

The Midwest Biomass Inventory Assessment

Heating the Midwest Conference

April 26, 2012

Eau Claire, WI



NDSU NORTH DAKOTA
STATE UNIVERSITY



Agricultural Utilization Research Institute

The Objective

Provide a “snapshot” of Midwest biomass resources for the 2012 Heating the Midwest Conference and furthering the Heating the Midwest vision.

Questions to Consider

- What are the takeaways from this presentation?
- What additional questions remain?
- How are you going to use this information?

Organization

Background

Energy Consumption and Prices

Biomass Fuel Attributes

Method

Results

Implications

Defining Biomass

Biomass includes plant and animal-based organic material including energy crops, agricultural crops, trees, food, feed, and fiber crop residue, aquatic plants, forestry and wood residues, agricultural, industrial, and municipal wastes, processing by-products and other non-fossil organic material.

*American Society of Agricultural
and Biological Engineers, 2011*



Feedstocks of Interest



Crop Residue

**Dedicated Energy
Crops**



**Forest/Woody
Biomass**

Current Energy Consumption

Energy Consumption (Trillion Btus)

	Residential	Commercial	Industrial
Coal	2	20	326
Natural Gas	1,148	665	859
Fuel Oil	90	31	172
LPG	134	18	113
Biomass	74	19	150
Other*	17	40	39
Total	1,465	793	1,659

Source: State Energy Data System, Energy Information Administration

#Does not include electricity or biofuel coproducts

*Kerosene, gasoline, hydroelectric, geothermal, solar

Heating Fuel Prices (Root 2012)

Source: Root, 2012

Fuel	Price Range					2012 Price (est.)
Coal (\$ per ton)	20.00	30.00	40.00	50.00	60.00	52.74
\$ per million Btu	1.00	1.50	2.00	2.50	3.00	2.64
Natural Gas (\$ per MMBtu)	2.00	3.00	4.00	5.00	6.00	2.75
Liquid Propane (\$ per Gallon)	1.00	1.50	2.00	2.50	3.00	2.04
\$ per million Btu	10.95	16.42	21.90	27.37	32.85	22.34
#2 Fuel Oil (\$ per gal)	2.50	3.00	3.50	4.00	4.50	4.00
\$ per million Btu	18.25	21.90	25.55	29.20	32.85	29.20
Diesel (\$ per gal)	3.00	3.50	4.00	4.50	5.00	4.05
\$ per million Btu	21.90	25.55	29.20	32.85	36.50	29.56
Gasoline (\$ per gal)	2.00	2.50	3.00	3.50	4.00	3.86
\$ per million Btu	16.00	20.00	24.00	28.00	32.00	30.88
Electricity(\$ per kW-hr)	0.05	0.10	0.15	0.20	0.25	0.15
\$ per million Btu	14.65	29.30	43.95	58.60	73.25	43.95
Wood Pellets (\$ per ton-bulk)	60.00	80.00	100.00	120.00	140.00	120.00
\$ per million Btu	3.75	5.00	6.25	7.50	8.75	7.50
Wood Pellets (\$ per 40 lb bag retail)	3.00	4.00	5.00	6.00	7.00	4.05
\$ per million Btu	9.38	12.50	15.63	18.75	21.88	12.66
Ag Biomass or Corn Stover (\$ per ton)	20.00	40.00	60.00	80.00	100.00	70.00
\$ per million Btu	1.67	3.33	5.00	6.67	8.33	5.83
Corn (\$ per bushel)	3.00	4.00	5.00	6.00	7.00	6.15
\$ per million Btu	2.22	2.96	3.70	4.44	5.19	4.52

Biomass Characteristics

Heat value

Moisture
content

Ash

Si, K, Cl
content

Size and
Density

Fuel Property	Residential/Commercial Densified Fuel Standards See Notes 1 - 3		
	PFI Premium	PFI Standard	PFI Utility
Normative Information - Mandatory			
Bulk Density, lb./cubic foot	40.0 - 46.0	38.0 - 46.0	38.0 - 46.0
Diameter, inches	0.230 - 0.285	0.230 - 0.285	0.230 - 0.285
Diameter, mm	5.84 - 7.25	5.84 - 7.25	5.84 - 7.25
Pellet Durability Index	≥ 96.5	≥ 95.0	≥ 95.0
Fines, % (at the mill gate)	≤ 0.50	≤ 1.0	≤ 1.0
Inorganic Ash, %	≤ 1.0	≤ 2.0	≤ 6.0
Length, % greater than 1.50 inches	≤ 1.0	≤ 1.0	≤ 1.0
Moisture, %	≤ 8.0	≤ 10.0	≤ 10.0
Chloride, ppm	≤ 300	≤ 300	≤ 300
Heating Value	NA	NA	NA
Informative Only - Not Mandatory			
Ash Fusion	NA	NA	NA

