COMPARING ALTERNATIVE OPINION SURVEY BASED ESTIMATES WITH ACTUAL LAND SALES IN NORTH DAKOTA

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

MASTER OF SCIENCE

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ABSTRACT

Fluhrer, Jedediah Owen; M.S.; Program of Natural Resources Management; Department of Agribusiness and Applied Economics; College of Agriculture, Food Systems, and Natural Resources; North Dakota State University; August 2005. Comparing Alternative Opinion Survey Based Estimates with Actual Land Sales in North Dakota. Major Professor: Dr. Steven D. Shultz.

Regression models were used to quantify factors influencing differences in opinion-based agricultural land value estimates and actual sales in North Dakota at two levels of geography: 1) at the county-level and 2) at the segment-level. Differences in June Agricultural Survey and North Dakota Land Value Survey estimates aggregated at the county-level were regressed against survey characteristics, land cover characteristics, and soil variance within counties. At the segment-level of analysis, differences in June Agricultural Survey segment values and market sales were regressed against market sale size, distance between segment and sale, land cover characteristics, and soil characteristics.

Survey reports and the percentage of the county in wetlands were found significant at the 90% confidence level in 2 county-level models. In all of the segment-level models, spring wheat yield and gross revenue were found significant at the 95% confidence-level.

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Thank you goes to the North Dakota Agricultural Statistics Service for providing access to the June Agricultural Survey files. Specifically, I thank David Knopf and Bill Meyer for their efforts in making the data available. Thank you to the North Dakota County Recorders and Tax Directors. Without their help collecting agricultural land sales this study would not have been possible.

A special thank you goes to my advisor, Dr. Steven Shultz, for his constructive criticism, and guidance through my graduate program. In particular I thank him for encouraging me to explore a career in natural resources.

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TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER 1. INTRODUCTION

Buyers and sellers of agricultural land, lending institutions, conservation agencies, and policy makers all require accurate, timely, and site-specific land value data. In North Dakota and many other states, land value data are commonly available from either opinion-based surveys or market sales. However, it is not well understood how or why these value estimates often differ from each other.

Opinion-based land value estimates in North Dakota are collected annually by the National Agricultural Statistics Service (NASS) at two alternative levels of geography. At the segment-level, opinion estimates are collected through the June Agricultural Survey (JAS) in North Dakota and the rest of the contiguous 48 states, however, they are aggregated and displayed publicly at the state-level. County-level estimates of both total values and rental values, on a per acre basis, are also collected through the North Dakota Land Value Survey (NDLVS). The NDLVS, which is funded by the North Dakota State Land Department and administered by the North Dakota Agricultural Statistics Service, asks farmers and ranchers their opinions on rent and market values in their locality.

The North Dakota chapter of the American Society of Farm Managers and Rural Appraisers compiles an informal and unpublished annual report of minimum and maximum land values and rents each year. The data are based on a survey given to members who report cropland and pastureland sales or observed rents by county or region. Members occasionally report the value of land sold or leased for hunting purposes.

Information on individual market sales is also available in North Dakota from county courthouse deed records. However, North Dakota is a non-disclosure state. Buyers of land may choose to keep sale information confidential. Sales information available to the public includes the names of the buyer and seller, township, range, section, the number of acres, and the consideration given for the land. Public land sale records are difficult to use in mass appraisals or land value modeling because they are time consuming to collect. Also, county records give no indication if the sale was arms-length or whether, for example, the land was purchased for agriculture, development, or recreation. To effectively use market sales, either the grantee or grantor must be contacted to verify the details of the sale.

To date, little research has been conducted to quantify the potential differences between opinion-based estimates conducted by NASS at the county-level, JAS estimates conducted at the segment-level, and market sales. Accurate land value information is important to many segments of North Dakota's agricultural sector. At the local-level, lending institutions require land value estimates (appraisals) when making agricultural loans. At the state- and national-levels, agencies such as the U.S. Department of Agriculture (USDA) and the U.S. Fish and Wildlife Service (USFWS) require land value estimates to determine fair market values for conservation easements.

The North Dakota State Land Department makes leasing, easement, and permit decisions based on opinion estimates from the North Dakota Land Value Survey. In 2003 the North Dakota State Land Department controlled 713,634 acres of land, which resulted in over $4 million in revenue ("Biennial Report for the Board of University and School Land," 2004). A difference in the land value estimates used by the State Land Department of 2% would result in a difference of $80,000 in revenue annually. Due to the limited literature on the potential differences between market transactions and opinion-based surveys of land values, and conflicting results from the few existing studies of this type outside of North Dakota, research on the magnitude and cause of differences between opinion- and market-based estimates of land values in North Dakota is justified.

Problem Statement

It is not known if land value estimates based on the June Agricultural Survey (JAS), North Dakota Land Value Survey (NDLVS), and market sales differ substantially from each other, and why they may differ.

Research Objectives and Procedures

The first objective of this study was to evaluate whether county-level land value estimates from the June Agricultural Survey (JAS) and the North Dakota Land Value Survey (NDLVS) differ statistically from each other and to explain these differences. The second objective was to quantify and explain the differences between individual JAS segment reported land values and nearby comparable market sales.

It was hypothesized that differences between opinion- and market-based land value estimates will be greatest in counties having diverse or widely ranging levels of both soil productivity and land cover. It was also suspected that differences would increase as the distance between survey sites and market sales increases, and decrease as the number of survey samples increase.

Pair wise t-tests were used in all 53 North Dakota counties to evaluate whether potential differences between NDLVS and JAS land values at the county-level were statistically different. The factors influencing differences between opinion-based estimates at the county-level for 2002 were quantified through the estimation of a regression model that specified land value differences to be a function of the percentage of the county in cropland, the percentage of the county in wetlands, the number of JAS opinion reports for the county, and alternative measures of soil productivity.

A second set of regression models were used to explain the differences between JAS segment values and nearby market sales from 2001 through 2003 in 33 North Dakota counties (counties with digitized soil data at the time the study was initiated). These models account for difference in parcel sizes, distance between JAS segment and sale, wetland acreage, gross revenues, and soil productivity.

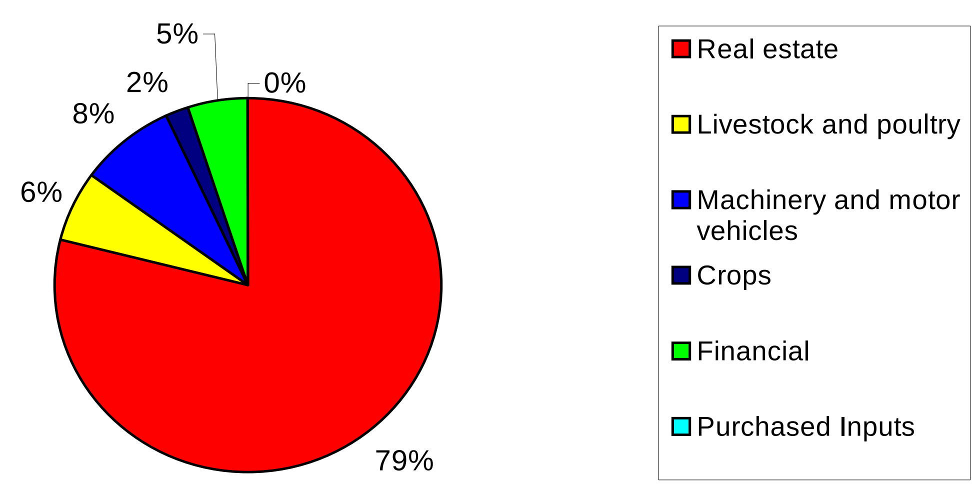
CHAPTER 2. BACKGROUND AND LITERATURE REVIEW

The Background and Literature Review is divided into three sections. The first section describes land value trends in the United States and North Dakota. The second section provides a summary of land valuation procedures and the use of the hedonic valuation method (HVM) to quantify the determinants of land value. The third section provides information on geographic information system (GIS) and related databases used in this research including: Soil Survey Geographic (SSURGO) Database, Cropland Data Layer (CDL), and National Wetlands Inventory (NWI).

Trends in Agricultural Land Values

Trends in U.S. Agricultural Land Values

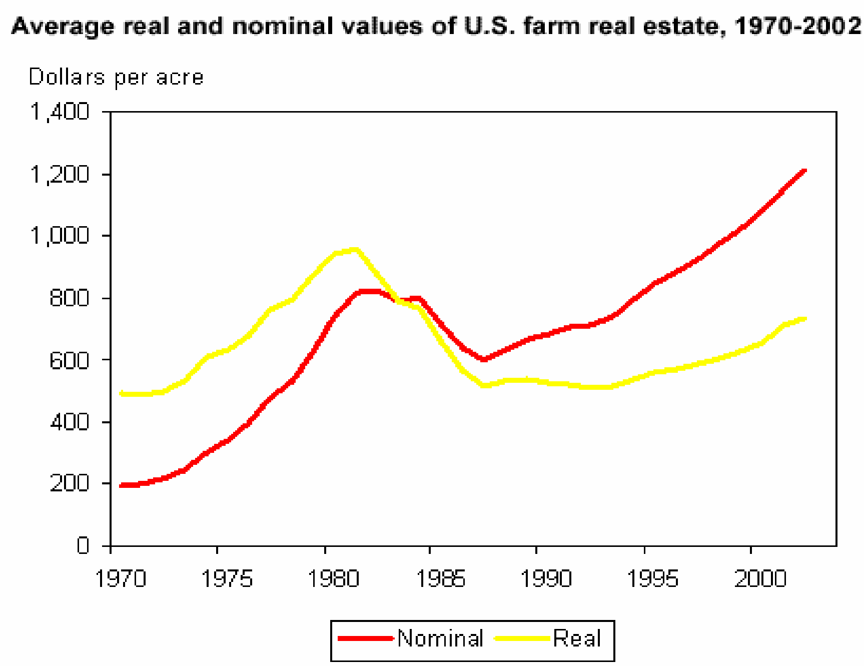
Real estate accounts for the majority of the wealth in the agricultural sector in the United States. In 2000, real estate comprised 79 percent of the total U.S. farm assets and was the single largest investment in a typical farm portfolio (Figure 1).



Source: “Land Use, Value, and Management: Agricultural Land Values” 2004

Figure 1. U.S. Farm Business Assets, 2000.

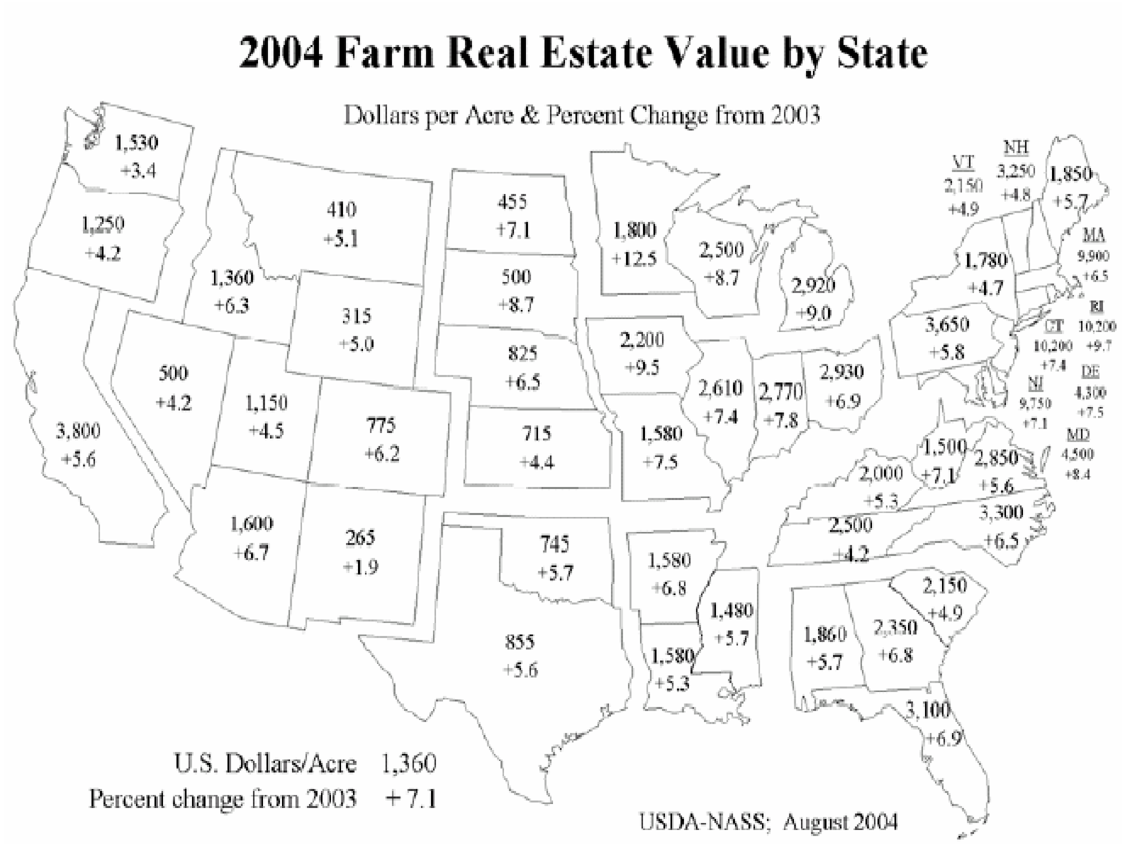
Over time, farmland values in the United States have fluctuated greatly. Average prices quadrupled between 1972 and 1982, fell by more than 25% between 1983 and 1987, and have increased by approximately 39% in inflation adjusted terms (1982 dollars) since 1987 (Figure 2).



Source: "Land Use, Value, and Management: Agricultural Land Values" 2004

Figure 2. Average real and nominal values of U.S. farm real estate, 1970-2002.

More recently, farm real estate values, a measure of the value of all land and buildings on farms, averaged $1,270 per acre as of January 1, 2003, up 5% from 2002. While overall land values have trended upward since 1987, cropland values vary widely across states and regions (Figure 3) for obvious reasons. States along the east coast exhibit the highest agricultural land values in the United States, primarily due to development pressures. A major portion of land value in the midwest is the result of income generating capacity through agricultural crops. Soil quality, rainfall, and the length of the growing season have the greatest impact on the income generating capacity of land. Federal farm policy has also exerted indirect influence on cropland values through commodity supply control programs, direct payments, and subsidized insurance since the 1930s ("Agricultural Land Values and Cash Rents" 2003).



Source: "Land Use, Value, and Management: Agricultural Land Values" 2004

Figure 3. Average values per acre of farm real estate, August 2004.

Trends in North Dakota Agricultural Land Values

North Dakota agricultural land values are closely tied to farm profitability, interest rates, and the strength of the overall economy. Recently, low returns on other investments have made agricultural land attractive to outside investors. A study of 2003 North Dakota land values by the North Dakota Agricultural Statistics Service showed the greatest annual percentage increase in land values since the late 1970s. These prices are now approaching the all time high of about $530 per acre in 1981, however in constant dollars current values are about one-half of the levels in 1981 ("North Dakota Crop Land Values Show Greatest Increase in 25 Years" 2004).

While external factors play a role in land values in North Dakota, soil productivity and climate also affect value. Figure 4 shows the 1969 North Dakota State University climate-adjusted soil productivity map at the township-level of analysis. The range of observed values in North Dakota is from 4 to 92 based on a scale of 1 to 100. The area of low productivity in the southwest portion of the state represents the Badlands while the area on the very eastern border represents the Red River Valley. Soil productivity differences among areas are quite dramatic and result in very different agricultural land productivity and values.

Figure 5 is a map of the 2002 North Dakota Agricultural Statistics Service county-level land value opinion survey. This map represents opinion estimates of per acre land value at the county-level. Moving from the western portion of North Dakota east, land values increase as soil productivity increases with the Red River Valley on the eastern border having the highest soil productivity and the highest land values.

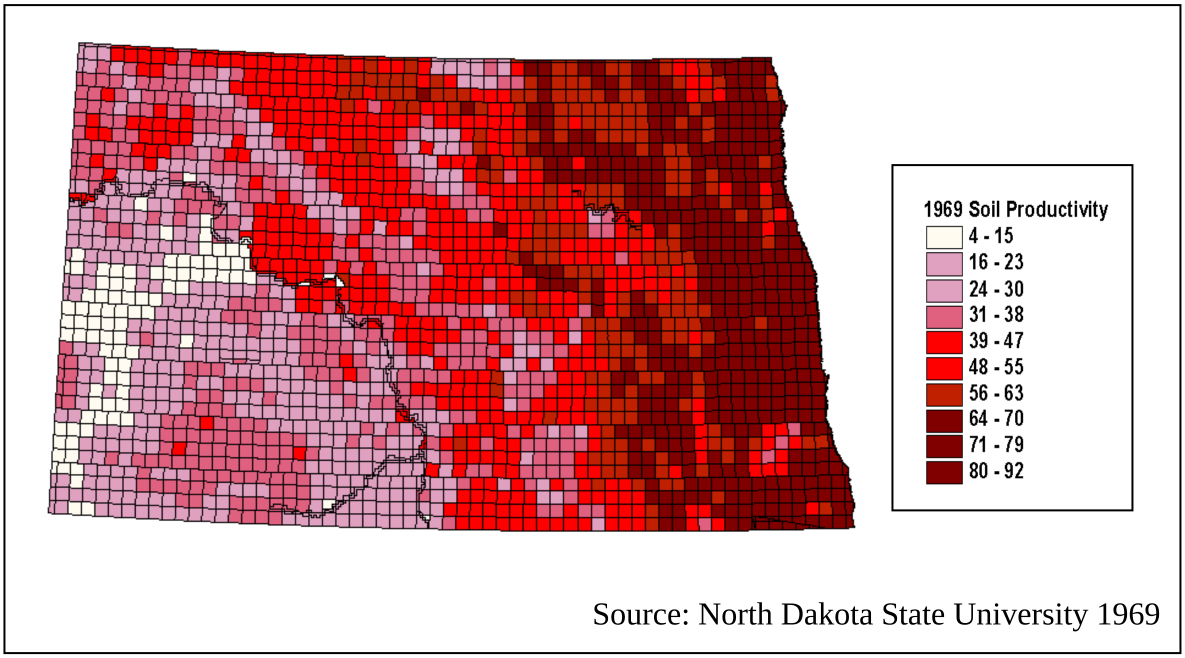


Figure 4. 1969 NDSU climate-adjusted township soil productivity rating.

