BC FoodWeb

Peer-reviewed research

RESEARCH SUMMARY

Improving on-farm climate mitigation and adaptation through stewardship programs

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Production Type
- Various

Practice Benefit(s)
- Increased flood and drought resilience
- Decreased net greenhouse gas emissions

Research Location
- Delta, BC

KEY TAKEAWAYS

- **Enrolment in agricultural stewardship programs** (for grassland set asides, winter cover cropping, and hedgerows) **improved on-farm climate mitigation and adaptation.**
- Specifically, enrolment in hedgerow and grassland set-aside with winter cover cropping stewardship programs **increased soil organic carbon stocks by 60-70%** and **improved soil water regulation** (the ability of soil to receive, store, and redistribute water).

Key Terms:
- *Climate mitigation: reducing net greenhouse gas (GHG) emissions.*
- *Climate adaptation: actions that reduce the negative impact of climate shifts and extremes.*

Figure 1. Soil sampling in a grassland set-aside. Photo by the research team.

HOW CAN THIS RESEARCH BE USED?

- Farmers seeking to improve on-farm climate mitigation and adaptation can participate in agricultural stewardship programs. These programs offer cost-sharing with farmers to **help offset the costs** involved with planting and managing ecological features (i.e. hedgerows, cover crops, etc.).
- Our findings **support the expansion** of agricultural stewardship programs.

WHY WAS THIS RESEARCH DONE?

The objective of this research was to quantify the ability of three agricultural stewardship programs to increase on-farm climate mitigation and adaptation, indicated by improvements in soil carbon storage and soil water regulation. Increasing soil carbon storage mitigates climate change by pulling carbon dioxide, a greenhouse gas, out of the atmosphere. Improving soil water regulation leads to better flood and drought resilience.

RESEARCH SUMMARY

The stewardship programs examined in this study have been implemented by the Delta Farmland and Wildlife Trust (DF&WT) since the early 1990s. The programs include:

1. Hedgerows (HR)
2. Grassland set-asides and winter cover crops (GLSA + WCC)
3. Winter cover crops only (WCC)

These programs incentivize the ecological practices listed above and are implemented to improve both soil conditions and wildlife habitat in agricultural systems of the Fraser River Delta, BC. They offer a cost-share with farmers to help offset the costs of planting, managing, and temporarily removing the land from production.

Although these programs have been shown to support numerous ecosystem services, such as pollination and biodiversity, it was unclear how they contributed to on-farm climate mitigation and adaptation. This research helps identify additional benefits of stewardship programs.

Figure 2. First year grassland set-aside containing phacelia. Photo by the Delta Farmland and Wildlife Trust.

WHAT WAS THE OUTCOME?

Overall, our results suggest that agricultural stewardship programs can improve sustainability within the agricultural landscape while maintaining economic viability of crop production. Specifically, we found that stewardship programs involving hedgerows and grassland set-asides promote the accumulation of soil carbon and lead to improved soil water regulation.

HR and GLSA + WCC stewardship programs led to significantly higher soil organic carbon, which was measured in two ways:

1. Soil organic carbon concentration was significantly higher in HR and GLSA + WCC (86% and 44% respectively) in the top 15 cm of soil compared to non-program fields (Figure 3A).
2. Soil organic carbon stocks were significantly higher in HR and GLSA + WCC (71% and 63% respectively) in the top 30 cm of soil compared to non-program fields (Figure 3B).

Topsoil (0-30 cm) water holding capacity was 93% greater in HR, compared to cropped regions of non-program fields (Figure 3C). Higher water holding capacity allows for an agricultural landscape to mediate periods of high rainfall without degrading the soil. Conversely, during dry months such as July and August, higher water holding capacity can help sustain soil water and decrease irrigation requirements. Hedgerows can also serve as buffers to water and nutrient losses from cropped areas and are important for regulating water movement across an entire agricultural area.

