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Agriculture Residue Harvest & Collection: Obstacles & Opportunities

By: **Mark Stumborg, P.Eng.**
Agriculture and Agri-Food Canada
Swift Current, Saskatchewan

Canada

Producer Value Equation for Harvest

1. Seed Quantity and Quality
2. Time
3. Capital Cost (Purchase and Depreciation)
4. Operational and Maintenance Costs

We are trying to add another:

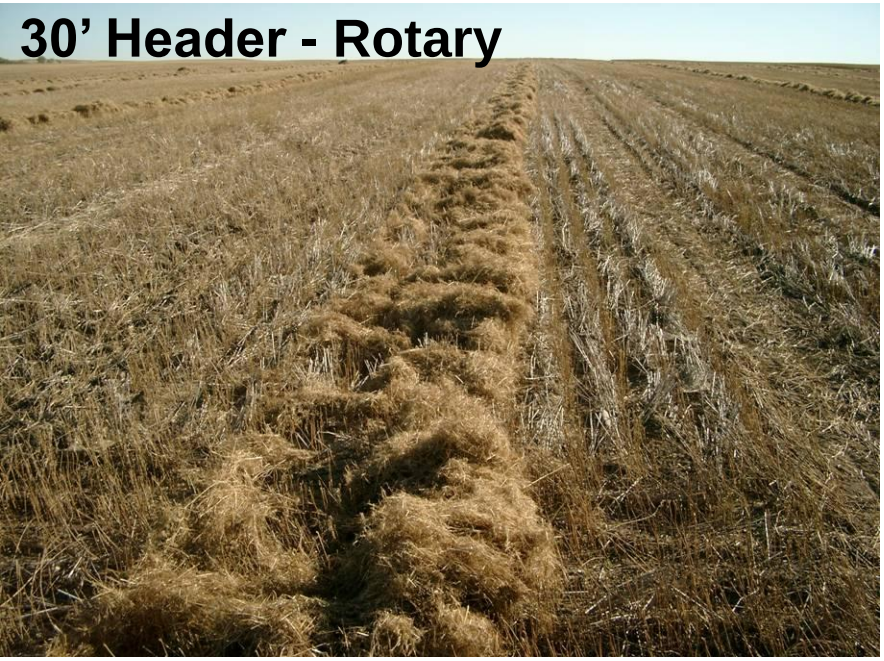
Crop Residue Quantity and Quality

Harvest Challenges

Rotary vs. Conventional Combines:

- **Rotary combine: grinding action leaves less baleable straw with considerably affected quality and integrity.**
- **Conventional: responsible for harvesting <25% of the combined acres.**