Previous Inventories and Related Research

- *Northeast Iowa Biomass Asset Map*
- *Michigan Biomass Inventory*
- *Michigan Forest Biomass Information System*
- *Minnesota Forest Biomass Availability (Becker et al)*
- *Minnesota DNR Biomass Program Maps*
- *Wisconsin Renewable Fuel Availability, Extraction, and Usage Potential Impacts Report*
- *Biomass Energy Analytical Model (BEAM)*

Method

Evaluated existing national biomass assessments (assumptions, methodology, data)

Selected the Billion Ton Study Update (BTS2) as the most suitable

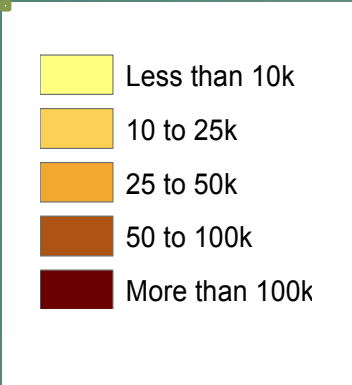
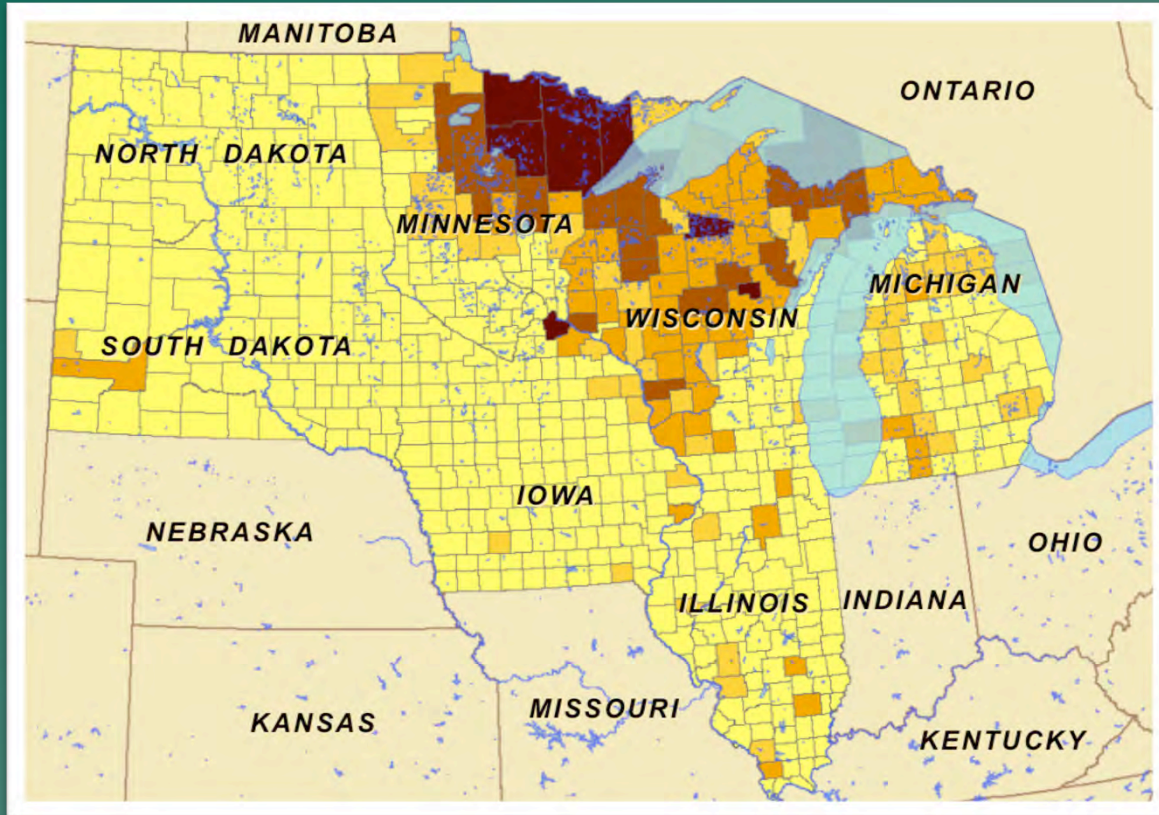
Assembled and analyzed data to achieve the project's objective