RESEARCH SUMMARY

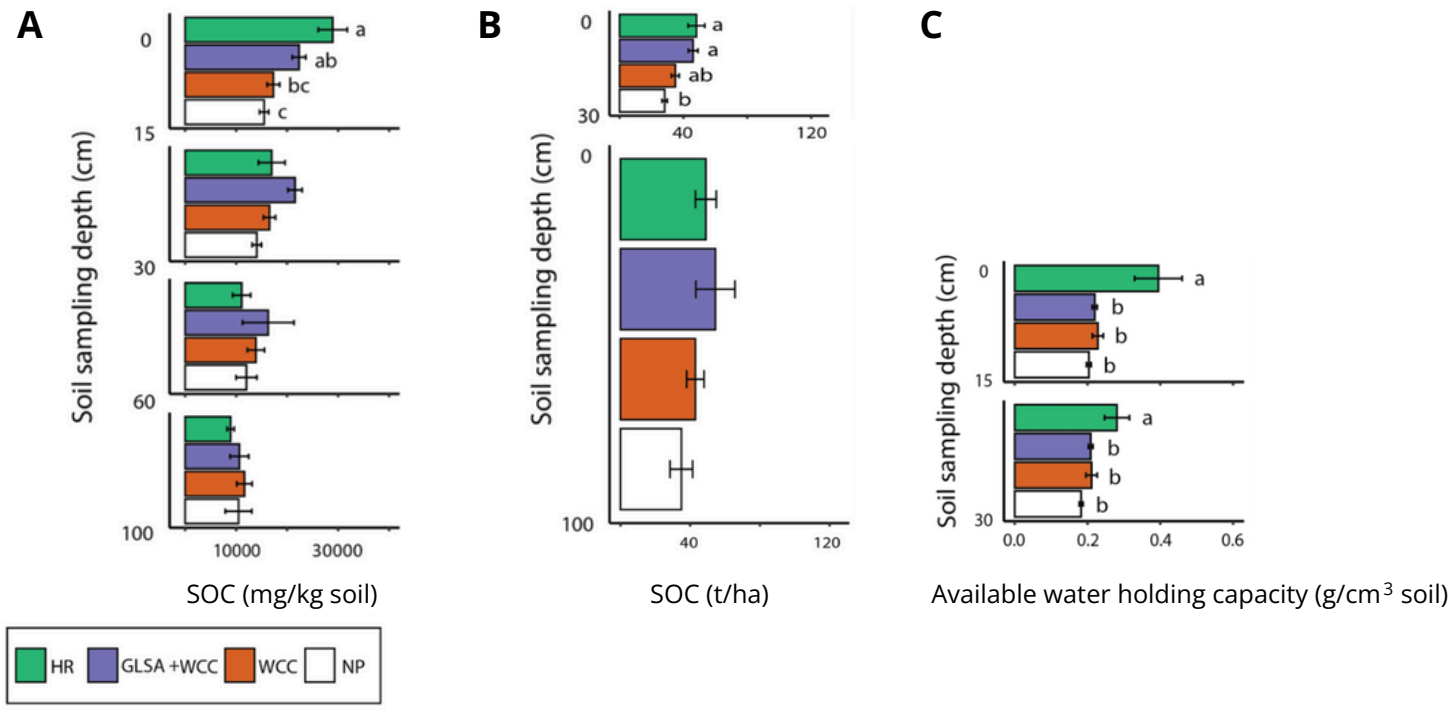

Figure 3. *(A)* Average soil organic carbon (SOC) concentration of each stewardship program at different soil depths. *(B)* Average soil organic carbon stock of each stewardship program at different soil depths. *(C)* Average soil water holding capacity of each stewardship program at soil depths 0-15 cm and 15-30 cm. Programs that share the same letter (a, b, or c) are not significantly different. NP = fields with No Program implemented.

The ability of soil to withstand mechanical pressures (i.e. tillage) was 25% and 14% greater in HR and GLSA + WCC program fields, respectively, compared to non-program fields. Increased ability to withstand mechanical pressures is important for maintaining soil structure and slowing the movement of water. This could provide producers with more viable days to run heavy machinery without soil compaction, allowing for greater flexibility in seed-bed preparation, harvest, and winter cover crop planting.