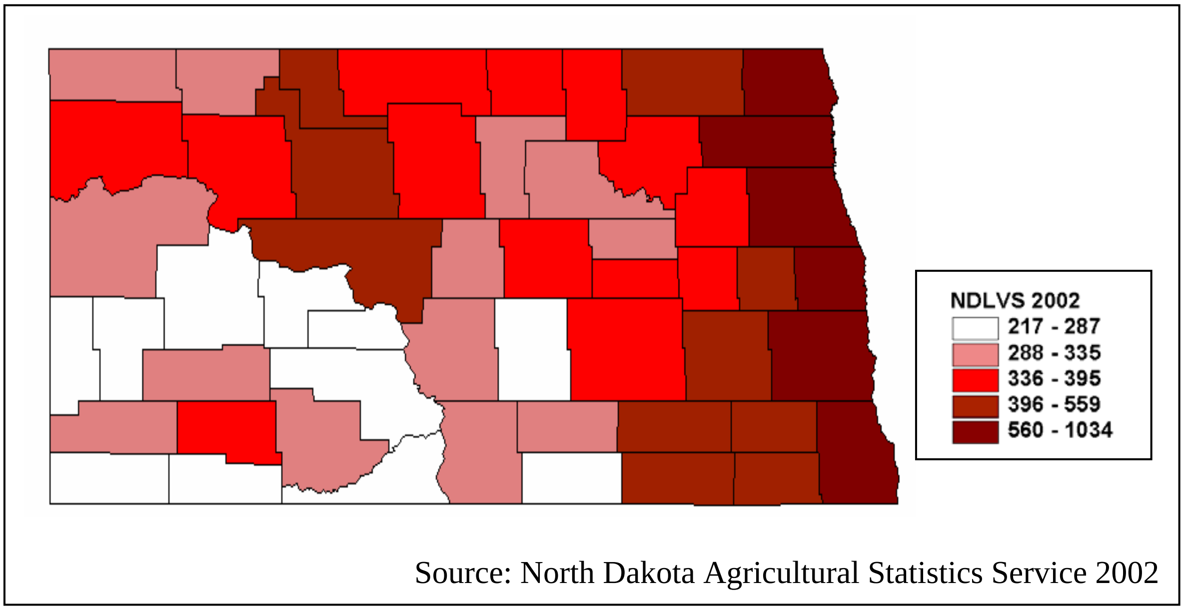


Figure 5. North Dakota Agricultural Statistics Service 2002 county land values.

Land Valuation Methods

Discounted Cash Flow

The discounted cash flow method of land valuation assumes property values are a function of the present value of a stream of expected future net cash flows from agricultural production (Elad et al. 1994). However, expected cash flows are difficult to estimate with land having potential future alternative uses and many types of land, including wetlands and woodlands, have no present or projected income stream but still have a positive value (Vasquez et al. 2002). The discount rate used in the calculation of present value also poses problems to researchers. Changes in future interest rates, risk factors, and inflation all effect decisions on discount rate; however, these factors are extremely difficult to predict with accuracy. Discounted cash flow is appropriate when agriculture constitutes the highest and best use of the land. If agriculture is the highest and best use for a particular piece of land, then economic theory suggests discounted cash flow and market value will be equal.

Agricultural lands are increasingly being purchased for reasons other than agricultural production. Hunting, recreation, investment, and development interests are increasing demand on a fixed land supply resulting in increasing values. In these cases the market values are often higher than the expected future income from the land (Shane et al. 2003).

Opinion-Based Surveys

Opinion-based land estimate studies are generally made through surveys of farmers and ranchers, or local experts (usually appraisers), by asking them to estimate land values in their area. These studies assume farmers and ranchers are aware of market transactions and are able to estimate the value of land they own or rent. In North Dakota there are two opinion-based land value surveys conducted each year: the June Agricultural Survey (JAS) and the North Dakota Land Value Survey (NDLVS).

The June Agricultural Survey (JAS) is one of the most comprehensive surveys conducted by the National Agricultural Statistics Service (NASS). Each year approximately 10,000 segments nationwide, each measuring roughly one square mile, are selected from the major land use stratums across the contiguous 48 states. In North Dakota there are approximately 420 segments surveyed by the JAS each year, representing a random sample of land uses throughout the state.

Farm operators within the selected segment are identified and interviewed face to face regarding agricultural practices within the segment. The survey is designed to account for all agricultural activities and land uses within the segment boundaries including crop acreage, genetically modified crop acreage, grain stocks, cattle inventory, hog inventory, sheep inventory, poultry inventory, land values, cash rents, farm numbers, and value of sales (“Sample Survey and Census Programs of NASS” 2002).

Operators are also asked specific questions regarding land value and rent. The operators are asked how many acres they own, how much land they rent, and how many acres they rent to others. The JAS asks operators what they believe the market value is of all land inside the segment they operate in. The operator is then asked to value the cropland separately from pasture, grazing or grassland, and from the other land uses within the segment.

The North Dakota Agricultural Statistics Service (NDASS) conducts an annual survey, paid for by the North Dakota State Land Department, at the county-level of analysis in late January and early February of each year. These surveys, which are unique to North Dakota, are used to obtain cash rental rates and the value of rented land in each county of North Dakota. Data are collected for non-irrigated cropland, pasture, alfalfa hay, other tame hay, and wild hay. Reported data include the number of observations, means, modes, maximums, and minimums.

Market Sale Data in North Dakota

North Dakota state statutes allow buyers of land to maintain the sale price of real estate transactions confidential. However, in most counties of the state, anecdotal evidence suggests that more than 70% of the agricultural land sales are not specified to be confidential and are therefore available through public deed records in county courthouses. However, to be used for appraisals or other valuation studies it is important that such sales be verified as being arms-length (not between family members), not including buildings or equipment and purchased with cash or cash equivalents.

Although the state of North Dakota taxes agricultural land based on its productive value, the Office of the State Tax Commissioner, in collaboration with county tax directors, regularly verifies and compiles all arms-length and land only agricultural land sales in the state as part of an "assessment ratio study" (they compare sale values with assessed taxable values). Normally the data are not released to the public but the data were made available for this study.

Another potential source of agricultural market sales are rural appraisers who regularly collect, verify, and use agricultural sales (both disclosed and non-disclosed) for appraisal purposes. In many states, appraisers are regularly surveyed by other appraisers (the case in North Dakota) or by university researchers (as done in Nebraska and South Dakota) to obtain regular and consistent estimates of changing agricultural land values.

However, such appraiser surveys often (as in North Dakota) only report ranges of land values (minimum and maximum) and/or are only at county- or regional-levels of analysis.

Determinants of Agricultural Land Values

Researchers have tried to identify the determinants of agricultural land values since the early 1900s. Studies have been conducted on the value of buildings, distance to towns, soil, crop yields, environmental amenities such as rivers and wetlands, and other assorted land attributes. Land attributes do not have easily identifiable values because there are no direct markets for individual land characteristics. Due to this limitation, hedonic valuation method (HVM) models have been used to estimate the relationship between environmental amenities and agricultural land values. Agricultural land is commonly treated as a homogeneous factor of production, however land has many attributes that vary among parcels (Palmquist 1989). It is these attributes that give land its value and define what a buyer is willing to pay for it. The HVM model developed by Rosen (1974) is based on several assumptions: that individuals seek to maximize their utility by choosing among a continuous spectrum of products and services, subject to a budget constraint and profit-maximizing behavior of sellers; that buyer’s choices are subject to diminishing marginal utility; that consumers may choose from a continuous range of goods; and that the quantity demanded equals quantity supplied. In the case of agricultural land it is unrealistic to assume that buyers may choose from a continuous range of goods. A buyer may be able to find several of the desired characteristics but it is unlikely that all of the desired traits are available.

The first stage of the HVM is the estimation of the implicit price function. The price function is a regression model where the value of a market good, for example agricultural land, is the dependent variable and the attributes of the good, which make up its market value, are the independent variables. The basic HVM developed by Rosen, when applied to agricultural land, is summarized in a simple linear formula given by Equation 1.

(1) $$P_1 = f\,(Z_1, Z_s, Z_e, Z_l),$$

where P_1 = agricultural land prices,

Z_l = land uses,

Z_s = soil characteristics,

Z_e = environmental characteristics, and

Z_l = location.

Examples of land uses included in past agricultural-value-based hedonic studies include agricultural crops and pasture land. Soil characteristics often include crop-specific soil productivity based on spring wheat yields or forage production, land capability classes, soil productivity indices, and drainage. Environmental characteristics used in past studies include wetland characteristics, slope, erosion potential, and flooding potential. Location is also an important determinant of land value. Growing season, frost-free days, and average yearly rainfall have also been used in past hedonic based studies as factors representing location.

The Results from Previous Land Valuation Studies

A study conducted by Xu et al. (1993) used hedonic regression to model the impact of gross revenue, soil productivity, irrigation, distance to town, and size of parcel on the per acre sale price of cropland. The study focused on 24 of Washington state’s 39 counties. These 24 counties were arranged into 6 homogeneous regions. Land sales were collected for the years 1980 through 1987 from Farm Credit Service sales books. In this study, only sales described as "arms length," containing cropland, and greater than 10 acres were used. Buyers of parcels were surveyed by telephone regarding various land attributes. As expected, gross income was found to be positive for all models. Soil productivity, as measured by average land capability class in the parcel, had a negative impact on price, which was expected as the land capability class is based on a 1 to 7 scale (1 being the highest soil productivity and 7 the lowest). Irrigation was found to have a positive effect on land values with center pivots having the most impact on land value. Distance from the nearest town had a negative effect on land values as expected. The study concluded that individual parcel characteristics, particularly permanent improvements such as irrigation, have significant impact on land values. The six regions analyzed in Washington state were found to exhibit differing price functions across regions indicating separate markets.

Elad et al. (1994) used land sale data obtained from the Farm-Rural Land Market survey conducted by the University of Georgia from 1986 to 1989 to analyze the impact of parcel size, proportion of cropland, distance to market, presence of buildings, and farmland uses on land values in the state of Georgia. The state was broken into six regions: north, greater Atlanta, west central, east central, southwest, and southeast. As expected sale size had a negative impact on per acre land values in all regions, the increased capital requirements for large parcels reduces the number of buyers. The proportion of cropland in the parcel was not found to significantly impact per acre land values except in the southwest region. The distance from the market, in this study Atlanta, was significant and negative in the west central and southern regions. In the east region there was a positive sign, indicating that the tracts sold were not discounted as the distance from Atlanta increased. The absence of buildings was found to have a negative coefficient for the north and east central regions; however, in the southwest region it was a positive coefficient. It was expected that improvements in the form of buildings would bring an increase in value, however in the southwest region, the major row cropping area in the state, acreage not tied up by buildings but available for farming is viewed as a plus. The results of the study indicated that the characteristics surrounding farmland do differ in importance and influence upon farmland values depending on regional location. An entire state such as Georgia functioning as a single agricultural market is very unlikely.

A study conducted by Boisvert et al. (1997) evaluated the relationship between land values and productivity, erosion and leaching potential, and education level of farm operators in the Lower Susquehanna River Basin of Pennsylvania. Land values and rental rates, collected by the USDA through area studies, were regressed against corn yield, whether the land is used for crops or livestock, the number of years owned, field size, education of the operator, and environmental vulnerability measures. Productivity, as measured by corn yield, was found to affect market value and rental rates positively. Cropland had a positive parameter estimate in rental models. This finding was consistent with the hypothesis that the most productive land would be placed in crops. The number of years the land has been owned was positively related to value in the models; however, the standard errors associated with this variable are relatively high. Field size was found to be an insignificant variable in the models. Land values were positively related to the education of the operators. Educated operators were those who had received some college education. It is not known whether this result is caused by their education leading them to farm "better" land, having better information, or if they have inflated opinions on the value of land. The regression models indicated environmental vulnerability has a negative relationship to land values, as hypothesized.

A study conducted by Vasquez et al. (2002) used sales of irrigated cropland collected through Farm Credit Services in southern Idaho from 1993 through 1998 to evaluate irrigated cropland values. Sales from Farm Credit Service contained information on dates, irrigation systems, location, size, and rents. With the help of geographic information system (GIS) technology, data were gathered on the shortest distance to each population center, slopes of tracts, and estimated soil productivity. Results indicated sale size had a negative impact on per acre sale price since, as land sales become larger, fewer bidders exist due to economic constraints. Soil productivity, based on a scale of 1 to 7, with one being the more productive soil type, was found to have a negative relationship on sale prices on a per acre basis.

Shultz et al. (2004) analyzed the impact of sale size, gross revenue, wetlands, and wetland easements on agricultural land in North Dakota. The study analyzed 236 agricultural land sales between 1995 and 2002, collected from county deed records in North Dakota for three contiguous counties in the southeastern part of the state. The results of the study indicated that sale size did not have a significant impact on per acre sale prices. This result was a surprise to researchers as previous land value studies have indicated a decrease in per acre value as sale size increases.

Results of the Shultz et al. study found that permanent wetlands, when surrounded by cropland, had a significant negative impact on per acre sale prices. Temporary wetlands, when surrounded by cropland, were found to have a small but statistically significant positive effect on land values. The Hedonic Valuation Model studies are summarized in Table 1.

Table 1. Past Hedonic Valuation Model studies of the determinants of agricultural land values.

Author and Year	Location	Source of Data Type of Land Value Data	Variables and Effect on Agricultural Land Values
Xu et al. 1993	Washington state	Farm Credit Services Sales	Soil productivity (+) Pasture (+) Gross income (+)
Elad et al. 1994	Georgia	Farm-Rural Land Market Survey, Georgia Statistical Abstract, U.S. Census of Agriculture Sales	Size (-) Percentage cropland (?)
Boisvert et al. 1997	Lower Susquehanna River Basin	USDA Area Studies, Census of Agriculture Enumerative opinion survey	Corn yield (+) Land use in crops (+)
Vasquez et al. 2002	Idaho	Farm Credit Services Sales	Size (-) Soil productivity (+) Net farm income (+)
Shultz et al. 2004	North Dakota	Dickey, Ransom, and Sargent county deed records verified by telephone and mail survey Sales	Permanent wetlands (-) Productivity (gross revenue) (+)

June Agricultural Survey Studies Outside North Dakota

No known studies have specifically evaluated the accuracy of JAS values or other land owner/operator land value surveys such as the North Dakota Agricultural Statistics Service NDLVS. However, an article by Gertel (1995) compared actual land sales data with opinion-based land value surveys of ‘local experts’ in Illinois, Maryland, and Arizona. Roka et al. (1997) evaluated the use of JAS land value data for a hedonic analysis of farmland attributes in the five-state Corn Belt region of Illinois, Indiana, Iowa, Missouri, and Ohio.

Gertel focused on comparing actual market sales with opinion-based land values from alternative sources in Illinois and Maryland. Three opinion-based surveys were compared: an Economic Research Service (ERS) survey of landowner operators conducted by NASS (a pre-JAS survey), a survey of County Executive Directors by the Agricultural Stabilization and Conservation Service (ASCS), and ERS/NASS survey of real estate brokers and lenders. All opinion-based surveys appear to have been conducted at the county-level of analysis.

In Illinois, 19,847 arms-length agricultural sale transactions from 1983 through 1991 were averaged across counties (weighted by sale size) and averaged at the state-level (weighted by the number of sales in the countie). Both county- and state-level values were compared to land value estimates from the three different land value surveys. Although no statistical analyses of the Illinois data were made, it was noted that both actual sales and estimates of sales by brokers and lenders were similar, and in most years, greater than survey values from either ERS/NASS (landowner) or ASCS (County Executive Directors).

In Maryland, 1,521 agricultural arms length sales from 1987 to 1991 in 23 counties were grouped into 17 strata and again compared to land values from the three opinion surveys after editing out statistical outliers associated with development sales or properties with unique amenities. The author noted that differences among land sale values and survey values were highly dependent on the region of analysis, the size of sold tracts, and nearby population densities. Land sale values were on average 27% higher than landowner survey values, 19% higher than County Director estimates, and 10% lower than real estate broker/lender estimates.

The Roka et al. study estimated a hedonic model of agricultural land sales based on JAS data and selected soil attributes with the specific objective of evaluating the appropriateness of JAS data in hedonic modeling. It was thought that this nationwide data set could be used in lieu of more expensive and difficult to collect data on individual sales transactions. The model is estimated over the 1994 to 1996 time period. In addition to using the JAS for land values, a variety of farm and owner/operator characteristics are taken from JAS and used as explanatory variables in the model. Additional explanatory variables are obtained from the USDA Natural Resource Inventory (NRI). Model specifications for the years 1994 and 1995 included a variable 'SOLD', a binary measure of whether JAS respondents had sold property in the previous year. In 1994 and 1995 1.4% of JAS respondents had sold property. In 1996, this question was dropped from the JAS.

Based on the fact that the SOLD variable did not have a statistically significant impact on sale prices in 1994 and 1995, the authors conclude there is "some evidence that the land value opinion given in the JAS match market opinions" with the caveat the imputed JAS values may have an impact on this match. A second indication of the JAS matching market opinions is that the estimated hedonic coefficients (marginal prices of land characteristics) are consistent (stable) across years. The fact that the best estimated model only explained one third of the variation in land values was blamed on a lack of detailed explanatory variables and, in particular, a lack of soil productivity data specific to JAS tracts, rather than the quality of JAS land value data.

Advances in GIS Databases

Advances in Geographic Information Systems (GIS) have allowed researchers to collect data that were previously unattainable due to time constraints or technology limitations. State and federal agencies such as the Natural Resource Conservation Service (NRCS), US Fish and Wildlife Service (USFWS), and National Agricultural Statistics Service (NASS) publish GIS-based data in digitized form for soils, crop coverage, and wetlands. The United States Department of Agriculture (USDA) Farm Service Agency has now begun digitizing common land units (CLUs). Eventually, the layer will include all farm fields, rangeland, and pastureland in the United States ("Common Land Unit" 2003).

