

# OVERVIEW OF DATA ANALYSES USED TO ESTIMATE C STOCKS IN SHELTERBELTS IN SASKATCHEWAN

No. SASK-1

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### SHELTERBELT DATA ANALYSES

Shelterbelts have been planted Saskatchewan for more than a century, since 1901, under the provisions of the Government of Canada's Prairie Shelterbelt Program (PSP). In the past two decades, the storage potential of shelterbelts was recognized, but there was a lack of shelterbelt distribution data and growth models. To estimate the carbon stocks in shelterbelts for the agricultural land in Saskatchewan, the following data analyses are performed (Figures 1 and 2):

- Cluster analysis is used to group and map 106 ecodistricts into 31 clusters based on similar tree-growth variables for simulation modeling purposes
- Shelterbelt planting and distribution during eight decades and their estimated length are mapped across 31 clusters for six common shelterbelt species
- Unbiased selection of field sampling sites is achieved by a modified randomized branch sampling (RBS)

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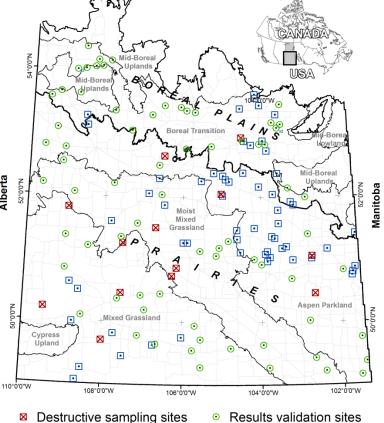




Figure 1. Locations of randomly selected shelterbelt sites for field data sampling in Saskatchewan.

procedure to collect data from shelterbelts at randomly selected township locations within randomly selected soil polygons within randomly selected ecodistricts within the cluster with the highest number of trees ordered though the PSP (i.e. model parameterization cluster)

- Field data are collected from white spruce (WS), hybrid poplar (HP), Manitoba maple (MM), Scots pine (SP), green ash (GA), and caragana (CG) shelterbelts at a total of 143 sites: 13 for destructive sampling, 59 for model parameterization, and 71 for validation of results (Figure 1)
- Field data are used to parameterize the 3PG model and perform tree growth simulations for a 60-yr period, from 1954 to 2014, for three spacings (2.0, 3.5, and 5.0 m, all within a linear row of planted trees) and four mortality levels (0, 15, 30, and 50%) within the parameterization cluster; additionally, 3PG model simulations are conducted for the remaining 30 clusters encompassing the entire agricultural land base in Saskatchewan









# GENERATED SHELTERBELT PRODUCTS

- Yield tables quantifying shelterbelt volume increment are generated by the 3PG model and used as input data in the CBM-CFS3 model
- In CBM-CFS3, C stocks for six shelterbelt species are generated in 31 clusters and validated with field data
- Finally, maps of the carbon stocks inventory are created, including total ecosystem carbon (TEC) and carbon stocks additions (Figure 2)
- Carbon inventories are generated for four periods: a/ planted 1925-2009; b/ since 1990, regardless of
- DATA ANALYSES PRODUCTS 1. Spatial dataset and 1. Soil Landscapes of Cluster analysis of 106 map of clusters Canada (SLC) data agricultural ecodistricts 31 clusters of similar 42 variables used 2. National ecological ecodistrict done separately for five 4-8 clusters per soil zone framework for Canada soil zone 1-9 ecodistricts per cluster 3. Prairie Shelterbelt 2. Probability maps of Mapping shelterbelt Program's tree orders shelterbelts distribution and length Decadal time laps maps 4. On-screen, hand-By planting period For six common species By species digitized shelterbelts Expected length estimated 3. Located random 3. Prairie Shelterbelt shelterbelt sites for Randomized branch Program's tree orders field data collection sampling approach to Model parameterization data **Product 1** identify sampling sites Results validation data Six species & five soil zones 4. Carbon stocks 1. SLC data 3PG and CBM-CFS3 inventory and maps models parameterization Total ecosystem carbon Products 1, 2, and 3 Carbon stocks additions and simulations Simulations: a/ 1925-2009: 5. Annual climate data In 31 clusters; six species b/ since 1990; c/ planted 1990-2009: d/ future climate (A2 worst case scenario)

Figure 2. Overview of shelterbelt data analyses and products created for the agricultural land in Saskatchewan.

planting period; c/ planted 1990-2009; and d/ planted 2015-2075, using the A2-scenario of future climate projections by the Canadian Centre for Climate Modelling and Analysis

• All generated products (Figure 2) are valuable tools for shelterbelt decision support systems for future tree planting on agricultural landscapes

#### FURTHER READING

Amichev, B.Y., et al. 2015. Mapping and quantification of planted tree and shrub shelterbelts in Saskatchewan, Canada. *Agroforestry Systems* 89(1):49-65

Amichev, B.Y., et al. 2016. Carbon sequestration by planted shelterbelts in Saskatchewan: 3PG and CBM-CFS3 model simulations. *Ecological Modelling* 325:35-46

AGGP Fact Sheet(s): SASK-2, SASK-3, SASK-10

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