State and Biomass Feedstock 2012 (thousand tons)

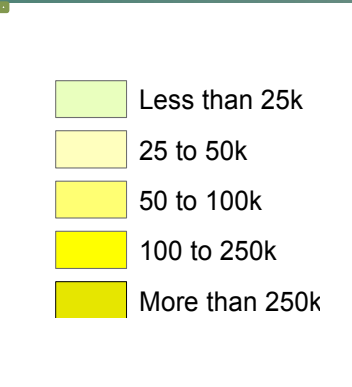
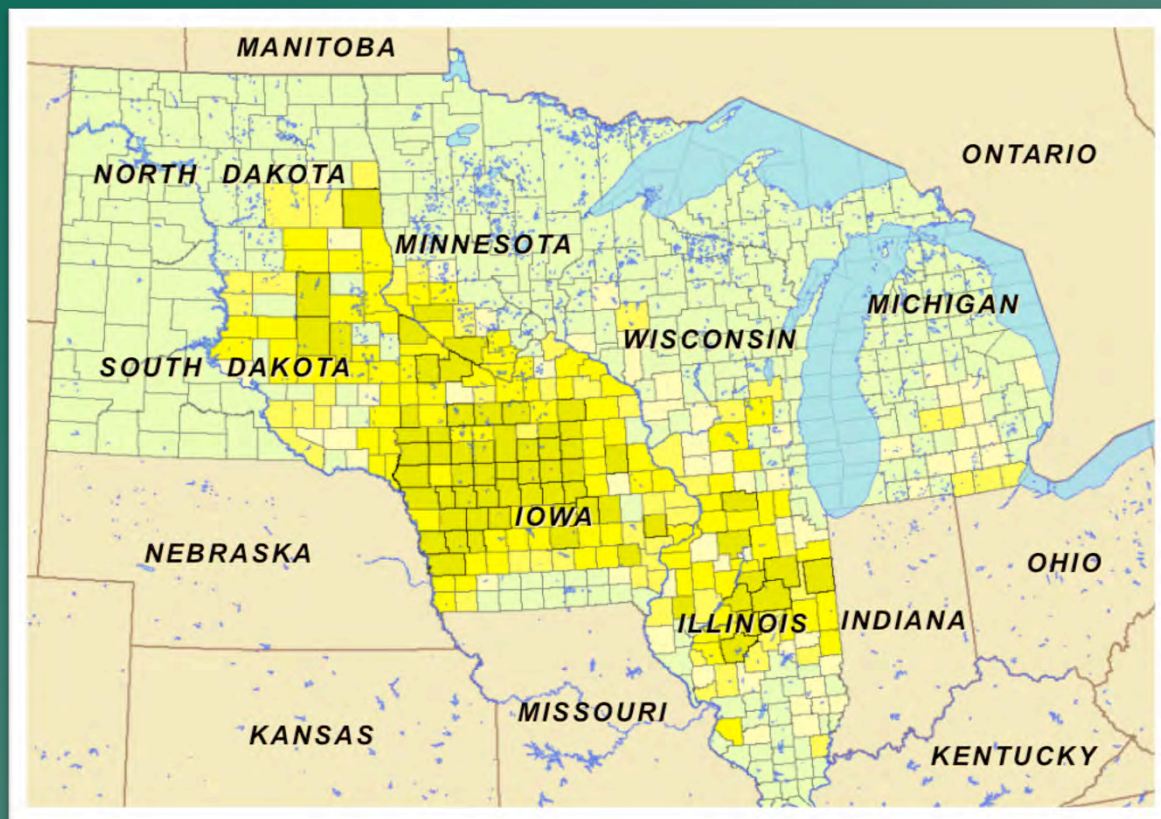
Agricultural Biomass	Illinois	Iowa	Michigan	Minnesota	North Dakota	South Dakota	Wisconsin	Total
<i>Crop Residue</i>								
Barley Straw	-	-	-	43	701	-	-	744
Corn Stover	9,496	20,777	1,070	6,998	1,366	4,960	1,563	46,229
Oat Straw	-	-	-	-	-	-	-	-
Wheat Straw	862	8	832	420	229	3,009	232	5,592
Total	10,358	20,785	1,902	7,460	2,295	7,969	1,795	52,564
<i>Hay</i>	2,016	4,319	1,753	4,602	4,286	6,753	5,513	29,240
Total	12,374	25,104	3,655	12,062	6,581	14,722	7,308	81,805
Dedicated Energy Crops								
<i>Perennial grass</i>	-	-	-	-	-	-	-	-
<i>Woody Energy Crops</i>	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-
Forest Biomass								
<i>Logging Residue & Thinning:</i>	276	102	898	873	7	68	1,130	3,353
<i>Other Removal Residue</i>	234	62	294	656	15	14	1,049	2,324
Total	510	164	1,191	1,528	22	82	2,179	5,677
Secondary Biomass								
<i>Mill Residue</i>	24	9	9	12	2	0	41	98
Total	12,908	25,277	4,855	13,602	6,605	14,804	9,528	87,579