The Soil Survey Geographic (SSURGO) Database produced by the Natural Resource Conservation Service is an attribute database containing physical and chemical soil properties. Information such as particle size, bulk density, flooding, and organic matter is available through the SSURGO Database. The database includes use and management data for water management, rangeland potential, crops, and wildlife habitat suitability ("Soil Survey Geographic (SSURGO) Database" 1995).

Figure 6 shows the variation in soybean productivity in central Barnes County at the section-level of analysis. The figure illustrates how soil productivity for soybeans varies between adjoining soil types. In North Dakota and most states, it is very rare to find a single soil type across an area even as small as a ¼ section (160 acres).

The USDA began using satellite imagery in its national sampling frame as a major input in 1978. During early years of the program, satellite imagery was used to improve statistical precision of crop acreage estimates. Satellite imagery is still used to improve statistical precision but has evolved into a Geographic Information System (GIS)-based data file known as the Cropland Data Layer (CDL). The CDL has been produced annually in North Dakota since 1997 by the North Dakota Agricultural Statistics Service (NDASS). The CDL classifies the majority of crops grown in North Dakota along with water and urban areas. The CDL is commonly used in watershed monitoring, soil use analysis, agribusiness planning, and other remote sensing/GIS value added industries (Allen et al. 2002). Figure 7 illustrates the 2003 CDL in North Dakota.

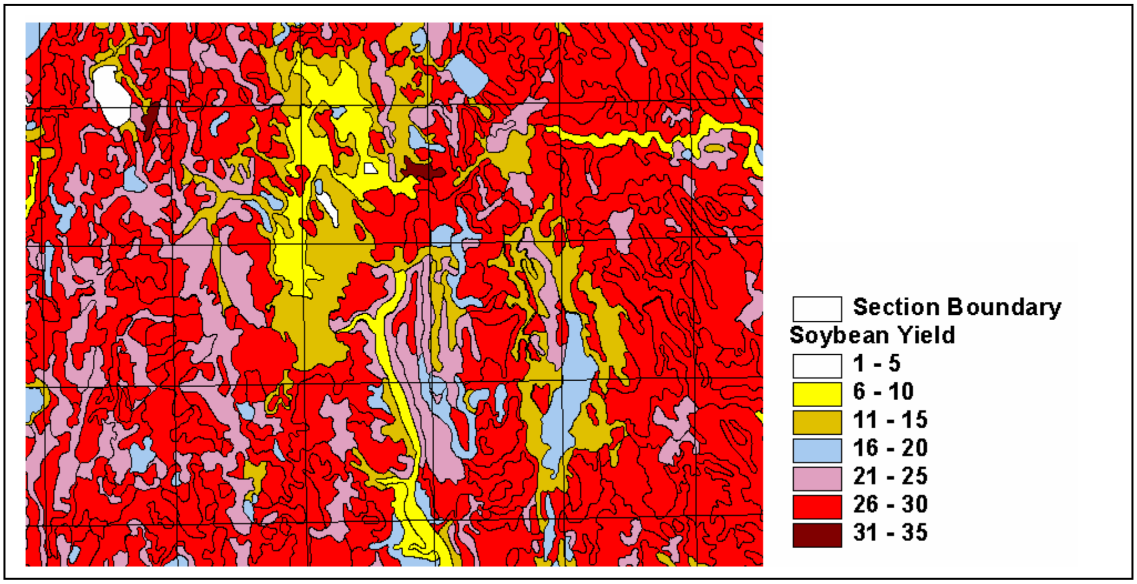
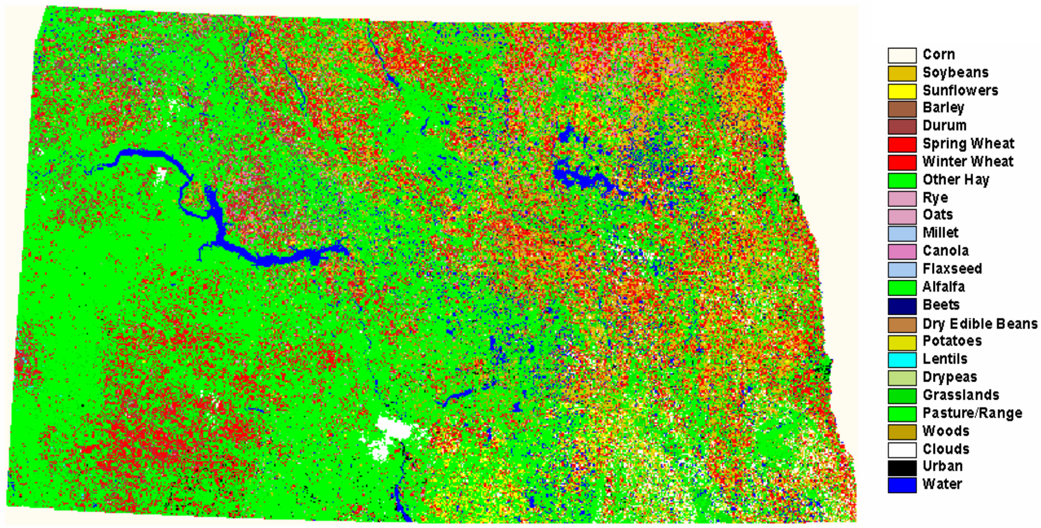


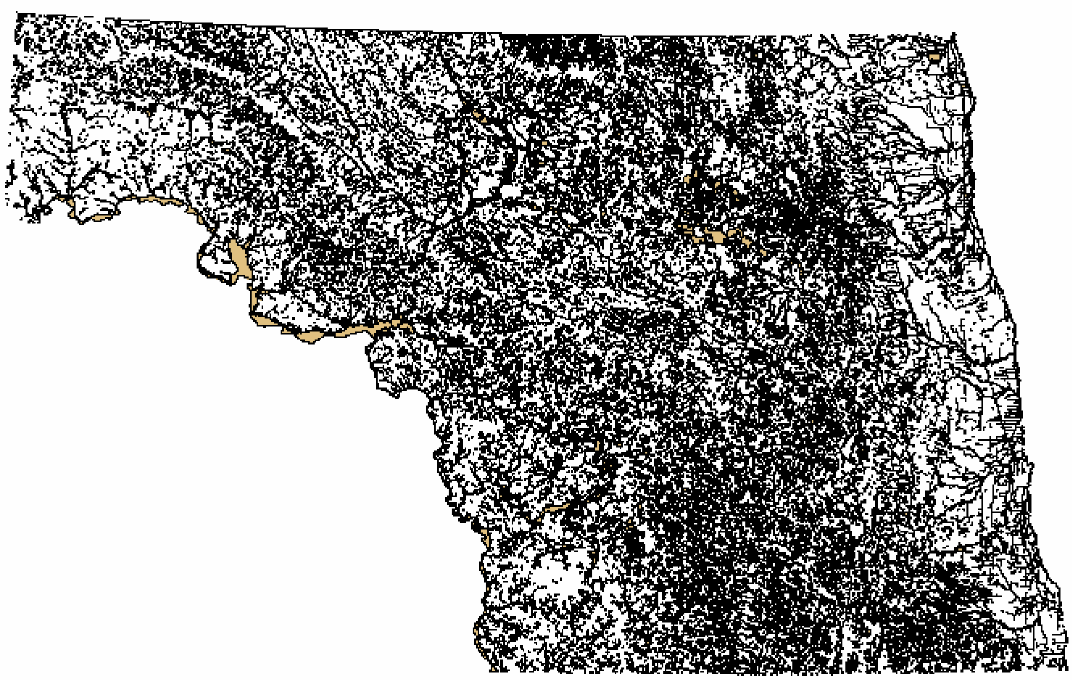
Figure 6. Soybean production in bushels per acre for sections in central Barnes County.

The U.S. Fish and Wildlife Service began the National Wetlands Inventory (NWI) in 1974 in an effort to classify and map the nation's wetlands to evaluate wetland status in the United States. NWI maps were developed from high altitude aerial photographs conducted in July or August during the mid-1980s ("National Wetlands Inventory History and Objectives" 2002). NWI maps contain information regarding the location and classification of wetlands, streams, lakes, and estuaries. The NWI Basin coverage of North Dakota is shown in Figure 8. This coverage was developed by Northern Prairie Wildlife Research Center using the NWI coverage from the USFWS. The NWI was converted to 5 classifications: temporary, seasonal, semi-permanent, lake, and river (Reynolds et al. 1997). A larger scale version of the NWI Basin coverage is shown in Figure 9.



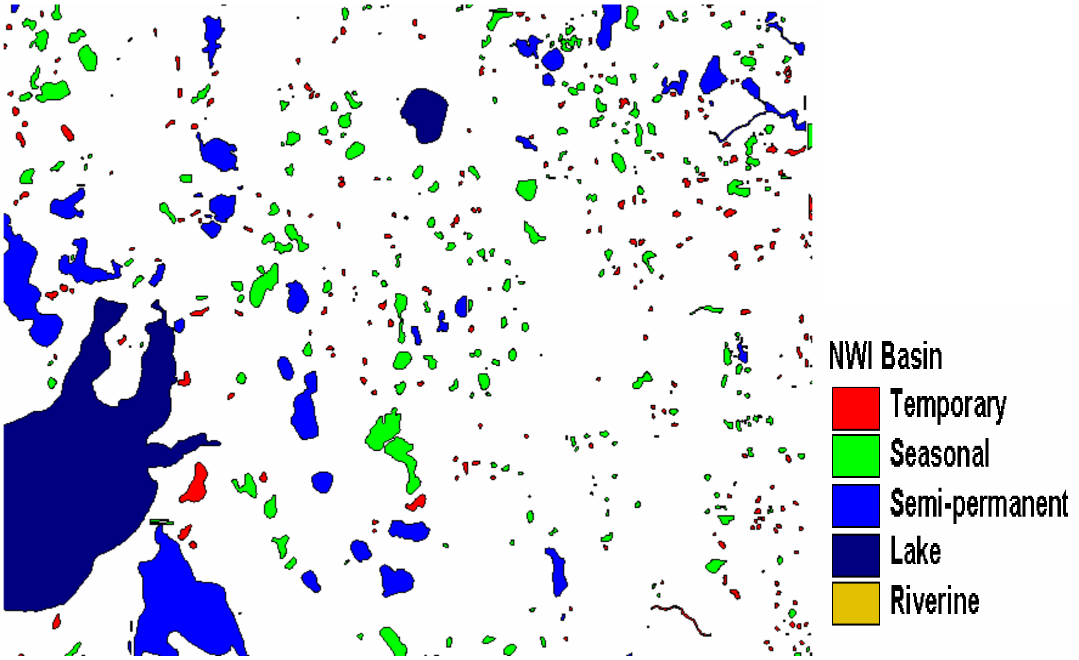
Source: National Agricultural Statistics Service 2003

Figure 7. 2003 North Dakota Cropland Data Layer.



Source: Reynolds et al. 1997

Figure 8. North Dakota National Wetlands Inventory basin coverage.



Source: Reynolds et al. 1997

Figure 9. National Wetlands Inventory basin coverage.

CHAPTER 3. METHODS AND PROCEDURES

The first study objective was to quantify and explain differences between two sources of year 2002 agricultural land value estimates at the county-level across North Dakota. Specifically, opinion survey-based estimates from the NDLVS and the JAS were compared. The second objective was to quantify and explain differences between individual segment-level reported land values from the JAS with nearby agricultural market sales during the 2001 through 2003 time period in 33 North Dakota counties for which SSURGO soil productivity data were available.

Quantifying Differences Between JAS and NDLVS County Land Value Data

Mean year 2002 NDLVS opinion-based survey values, which are already compiled and reported by the North Dakota office of NASS at the county-level of analysis, were compared to average year 2002 JAS land values aggregated at the county-level. JAS crop and pastureland values were aggregated from reported segment-level JAS data provided by NASS. Only counties with at least two JAS market segments were compared in order to maintain the confidentiality of JAS respondents and because of the limited statistical confidence associated with very small sample sizes. The formula to calculate differences is shown in Equation 2:

(2) $$\text{Percentage Difference (JAS vs. NDLVS)} = \frac{JAS - NDLVS}{NDLVS}$$

Using the formula, a JAS land value estimate larger than the NASS estimate for the county would result in a positive percentage difference between estimates. JAS land value estimates smaller than NDLVS estimates for the county would result in a negative percentage difference between estimates. Difference maps were broken down into three groups, for both crop and pasture, based on the percentage difference in each county.

Statistical t-tests were conducted at the 95% confidence-level to evaluate whether the observed differences between alternative land value estimates were statistically different from each other. Specifically, each county was an observation except in situations where the county had insufficient sample sizes. The null hypothesis is that there is no difference between estimates.

The two-sided T-test is given as follows:

$$T = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

The following test was conducted:

Test 1) Ho: μNDLVS = μJAS

Ha: μNDLVS $\neq$ μJAS

County-level cropland comparisons were analyzed within three categories: JAS cropland values more than 5% greater than NDLVS cropland value estimates, JAS cropland values more than 5% less than NDLVS cropland value estimates and JAS cropland values between 5% less and 5% more than NDLVS cropland value estimates.

County-level pastureland comparisons were also made within three categories: Counties with JAS pastureland estimates 5% greater than NDLVS pastureland estimates, JAS pastureland estimate 5% less than NDLVS county pastureland estimates and JAS county level pastureland between 5% less and 5% more than NDLVS pastureland estimates.

Quantifying Factors Influencing Differences in County-Level Land Values

In order to quantify factors influencing differences in NDLVS and JAS county-level land values a regression model was specified based on survey characteristics and biophysical characteristics of the counties. Survey characteristics were compiled from the 2002 JAS. Biophysical characteristics from the county were compiled from 2002 North Dakota Agricultural Statistics, the National Wetlands Inventory (NWI), and the 1969 NDSU climate-adjusted soil productivity rating. Survey characteristics include the number of JAS reports for the county (Xr). Biophysical characteristics include the percentage of the county in cropland (Xc), the percentage of the county in wetland (Xw), and the standard deviation of 1969 NDSU soil productivity rating (Xp).

All county-level regression models use a variation of the same dependent variable: the percentage difference between JAS county-level land value estimates and NDLVS county-level land value estimates. County-level regression models are based on Equation 3.

(3) DIFLVAL = f (Xr, Xc, Xw, Xp),

where DIFLVAL = positive difference, negative difference or absolute difference in land value;

Xr = number of JAS survey reports for the county (-);

Xc = percentage of the county in cropland (-);

Xw = percentage of the county in wetlands (+); and

Xp = the standard deviation of the 1969 NDSU Soil Productivity Rating (+).

It is hypothesized the variable Xr (jassurvrep), representing the number of JAS survey reports in the county, will have a negative impact on the percentage difference between JAS and NDLVS estimates. It is believed an increase in the number of JAS surveys will give a true estimate of mean county-level land values. Market participants generally have an idea of current market values. In some instances, individuals may give opinions on value that are extremely high or extremely low. In some counties, there are as few as three JAS survey respondents. These extreme estimates will have a significant impact on mean county-level land value estimates.

The percentage of the county in cropland was obtained from North Dakota Agricultural Statistics for 2002 compiled by the North Dakota Agricultural Statistics Service. To determine the percentage of the county in cropland (Xc) (perccntycrop), the number of acres planted in wheat, barley, oats, rye, sunflowers, canola, soybeans, flaxseed, corn, dry edible beans, peas and lentils, potatoes, sugar beets, and summer fallow acres were summed and then divided by the total acres in the county. As the percentage of the county in cropland increases, it is suspected to decrease the difference between estimates for all models. It is believed that market participants value agricultural land more consistently in counties that have homogeneous land cover. Market participants as a group should make similar estimates in counties where they do not have to estimate the value of many different land covers within the same area.

The National Wetlands Inventory (NWI) basin coverage was used to calculate the percentage of the county in wetlands (Xw) (perccntywet). For this study, acres of seasonal and semi-permanent wetlands in the county were calculated using GIS technology to overlay the county boundaries and then to clip the NWI coverage. The total acres of seasonal and semi-permanent wetlands were then estimated using the clipped county coverage and divided by the total acres within the county to get a percentage. As wetland acres increase, the percentage difference between estimates should increase. Wetlands are highly variable both in type and size. When survey respondents are asked to estimate land value for either the JAS survey or the NDLVS, the impact of wetlands on estimates is likely to be highly variable among individuals. For example, a JAS segment may contain several small wetlands within a crop parcel. When asked to value the cropland within the segment the respondent will likely take into consideration these wetland acres. However, the next JAS segment may not contain any wetland acres and the value estimate placed on the cropland within this segment will likely reflect this. In areas where there are large numbers of wetlands the likelihood of two or more individuals valuing land the same is unlikely.

The standard deviation of soil productivity (Xp) (stdevsoil) within the county was calculated using the 1969 NDSU climate-adjusted soil productivity rating. The 1969 NDSU soil productivity rating is given at the township-level of analysis and has a rating of 1 to 100. Using the township ratings, a standard deviation for soil productivity within the county was calculated. It is hypothesized that as standard deviation of the 1969 NDSU soil productivity rating increases the difference between opinion estimates should increase. Individuals are more likely to give similar land value estimates in counties where the soil productivity is homogenous. Further descriptions of how these variables were used in the regression model are included in Table 2.

Differences Between JAS Land Values and Nearby Market Sales

Similar comparisons as to those made at the county-level were also made between individual segment-level JAS land values for crop and pastureland with nearby comparable market sale values. However, the time frame of these comparisons were expanded to cover the 2001 to 2003 time period so more comparisons could be made and so comparisons would be based on surveys and sales for the same year. Each JAS survey segment was classified by the survey year, and by its predominant land use (crop, pasture,

Table 2. Summary of explanatory variables used in county-level regression models.

Variable Name	Definition	Unit of Analysis	Expected Effect on Difference Between JAS and NDLVS Estimates		
			Model		
			Positive	Negative	Absolute
jassurvrep (Xr)	Total reports for the county from JAS surveys		-	-	-
perccntycrop (Xc)	Percentage of the county in cropland	Percentage of total acres in the county	-	-	-
perccntywet (Xw)	Percentage of county in permanent and semi-permanent wetlands	Percentage of the total acres of the county in permanent and semi-permanent wetlands	+	+	+
stdevsoil (Xp)	Standard deviation of 1969 climate-adjusted soil productivity rating for the county	Standard deviation	+	+	+

or mixed land). Any nearby market sales occurring in the same year of the sale were obtained from our statewide database of arms length, land only, publicly disclosed land sales and/or sales verified by individual rural appraisers throughout the state.

