November 13, 2018

Ag Land Highest and Best Use Study

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Two Research Objectives for Improving Ag land property Assessments in South Dakota

- 1) **Determine highest and best use** for each soil map unit (crop or non-cropland)
- 2) **Determine relative productivity** of soil map unit relative to other soils in county with similar best use.
  - i.e. what is the relative productivity of a crop soil to the best crop soil in the county?

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Terminology: Appraisal Institute. *The Dictionary of Real Estate Appraisal.* 6th Edition.

- **income capitalization approach.** Specific appraisal techniques applied to develop a value indication for a property based on its earning capability and calculated by the capitalization of property income.
- **most probable use** 1. The use to which a property will most likely be put **based on market analysis** and the **highest and best use conclusion**. The most probable use is the basis for the most probable selling price of the property. *See also* most probable selling price. 2. Highest and best use in the context of market value.
- **highest and best use** 1. The **reasonably probable** use of property that results in the **highest value**. The four criteria that the highest and best use must meet are legal permissibility, physical possibility, financial feasibility, and maximum productivity. 2. The use of an asset that maximizes its potential and that is possible, legally permissible, and financially feasible. The highest and best use may be for continuation of an asset's existing use or for some alternative use. This is determined by the use that a market participant would have in mind for the asset when formulating the price that it would be willing to bid. (IVS) 3. [The] highest and most profitable use for which the property is adaptable and needed or likely to be needed in the reasonably near future. (Uniform Appraisal Standards for Federal Land Acquisitions)
- **use value assessment**. An assessment based on the value of property as it is **currently used**, not on its market value considering its highest and best use. This sort of assessed value is sometimes used where legislation has been enacted to preserve farmland, timberland, or other open space land on urban fringes.

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Relevant Standards of Appraisal. "2018-2019 USPAP". The Appraisal Foundation.

- **Mass appraisal-** the process of valuing a universe of properties as of a given date using standard methodology, employing common data, and allowing statistical testing.
- **Mass appraisal model-** a mathematical expression of how supply and demand factors interact in a market.
- Develop an opinion of the **highest and best use** of real estate. An appraiser must analyze the relevant legal, physical, and economic factors to the extent necessary to support the appraiser's highest and best use conclusion(s).
- When an **income approach** is necessary for credible assignment results, an appraiser must:
  - Analyze such comparable rental data as are available and/or the potential earnings capacity of the property to estimate the gross income potential of the property.

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Study Overview/ Issues

- Research focus was on HBU determination method/process and impact.
- Study, as currently constructed, provides an estimate of impact if a switch in method in determining HBU.
- Department of Revenue (DOR) soil data included older soil data, non-uniform reporting of soil ratings/assessments, local adjustments, and other issues that prevented an exact estimate of impact if there was a switch in the method of HBU determination.

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Explore Changes to Assessments if a change to Highest and Best Use Determinations

Current Method

- Unit of Analysis: Soil Map Unit
- NRCS Land Capability Class
- Crop Rating
- Forage Use Value

Most Probable Use

- Unit of Analysis: Soil Map Unit
- Probability of Cropland
- Crop Rating
- Forage Use Value

Actual Use

- Unit of Analysis: Soil Map Unit
- Percent of Cropland Use (USDA-NASS Cropland Data Layer)
- Crop Rating
- Forage Use Value

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Current Method

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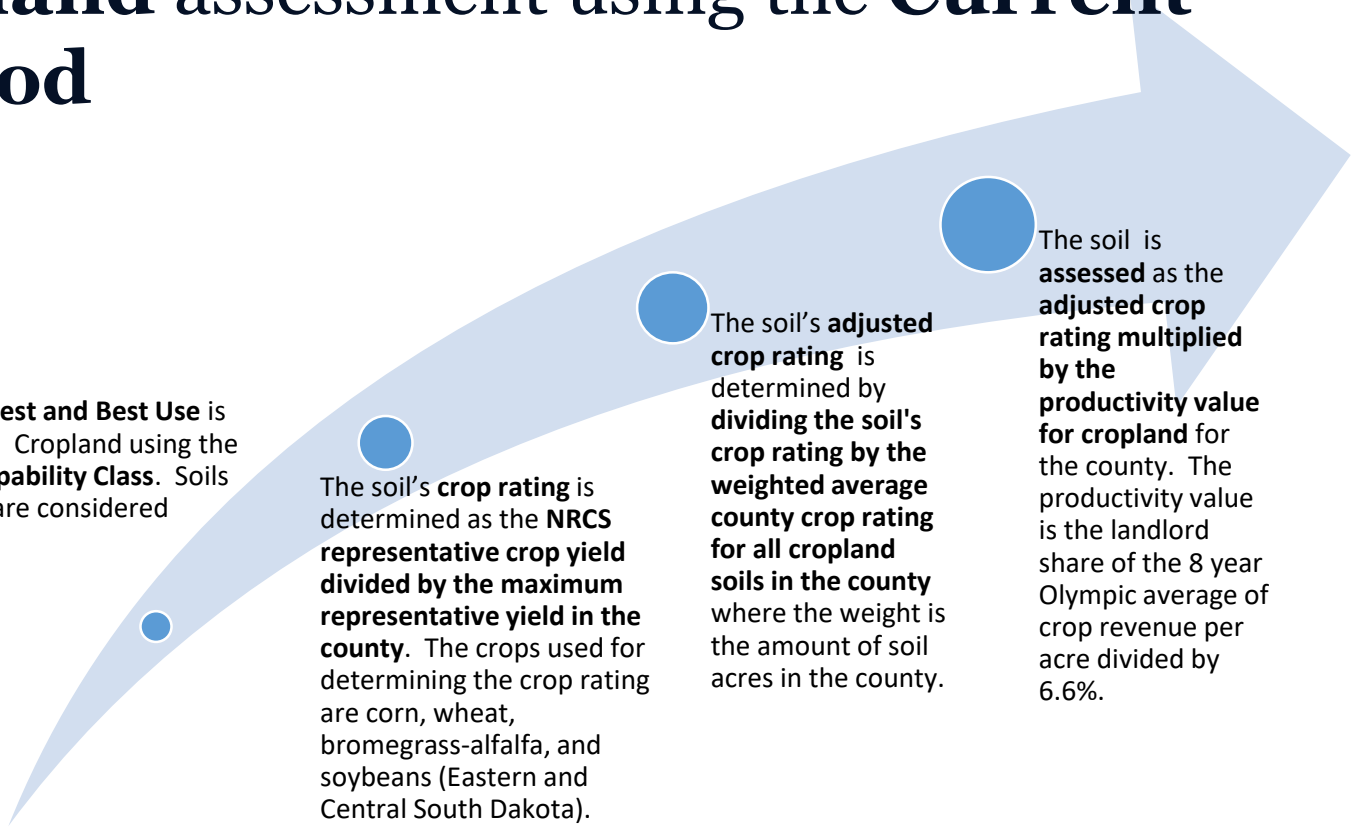
Cropland assessment using the **Current Method**



The soil's **Highest and Best Use** is determined as Cropland using the **NRCS Land Capability Class**. Soils in classes 1-3 are considered cropland.