30’ Header - Rotary

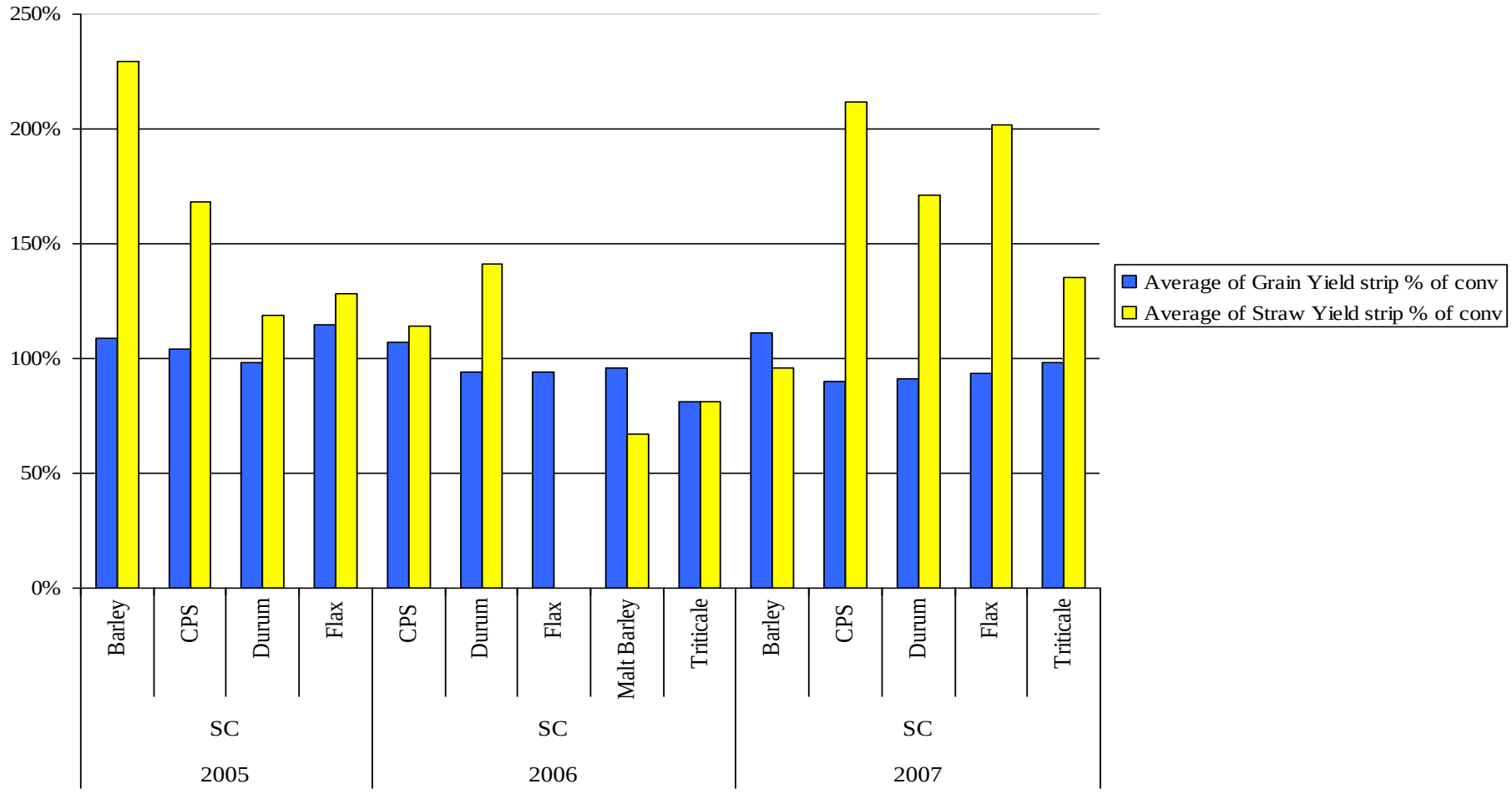


20’ Header - Conventional

Seed Quality

- **Malting Barley:**
  - Stripper leaves many awns & cleaner sample.
- **Lentils:**
  - Leaves 10 – 12” stubble.
  - No dirt & few cracks or peels.
- **Flax:**
  - Works with tough straw.
  - Less overall loss
- **All crops: picks up down material (lodged, tracks, sawfly, etc.)**

