

Bioenergy Feedstock Supply from Wheat Straw: A Farm Level Model with Multiple Markets, Disease Risks and Soil Trade-offs

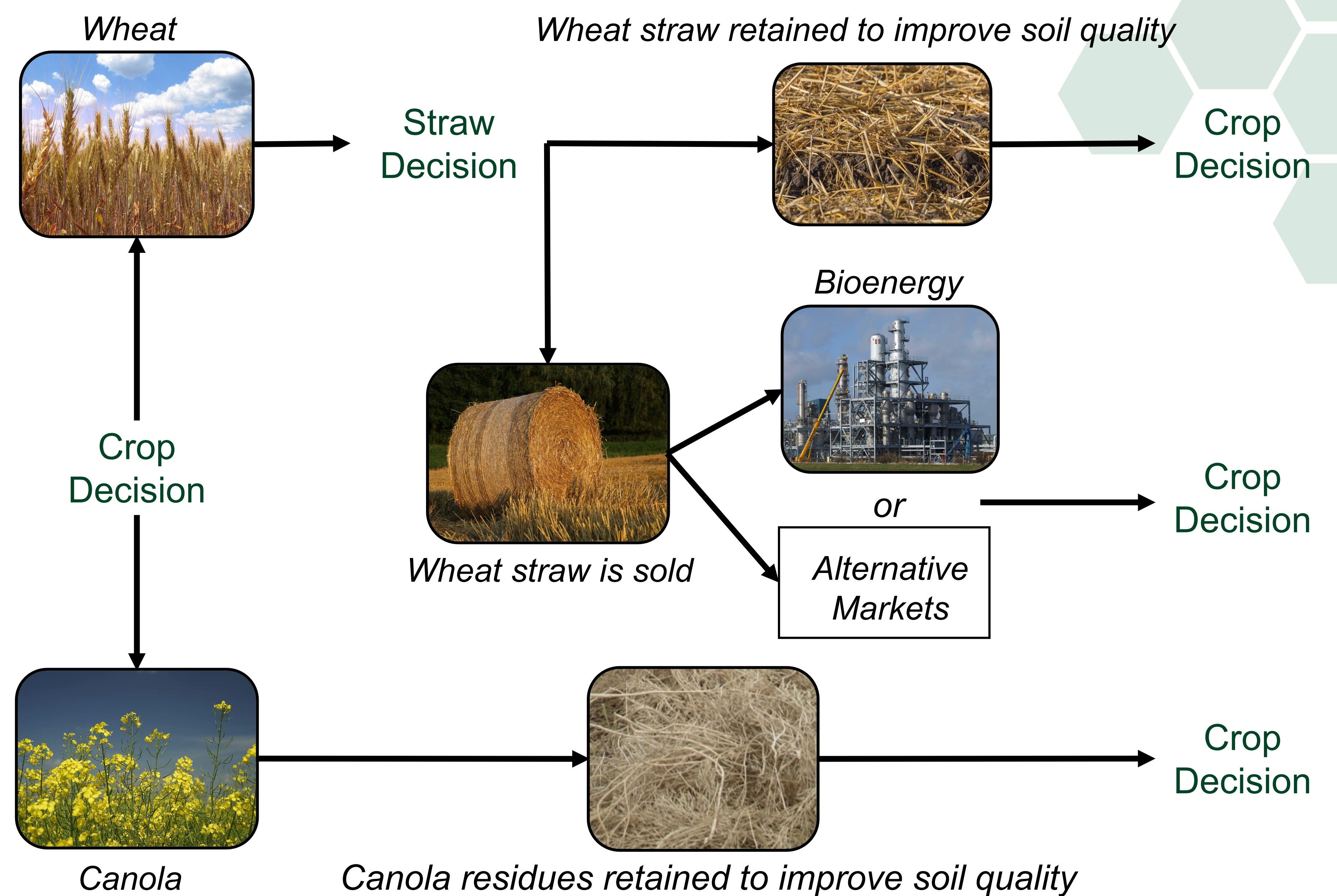
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BACKGROUND: WHEAT STRAW SUPPLY FOR BIOENERGY IN ALBERTA

- Prospective bioenergy industries in Alberta will require a reliable and significant supply of biomass feedstock.

Q: What is the availability of wheat straw as a bioenergy feedstock in Alberta?