The soil's **crop rating** is determined as the **NRCS representative crop yield divided by the maximum representative yield in the county**. The crops used for determining the crop rating are corn, wheat, bromegrass-alfalfa, and soybeans (Eastern and Central South Dakota).

The soil's **adjusted crop rating** is determined by **dividing the soil's crop rating by the weighted average county crop rating for all cropland soils in the county** where the weight is the amount of soil acres in the county.

The soil is **assessed** as the **adjusted crop rating multiplied by the productivity value for cropland** for the county. The productivity value is the landlord share of the 8 year Olympic average of crop revenue per acre divided by 6.6%.

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Non-cropland assessment using the **Current Method**

The soil's **Highest and Best Use** is determined as **Non-Cropland** using the **NRCS Land Capability Class**. Class 5-8 soils are considered non-cropland.

The soil's **range rating** is determined as the soil's **forage use value divided by the maximum forage use value** in the county.

The soil's **adjusted range rating** is determined by **dividing the soil's range rating by the county weighted range rating for all non-cropland soils** in the county where the weight is the amount of acres.

The soil is **assessed** by **multiplying the adjusted range rating by the county productivity value for non-cropland.** The non-cropland productivity value is the 8 year Olympic average of the pastureland rental rate.

The soil's **forage use value** of soil is determined as the **NRCS range production adjusted for the forage palatability** based on the types and quantities of plant species that are associated with the soil map unit.

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Most Probable Use (MPU) Method

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Method for Determining Most Probable Use: Machine Learning

- Wilson, Donald C. "Highest and best use analysis: Appraisal heuristics versus economic theory." *The Appraisal Journal* 63.1 (1995): 11.
  - Zillow Zestimates
  - Acre Value (farmland)
- Use NRCS soil data, gridded weather maps, and land use data from USDA-NASS Cropscape
- Build an Ensemble of Decision Trees to make MPU determination for micro subsets of like properties

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MPU Method

- MPU model uses 50% probability to break point for most probable use.
  - If there is a 50% or greater probability that the soil map unit will mostly be used as cropland, then all of that soil in the county is assessed as a cropland soil.
  - If there is less than 50% probability of a soil to be mostly utilized as cropland, then all of that soil type in the county is assessed as non-cropland.
- MPU shifts can be greater or less than actual use.
  - Similar to the current method, each soil map unit is defined as a non-cropland or a cropland soil– no mixed use assessments.
  - However, the MPU model can be modified to do a mixed use assessment, similar to an actual use method.

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Variables we explored to determine probabilities of use

- USDA-NASS Cropscape Use Patterns
- Prism Gridded Weather Data (temps and precip)
- NRCS Crop Productivity Index
- Forage production and value
- Net Income from Cropland
- Cropland Revenue
- NRCS Representative Yields
- APEX Simulated Yields
- NRCS Silt, Sand, and Clay Content in Top Layer
- NRCS Fragments in soil (rocks)
- Mean Slope
- Slope Length
- NRCS Land Capability Class
- Vegetative Index (satellite)
- NRCS Ponding Frequency

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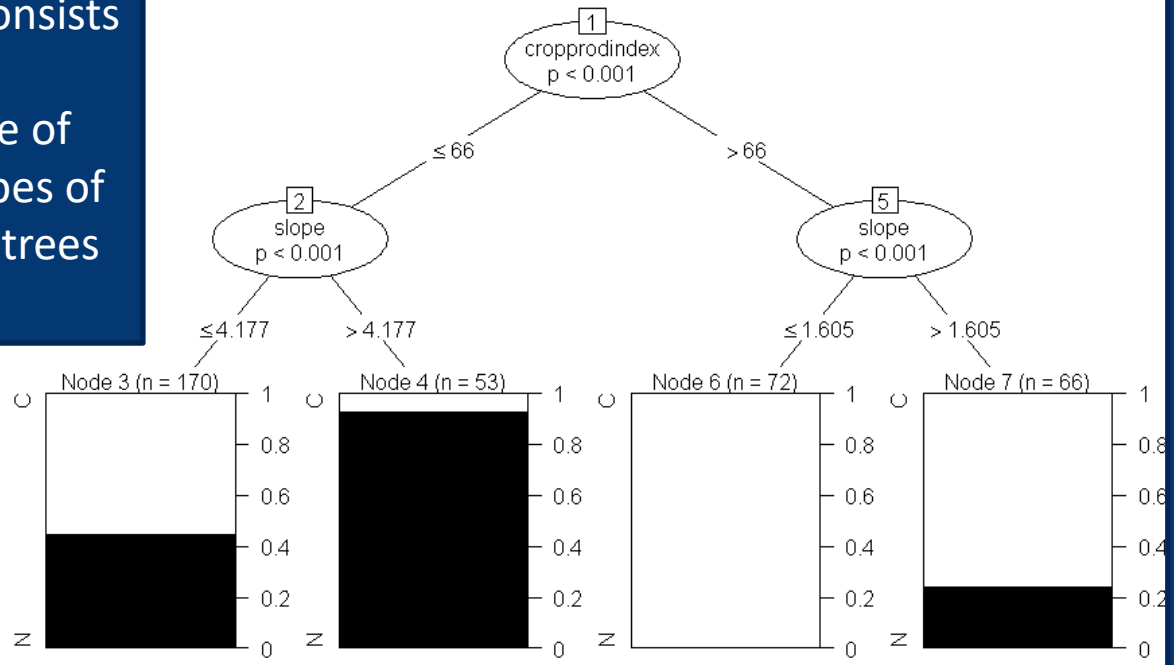
Sample Single Decision Tree

Model consists of an ensemble of these types of decision trees



If and then rules that segregate the data to make a prediction.

If crop productivity index is less than 66 and slope is greater than 4.177% then > 90% of the sample was Non-Cropland MPU.