WHAT'S NEXT?

This research supports the expansion of stewardship programs to other regions of BC. To build on the results we observed in this study, future studies should control varying contexts such as management practices, crops, and other important physical and chemical soil characteristics. Additionally, standardizing the implementation of these practices may achieve greater improvements in climate mitigation and adaptation, while also making the incorporation of stewardship programs easier and less costly for farmers.

HOW WAS THE RESEARCH DONE?

This study was conducted in the Fraser River Delta of southwestern BC, in the municipality of Delta. In the spring of 2018, we sampled a total of 61 agricultural fields and 14 adjacent hedgerows. 26 of the agricultural fields and 6 hedgerows (Figure 4) were enrolled in a DF&WT stewardship program at some point between 1992-2016. Enrolment in the programs ranged from 5-8 years for the GLSA program and 3-17 years for the WCC program. Remaining fields which were not enrolled in any program were assigned to the control group (non-program annually cropped fields).

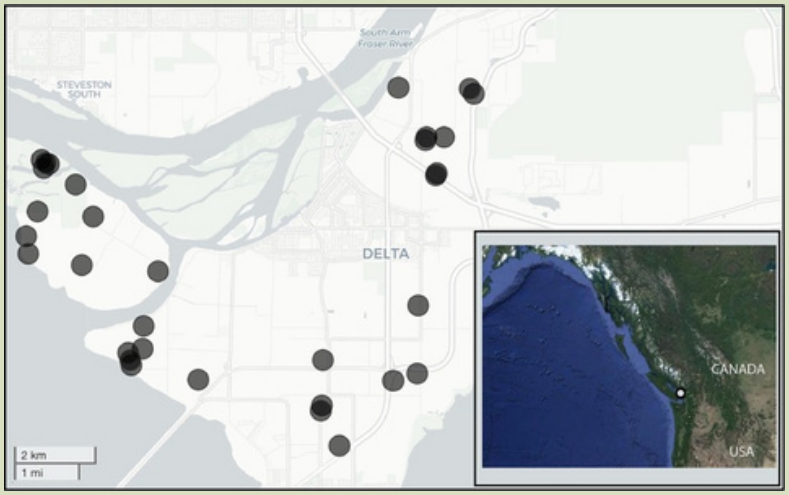

Figure 4. Map of the sampling sites in Delta, BC.

We collected soil samples at depths of 0 to 15 cm, 15–30 cm, 30–60 cm, and 60–100 cm. We measured soil organic carbon concentration and calculated soil organic carbon stocks. We calculated soil available water holding capacity and workability threshold (ability of the soil to withstand mechanical processes such as tillage).

ABOUT THIS BRIEF

This brief is based on the following scientific journal article:

Kersey, J. H., Paul, S. S., Dowell, L., Krzic, M., & S. M. Smukler. (2024). 25-years of stewardship programs enhance regenerative outcomes in river delta soils of southwestern British Columbia, Canada. Geoderma, 443. https://doi.org/10.1016/j.geoderma.2024.116808

Want to learn more?

- For any questions regarding this research, contact Jordy Kersey at kerseyj@mail.ubc.ca
- For more information on stewardship programs offered by the Delta Farmland and Wildlife Trust visit: https://deltafarmland.ca/our-programs/stewardship-program-applications/
- The Land Degradation Surveillance Framework can be found at https://apps.worldagroforestry.org/soc/ldsf.pdf

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Funding for this research was provided by the British Columbia Ministry of Agriculture and Food Contract # URACP19-204, the Natural Sciences and Engineering Research Council of Canada's Discover Grant program, a Mitacs internship grant, and a University of British Columbia Four-Year Doctoral Fellowship. This research was conducted by the University of British Columbia, Vancouver.

Funding for this research brief was provided in part by the governments of Canada and British Columbia under the Sustainable Canadian Agricultural Partnership, a federal-provincial-territorial initiative; additional funding provided by CleanBC.