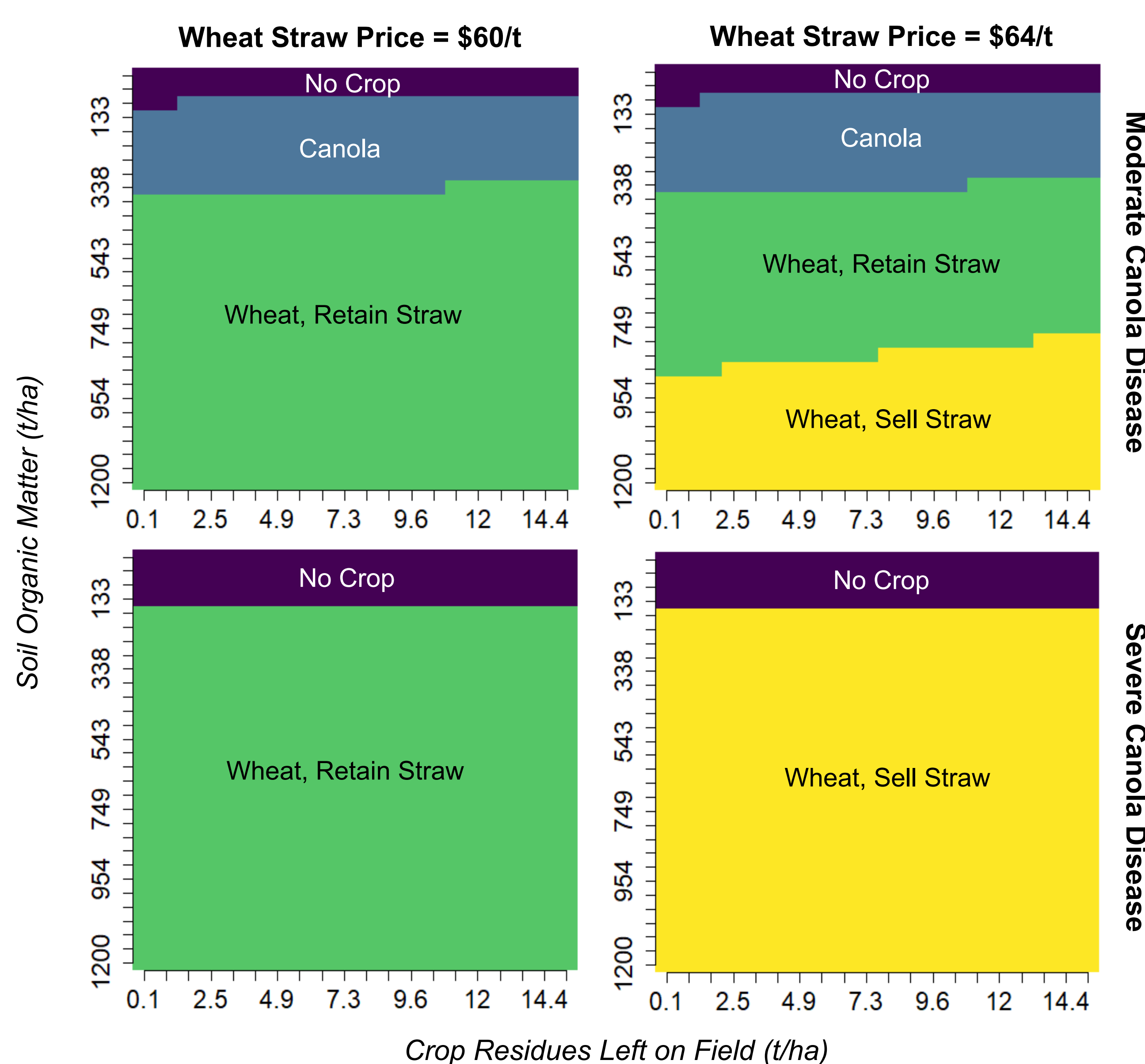
- Straw availability depends on farmer decisions
 - Crop choice (i.e. wheat or canola).
 - Whether wheat straw is retained for soil improvement or sold to bioenergy or alternative markets (e.g. animal bedding).
- Factors that may affect these decisions:
 - Soil quality (i.e. soil organic matter (SOM))
 - Stochastic crop yields.
 - Expected crop and wheat straw prices at the time of seeding.
 - Wheat straw prices after fall harvest.
 - Severity and presence of canola disease (i.e. blackleg and clubroot) and the effect on canola yields.



OPTIMAL CROP AND STRAW MANAGEMENT DECISIONS

Optimal Farmer Decisions Given SOM and Crop Residue Levels

Model Framework



- A dynamic programming model estimates optimal crop and straw decisions.
- Optimal decisions maximize the value of farmland given combinations of crop and straw prices, SOM levels, crop residue levels, and canola disease states.
- The model is calibrated using county-level SOM and crop yield data, and regional price and cost data, for a given county in Alberta (i.e. Strathcona County).

Model Results

- When yield losses from canola disease are small, canola is the most attractive crop at today's prices over most SOM/residue conditions.
- When yield losses from canola disease are *moderate* or *large*, wheat becomes more attractive depending on SOM levels.
 - *moderate* canola yield loss: wheat is optimal if SOM is greater than 338 t/ha (see adjacent figure).
 - *large* canola yield loss: wheat is optimal crop if SOM is greater than 133 t/ha.
- Straw is never sold when straw prices are \$60/t or less.
- High straw prices make selling straw more attractive but SOM and crop residue levels affect this choice.
 - When the price of straw is \$64/t, straw is sold but only if SOM levels are above 749-872 t/ha depending on crop residue levels (see adjacent figure).

IMPLICATIONS FOR BIOENERGY PRODUCERS

- Existing research on agricultural residue availability usually makes simplifying assumptions about how much biomass will be available for bioenergy.
 - Assumes a constant amount or percentage of residues are left on the soil.
 - Does not account for alternative wheat straw markets.
- Economic modelling suggests that the availability of wheat straw for bioenergy production will be variable over time, as farmers adjust their crop and residue management decisions to:
 - Enhance existing soil quality.
 - Change the presence and severity of canola disease.
 - Take advantage of high wheat, canola, and straw prices.

PARTNERS