IH & SC Plots: Biomass and Grain Yields



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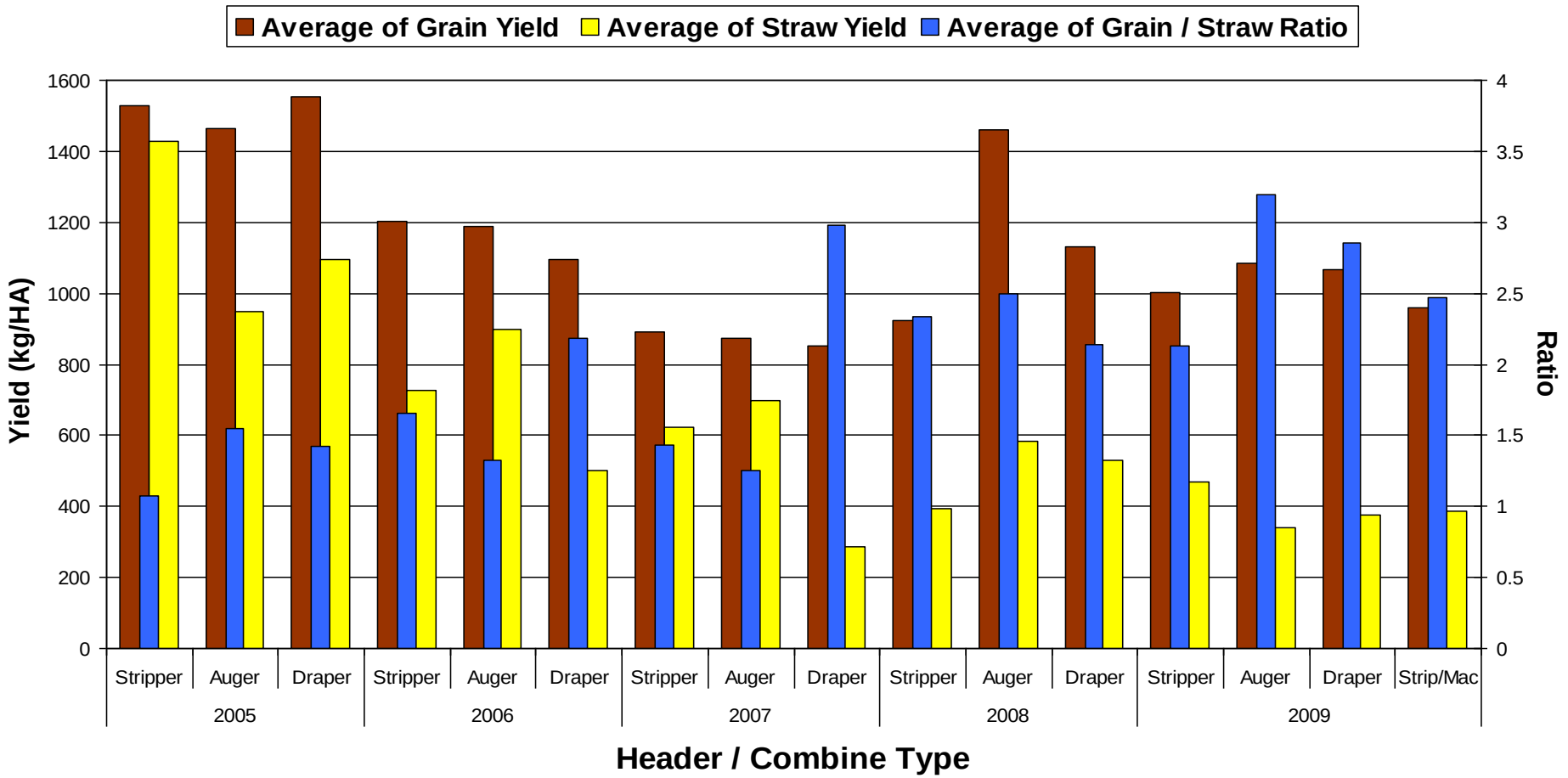
Simonson Flax Demonstration



Demonstration Yields

2005 - 2008

	Ave Grain Yield (Kg/ha)	% of Draper Rotary	Ave Straw Yield (Kg/ha)	Straw as % of Draper Rotary
Stripper / Conventional and Stripper Rotary	1144	98	794	132
Auger / Conventional	1253	108	783	130
Draper / Rotary	1166	100	603	100

2005 - 2007

	Ave. Grain Yield (Kg/ha)	% of Draper Rotary	Ave Straw Yield (Kg/ha)	Straw as % of Draper Rotary
Stripper/Conventional and Stripper/Rotary	1217	103	927	148
Auger/Conventional	1185	101	849	135
Draper/Rotary	1177	100	628	100

Stripper Header Issues and Modifications

Bull Nose Adjustment:

- Difficult to adjust according to variable crop height or condition.
- Excessive interference causes increased straw breakage & grain loss.
- Desiccation appears to embrittle plant components, increasing losses.

Addition of a height indicator for operator visibility

Addition of guage wheels for rotor height control.