2012 Forest Biomass by County (Tons)



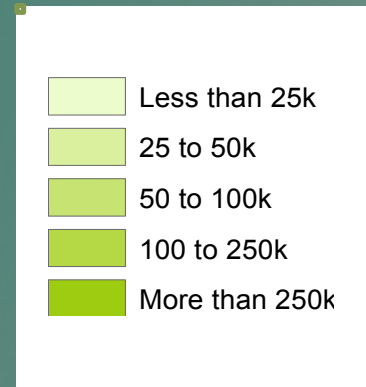
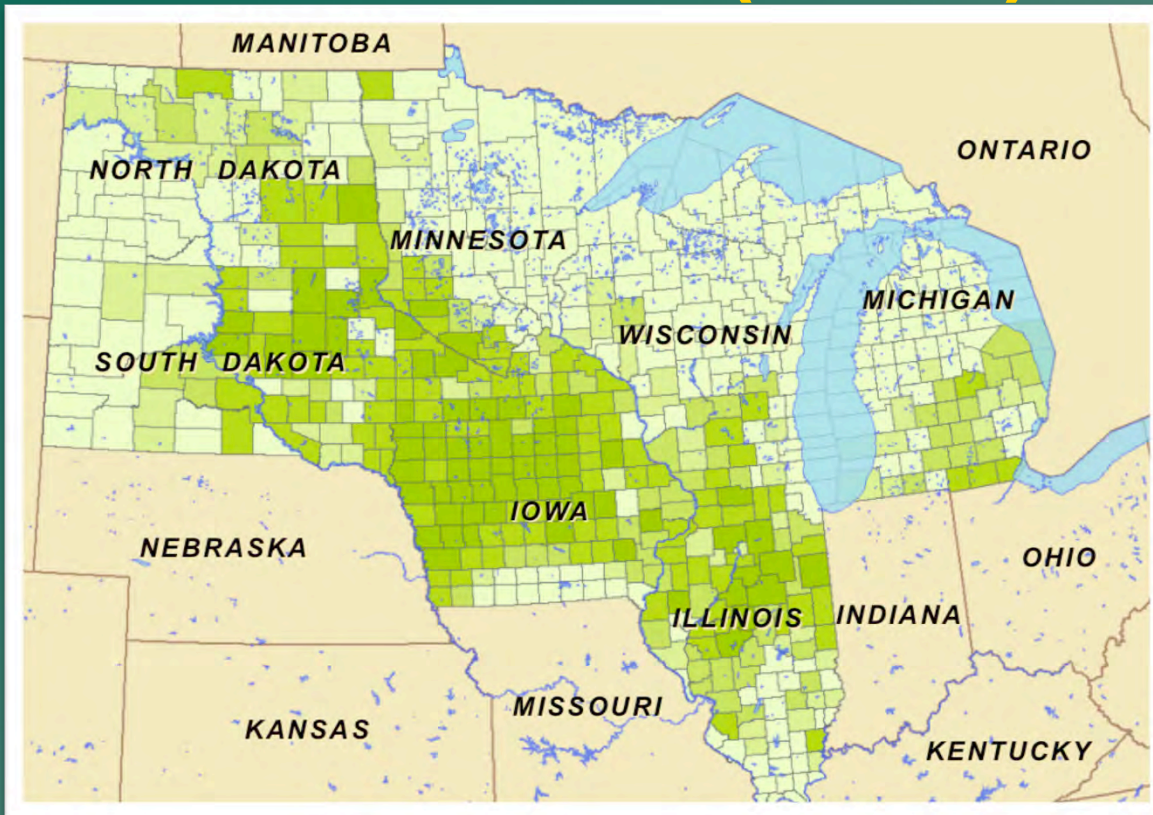
State	Tons
Illinois	510
Iowa	164
Michigan	1,191
Minnesota	1,528
North Dakota	22
South Dakota	82
Wisconsin	2,179
Total	5,677