However, these JAS-market sale comparisons were only made in 33 counties across the state for which detailed SSURGO GIS based soils data existed at the time the study was initiated. These counties are shown in Figure 10 and include Barnes, Burke, Burleigh, Cass, Cavalier, Dickey, Divide, Emmons, Golden Valley, Grand Forks, Grant, Griggs, Kidder, Lamoure, Logan, McIntosh, Morton, Pembina, Ramsey, Ransom, Renville, Rolette, Sargent, Sheridan, Sioux, Stark, Steele, Stutsman, Towner, Traill, Walsh, Wells, and Williams.

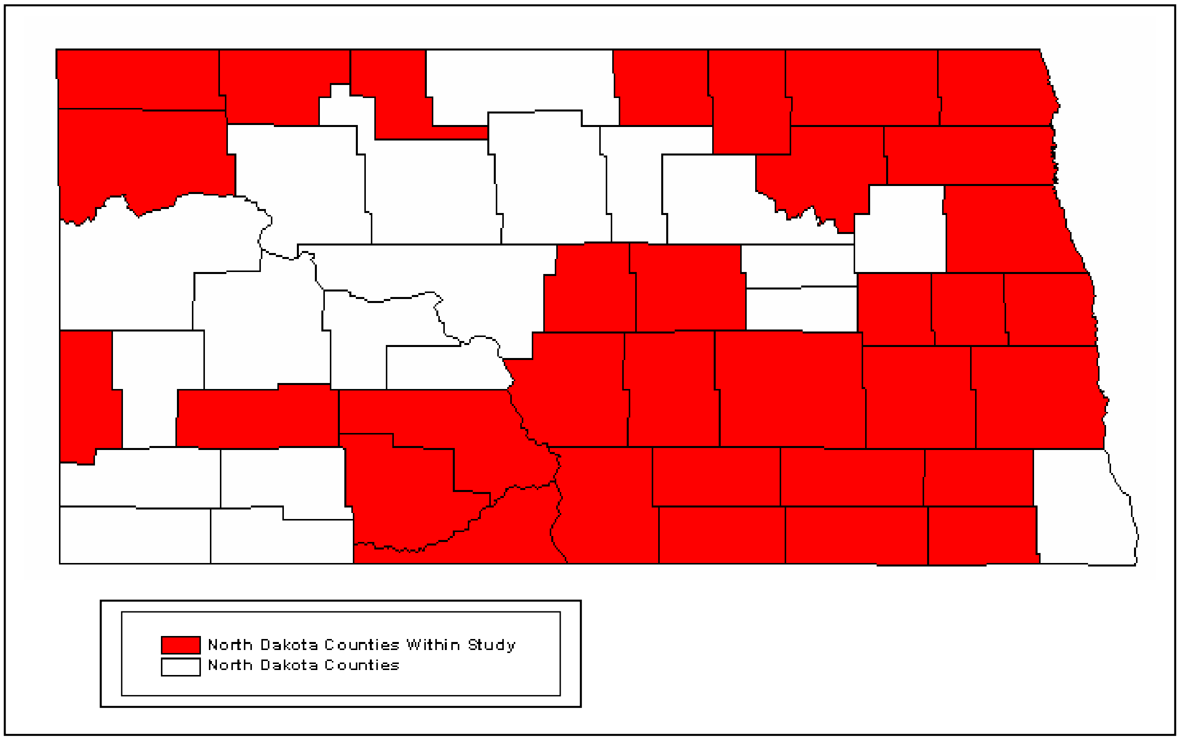


Figure 10. North Dakota counties used in JAS segment-level study.

Market sales were digitized based on legal descriptions and acreage associated with the sale in conjunction with the following GIS databases: common land units (CLUs) of the USDA Farm Service Agency representing farm fields (which are currently available in about half of all North Dakota counties) and public land survey boundaries (township, range, sections, and quarters).

Digitized parcels were spatially overlaid with the NASS cropland data layer for the corresponding year. After the parcels were overlaid, the percentage of each tract associated with crop, pasture, and wetland was calculated. Since CRP acreage is not distinguished from pasture and because it is usually valued as cropland, all pasture acreage was reviewed using USDA-NAIP color air photos in an attempt to identify if it was actual pastureland or cropland. Pasture exhibits distinct color patterns (brown patches) in contrast to a more solid and consistent green color for CRP in these photos. Other evidence from these photos, which indicates that the land is pasture rather than CRP, includes cattle trails, watering stations, and fences.

Quantifying Factors Influencing Differences in JAS Segment and Market Sale Values

In order to quantify differences in segment-level land values two models were developed based on land cover. Land cover models based on cropland and mixed land covers were further broken down based on the difference in per acre land values. To calculate differences between JAS values and nearby land values based on market sales, the average of several surrounding market sales were compared to the JAS estimate and treated as a single observation. Percentage difference between JAS and market values were therefore calculated on per acre basis using Equation 4.

$$\frac{JAS(\$/AC) - Market(\$/AC)}{Market(\$/AC)} \tag{4}$$

JAS values more than 5% greater than market values were used in the positive difference model. JAS values more than 5% less than market values were used in the negative difference model. Absolute differences between land values were used in a third model.

All of the segment-level models share the same dependent variable: the difference between per acre price estimates for JAS segments and per acre values for market sales divided by the per acre price of the market sale (Equation 4). JAS segments containing cropland only use dollar per acre estimates based on the average per acre cropland estimate from JAS survey respondents. For JAS segments containing a mix of cropland and pastureland, per acre land value estimates had to be derived. The JAS (Procedural Appendix) does not ask questions regarding the total per acre value for the entire JAS segment, instead it asks respondents to give a per acre value for the cropland acres and a per acre value for pastureland acres. JAS segments are broken into three categories: cropland, pastureland, and wasteland. In order to derive a per acre value for the entire JAS parcel, waste acres were converted to cropland acres or pastureland acres depending on the percentage of the parcel in each type. The total acres of cropland and pastureland, after converting the waste acres, were multiplied by the corresponding value estimates for cropland and pastureland. Mixed JAS segment per acre values were derived using Equation 7.

(5) [(((((Crop land acres / (crop + pasture acres in parcel)) * waste acres) + crop land acres) * cropland value estimate for the parcel) + (((((pastureland acres / (crop + pasture acres in parcel)) * waste acres) + pastureland acres) * pastureland values estimate for the parcel)] / total acres in JAS parcel

Segment level regression models for crop and mixed land use segments are based on Equation 6.

(6) DIFLVAL = *f* (Xs, Xd, Xw, Xy, Xg,),

where DIFLVAL = positive difference, negative difference or absolute difference in land value;

Xs = sale size (-);

Xd = distance of sales from JAS segments (+);

Xw = difference in % wetlands between JAS and market sales (+);

Xy = difference in SSURGO spring wheat yield per acre (+); and

Xg = difference in JAS and market sale gross revenue per acre (+).

It is hypothesized that sale size (size) will have a negative effect on the absolute difference between JAS and market sale values per acre for both cropland and pastureland.

As sale size increases the differences in per acre value should decrease. Past studies have shown (Gertel 1995) that market sales are consistently smaller than the whole ownership units opinion survey respondents are asked to value, resulting in opinion estimates of land value that are lower than market value.

Distance (dist) (Procedural Appendix) from JAS segment to market sale is expected to have a positive impact on absolute differences. This hypothesis is based on the idea that sales closer to the segment will have a greater influence on the land value estimate given by the owner or operator. Farmers and ranchers generally pay very close attention to land sales in the area they operate. Recent sales in close proximity to the JAS segment in which the farmers and ranchers operate will likely have a strong influence on their land value estimates. This would hold especially true if the sale had similar characteristics to the JAS segment.

Digitized locations (Procedural Appendix) of JAS segments and market sales were overlaid with the Soil Survey Geographic (SSURGO) database produced by the Natural Resource Conservation Service (NRCS). The (SSURGO) database contains information on crop and range yields for each soil classification. Using the SSURGO database the average spring wheat yield (bushels) and range yield (lbs) per acre for each JAS segment and each market sale were calculated.

The digitized market sales were also overlaid upon the NASS Cropland Data layer to determine the percentage cropland, percentage pastureland, and percentage wetlands for each sale. As the difference in percentage cropland (dfpercrop) between JAS segments and market sales increases, the difference in cropland value between JAS and market sales should also increase. It is expected that landowners will base opinion estimates on sales similar to the land that they are asked to value. As the difference in percentage cropland (dfpercrop) between JAS segments and market sales increases, the difference in pastureland value between JAS and market sales should also increase.

The difference in percentage land in wetlands (dfperwet) between JAS and market sales should have a positive influence on the difference between JAS estimates of cropland value and market sale cropland value. The difference between SSURGO spring wheat yield per acre (dfspwhtyld) for JAS and market sales and the difference between land value estimates for JAS and market value for both cropland and pastureland should have a positive relationship. As the difference in spring wheat yield increases, the difference in land value estimates should also increase. It is expected that landowners and operators take yield into consideration when making land value estimates.

A second version of the segment-level model substitutes the spring wheat yield variable for gross revenue (dfgrrev). Gross revenue per acre was calculated based on yields derived from the SSURGO soils database. SSURGO spring wheat yields (calculated as bushels per acre) were multiplied by the number of acres in crop land and CRP for the sale parcel or JAS segment and then multiplied by the average price per bushel for the year of sale or JAS segment. Range production was converted to animal unit months (AUMs). SSURGO range yields (calculated as lbs per acre) were multiplied by the acres of pasture in the parcel, multiplied by 0.35 to obtain available pounds of forage, and then divided by 793 to obtain AUMs. Total AUMs were then multiplied by calf production per month, multiplied by calf price plus weight of cull cows per month, and multiplied by cull cow price (Aakre et al. 2003). Spring wheat prices ($3.09) were calculated as the average sale price from July of 2000 through June of 2003 as reported by the NDASS. Cow and calve prices ($40.53 and $96.70 respectively) were calculated as the average sale price from 2001 through 2003 as reported by NDASS. Gross revenue is shown in Equation 7.

(7) ((spring wheat yield x (cropland acres + CRP acres) x spring wheat price) + (((range yield x pasture acres x 0.35)/793) x ((cow price x 0.25) + (calf price x 0.5275)))) / (total acres in JAS segment or market sale)

It is hypothesized that owners and operators take into account the productive value of the entire parcel when making land value estimates. Therefore, as the difference in gross revenue per acre (dfgrrev) between JAS and market sales increases the difference between the JAS values and market value for cropland and pastureland should also increase. Table 3 summarizes the independent variables used in the segment-level models.

Table 3. Summary of independent variables used in the segment-level models.

Variable Name	Definition	Unit of Analysis	Expected Influence on Difference in Land Values		
			Model		
			Positive	Negative	Absolute
size (Xs)	Size of market sale	Acres	-	-	?
dist (Xd)	Distance from JAS segment to market sale	Miles	+	+	?
dfperwet (Xw)	Difference in the percentage of the parcel in seasonal and semi-permanent wetlands between JAS and market sale	Percentage	+	+	?
dfspwhtyld (Xy)	Difference in the spring wheat yield between JAS and market sale	Bushels/acre	+	+	?
dfgrrev (Xg)	Difference in gross revenue per acre	$/acre	+	+	?

CHAPTER 4. RESULTS: OBSERVED DIFFERENCES BETWEEN ALTERNATIVE SOURCES OF LAND VALUES

In this chapter, collected land value data from the JAS, NDLVS, and comparable market sales are summarized. An evaluation of how alternative sources of land value data differ from each other at the state, regional, county, and segment-levels of analysis follow the summary of collected data.

A Summary of Collected Land Value Data

JAS Data

JAS data are summarized in two ways: at the county-level when compared to NDLVS data and at the segment-level when compared to market sales.

JAS County-Level Data

The 2002 JAS sites are spread randomly throughout North Dakota (Table 4) with 37% of the JAS sites containing both crop and pasture activities while 63% contained cropland activities only. JAS segments with cropland activity only are primarily located on the eastern half of North Dakota. A small number of counties in the northwest corner of the state also contain JAS segments with cropland activity only.

2002 JAS county-level cropland values ranged from $191 to $973 and averaged $402 per acre (rental values ranged from $17 to $57 and averaged $31), while pastureland values ranged from $100 to $303 and average $174 per acre (rental values ranged from $4 to $15 and averaged $10 per acre). JAS county-level cropland and pastureland values (for counties having at least two survey respondents and two JAS sites) generally increase from west to east across North Dakota which is expected as soil productivity in the state follow this same geographic patterns (Figures 11 and 12).

Table 4. Summary of 2002 JAS segments, and JAS and NDLVS reports by county.

County	JAS Segments	JAS Crop Reports	JAS Pasture Reports	NDLVS Crop Reports	NDLVS Pasture Reports
Adams	9	18	4	42	33
Barnes	11	30	NA	37	23
Benson	14	19	6	35	32
Billings	2	2	2	34	28
Bottineau	11	14	4	40	24
Bowman	6	6	2	32	21
Burke	4	5	NA	40	22
Burleigh	7	3	NA	33	32
Cass	9	16	NA	30	NA
Cavalier	13	34	NA	57	7
Dickey	11	31	9	31	30
Divide	9	15	5	37	25
Dunn	7	15	16	30	29
Eddy	2	5	5	24	24
Emmons	9	18	12	33	30
Foster	4	10	4	30	24
Golden Valley	7	3	3	27	22
Grand Forks	10	22	NA	44	12
Grant	7	11	8	30	31
Griggs	3	6	NA	29	25
Hettinger	3	2	NA	34	30
Kidder	5	5	3	34	33
Lamoure	7	21	3	28	21
Logan	7	21	13	29	31
McHenry	7	15	3	36	35
McIntosh	3	9	2	30	31
McKenzie	6	22	15	29	18
McLean	13	25	7	28	25
Mercer	6	18	10	30	34
Morton	11	12	10	37	34
Mountrail	9	17	3	27	19
Nelson	13	39	6	43	31
Oliver	3	4	6	31	30
Pembina	9	27	NA	42	9
Pierce	8	17	10	27	27
Ramsey	8	10	NA	33	12
Ransom	6	19	8	30	19
Renville	11	22	4	38	18
Richland	9	33	NA	31	10
Rolette	6	20	7	30	27

Table 4. (continued)

County	JAS Segments	JAS Crop Reports	JAS Pasture Reports	NDLVS Crop Reports	NDLVS Pasture Reports
Sargent	2	8	2	35	20
Sheridan	6	19	9	29	21
Sioux	3	8	4	38	24
Slope	5	2	NA	42	26
Stark	9	25	18	30	30
Steele	7	9	NA	32	17
Stutsman	15	14	8	33	33
Towner	8	9	3	40	16
Traill	10	30	NA	30	NA
Walsh	12	40	4	44	18
Ward	17	41	16	40	33
Wells	8	26	5	37	23
Williams	13	42	16	32	20

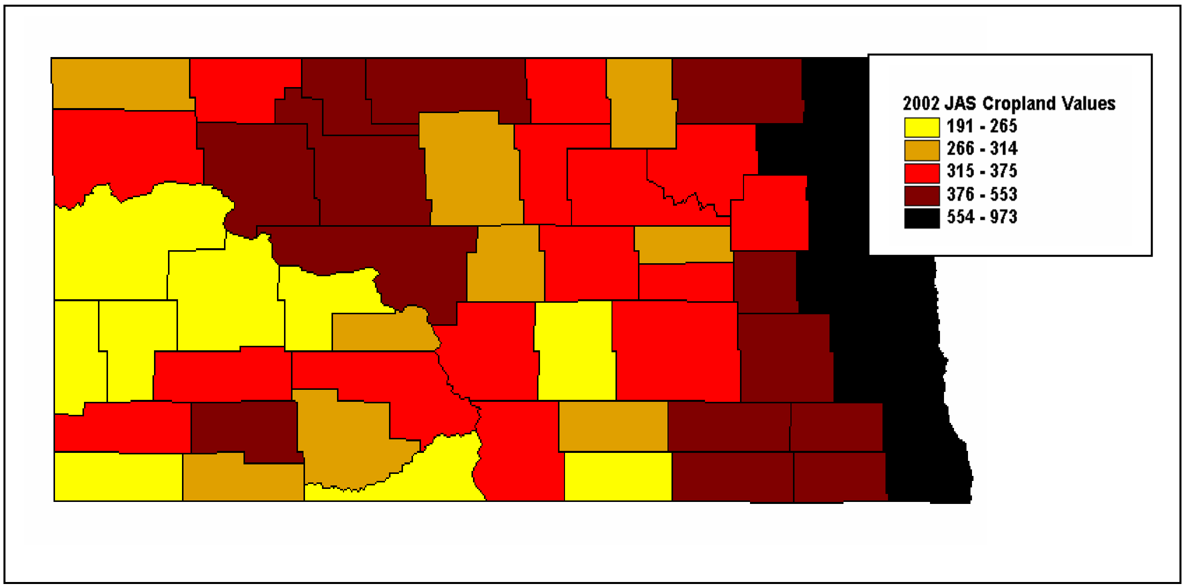


Figure 11. 2002 JAS county-level cropland values.

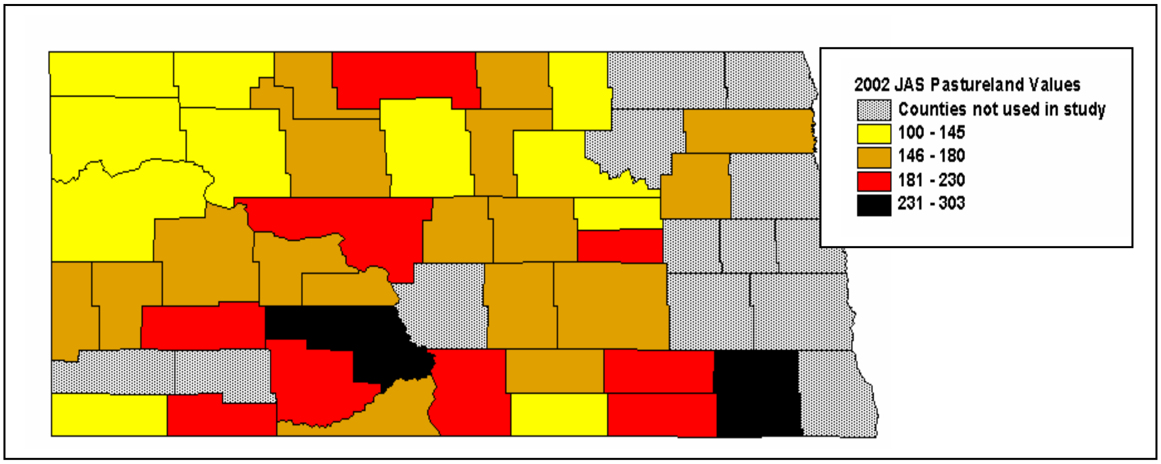


Figure 12. 2002 JAS county-level pastureland values.