Residue Export Sustainability Issues

1. Loss of Erosion Protection
2. Loss of Soil Nutrients
3. Loss of Carbon from the System
4. Economic Returns for Producers

Indian Head Long-Term Rotations 1957-1987

Rotation: Fallow - Spring Wheat - Spring Wheat
All plots - Conventional Tillage System

	Fertilizer	Straw	Total Org C (0–6") T ha^{-1}	Total Org N (0–6") kg ha^{-1}	Fallow Yield Bu ac^{-1}	% of A	Stubble Yield Bu ac^{-1}	% of A
A	Fertilized	Left	38.5	3243	38	100	34	100
B	Fertilized	Removed	38.2	3067	39	103	35	103
C	No Fertilizer	Left	36.4	2966	34	89	13	38

Indian Head Long-Term Rotations 1990-2002

Rotation: **Fallow - Spring Wheat - Spring Wheat**
All plots - Zero Tillage System

	Fertilizer	Straw	Fallow Yield Bu ac^{-1}	% of A	Stubble Yield Bu ac^{-1}	% of A
A	Fertilized	Left	44	100	37	100
B	Fertilized	Removed	45	102	38	103
C	No Fertilizer	Left	24	55	11	30

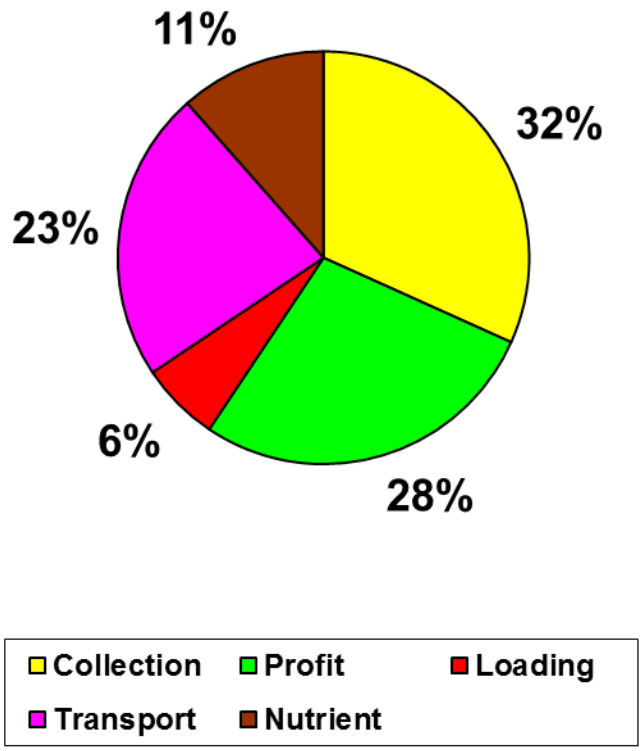
Erosion Impact of Stover Removal

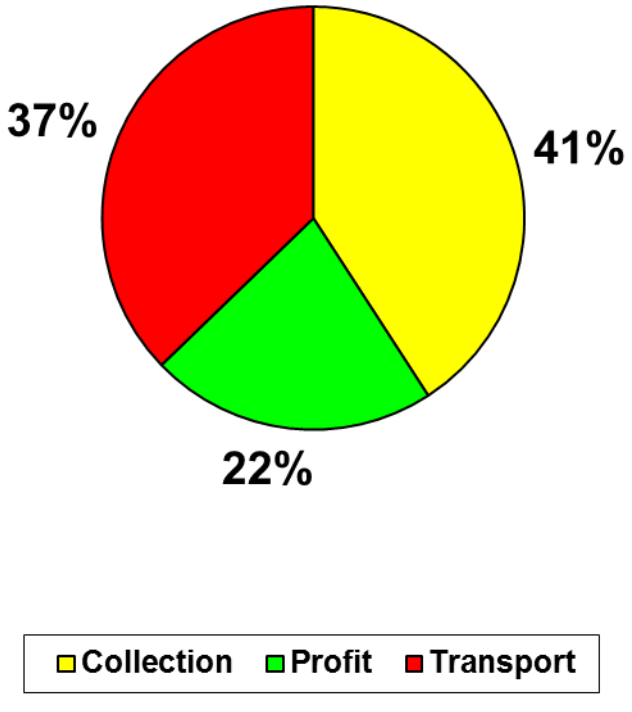
Tillage System	Residue Level kg ha^{-1}	Peak Run-Off mm hr^{-1}	Run-Off Volume mm	Sediment Yield kg ha^{-1}
No-Till	0	17.0	4.5	72.0
	750	9.0	2.6	11.0
	1500	1.0	0.2	7.0
Conv. Till	0	51.0	35.5	2812
	750	34.0	32.7	1001
	1500	26.0	18.0	513

Note: No-till @ 12% slope, Conventional Till @ 9%slope.

Mostaghimi et al. (1992).