2012 Corn Stover by County (Tons)



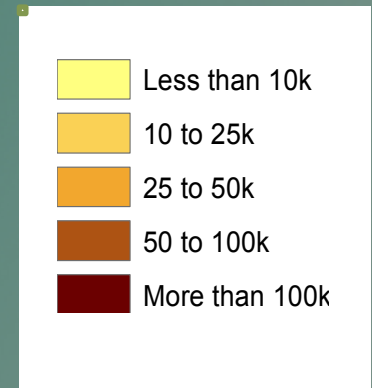
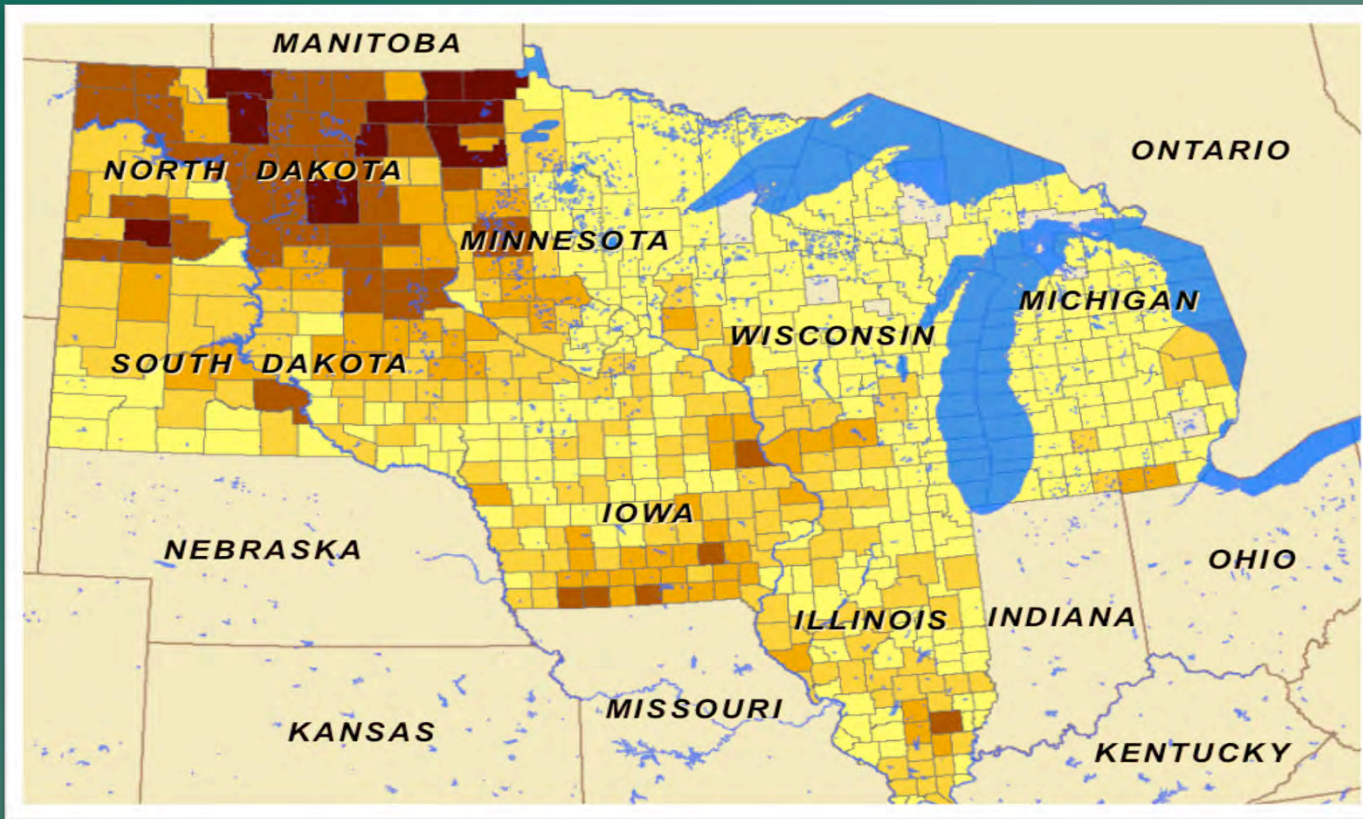
State	Tons
Illinois	9,496
Iowa	20,777
Michigan	1,070
Minnesota	6,998
North Dakota	1,366
South Dakota	4,960
Wisconsin	1,563
Total	46,229