JAS Segment-Level Data

A total of 533 JAS survey sites were assembled containing data on land values and rental values throughout North Dakota covering the 2001 to 2003 time period. The number of JAS sites within the study counties varied from year to year with a high of 198 sites in 2002 and a low of 150 sites in 2003 (Table 5). On average, each county used in the study contained 9.6 individual (the same JAS sites may be surveyed in consecutive years) JAS sites for the 3-year study period with a low of 2 sites in Sargent County and a high of 17 sites in Stutsman County (Figure 13).

Table 5. JAS data assembled for the study by year.

Year	Total Sites (Study Counties)	Average Sites (Per County)	Range of Sites (Across Counties)	Sites With Crop Activity Only	Sites With Both Crop and Pasture Activity
2001	185	5.6	2 - 13	115	70
2002	198	6	2 - 13	122	76
2003	150	4.5	2 - 12	98	52
All	533	16.15	5 - 38	335	198
Unique Sites	318	9.63	3 - 17	-	-

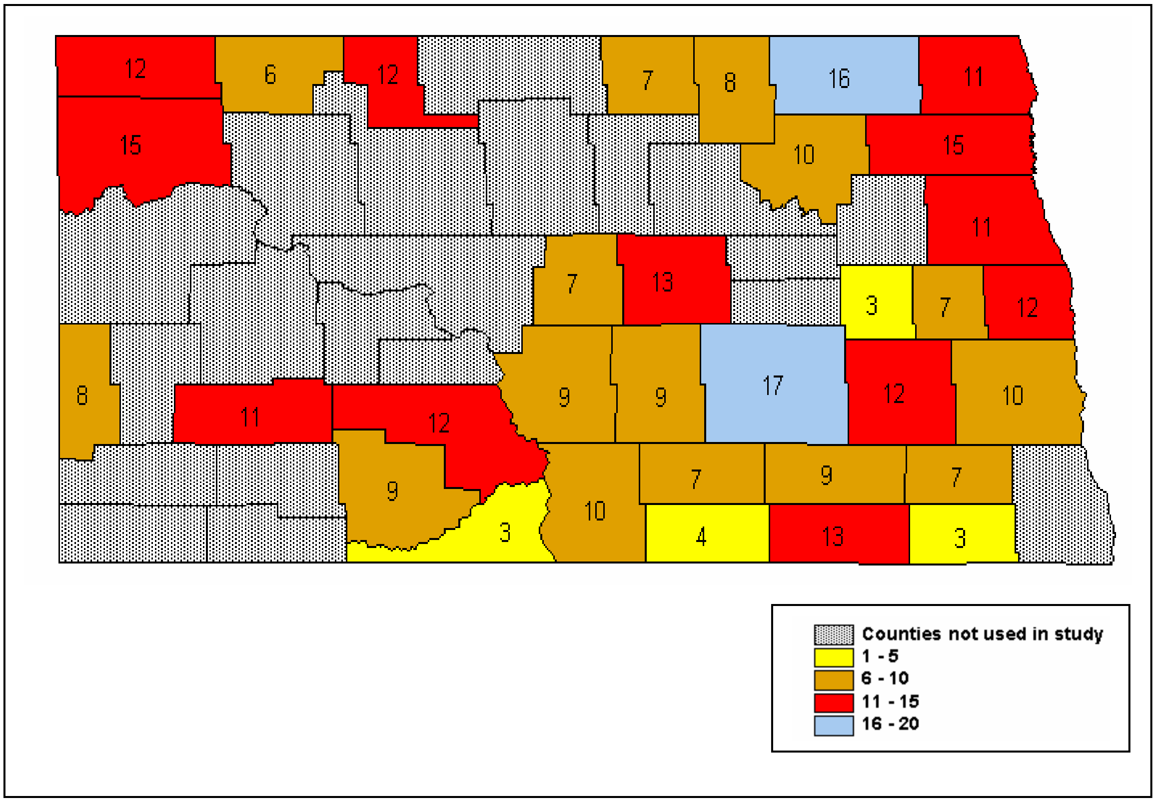


Figure 13. Numbers of individual JAS sites across ND counties during the 2001-2003 study period.

From 2001-2003, JAS average cropland values increased from $455 to $489 per acre (3.7% per year). During the same time period, average pastureland values decreased from $218 to $214 per acre (.9% per year) (Table 6). From 2001-2003, JAS cropland rent values decreased from $35.30 to $34.87 per acre, and pasture values decreased from $10.08 to $9.96 per acre (Table 7).

Table 6. JAS land value data from assembled sites ($/acre).

Year	Mean Crop Values	Std. Dev. Crop Values	Mean Pasture Values	Std. Dev. Pasture Values
2001	455	280	218	282
2002	466	225	205	108
2003	489	260	214	136
All Years	469	255	212	191

Table 7. JAS rent value data from assembled sites ($/acre).

Year	Mean Crop Rent Values	Std. Dev. Crop Rent Values	Mean Pasture Rent Values	Std. Dev. Pasture Rent Values
2001	35.30	14.86	10.08	3.55
2002	35.09	15.86	10	4.42
2003	34.87	14.93	9.96	4.12
All Years	35.09	15.24	10.02	4.04

NDLVS Values

NDLVS crop and pastureland values were assembled for every county (and year) in which corresponding JAS data were available. On average, each county contained 35 NDLVS cropland survey reports, with a low of 21 and a high of 57. Cropland reports were more frequent than pasture reports (35 versus 27) (Table 8). NDLVS reports were therefore more frequent than JAS survey sites in every county. NDLVS crop values increased, on average, 3.7% from 2001-2003 while pastureland values increased, on average, 4.2% from 2001-2003.

Table 8. Number of NDLVS cropland value surveys across counties.

Year	Average Crop Reports per County	Average Value of Rented Crop Land	Average Crop Rental Rate	Average Pasture Reports per County	Average Value of Rented Pasture Land	Average Pasture Rental Rate
2001	36	397	31	27	175	11
2002	34	410	32	26	180	11
2003	35	427	32	28	190	11
All Years	35	411	32	27	182	11

2002 NDLVS county cropland values ranged from $217 to $1034 per acre (rental values ranged from $20 to $64 per acre), while county pastureland values ranged from $126 to $276 per acre (rental values ranged from $7 to $18 per acre). As was the case with JAS based values, NDLVS county-level cropland and pastureland values generally increase from west to east (Figures 14 and 15).

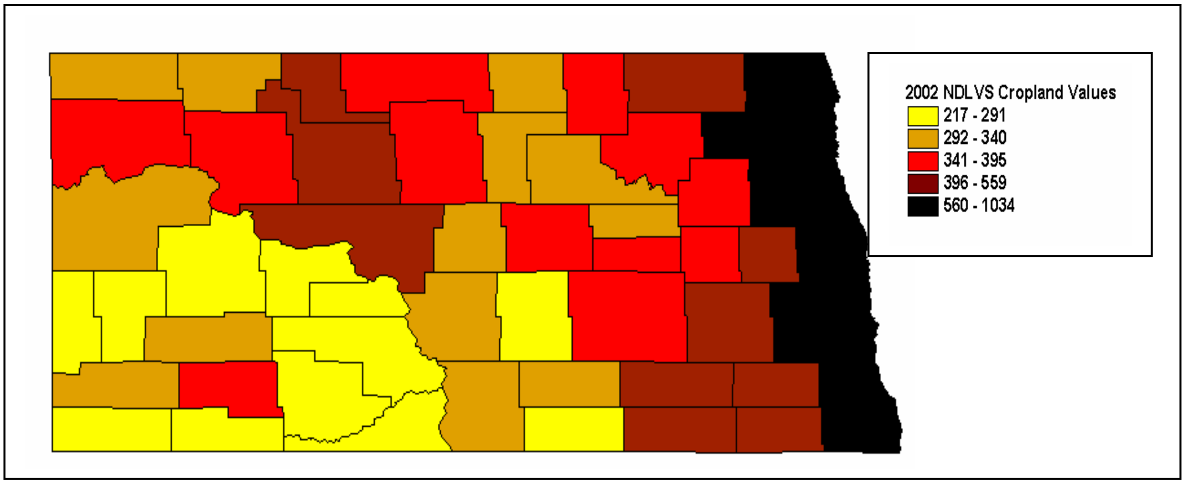


Figure 14. 2002 NDLVS-based county cropland values.

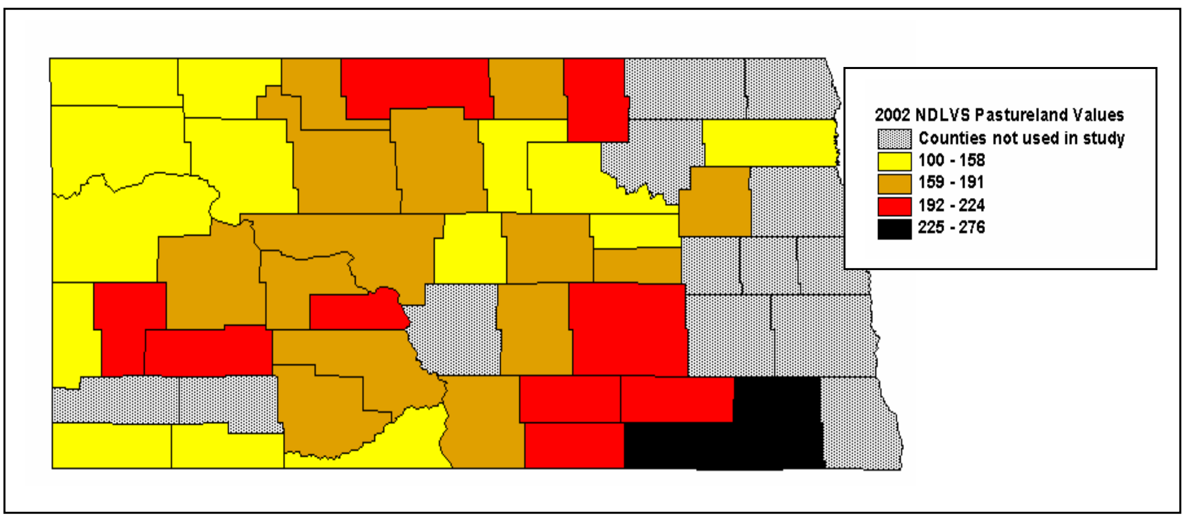


Figure 15. 2002 NDLVS-based county pastureland values.

Comparable Sales

A minimum of two and a maximum of three comparable (market) sales were collected for each JAS survey data site. A total of 566 market sales were collected throughout the 33 county study areas from 2001- 2003 (Figure 16). Comparable cropland sales ranged from $81 to $2013 per acre, while pastureland sales values ranged from $33 to $660 per acre. (Table 9) Market sale average cropland values increased from $465 per acre to $656 per acre from 2001 to 2003. Comparable market sale (sales collected in the 33 county study area) average cropland values grew 18.8% per year while pastureland values grew 8.1% per year from 2001 to 2003.

Differences Between Alternative Sources of Land Value Data

The maps portraying county-level JAS and NDLVS land values presented in the previous section provided a preliminary indication that the JAS and NDLVS county-level land values were similar at least in the sense that both sets of land value data showed increasing land values from west to east across North Dakota. In the remainder of this chapter, the results of more detailed and direct comparisons of potential differences between JAS and NDLVS land values are presented. Results include: reporting actual and percentage based differences between the two data sources at the county-level of analysis for the year 2002; mapping differences to identify spatial patterns potentially influencing differences; the use of paired t-test to evaluate the statistical significance of observed differences; a preliminary attempt to identify what factors may be influencing potential differences by contrasting the characteristics of counties (land use and productivity measures) among cases of small (or no) land value differences with high (both positive and negative) differences. In all cases, comparisons are made separately for crop and

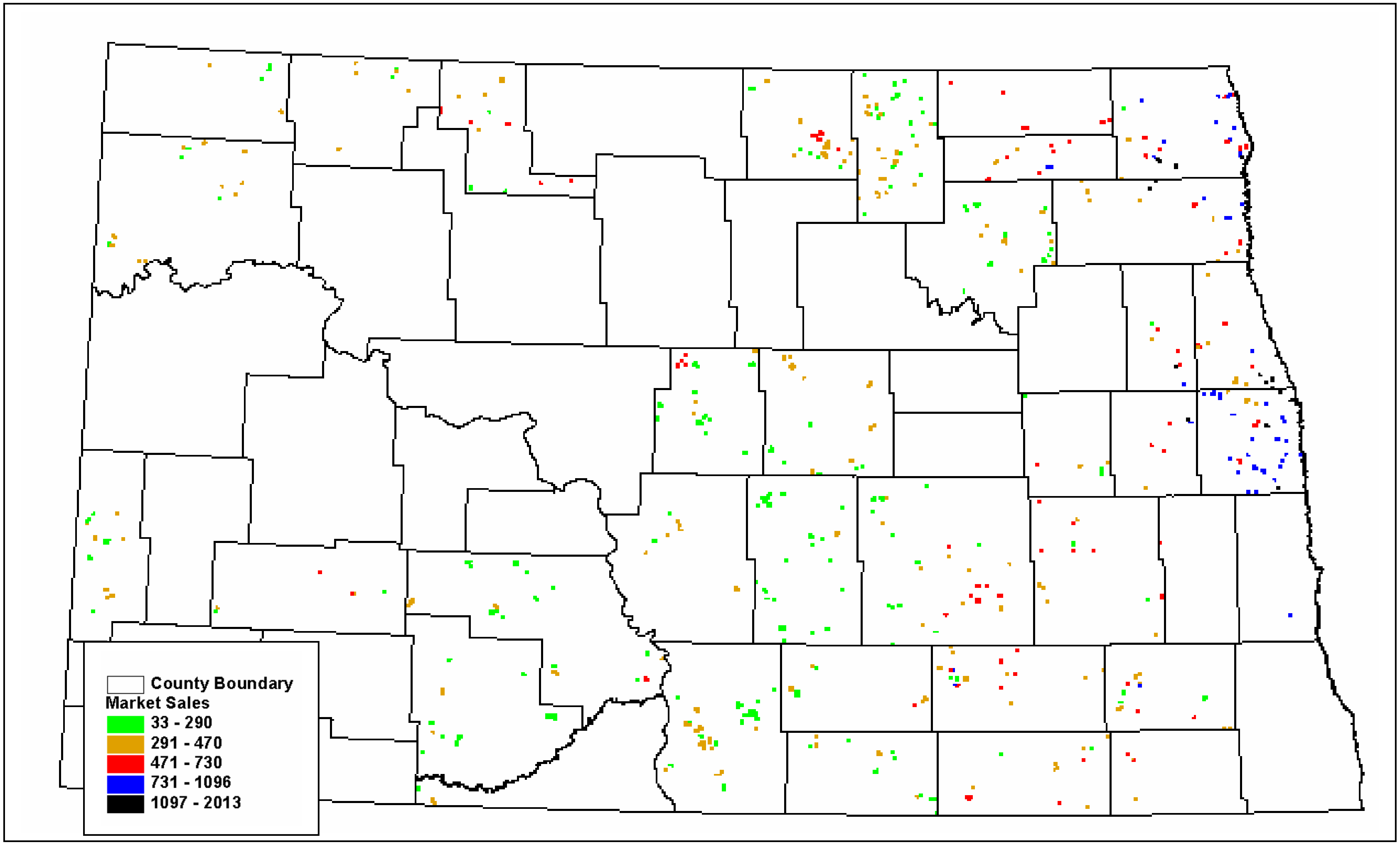


Figure 16. Market sales used in study.

Table 9. Comparable market sale values.

Year	Mean Crop Values	Std. Dev. Crop Values	Mean Pasture Values	Std. Dev. Pasture Values	Mean Mix Values	Std. Dev. Mix Values
2001	465	274	255	106	323	193
2002	506	259	237	95	337	151
2003	656	370	298	145	428	300
All	549	319	262	117	363	228

pastureland and for both total values and rental values.

In the final section of the chapter, similar evaluations are made to evaluate how JAS land value estimates for particular segments during the 2001 to 2003 time period differ from nearby comparable market sales. The analysis does not include rental values because it was not possible to determine them from sales data.

Differences between year 2002 county-level JAS and NDLVS cropland and pastureland value estimates on a percentage basis are summarized in Table 10. Overall (across all 53 counties for cropland and 39 counties with pastureland estimates), only minor differences were noted between JAS and NDLVS data. JAS-based cropland values were, on average, 1.9% lower than NDLVS cropland values. JAS pastureland values were, on average, 3.8% lower than NDLVS pastureland values. Neither of the differences were found to be significant using a 2-sided t-test at the 95% confidence-level. The t-statistics were 1.25 for cropland difference and 1.30 for pastureland differences. Similarly, the overall standard deviations of JAS and NDLVS values are of similar magnitude ($170 and $176, respectively, for crop and $40 and $32, respectively, for pasture).

However, there are many cases of particular counties where larger differences between average land values were noted. In some counties, cropland differences were as

Table 10. JAS and NDLVS county-level land value comparisons.