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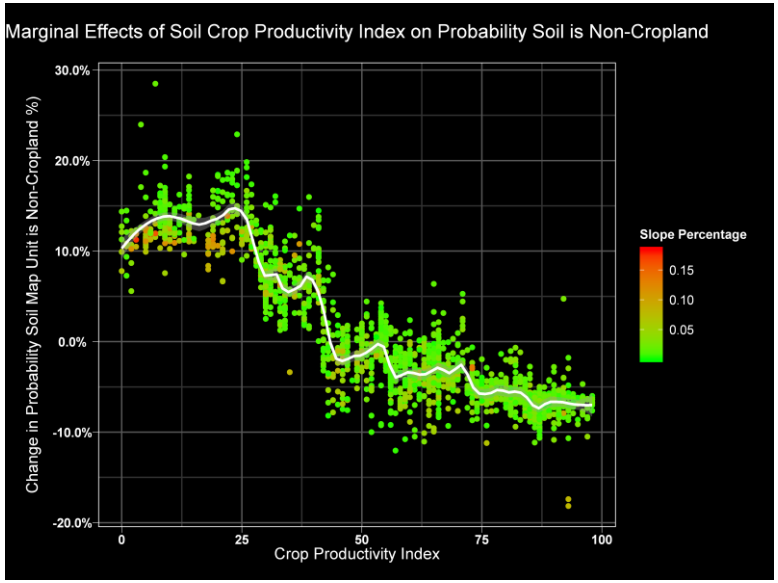
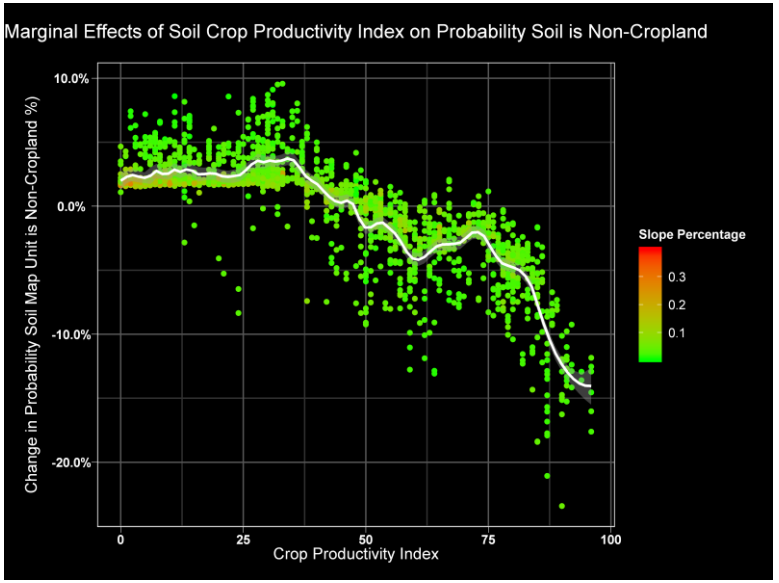
Marginal Effects of the Crop Productivity Index on Probability Soil Map Unit MPU is Cropland

East South Dakota



West South Dakota



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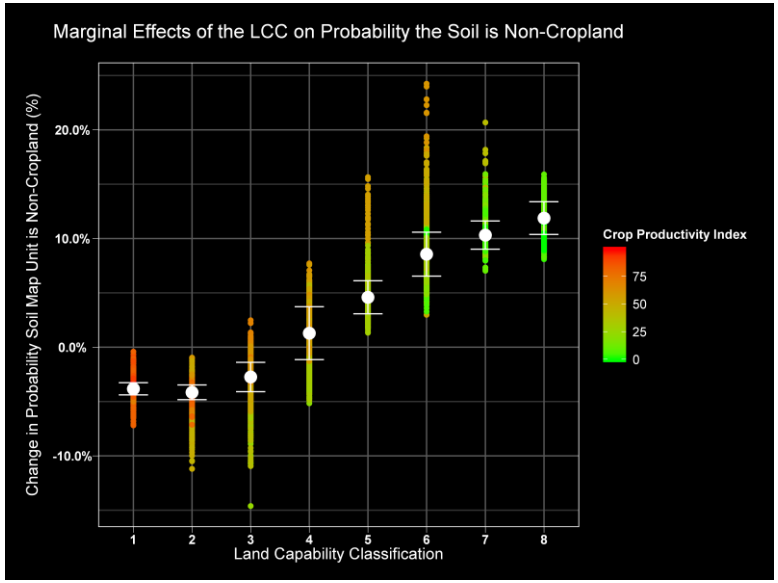
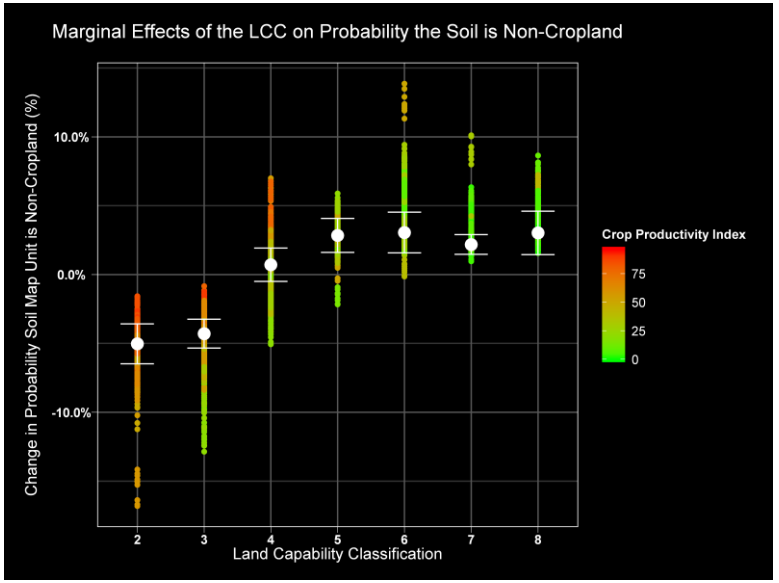
Marginal Effects of the Land Capability Classification (LCC) on Probability Soil Map Unit MPU is Cropland