Cost Division for Export





Based on 50 km Haul, FOB Plant, & Custom Rates in Saskatchewan. Estimated cost: $65 - $70 tonne^{-1} in 2012.

Flax Value Equation: Shelbourne Header

a) Grain: Potential gain in grain yield;
b) Improvement in opportunity cost due to higher field rates and improved harvest window (flax harvest August 8 – 14);
c) Reduced wear & tear on combine (50% less material);
d) Up to 20% less fuel required;
e) Potentially cleaner seed sample;
f) Potential saving of desiccation;
g) Opportunity for higher value straw returns.

Producer Returns: Quality Starts @ Harvest

Low Value Uses:

- Example: flax pulp for paper quality enhancement.
- Producer Net Range: $ 5 to $10 per tonne.
- Savings from disposal and chopping: ~$1 per tonne.

Medium Value Uses:

- Examples: insulation products, plastic composites, and low end textiles.
- Producer Net Range: $30 to $100 per tonne.

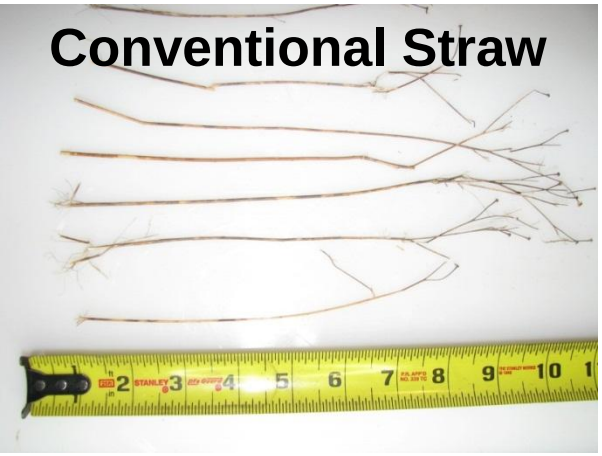
High Value Uses:

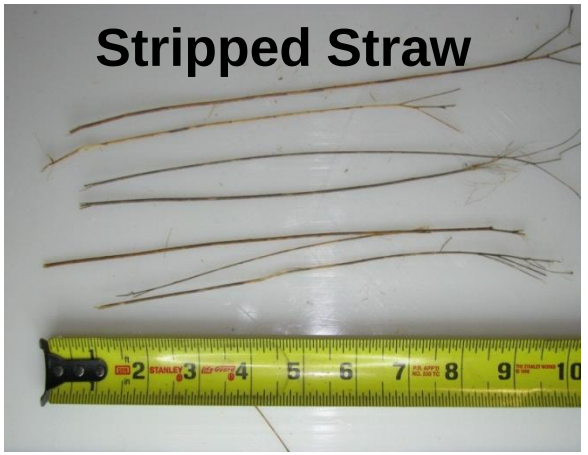
- Examples: high-end plastic composites and textile applications.
- Producer Net Range: $60 to $150 per tonne.

Note:

Potential producer returns depend on fibre length, cleanliness, strength, & quantity. Rotary harvested straw can only meet the requirements for low value uses.

Mascerated Flax Straw: Preprocessing & Densification





Typical Flax Straw Round Bale Weights: 1350 lbs

Mascerated Flax Straw Bale Weight: 2200 lbs

A 63% Increase !

Mascerating Wheat Straw

Before

After

Initial Observations

- Masceration increased straw losses.
- Masceration did not increase round bale density.
- Masceration increased square bale density by ~17%.

New Land Impact Analysis Tool

BIMAT

Biomass Inventory Mapping and Analysis Tool

Why did Canada build it?

- **Provide access to accurate and reliable Canadian biomass and landscape information via the Internet.**
- **Facilitate analysis of biomass inventory and impact of exploitation of selected agricultural, forestry, and municipal woody biomass.**

Where is the BIMAT located?

Go to: www.agr.gc.ca

Use search & follow the BIMAT links to the Land Resource Viewer.

Or go to: http://atlas.agr.gc.ca/bimat

BIMAT II Function Improvements

Function Improvements

- Estimates for grain production;
- Alternative crop residue harvest system modeling;
- Modeling of annual variability in biomass supply;
- Land suitability information for the production of new forestry and forage crops for cellulosic feedstocks;
- Logistics and carbon accounting information;

Expand Biomass Reference Material

- Add information about quality, conversion processes and life cycle evaluation.