	JAS Crop	NDLVS Crop	JAS Pasture	NDLVS Pasture
Observations (surveys)	914	1804	275	1046
Mean Observation per County	17	34	7	27
Mean Value ($/acre)	$402	$410	$174	$181
Standard Deviation	$170	$176	$40	$32
Difference	-$8 (-1.9%)*		-$7 (-3.8%)*	
Std. Dev. of Differences	46.5		32.4	
Range of Differences	-20% to 31%		-37% to 64%	
Percentage of Counties with Differences > +5%	23%**		28%***	
Percentage of Counties with Differences > -5%	28%**		54%***	
Percentage of Counties with Differences > +10%	11%**		15%***	
Percentage of Counties with Differences > -10%	19%**		30%***	

* These differences (across all 53 counties for cropland and 39 counties for pastureland) were not found to be statistically different using a 2-sided t-test at the 95% confidence level.
** Percentages based on all 53 North Dakota counties.
*** Percentage based on 39 North Dakota counties with pastureland values for both JAS and NDLVS surveys.

high as –20% and 31% while pastureland differences were as high as –37% and 64%. Similarly, 12 counties (23%) had JAS crop values that were more than 5% higher than NDLVS crop values while 21 counties (28%) had JAS cropland values that were more than 5% lower than NDLVS crop values.

With pastureland values, differences were even more extreme: 11 of the 39 study counties (28%) had JAS pastureland values that were more than 5% higher than NDLVS pastureland values while 21 of the 39 study counties (54%) had JAS pastureland values that were more than 5% lower than NDLVS pastureland values.

As can be seen from Figure 17, differences between JAS and NDLVS cropland values occur throughout the state and do not appear to follow any particularly recognizable pattern. An exception to this would be the west-central part of the state which contains many counties with JAS-based cropland values lower than NDLVS values. Also, from the maps, it can be seen that the predominately observed differences involve JAS cropland values being lower than NDLVS values.

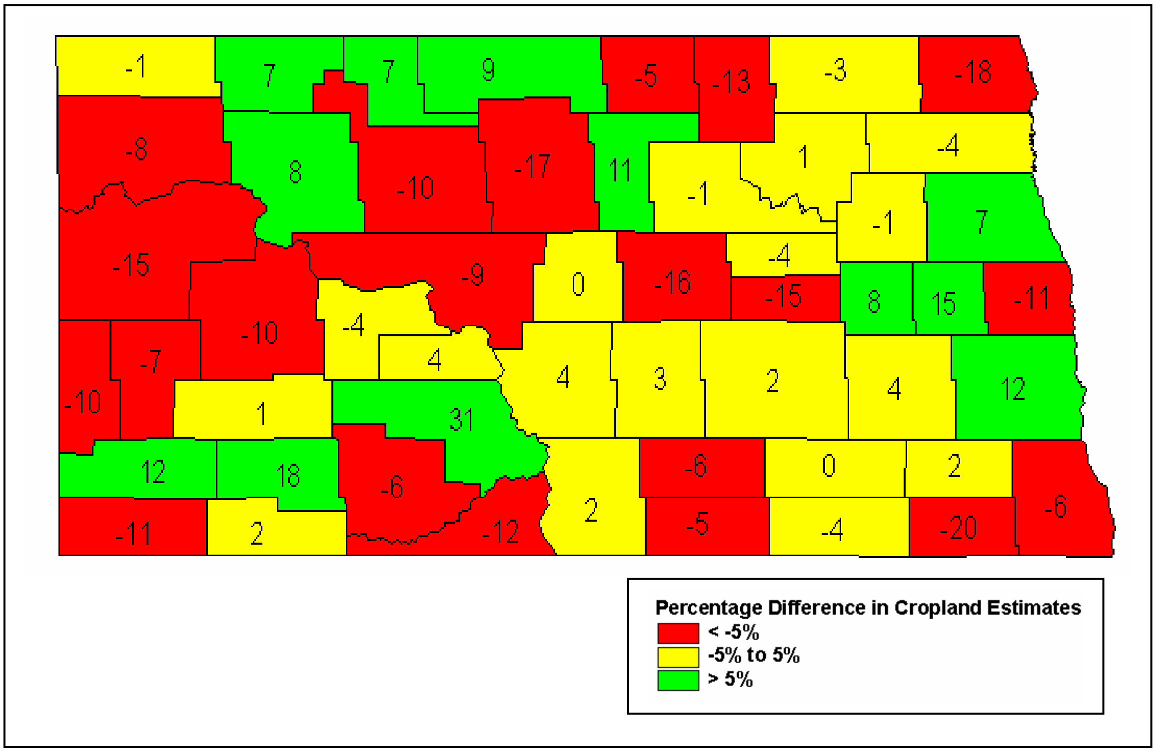


Figure 17. Differences in JAS and NDLVS cropland values at the county level.

Pastureland differences between JAS and NDLVS are shown in Figure 18. Differences were not calculated for 14 counties (mostly in the extreme eastern half of the state) because of missing data. Similar to cropland, differences were spread randomly throughout the state. However, differences in the west central part of the state, like cropland differences, have JAS pastureland values lower than NDLVS pastureland values.

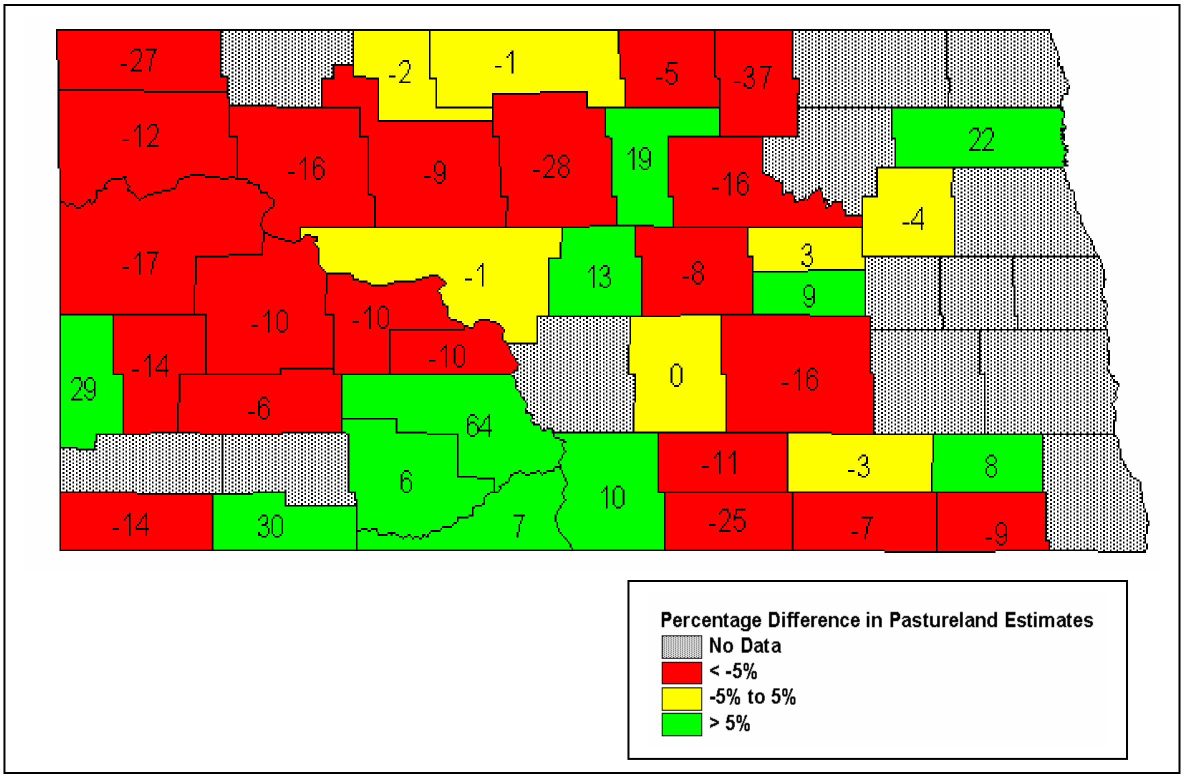


Figure 18. Differences in JAS and NDLVS pastureland values at the county level.

From the map, it can also be observed that JAS values are predominately less than NDLVS pastureland values throughout the state. Percentage differences between year 2002 county-level JAS and NDLVS cropland and pastureland rent estimates on a percentage basis are summarized in Table 11. Overall (50 counties for cropland and 38 counties for pastureland) differences between JAS and NDLVS cropland and pastureland rent estimates were greater than differences in JAS and NDLVS cropland and pastureland value estimates. JAS cropland rent estimates were 4.7% less than NDLVS cropland rent estimates and JAS pastureland rent estimates were 9.4% less than NDLVS pastureland rent estimates. Using a paired t-test at the 95% confidence-level, both JAS cropland and pastureland rent estimates were significantly less than NDLVS crop and pasture rent estimates (the t-statistics were –

2.26 for crop and –3.97 for pasture differences). The differences in rent value for cropland and pastureland by county are shown in Figures 19 and 20.

Table 11. JAS and NDLVS county-level rent comparisons.

	JAS Crop Rent	NDLVS Crop Rent	JAS Pasture Rent	NDLVS Pasture Rent
Observations (surveys)	631	1731	239	986
Mean Observations per County	12	34	6	26
Mean Value ($/acre)	31	32	10	11
Standard Deviation	11.85	10.34	2.78	2.37
Difference	-1.14 (-4.7%)*		-1.01 (-9.4%)*	
Std. Dev. of Differences	3.56		1.57	
Range of Differences	-31% to 29%		-45% to 22%	
Percentage of Counties with Differences > +5%	12%**		18%***	
Percentage of Counties with Differences > -5%	54%**		63%***	
Percentage of Counties with Differences > +10%	6%**		11%	
Percentage of Counties with Differences > -10%	24%**		45%	

* These differences (across 50 counties' cropland and 38 counties' pastureland) were found to be statistically different using a 2-sided t-test at the 95% confidence level.
** Percentages based on all 50 North Dakota counties.
*** Percentage based on 38 North Dakota counties with pastureland rent values for both the JAS and NASS surveys.

Cropland rent differences in individual counties ranged from –31% to 29% while pastureland rent differences were as high as –45% to 22%. Similarly, 6 counties (12%) had JAS cropland rent differences 5% greater than NDLVS cropland rent while 27 counties (54%) had JAS cropland rent differences –5% greater than NDLVS cropland rent. Analysis of pastureland rent differences shows 7 counties (18%) had JAS rent values 5% greater than NDLVS rent values while 24 counties (63%) had JAS pastureland rent values –5% less than NDLVS pastureland rent.

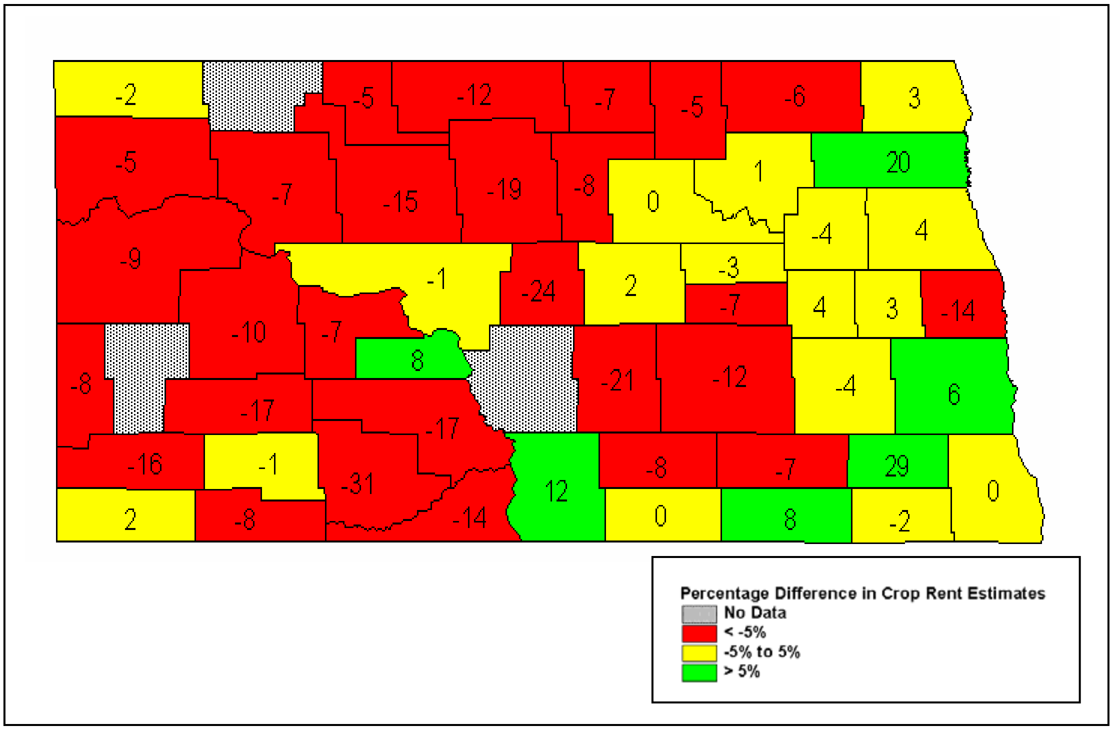


Figure 19. Differences in JAS and NDLVS cropland rent values at the county level.

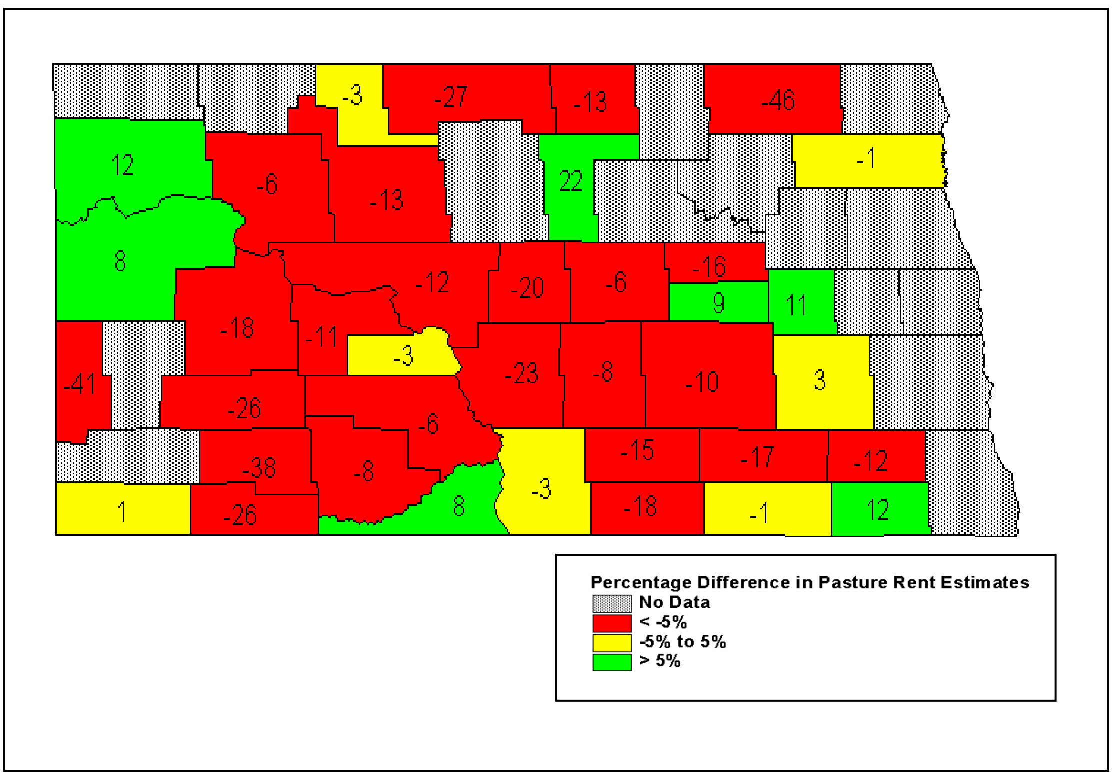


Figure 20. Differences in JAS and NDLVS pastureland rent values at the county level.

Tables 12 and 13 summarize county-level characteristics for both cropland and pastureland by the percentage difference in estimates from the JAS and the NDLVS. From these tables few apparent characteristic patterns appear across both cropland and pastureland estimates. The one exception is the NDSU climate-adjusted standard deviation. In both cropland and pastureland, counties with JAS estimates at least 5% lower than NDLVS estimates appear to have higher deviations in soil productivity at the county level.

Table 12. County-level statistics by levels of differences among JAS and NDLVS cropland values.

	No (or low) Differences (n=20)	JAS > NDLVS (>5%) (n=12)	JAS < NDLVS (>-5%) (n=21)
Mean JAS Crop Value* ($/AC)	375	485	380
Mean NDLVS Crop Value* ($/AC)	376	435	428
Mean JAS Crop Rent* Value* ($/AC)	28	35	30
Mean NDLVS Crop Rent* Value ($/AC)	24	23	24
Mean JAS Surveys per County	20	14	17
Mean NDLVS Surveys per County	35	34	21
Mean Cropland Acres in County (% of County)	59.76	66.40	55.89
Mean Permanent Wetlands** in County (% of County)	3.64	3.36	3.64
Spring Wheat Yield*** (Bushels/AC)	26	26	25
NDSU Climate-Adjusted Standard Deviation	7.79	7.29	8.41

*Average of county-level JAS and NDLVS values.
**Semi-permanent and permanent wetlands.
***Based on STATSGO soil database.

This may be an indication that survey respondents value land lower at the segment-level when there is a high variation in land productivity, but when asked to generalize land values in their area, they tend to identify their area with higher land values. Further testing across a longer time frame is necessary.

Table 13. County-level statistics by levels of differences among JAS and NDLVS pastureland values.

	No (or low) Differences (n=7)	JAS > NDLVS (>5%) (n=11)	JAS < NDLVS (>-5%) (n=21)
Mean JAS Pasture Value* ($/AC)	182	200	158
Mean NDLVS Pasture Value* ($/AC)	186	168	186
Mean JAS Pasture Rent* Value* ($/AC)	10	11	8
Mean NDLVS Pasture Rent* Value ($/AC)	11	10	10
Mean JAS Surveys per County	5	7	8
Mean NDLVS Surveys per County	25	26	25
Mean Cropland Acres in County (% of County)	65.50	51.69	53.49
Mean Permanent Wetlands** in County (% of County)	6.39	3.16	4.45
Spring Wheat Yield*** (Bushels/AC)	27	25	25
NDSU Climate Adjusted Standard Deviation	8.03	7.77	8.13

*Average of county-level JAS and NDLVS values.
**Semi-permanent and permanent wetlands.
***Based on STATSGO soil data base.

