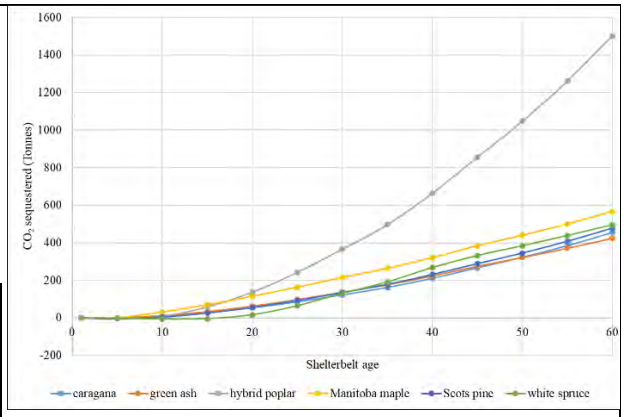

Figure 1. Total CO_2 sequestered by different shelterbelt tree species in the Brown Soil Zone of Saskatchewan.

The production, transportation and planting of shelterbelt trees result in greenhouse gas emissions, however, once established all trees exhibit net sequestration of carbon over their life span. Considering both CO_2 equivalent emissions and sequestration all six shelterbelt tree species were carbon neutral (total emissions – total sequestration) by year eleven after establishment.

There are some minor differences in the sequestration level of various species in different locations (See Table 1). Caragana, green ash, hybrid poplar, and Manitoba maple provide higher sequestration in the Brown soil zone, whereas Scots pine perform better in the Black soil zone, and white spruce in the Dark Brown soil zone.

Shelterbelts represent an important resource for reducing greenhouse gases in the atmosphere. Although some producers might consider them as nuisance in operating their farm business, they are nonetheless an important environmental asset.

In addition to climate regulation, they provide other benefits to society including increased biodiversity, snow capture, reduce damage from heavy winds, and aesthetically pleasing landscapes.

CONCLUSION

In conclusion, this study found that after taking into account all different activities related to a farm shelterbelt, hybrid poplar had the highest level of carbon stored of the six species in all three soil zone clusters. One km long shelterbelt in the Brown soil zone could sequester 1,501 t CO_2, although in other soil zones it could be as low as 1,461 t CO_2. The Brown soil zone has typically more arid and less nutrient dense soils compared to the Dark Brown and Black soil zones, resulting in a decrease in the amount of expected biomass. However, this was not the case for hybrid poplar, which showed the highest biomass and carbon sequestration by age 60 in the Brown soil zone. Caragana, green ash, Manitoba maple and scots pine all reported a slightly higher biomass and carbon sequestration in the Brown soil zone relative to other soil zones. White spruce was the only species that reported a higher biomass and carbon sequestration in the Dark Brown soil zone, and lower amount in the Brown soil zone. This may be due to white spruce being sensitive to decreased levels moisture than the other species.

FURTHER READING

Rudd, Lindsey. 2020. Carbon Life Cycle Assessment of Shelterbelts In Saskatchewan. M.E.S. thesis. University of Saskatchewan, Saskatoon. https://harvest.usask.ca/handle/10388/12837

CONTACT FOR MORE INFORMATION: SASKAGROFORESTRY.CA/

ACKNOWLEDGEMENTS & COPYRIGHT

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