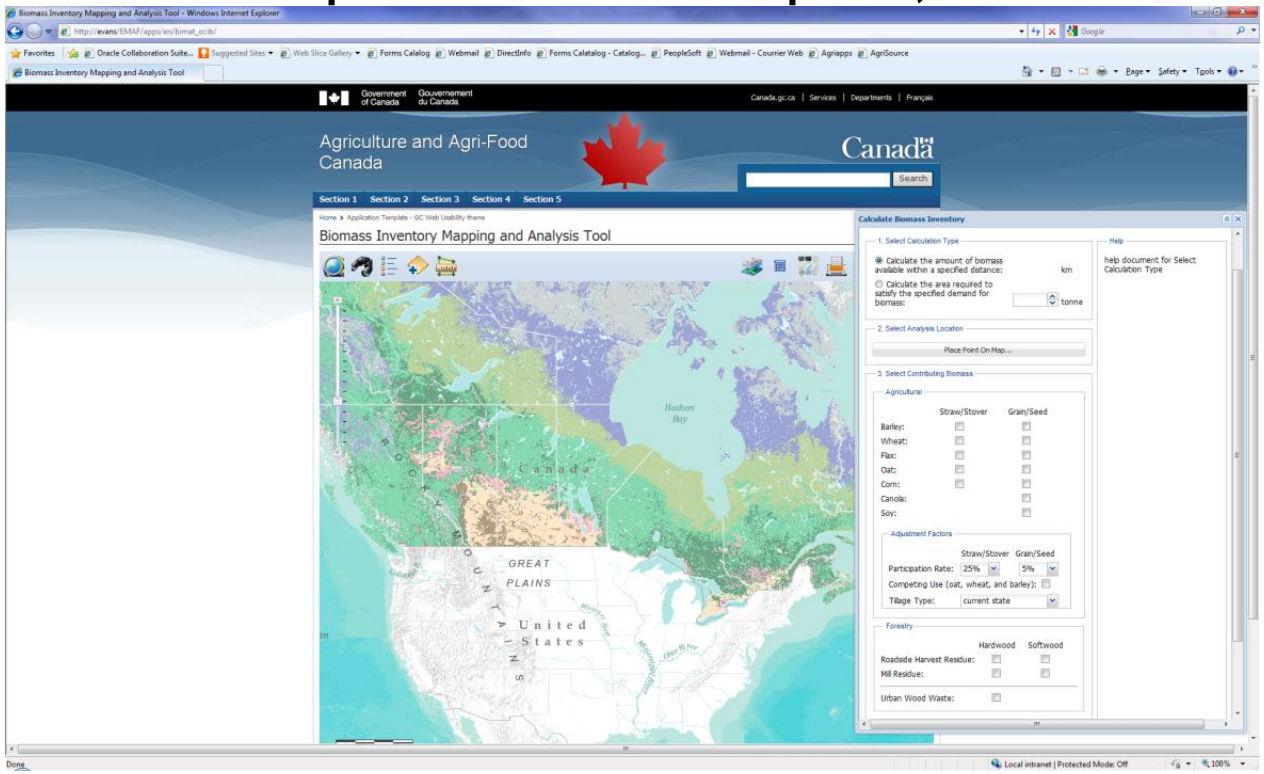
Straw and Grain Input Data Statistics for BIMAT 2

- **Estimated Number of Input Datasets accessed (>29,245)**
  - **ASCII: 28,630**
  - **Geotiffs: 546**
  - **Spreadsheets: 3**
  - **Shapefiles: 13**
  - **Tables: 54**
- **19+ Python Scripts**
- **Lines of code????**

Road distances from origin cells to the surrounding destination cells within 250 km have been calculated using National Road Network dataset *(9,637,254 records).*

Next Steps

- **BIMAT II is scheduled to be released within AAFC on March 31, 2013**
  - **Dev Version: http://evans/EMAF/apps/en/bimat_ocib/**
- **External Release expected to be around April 30, 2013**



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- Wheatland Conservation
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Thank You for Your Attention !

Canada