Differences Between Site-Specific JAS Values and Nearby Market Sales

Comparisons between JAS land values and nearby comparable sales are made at varying times (for individual JAS survey sites) over a 3-year period (2001-2003) so that it would be possible to associate 527 (6 of the 533 sites not used because 2 corresponding sales could not be found) JAS survey sites with 566 comparable sales. The intention was to collect between two and three nearby comparable sales for each year 2002 JAS survey site. When no comparable sales occurred near a particular JAS survey site for that year, an earlier JAS survey year was used and matched with sales. Some comparable sales were used for multiple JAS sites (when they were the closest sale in proximity to multiple JAS sites).

These analyses were conducted in the 33 counties across North Dakota for which detailed SSURGO soil productivity data existed at the time the study was undertaken. These 33 counties, along with the locations of comparable sales, were previously shown in Figure 16. The locations of specific JAS survey sites are not contained in this (or any subsequent maps) in order to maintain the confidentiality of JAS respondents.

Characteristics of JAS and Market Sales

Most (63%) of the 527 JAS segments used in the analysis were comprised entirely of cropland versus less than 1% for pastureland (only 2 JAS sites) and 36% for mixed land uses (both cropland and pastureland). Similar ratios of market sales were collected for the study: 65% for cropland, and around 1% for pastureland and 34% for mixed land uses (Table 14). Most (82%) JAS sites had three corresponding market sales (the remainder had at least two). The average distance from JAS sites to market sales was 13 miles (cropland), 11 miles (pastureland), and 14 miles (mixed land uses).

Table 14. Characteristics of JAS segments and market sale parcels (2001-2003).

	JAS Segments	Market Sales
1) Cropland		
Observations	331	969
% JAS Observations with 3 Market Sales*	90%	
Mean & Std. Dev. Land Values ($/Acre)	$529 ($255)	$483 ($232)
Mean Sale Parcel Size (Acres)		240
Mean Spring Wheat Yield (Bu/Acre)	37	36
Wetlands (%)	6%	3.8%
Mean Distance: Segments to Sales (miles)	13	
2) Pastureland		
Observations	2	6
% JAS Observations with 3 Market Sales*	100%	
Mean & Std. Dev. Land Values ($/Acre)	$260 ($85)	$429 ($116)
Mean Range Productivity (Pounds Forage/Acre)	3394	3,214
Mean Sale Parcel Size (Acres)		262
Wetlands (%)	7.4%	21%
Mean Distance: Segments to Sales (miles)	11	
3) Mixed Land (Crop and Pasture)		
Observations	194	524
% JAS Observations with 3 Market Sales*	67%	
Mean & Std. Dev Land Value ($/Acre)	$318 ($212)	$330 ($134)
Mean Sale Parcel Size (Acres)		380
Mean Spring Wheat Yield (Bu/Acre)	28	30
Wetlands (%)	5.2%	3.8%
Mean Distance: Segments to Sales (miles)	14	

* The minimum number of market sales per JAS site is 2.

Mean sale parcel sizes were larger among mixed and pasture sales (380 and 262 acres respectively) than cropland only sales (240 acres). Soil productivity measures (either spring wheat yields or pasture productivity) were on average similar within JAS segments and sale parcels. Mean spring wheat yields for cropland only JAS segments were 36.8 bushels per acre compared to cropland only market sale spring wheat yields of 35.6 bushels per acre. As was expected mixed land uses within JAS segments (crop and pasture) had lower spring wheat yields, but again they were similar to market sales with mixed land uses. The percentage of wetlands was higher within JAS segments for both cropland and mixed sales (almost double). However, the specific classification of JAS wetlands includes all ‘waste’ and might not entirely represent wetlands in the same way they are accounted for in market sales. In the case of pastureland, market sales had a considerably higher percentage of wetlands than JAS segments. This result is probably a function of JAS respondents not considering wetlands to be ‘waste’.

Reported JAS land values and market sales (both on a per acre basis) were highest amongst cropland followed by mixed land uses and pastureland (Table 14). JAS cropland values were $529 per acre compared to $483 per acre for cropland market sales. JAS mixed values were $318 per acre and market sale mixed values were $330 per acre. Mean JAS cropland values were higher than market sale values (by 8.6%) but lower for both pastureland (-65%) and mixed land uses (-3.2%). However, it is perhaps more relevant to evaluate the number of cases when JAS and market sales differ.

A Closer Evaluation of Differences Between JAS and Market Sales

Overall (average) percentage differences between JAS and corresponding market sales land values, and the results of the paired two-sided t-test used to evaluate the statistical significance of observed differences are summarized in Table 15. However, pasture only JAS segments were not frequent enough to warrant statistical comparisons.

On average, across all sales, JAS values were 11% greater than market sale values on per acre basis and this difference is statistically significant at the 99% confidence-level. Such differences are even greater (+17%) when comparing cropland only sales. Differences for pastureland only sales were - 40% but there were only two comparisons available.

Differences for mixed land uses were on average 3% and this difference was not statistically significant.

Table 15. Differences between JAS segments and nearby comparable sales.

	Paired Comparisons (n)	Mean Observed Difference (JAS vs. Sales)	T-Statistic
All Land Uses	527	+ 11%	2.76 *
Cropland	331	+ 17 %	4.35 *
Pastureland	2	- 40%	Not tested
Mixed Land Uses	194	+ 3%	- 0.77

* Statistically significant at the 99% confidence level.

The differences between JAS and market sales are further evaluated in Table 16 and Figures 21 and 22, which compare differences at the county-level across the state. From this, it can be seen that differences between JAS and market sale values are not consistent across all counties in the state.

Table 16. County-level differences between JAS and market values (n=33).

	All Comparisons	Cropland Comparisons	Mixed Land Use Comparisons
Percentage of Counties with Differences > +5%	58%	68%	39%
Percentage of Counties with Differences > -5%	18%	7%	43%
Percentage of Counties with Differences > +10%	52%	61%	21%
Percentage of Counties with Differences > -10%	9%	3%	29%

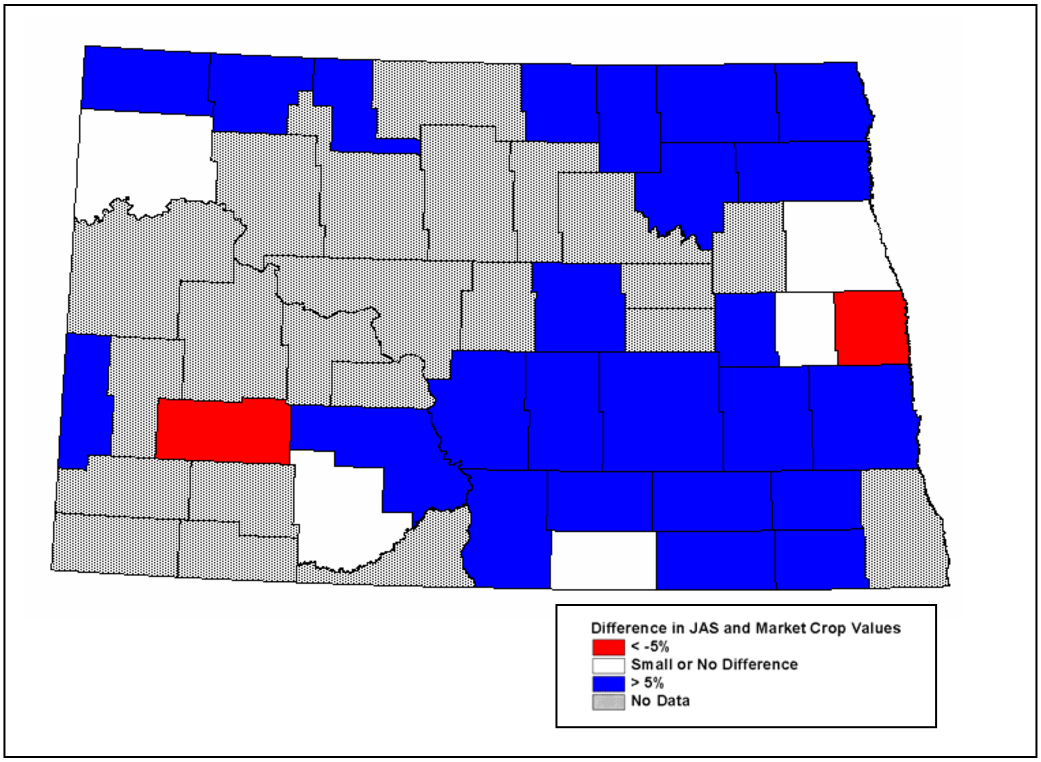


Figure 21. Counties with JAS-market sale cropland differences greater than 5%.

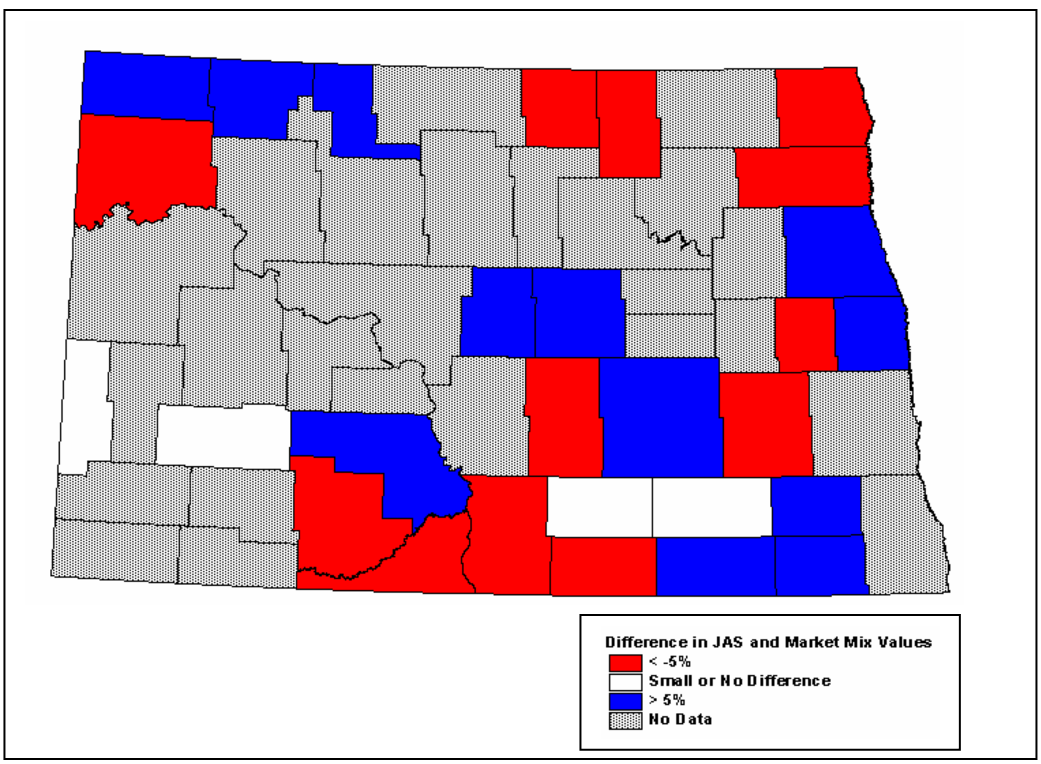


Figure 22. Counties with JAS-market sale mixed differences greater than 5%.

Similarly, differences between JAS and market sales are summarized by region in Table 17. While JAS values for cropland are consistently higher than market sale values across the entire state, these differences are highest in particular regions (North Red River Valley, Northeast, and Southeast). JAS values are greater than market values for mixed land uses in all but one region (North Red River Valley where it is sharply negative).

Table 17. Regional differences between JAS and market values.

	All Land Uses	Cropland	Mixed Land Uses
Statewide	11%	17%	3%
North Red River Valley	14%	21%	-21%
South Red River Valley	7%	7%	10%
Northeast	13%	18%	5%
Southeast	11%	20%	0%
Northwest	8%	11%	4%
Southwest	11%	9%	11%

Differences between JAS and market values by year are summarized in Table 18. From the table it can be seen that sharp variations across years do occur but that a pattern on changing differences is not apparent. Differences are noticeably smaller in 2003 than in other years.

Table 18. Differences between JAS and market sale values by year.

	All Comparisons	Cropland Comparisons	Mixed Land Use Comparisons
All years (2001-2003)	11%	17%	3%
2001	13%	12%	14%
2002	18%	28%	1%
2003	- 0.3%	6%	- 11%

Differences between JAS and market values by the number of comparable sales used (two versus three) are summarized in Table 19. Differences appear smaller when only two comparable sales are used which may indicate that having an extra comparable market sale is increasing the variation between JAS and market sales. Future research is warranted to evaluate procedures for removing one or more comparable market sales from the analyses based on alternative selection criteria.

Table 19. Differences between JAS and market sales using different numbers of comparable sales.

	2 Comparables	3 Comparables
All Comparisons	0.4%	14%
Cropland	8%	18%
Mixed Sales	-3%	5%

Correlation coefficients describing the strength of the linear relationship between JAS and market sale per acre values and character differences between JAS segments and market sales are shown in Table 20. This is intended to provide a preliminary indication of the factors which may be influencing per acre value differences. From this, it appears only that differences in spring wheat yield and gross revenue have a recognizable relationship with segment-level cropland value differences (correlation coefficients of 0.45 and 0.39, respectively). However, spring wheat yield and gross revenue do not appear to be highly correlated with differences in value for segment-level mixed land cover value differences. This may be an indication that the method used to derive per acre values for JAS mixed parcels was not an effective method in assigning value. More elaborate classification of JAS and market sale characteristics is likely needed in conjunction with multi-variate regression modeling to quantify the factors influencing the differences between JAS and market sale land values.

Table 20. Correlation coefficients for segment-level models.

	Difference in JAS and Market Cropland Values	Difference in JAS and Market Mixed Land Values
Year	-0.047	-0.126
Region	-0.032	0.07
Size	0.0634	-0.07
Distance	-0.012	0.01
Difference in % Cropland	0.196	0.175
Difference in % Wetland	-0.129	-0.009
Difference in Spring Wheat Yield	0.448	0.148
Difference in Gross Revenue	0.385	0.101

CHAPTER 5. RESULTS: COUNTY AND SEGMENT LEVEL LAND VALUE MODELS

Two sets of models were developed and interpreted to compare alternative sources of land value data: county-level models using data at the county-level of analysis, and segment-level models using data at the segment-level of analysis. The county-level models used the total number of survey reports at the county-level, the percentage of the county in cropland and wetlands, and variations in soil productivity to explain differences in JAS and NDLVS county-level values. Segment-level models used sale size, distance of sale from JAS segment, difference in the percentage wetland, and variations in soil productivity to explain differences in JAS segment and market sale values.

The County-Level Models

County-level models included the County-Level Cropland Model specifying differences in JAS and NDLVS county-level cropland values to be a function of the total number of JAS survey reports for the county, the percentage of the county in cropland, the percentage of the county in permanent and semi-permanent wetlands, and the standard deviation of the 1969 climate adjusted soil productivity for the county. The County-Level Pastureland Model specified differences in JAS and NDLVS county-level pastureland values to be a function of the total number of JAS survey reports for the county, the percentage of the county in cropland, and the percentage of the county in permanent and semi-permanent wetlands, and the standard deviation of the 1969 climate-adjusted soil productivity for the county.

In total, three variations of the county-level model were developed for both cropland values and pastureland values. The first model was absolute difference, where the dependent variable is based on the absolute difference in JAS and NDLVS per acre county-level values. The second model used positive difference, where only counties with JAS land value estimates at least 5% higher than NDLVS land value estimates were modeled. The last model used negative differences, where only counties with JAS land value estimates at least 5% lower than NDLVS land value estimates were modeled.

County-Level Model Dependent Variable

All of the county-level models share the same basic dependent variable: the difference in JAS county-level land value and NDLVS county-level land value. Tables 21 and 22 contain descriptive statistics associated with the dependent variable used in the cropland model and the pastureland model.

Table 21. Summary statistics for 2002 county-level cropland values.

Variable	Mean	Standard Deviation	Minimum	Maximum
NDLVS Crop Value ($/AC)	410	176	217	1034
JAS Crop Value ($/AC)	402	170	191	973
Percentage Difference Between JAS and NDLVS Values	-1.9%	10%	-20%	31%

Table 22. Summary statistics for 2002 county-level pastureland values.

Variable	Mean	Standard Deviation	Minimum	Maximum
NDLVS Pasture Value ($/AC)	181	32	126	289
JAS Pasture Value ($/AC)	174	40	100	303
Percentage Difference Between JAS and NDLVS Values	-3.8%	18.6%	-37%	64%

All 53 counties were used in the cropland model. Pastureland models contain only 46 counties due to insufficient NDLVS and JAS data. Mean cropland values at the county-level were similar for both NDLVS and JAS values during 2002, with a difference of only 1.01%. Pastureland differences at the county-level were also very similar with a difference of only 1.04%.

County-Level Explanatory Variables

The means and standard deviations of the explanatory variables across various county-level models are shown in Tables 23 and 24. These variables were extracted from

Table 23. Summary statistics of explanatory variables across county-level cropland models.

Variable	Mean	Standard Deviation	Minimum	Maximum
County-Level Crop Absolute Value Model (n=53)				
JAS Reports	17	11	3	42
Percentage of the county in cropland	59.7	18.2	18.5	93.7
Percentage of the county in wetlands	4.2	3.3	0	10.4
Standard Deviation of 1969 NDSU Soil Productivity	7.9	2.8	2.1	16.5
County-Level Crop Positive Value Model (n=12)				
JAS Reports	12	7	3	22
Percentage of the county in cropland	66.4	17.4	32.3	93.7
Percentage of the county in wetlands	3.3	2.6	0	7.1
Standard Deviation of 1969 NDSU Soil Productivity	7.3	3.2	2.1	11.8
County-Level Crop Negative Value Model (n=21)				
JAS Reports	18	11.8	3	42
Percentage of the county in cropland	55.9	21.8	18.5	93.3
Percentage of the county in wetlands	3.6	3.4	0	10.4
Standard Deviation of 1969 NDSU Soil Productivity	8.4	3.0	3.7	16.5

Table 24. Summary statistics of explanatory variables across county-level pastureland models.