East South Dakota



West South Dakota



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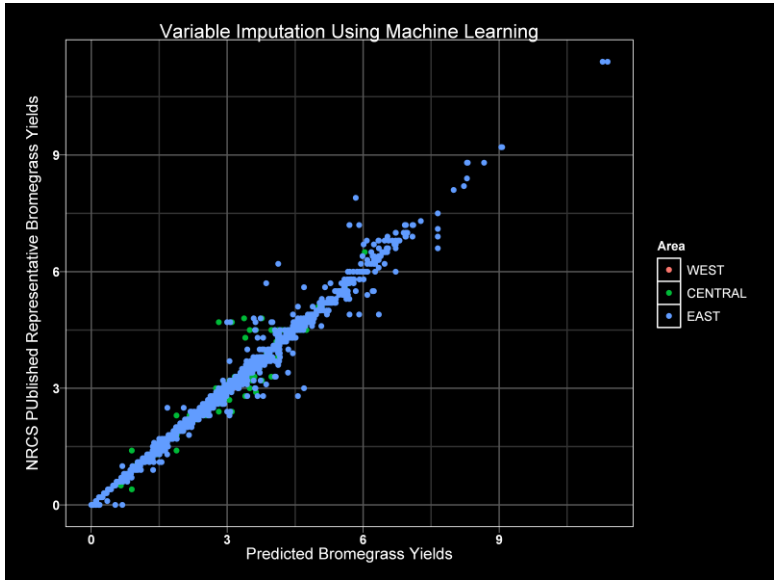
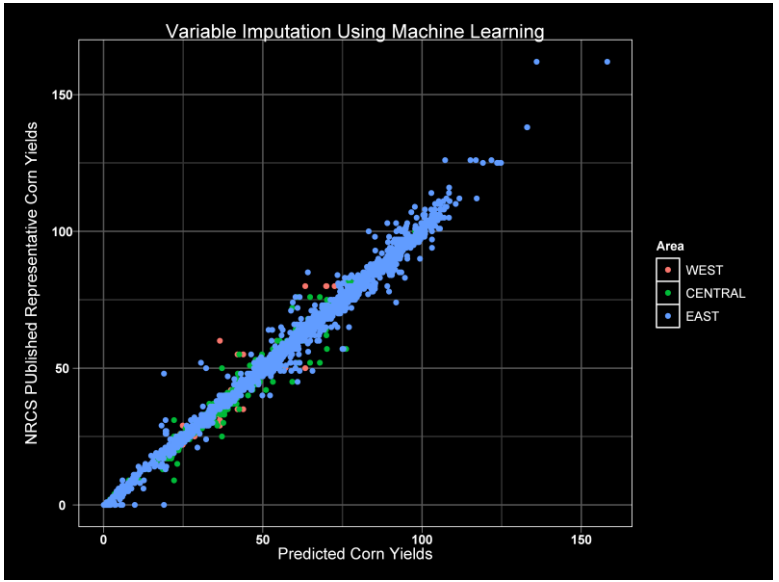
Impute Missing NRCS Data— Representative Yields By Component





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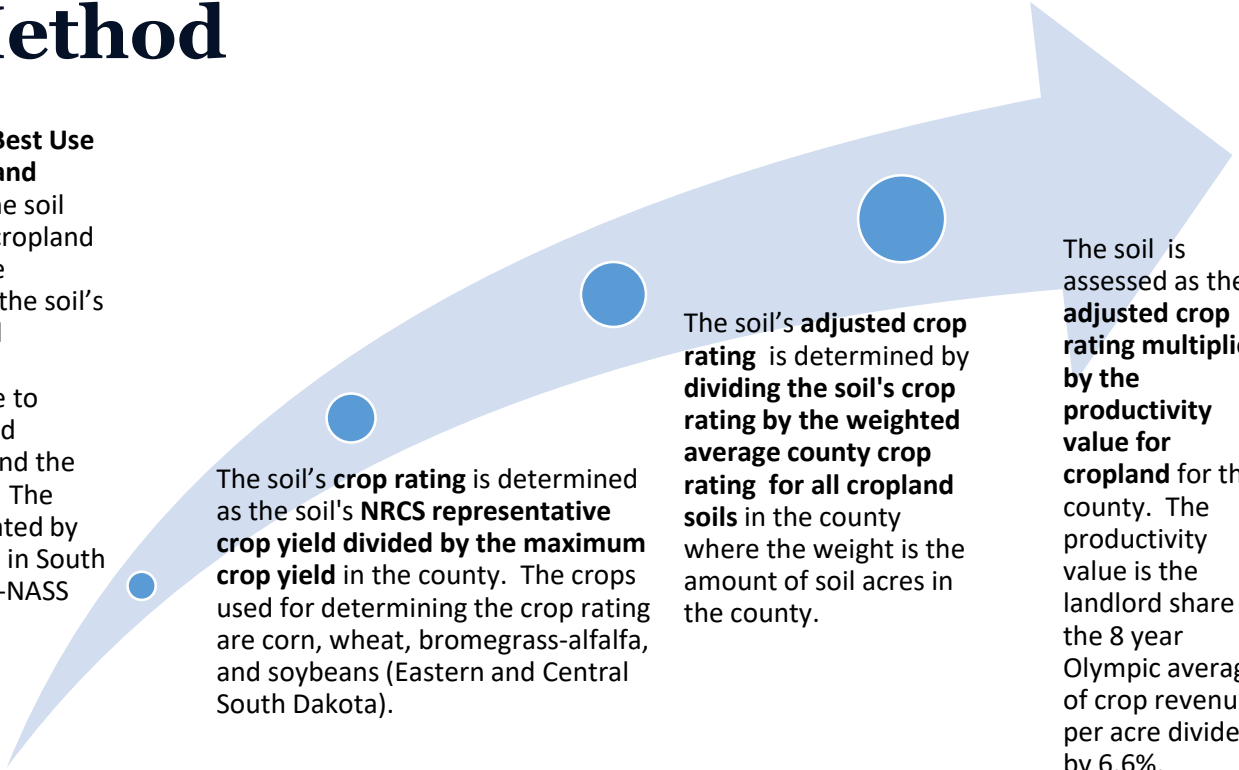
Cropland assessment using the **Most Probable Use Method**

The soil's **Highest and Best Use** is determined as **Cropland** when the probability the soil will be mostly used as cropland **exceeds .5 or 50%.** The probability is based on the soil's topography, NRCS Land Capability Class, crop productivity index, June to August precipitation and temperature, county, and the crop ratings of the soil. The probabilities are estimated by examining use patterns in South Dakota using the USDA-NASS cropland data layer.



The soil's **crop rating** is determined as the soil's **NRCS representative crop yield divided by the maximum crop yield** in the county. The crops used for determining the crop rating are corn, wheat, bromegrass-alfalfa, and soybeans (Eastern and Central South Dakota).

The soil's **adjusted crop rating** is determined by **dividing the soil's crop rating by the weighted average county crop rating for all cropland soils** in the county where the weight is the amount of soil acres in the county.

The soil is assessed as the **adjusted crop rating multiplied by the productivity value for cropland** for the county. The productivity value is the landlord share of the 8 year Olympic average of crop revenue per acre divided by 6.6%.