2012 Crop Residue by County (Tons)



State	Tons
Illinois	10,358
Iowa	20,785
Michigan	1,902
Minnesota	7,460
North Dakota	2,295
South Dakota	7,969
Wisconsin	1,795
Total	52,654

CRP



Estimated HHV by State and Biomass Feedstock 2012 (Trillion Btus)

Agricultural Biomass	Illinois	Iowa	Michigan	Minnesota	North Dakota	South Dakota	Wisconsin	Total
<i>Crop Residue</i>								
Barley Straw	-	-	-	0.6	10.0	-	-	10.6
Corn Stover	134.1	293.4	15.1	98.8	19.3	70.0	22.1	652.8
Oat Straw	-	-	-	-	-	-	-	-
Wheat Straw	11.8	0.1	11.4	5.7	3.1	41.2	3.2	76.5
Total	145.9	293.5	26.5	105.2	32.4	111.2	25.2	739.9
Hay	28.8	61.8	25.1	65.8	61.3	96.6	78.8	418.1
Total	174.7	355.2	51.6	171.0	93.7	207.8	104.1	1,158.0
Dedicated Energy Crops								
Perennial grass	-	-	-	-	-	-	-	-
Woody Energy Crops	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-
Forest Biomass								
Logging Residue & Thinnings	2.2	0.8	7.2	7.0	0.1	0.5	9.0	26.8
Other Removal Residue	1.9	0.5	2.3	5.2	0.1	0.1	8.4	18.6
Total	4.1	1.3	9.5	12.2	0.2	0.7	17.4	45.4
Secondary Biomass								
Mill Residue	0.2	0.1	0.1	0.1	0.0	0.0	0.4	0.9
Total	179.0	356.6	61.2	183.3	93.9	208.4	121.9	1,204.3

Biomass Inventory 2012

Agricultural Biomass	Thousand Tons	Trillion Btus
<i>Crop Residue</i>		
Barley Straw	744	11
Corn Stover	46,229	653
Oat Straw	-	-
Wheat Straw	5,592	76
Total	52,564	740
<i>Hay</i>	29,240	418
Total	81,805	1,158
Dedicated Energy Crops		
<i>Perennial grass</i>	-	-
<i>Woody Energy Crops</i>	-	-
Total	-	-
Forest Biomass		
<i>Logging Residue & Thinnings</i>	3,353	27
<i>Other Removal Residue</i>	2,324	19
Total	5,677	45
Secondary Biomass		
<i>Mill Residue</i>	98	1
Total	87,579	1,204

Implications

- Biomass inventory is not availability.
- Knowledge of current and future biomass feedstocks is necessary for the development of biomass markets.

Implications

- Assessments can serve as a starting point for local developers and other stakeholders to investigate the feasibility of new solid biofuel enterprises.
- The intent was to highlight information that would provide an initial, high-level estimate of the percentage of current energy used for heating that can be replaced with biomass.

Summary

- The amount of residue will increase significantly by 2025 as crop yields increase.
- Perennial grasses are also expected to be produced in sizable quantities in 2025.
- Reduced acres in the CRP will have a noticeable impact on crop residue inventory.

Acknowledgments

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Project Leads:

AURI, Alan Doering, Coproducts Utilization, Waseca, Minnesota

*North Dakota State University (NDSU), David Ripplinger, Dept. of
Agribusiness & Applied Economics, Fargo, North Dakota*

Questions?

David Ripplinger
North Dakota State University
david.ripplinger@ndsu.edu
701.231.5265



NDSU NORTH DAKOTA
STATE UNIVERSITY



Agricultural Utilization Research Institute