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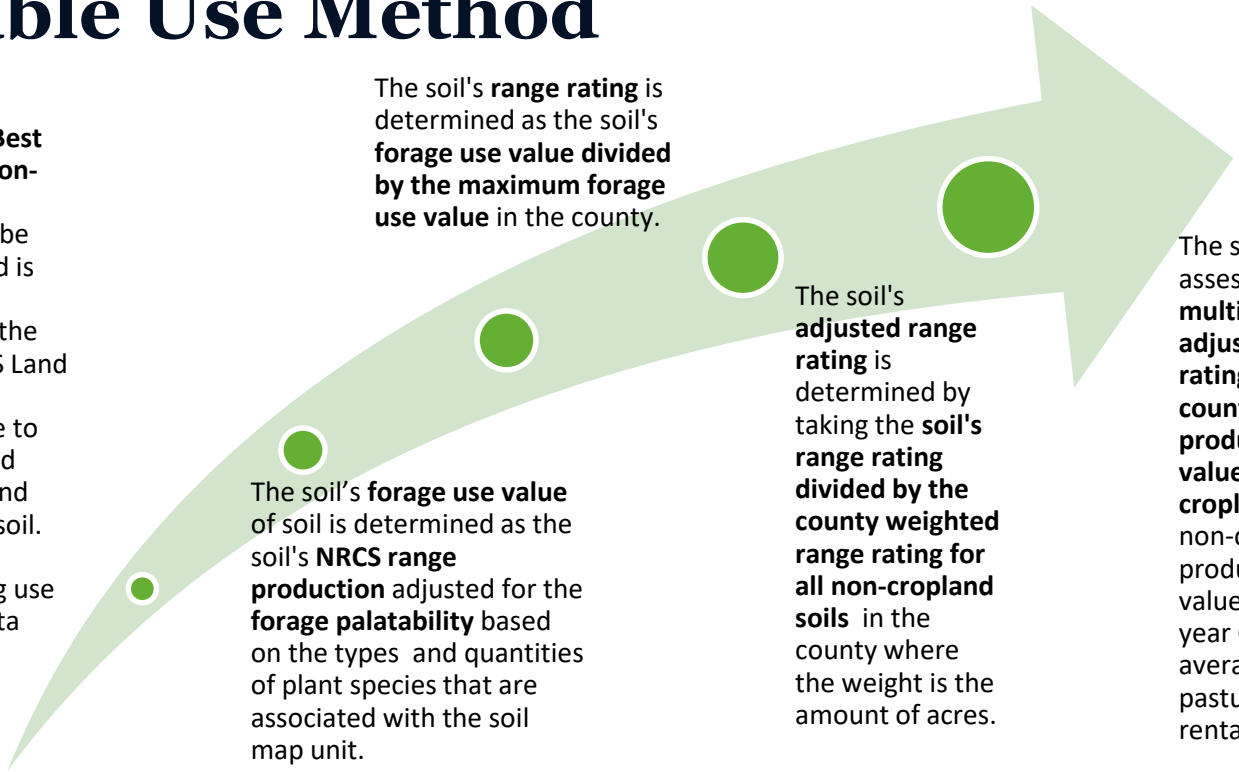
Non-cropland assessment using the **Most Probable Use Method**

The soil's **Highest and Best Use** is determined as **Non-Cropland** when the probability the soil will be mostly used as cropland is **below .5 or 50%.** The probability is based on the soil's topography, NRCS Land Capability Class, crop productivity index, June to August precipitation and temperature, county, and the crop ratings of the soil. The probabilities are estimated by examining use patterns in South Dakota using the USDA-NASS cropland data layer.



The soil's **forage use value** of soil is determined as the soil's **NRCS range production** adjusted for the **forage palatability** based on the types and quantities of plant species that are associated with the soil map unit.

The soil's **range rating** is determined as the soil's **forage use value divided by the maximum forage use value** in the county.

The soil's **adjusted range rating** is determined by taking the **soil's range rating divided by the county weighted range rating for all non-cropland soils** in the county where the weight is the amount of acres.

The soil is assessed by **multiplying the adjusted range rating by the county productivity value for non-cropland.** The non-cropland productivity value is the 8 year Olympic average of the pastureland rental rate.

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Actual Use Method

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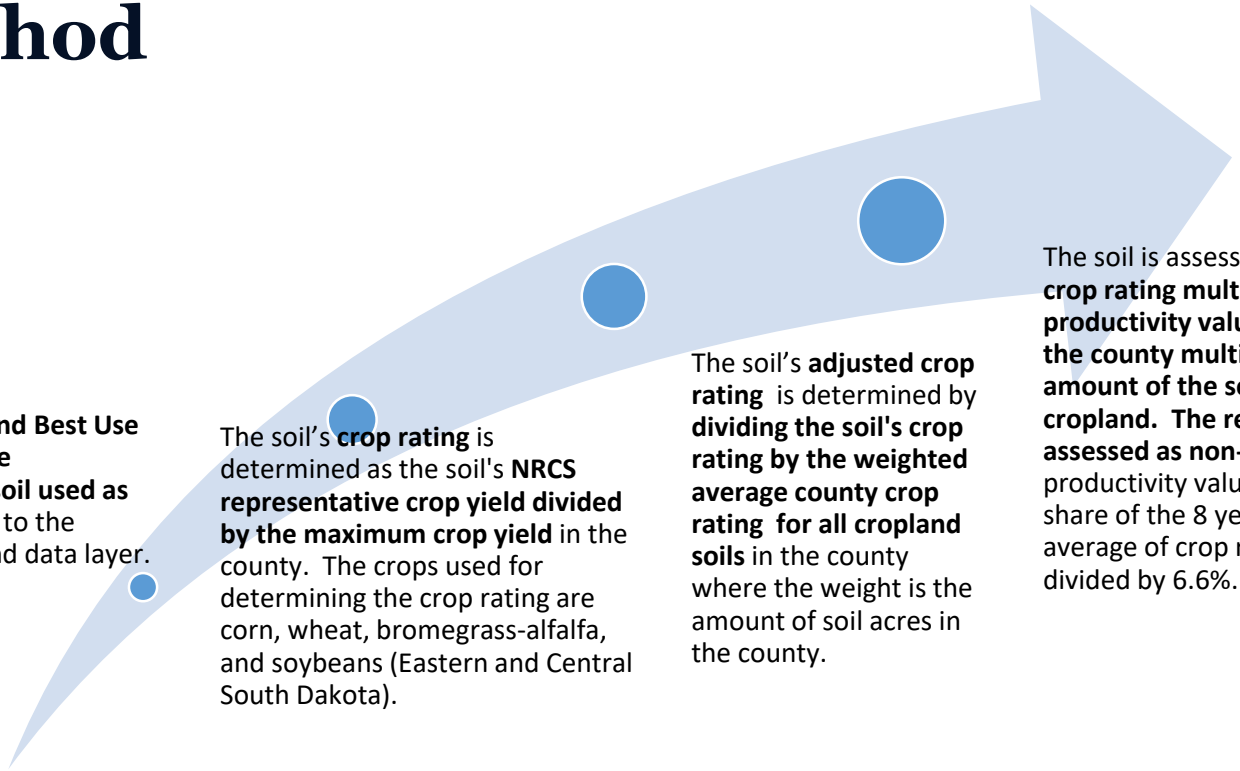
Cropland assessment using an **Actual Use Method**



The soil's **Highest and Best Use** is determined as **the percentage of the soil used as cropland** according to the USDA-NASS cropland data layer.

The soil's **crop rating** is determined as the soil's **NRCS representative crop yield divided by the maximum crop yield** in the county. The crops used for determining the crop rating are corn, wheat, bromegrass-alfalfa, and soybeans (Eastern and Central South Dakota).

The soil's **adjusted crop rating** is determined by **dividing the soil's crop rating by the weighted average county crop rating for all cropland soils** in the county where the weight is the amount of soil acres in the county.

The soil is assessed as the **adjusted crop rating multiplied by the productivity value for cropland for the county multiplied by the amount of the soil used as cropland. The remaining acres are assessed as non-cropland.** The productivity value is the landlord share of the 8 year Olympic average of crop revenue per acre divided by 6.6%.

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Non-cropland assessment using an **Actual Use Method**

The soil's **Highest and Best Use** is determined as **the percentage of the soil used as non-cropland** according to the USDA-NASS cropland data layer.

The soil's **range rating** is determined as the soil's **forage use value divided by the maximum forage use value** in the county.

The soil's **adjusted range rating** is determined by taking the **soil's range rating divided by the county weighted range rating for all non-cropland soils** in the county where the weight is the amount of acres.

The soil is assessed by **multiplying the adjusted range rating by the county productivity value for non-cropland multiplied by the percentage the soil used as non-cropland. The remaining acres are assessed as cropland.** The non-cropland productivity value is the 8 year Olympic average of the pastureland rental rate.

The soil's **forage use value** of soil is determined as the soil's **NRCS range production** adjusted for the **forage palatability** based on the types and quantities of plant species that are associated with the soil map unit.

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Findings

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URL: https://melliott-sdsu.shinyapps.io/r_app_HBU/

SDSU Extension

Ag Land Highest and Best Use Study

This study was funded by a special appropriation in the 2016 Legislative Session (HB1007). The purpose of the research is to provide objective data that will allow greater transparency in quantifying the probability of Highest and Best Use determinations for each soil type in a county. The study explores three different approaches for Highest and Best Use determination for Ag Land in South Dakota (Current Method, a Most Probable Use Method, and An Actual Use Method). Highest and Best Use is defined as the reasonably probable use of property that results in the highest value. The four criteria that the Highest and Best Use must meet are legal permissibility, physical possibility, financial feasibility, and maximum productivity.

Project Director: Dr. Matthew Elliott (matthew.elliott@sdstate.edu), Co Project Directors: Dr. Lisa Elliott, Dr. Douglas Malo, Dr. Tong Wang

Instructions: 1) Select a county of interest. 2) Select a variable of interest. 3) Define a local area of interest to calculate statistics at a field or parcel level by selecting the square icon in the map and drawing a box around the area of interest within the map (Optional)--Results are displayed in Figure 3.

Select County

Aurora

Select Table 1 Highest and Best Use Variable to Generate a Map

Assessed_Value_Current_Method_HBU

Opacity of the Selected Table 1 Highest and Best Use Variable Map

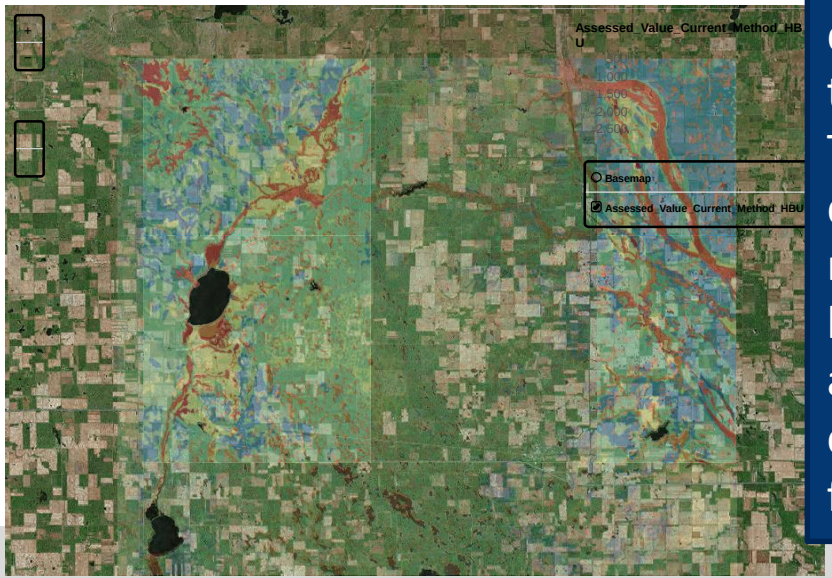
0 0.5 1

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Variable Description:

The Assessed_Value_Current_Method_HBU is the Ag land assessment in dollars per acre using the Current Method specified in state statutes for Highest and Best Use determination. The Current Method of assessment uses the NRCS Land Capability Classification to determine cropland or non-cropland Highest and Best Use for each soil. Once the use for each soil is determined, then the crop and range rating is used in conjunction with the county productivity value (i.e. the 8 year Olympic average of the 35% landlord share of crop revenue per acre for cropland, or the 8 year Olympic average pastureland rental rate for non-cropland, divided by the capitalization rate 6.6%) to assess each soil. Soils that have a land capability classification of 1 through 3 are considered cropland Highest and Best Use using the Current Method. Soils with a land capability classification of 5-8 are considered non-cropland. Soils with a land capability class of 4 depend on the relative difference between the crop rating and the range rating.

The expected assessment using the Current Method is made for a soil by dividing its crop rating if the Highest and Best Use is determined to be cropland, or the range rating if a non-cropland use is determined as the Highest and Best Use, by the county weighted average crop or range rating (weight is the soil map unit acres), and then multiplying by the county's cropland or non-cropland productivity value. The sum of all the assessments for a particular use-type (i.e. cropland or non-cropland) in a county, divided by the assessed acres for the same use-type, should result in the county productivity value for that use-type.



Most of the Research findings can be examined more closely on a website we developed for this project. The impact of different methods can be understood at the state, county, and field level.

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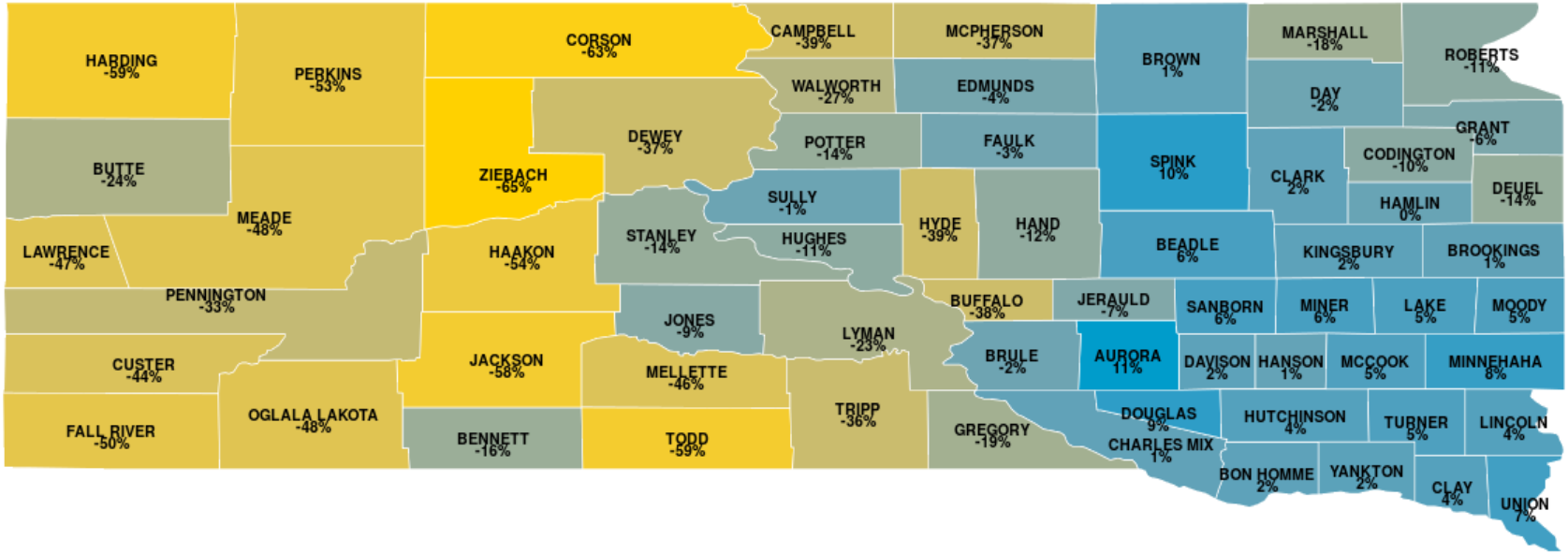
Expected Change in Ag Land Assessments if there was a switch to a Most Probable Use Method



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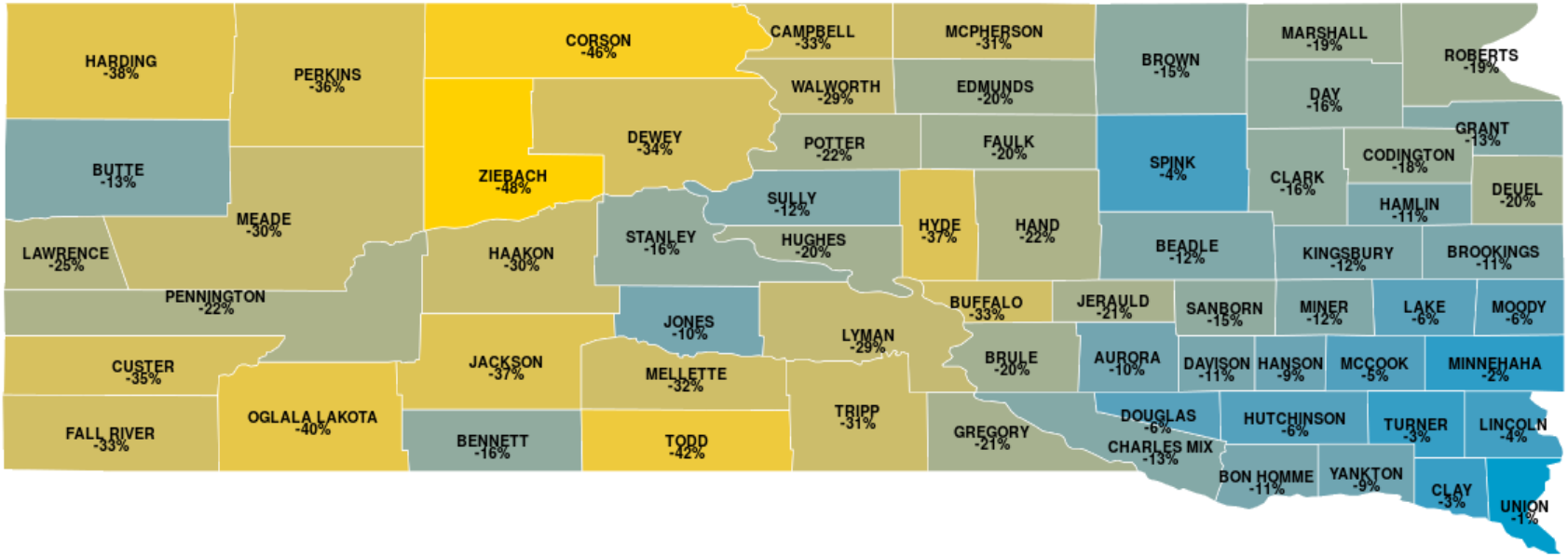
Expected Change in Ag Land Assessments if there was a switch to an Actual Use Method



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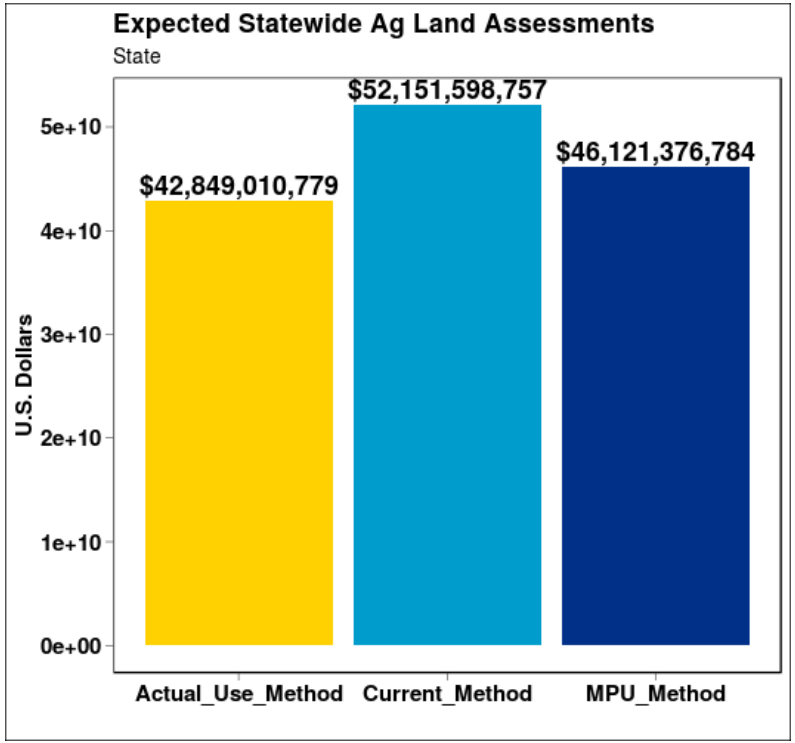
Expected Impact to Statewide Ag Land Assessments



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Implementation Issues
Data Issues

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Estimated Impacts may Differ from Actual Impact if there is a switch in HBU

Determinations

- We included Federal and Tribal Trust lands which are not in our current taxation system.
  - Valuation estimates and changes are based on ag land acres from USDA-NASS Cropscape that may or may not be taxable land.
- Existing easements and local adjustments were not available in GIS/electronic format to be used.

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Current NRCS soil data differs from Current DOR Soil Data in Table 1s and 2s

- New Soils vs. Existing County Soils

WTC	WILLIAMS-BOWBELLS-PARNELL COMPLEX	3E/2C/5W	0.666	0	Faulk	C670A	Bowbells-Niobell loams, 0 to 3 percent slopes
WVB	WILLIAMS-BOWBELLS-VIDA LOAMS	2E/2C/2E	0.821	0	Faulk	C672B	Max-Niobell-Noonan loams, 3 to 6 percent slopes
WWB	WILLIAMS-NIOBELL-NOONAN LOAMS	2E/3E/4S	0.703	0	Faulk	C732A	Bryant silt loam, 0 to 2 percent slopes
WXC	WILLIAMS-VIDA-BOWBELLS STONY LOAMS	7S/2C	0	0.46	Faulk	C732B	Bryant silt loam, 2 to 6 percent slopes
WZD	WILLIAMS-ZAHILL-BOWBELLS LOAMS	4E/6E/2C	0.598	0	Faulk	C732C	Bryant silt loam, 6 to 9 percent slopes
ZAE	ZAHILL LOAM	7E	0	0.366	Faulk	C745A	Bryant-Grassna silt loams, 0 to 2 percent slopes
ZCE	ZAHILL VERY STONY LOAM	7S	0	0.366	Faulk	C745B	Bryant-Grassna silt loams, 2 to 6 percent slopes
ZID	ZAHILL-LA PRAIRIE COMPLEX	6E/6W	0	0.514	Faulk	C769A	Tally fine sandy loam, 0 to 2 percent slopes
ZMC	ZAHL-MAX LOAMS	4E/3E	0.598	0	Faulk	C769B	Tally fine sandy loam, 2 to 6 percent slopes
ZMD	ZAHL-MAX LOAMS	6E/4E	0	0.488	Faulk	C773A	Williams-Bowbells-Noonan loams, 0 to 3 percent slopes
					Faulk	C773B	Williams-Bowbells-Noonan loams, 3 to 6 percent slopes
					Faulk	C810A	Bowdle loam, 0 to 2 percent slopes
					Faulk	C816A	Lehr loam, 0 to 2 percent slopes
					Faulk	C816B	Lehr loam, 2 to 6 percent slopes
					Faulk	C826A	Minnewasta loam, 0 to 2 percent slopes
	58 New Soils added or split				Faulk	C850A	Ruso coarse sandy loam, 0 to 2 percent slopes

- We could not match DOR soils with current NRCS soil data effectively to measure exact impact.
- The study adds soil types that are not in the current DOR tables.

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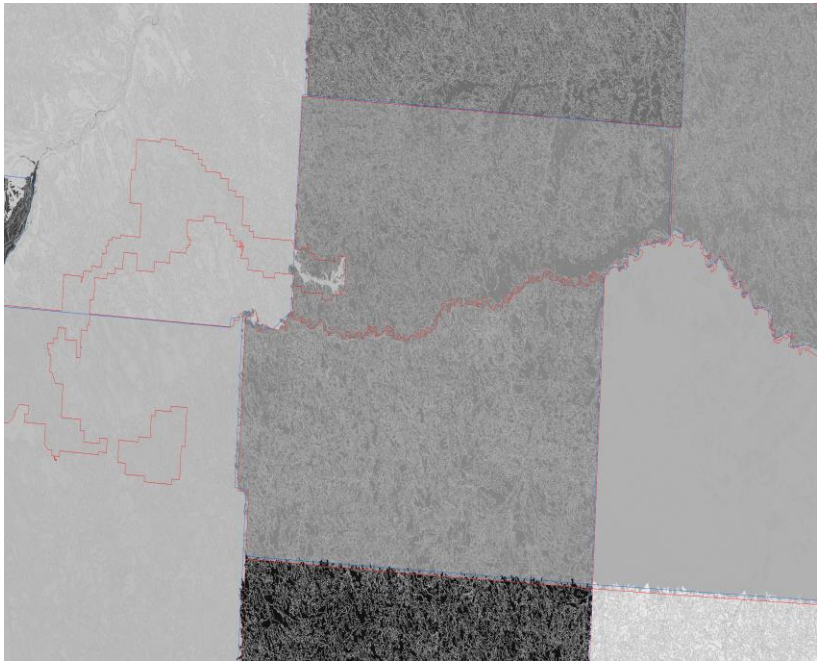
NRCS area boundaries are not county boundaries.

- NRCS soil boundaries do not match county boundaries. NRCS uses NRCS areas and an areaname.
- Counties can have additional acres when there is a mismatch in county and NRCS area boundaries.



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Issues using latest NRCS Soil Data

- Implementing new soil types at county level will be more difficult without GIS parcel data at the county level.
  - 11 Counties in SD do not have a GIS system to help with implementation or creating accurate parcel maps.
  - Implementation without GIS parcel data layer would require assessors to enter coordinates of parcels into the NRCS soil survey system to determine soil acreages and updated soil lists for each parcel.

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Conclusions

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SDSU General Research Conclusions

- NRCS soil ratings provide measures of soil productivity/capability, but are less accurate in predicting the **most probable use (slide 3 definition)** of Ag land– particularly in Western SD.
- NRCS ratings do not measure **highest and best use (slide 3 definition)**.
- Alternative methods and additional data can be used to improve highest and best use measures and better predict most probable use of Ag land.
- The additional data and updated methods would be consistent with the Appraisal Institute's definitions of highest and best and most probable use, and consistent with the Appraisal Foundation's standards for mass appraisal and highest and best use determination.

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Recommendation Given Our Research Findings

- We are recommending to add additional data and alter the method that determines Highest and Best Use. We recommend that additional data capture dimensions (financial feasibility) and current use patterns (probable use) that are not considered by NRCS.
- NRCS ratings and standards are based on the productivity/capability of soil alone.
- The recommendations, to be implemented, would require a change to the existing state statutes.

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Current South Dakota Statutes that Specify How Highest and Best Use is Determined

10-6-33.32. Division of land into categories. Agricultural land shall be divided by the director of equalization into categories, including cropland and noncropland. Each category shall be divided into classes based on soil classification standards developed by the United States Department of Agriculture Natural Resources Conservation Service.

Source: SL 2008, ch 44, § 9.

10-6-33.7. Classification of agricultural land in each county--Basis for soil valuation. Agricultural land in each county shall be divided into the eight classes defined by the United States Department of Agriculture's soil conservation service as published in its soil survey for each county. The county director of equalization shall, based on the agricultural lands soil survey classification, determine a value for each soil type.

Source: SL 1989, ch 86, § 5; SL 1991, ch 82, § 2; SL 2008, ch 44, § 17, eff. July 1, 2009.

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