Variable	Mean	Standard Deviation	Minimum	Maximum
County Level Pasture Absolute Value Model (n=39)				
JAS Reports	7	5	3	18
Percentage of the county in cropland	55.1	16.4	18.5	81.7
Percentage of the county in wetlands	4.4	3.5	0	10.4
Standard Deviation of 1969 NDSU Soil Productivity	8	2.6	2.9	14.6
County Level Pasture Positive Value Model (n=11)				
JAS Reports	7	3	3	12
Percentage of the county in cropland	51.7	18	18.5	79.5
Percentage of the county in wetlands	3.1	3.4	0	7.9
Standard Deviation of 1969 NDSU Soil Productivity	7.7	2.9	3.4	11.9
County Level Pasture Negative Value Model (n=21)				
JAS Reports	8	6	3	18
Percentage of the county in cropland	53.5	15.7	18.6	76.1
Percentage of the county in wetlands	4.5	3.7	0	10.5
Standard Deviation of 1969 NDSU Soil Productivity	8.1	2.0	4.4	11.7

four data sources: 2002 June Agricultural Survey, 2002 NASS Cropland Data Layer, SSSURGO digital soils database, and the 1969 NDSU Soil Productivity Study.

Discussion of County-Level Models

The regression outputs of county-level cropland models and pastureland models, which specify differences in JAS and NDLVS values to be a function of the number of JAS surveys, the percentage of the county in cropland, the percentage of the county in wetlands, and the standard deviation of the 1969 NDSU soil productivity study, are shown in Tables 25-30.

Table 25. County-level absolute value cropland model results.

Variable	Coefficient	Standard Error	P-Value
jassurvrep	-0.00	0.00	**0.08**
perccntycrop	0.08	0.05	0.12
perccntywet	-0.68	0.28	**0.02**
stdevsoil	0.00	0.00	0.76
cons	0.07	0.035	0.03
F-Statistic	2.24		
R^2	0.16		
Adjusted R^2	0.08		

Table 26. County-level positive cropland model results.

Variable	Coefficient	Standard Error	P-Value
jassurvrep	-0.00	0.00	0.95
perccntycrop	-0.11	0.14	0.42
perccntywet	-1.18	0.79	0.17
stdevsoil	-0.00	0.00	0.41
cons	0.29	0.11	0.03
F-Statistic	1.53		
R^2	0.46		
Adjusted R^2	0.16		

Table 27. County-level negative cropland model results.

Variable	Coefficient	Standard Error	P-Value
jassurvrep	0.00	0.00	0.54
perccntycrop	-0.07	0.06	0.29
perccntywet	-0.06	0.36	0.87
stdevsoil	0.00	0.00	0.51
cons	-0.10	0.03	0.01
F-Statistic	0.48		
R^2	0.11		
Adjusted R^2	-0.12		

All of the county-level models have low R^2 values and F-statistics. It is apparent that this model design does not identify all of the factors that influence differences in JAS

Table 28. County-level absolute value pastureland model results.

Variable	Coefficient	Standard Error	P-Value
jassurvrep	-0.00	0.00	0.43
perccntycrop	0.03	0.15	0.84
perccntywet	-0.87	0.81	0.29
stdevsoil	-0.00	0.00	0.70
cons	0.21	0.10	0.04
F-Statistic	0.69		
R^2	0.07		
Adjusted R^2	-0.03		

Table 29. County-level positive pastureland model results.

Variable	Coefficient	Standard Error	P-Value
jassurvrep	0.01	0.02	0.55
perccntycrop	0.26	0.40	0.54
perccntywet	-0.33	0.27	0.27
stdevsoil	0.00	0.028	0.97
cons	0.068	0.28	0.81
F-Statistic	0.56		
R^2	0.27		
Adjusted R^2	-.21		

Table 30. County-level negative pastureland model results.

Variable	Coefficient	Standard Error	P-Value
jassurvrep	0.00	0.00	**0.05**
perccntycrop	-0.08	0.15	0.57
perccntywet	-0.18	0.69	0.80
stdevsoil	0.01	0.00	0.15
cons	-0.26	0.95	0.01
F-Statistic	2.22		
R^2	0.35		
Adjusted R^2	0.20		

and NDLVS estimates at the county-level of analysis. The F-statistic of each model indicates the variables, when considered jointly, do not influence differences in land value estimate. Logically, it is assumed that there is some level of omitted variable bias in the models.

Although variables are missing from the county-level models, several variables are significant at the 90% confidence level. In both the county-level absolute value cropland model and the negative pastureland model the number of JAS reports had a significant negative effect on difference in estimate as expected. As JAS survey reports increase the difference in JAS and NDLVS county-level estimates decrease.

A surprise result in the county-level absolute cropland model was the significant negative effect of the percentage of the county in wetland acres. It was earlier predicted that an increase in wetland acres in the county would result in larger differences in county-level estimate. It is not clear why the wetland variable has a negative effect on estimate differences. One possibility is that an increase in wetland acres makes it likely that all survey respondents will take wetlands into consideration when making estimates. In areas that have few wetlands, only some of the survey respondents will take wetlands into consideration when making estimates. Another interesting note in the absolute value cropland model is the percentage of the county in cropland variable. Though only significant at the 85% confidence level the percentage of the county in cropland variable had a positive effect on differences in land value. It is likely the wetland and cropland variables are closely related. As the percentage of the county in cropland increases, the likely effect of the other acres in the county, whether they are wetland acres or some other land cover, only affecting a small portion of the respondents becomes more likely.

Future models would likely be improved if a variable were added regarding the percentage of the respondents whom consider the effect of wetlands or some other form of non-tillable acres in their estimate. All of the NDLVS respondents are considered active farmers and ranchers if they produce $1000 in agricultural products. However, CRP is considered a product by this definition and the farmer may not be "actively" producing a product in this case.

The results of the models are not surprising given the difference in survey methods used to gather JAS estimates and the NDLVS county-level land value estimates. JAS survey respondents are asked to value a particular piece of land at the segment-level of analysis while NDLVS survey respondents are asked what they believe the value of land is in their locality. The likely result of these differences is that respondents magnify the importance of certain variables in the JAS survey, wetlands for example, and downplay the importance of variables in the NDLVS survey. The questions are framed in such a way that comparisons are being made for two very different land value estimates.

The Segment-Level Models

Segment-level models included three cropland models specifying differences in per acre JAS cropland estimates and per acre market sale cropland values to be a function of market sale size, distance from market sale to JAS segment, difference in the percentage of the sale and JAS segment in cropland, difference in the percentage of the sale and JAS segment in wetlands, and a soil productivity measure (either difference in spring wheat yield per acre or difference in gross revenue per acre). It was decided that mixed segment-level models would not be estimated due to the inconsistency associated with identification of CRP acres within market sale segments. However, characteristics are shown for mixed land value comparisons.

Segment-Level Model Dependent Variable

All of the segment-level models contain the same dependent variable: the difference in per acre JAS estimates and similar near by market sale per acre values during the 2001-2003 time period. Table 31 contains descriptive statistics associated with this variable. A total of 331 cropland JAS segments were compared to 969 cropland market sales during the 2001-2003 time periods. A total of 194 mixed JAS segments were compared to 524 mixed land sales. Due to small sample sizes (only two JAS segments contained pastureland only) no model was estimated to compare differences in pastureland. For this portion of the study, JAS sections were compared only to sales during the same year. For each JAS segment two or three comparable sales were collected. The characteristics of these two or three market sales were then averaged. This "collective" set of characteristics was then compared to the JAS segment. The difference between the JAS segment and the

Table 31. Characteristics of JAS segments and market sale parcels (2001-2003).

	JAS Segments	Market Sales
1) Cropland		
Observations	331	969
% JAS Observations with 3 Market Sales*	90%	
Mean & Std. Dev. Land Values ($/Acre)	$529 ($255)	$483 ($232)
2) Pastureland		
Observations	2	6
% JAS Observations with 3 Market Sales*	100%	
Mean & Std. Dev. Land Values ($/Acre)	$260 ($85)	$429 ($116)
3) Mixed Land (Crop and Pasture)		
Observations	194	524
% JAS Observations with 3 Market Sales*	67%	
Mean & Std. Dev Land Value ($/Acre)	$318 ($212)	$330 ($134)

* The minimum number of market sales per JAS site is 2.

"collective" sales was used to form the models.

Segment-Level Explanatory Variables

The means and standard deviations across segment-level models are shown in Table 32. Variables were extracted from four sources: market sales collected from county courthouses throughout the state, North Dakota rural appraisers, NASS cropland data layer, and the SSURGO digitized soils database.

Table 32. Summary statistics of explanatory variables across segment-level models.

Variable	Mean	Standard Deviation	Minimum	Maximum
Segment-Level Crop Absolute Value Difference Model (n=331)				
Size (acres)	240	128	76	991
Distance (miles)	13	5.6	2.4	28
Difference in Percentage Wetland	6.1	6.5	0	44.1
Difference in Spring Wheat Yield (bushels/acre)	5	4.6	0	27
Difference in Gross Revenue ($/acre)	17	14	0	76
Segment-Level Crop Positive Value Difference Model (n=177)				
Size (acres)	250	126	107	914
Distance (miles)	13	8	2.5	28
Difference in Percentage Wetland	6.4	6.3	0	44.1
Difference in Spring Wheat Yield (bushels/acre)	5.6	5.1	0	27
Difference in Gross Revenue ($/acre)	18	15	0.33	69
Segment-Level Crop Negative Value Difference Model (n=103)				
Size (acres)	212	112	76	991
Distance (miles)	14	6	2	28
Difference in Percentage Wetland	6.1	6.6	0	39.2
Difference in Spring Wheat Yield (bushels/acre)	4.2	3.6	0	23
Difference in Gross Revenue ($/acre)	16	14	0	76

Discussion of Segment-Level Models

The regression output for the segment-level cropland models, which specify differences in JAS and market sale land values to be a function of the average size of the associated market sales, the average distance of the associated market sales from the JAS segment, the average difference in percentage wetland between the market sales and the JAS segment, the average difference in per acre spring wheat yield between the market sales and JAS segment, and the average difference in per acre gross revenue between the market sales and JAS segment are shown in Tables 33-35.

Similar to the county-level models segment-level models have very low R^2 values and F-statistics indicating there are significant variables missing from the models. As expected, both the difference in spring wheat yield and the difference in gross revenue were statistically significant at the 90% confidence-level in all models (Tables 33-35) and had a positive coefficient as expected. The distance variable had a positive coefficient in all models as expected but was only significant in the gross revenue version of the positive cropland model.

Table 33. Segment-level absolute value cropland model results.

	Version 1 Spring Wheat			Version 2 Gross Revenue		
Variable	Coefficient	Std. Error	P-Value	Coefficient	Std. Error	P-Value
size	-0.00	0.00	0.47	-0.00	0.00	0.33
dist	0.00	0.00	0.55	0.00	0.00	0.31
dfperwet	0.38	0.25	0.13	0.26	0.26	0.32
dfspwhtyld	0.02	0.00	**0.00**			
dfgrrev				0.00	0.00	**0.00**
cons	0.19	0.05	0.00	0.22	0.06	0.00
F-Statistic	8.6			3.58		
R^2	0.10			0.04		
Adjusted R^2	0.08			0.03		

Table 34. Segment-level positive cropland model results.

	Version 1 Spring Wheat			Version 2 Gross Revenue		
Variable	Coefficient	Std. Error	P-Value	Coefficient	Std. Error	P-Value
size	-0.00	0.00	0.25	-0.00	0.00	0.15
dist	0.00	0.00	0.15	0.00	0.00	0.10
dfperwet	0.28	0.40	0.47	0.13	0.41	0.75
dfspwhtyld	0.02	0.00	**0.00**			
dfgrrev				0.00	0.00	**0.06**
cons	0.28	0.08	0.00	0.35	0.08	0.00
F-Statistic	5.56			2.16		
R^2	0.11			0.05		
Adjusted R^2	0.09			0.03		

Table 35. Segment-level negative cropland model results.

	Version 1 Spring Wheat			Version 2 Gross Revenue		
Variable	Coefficient	Std. Error	P-Value	Coefficient	Std. Error	P-Value
size	0.00	0.00	0.14	0.00	0.00	0.18
dist	-0.00	0.00	0.70	-0.00	0.00	0.46
dfperwet	-0.43	0.20	**0.04**	-0.29	0.20	0.17
dfspwhtyld	-0.00	0.00	**0.04**			
dfgrrev				-0.00	0.00	**0.01**
cons	-0.19	0.04	0.00	-0.17	0.05	0.00
F-Statistic	2.64			3.21		
R^2	0.10			0.12		
Adjusted R^2	0.06			0.08		

CHAPTER 6. CONCLUSIONS

The first objective of this research was to estimate whether county-level land value estimates from the June Agricultural Survey (JAS) and the North Dakota Land Value Survey (NDLVS) differ from each other and to explain these differences. The second research objective was to quantify and explain differences between individual JAS segment reported land values and nearby comparable market sales.

County-Level Comparisons of JAS and NDLVS Estimates

Statistical comparisons of 2002 JAS and NDLVS estimates at the county-level of analysis for both crop and pasture indicated that values were not statistically different from each other. At the state-level and in most counties it would appear that using either JAS or NDLVS estimates would be appropriate. However, within individual counties there can be great differences in JAS and NDLVS land values. When these differences were shown spatially, no apparent patterns could be identified. Since the JAS is not reported at the county-level, the NDLVS will continue to be the best available source of county land value data.

Comparisons of JAS and NDLVS rent values show JAS rent estimates significantly lower than NDLVS rent estimates for both crop and pasture acres. Overall, JAS crop rent estimates were 4.7% less than NDLVS estimates and JAS pasture rent estimates were 9.4% less than NDLVS estimates. This may indicate that JAS rent values are not appropriate for statewide rent value estimates. This is likely due to small sample sizes associated with the JAS. Further research is warranted to compare JAS and NDLVS with actual rents before either is used statewide for policy purposes.

Differences between JAS and NDLVS cropland values at the county-level appear to be related to the number of JAS surveys within the county (Tables 12 and 13). When JAS survey numbers are low (usually less than 14) then JAS cropland estimate values are higher than NDLVS estimates. When JAS survey numbers increase, JAS cropland estimates are similar or less than NDLVS cropland estimates. In contrast, the number of NDLVSs does not appear to influence differences in land value estimates. The number of surveys is usually greater than 25.

Counties with high variations in soil productivity have JAS cropland and pastureland estimates lower than NDLVS estimates (Tables 12 and 13). With larger variations in soil productivity there is a much higher chance that survey locations will be different from each other resulting in differences in land value. This may also be an indication that survey respondents place greater emphasis on soil productivity when estimating segment-level values as compared to values in their locality. In counties with low percentages of wetlands, JAS estimates for both crop and pasture are rarely greater than NDLVS estimates. This indicates that differences in estimate may be greater when wetland conditions within JAS sites differ from nearby areas. This also reinforces the idea that JAS respondents, because they are asked to estimate values at the segment-level as compared to the NDLVS, which asks values in the surrounding locality, magnify the impact of wetland acres and soil productivity.

Comparisons of JAS Segments and Market Sales

Overall JAS cropland and mixed land estimate values are higher than nearby market sale values during the three-year study period (Table 14). A troubling aspect of this is that JAS segments contain a much larger percentage of wetlands/waste compared to market sales yet their values are still higher. JAS respondents were asked to report the number of waste acres, which may contain acres other than wetlands. However, NASS classifications only provide data on wetland acres. Also, the NASS CDL calculates CRP, pasture, hay, and fallow acres as pasture. The reliability of aerial photographs for classifying these differences in land cover is questionable. The result of these data limitations is that no additional interpretations should be made regarding JAS and market comparisons unless improvements in data collection can be made. There is no way to accurately calculate pasture, hay, CRP, and fallow acres in market sales, which limits the sample size.

Observed differences between JAS estimates and market sale values do not appear to be consistent over time. During the time period of this study, land values were increasing at the highest rate since the late 1970s. Interest rates were extremely low during the study period, making investments in land attractive to outside investors. It is suspected that a time lag exists between rapid changes in market value and when survey respondents realize and report these changes.

Comparisons of JAS segments with two comparable sales as opposed to three comparable sales (averaged) reveal that differences are smaller for JAS segments that compare only two sales as opposed to three. This result would seem illogical unless increasing the number of sales increases the chance that one of the three sales will be greatly different. It is recommended for future studies that comparable market sales be chosen carefully based on their characteristics.

Recommendations for Further Study

Future attempts at quantifying differences in land value estimates and actual market sales will be more successful if the accuracy of NASS data regarding land cover (crop, pasture, wetland, and CRP) can be improved. Digitized information on CRP acreage would greatly aid in the accuracy of comparisons between segment-level JAS and market sales.

Future comparisons of land value estimates and market sales should be performed over a longer time frame to quantify the effects of slow changes in market values as compared to rapid changes in land values during the time of this study. Access to a larger sample of sales would also improve the accuracy of comparisons. Many areas of North Dakota had a large number of sales that, under non-disclosure law, were not available for this research.

In conclusion, at the state-level, JAS and NDLVS land value data may be used interchangeably by policy makers. At the county-level however, NDLVS land value data should continue to be used. Further research is necessary to confirm the accuracy of state- and county-level JAS and NDLVS rent estimates.

For appraisers, NDLVS data will give an accurate indication of trends in county-level land values. However, there may be several distinct land markets even within a county. The continued collection of market sales will be necessary for analysis of these localized markets.

The buyers and sellers of agricultural land may use either JAS or NDLVS state-level data to spot trends and NDLVS county-level data to spot trends within counties. However, market sale analysis will be necessary to spot trends in localized sub-county markets.

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PROCEDURAL APPENDIX

The procedural appendix is broken down into two sections. The first section outlines the software used in this research. The second section focuses on the procedural steps necessary to access the data and extract the necessary information. Basic knowledge of operating systems and Arcview (AV) 3.2 and ARC 8.3 are necessary to the understanding of procedural steps used in this research.

Apparatus

Arcview 3.2 and Arcview 8.3, from the Environmental Systems Research Institute, Incorporated (ESRI), was the primary GIS software used in this study. AV extensions for 3.2 were Image Analyst, Spatial Analyst, Xtools version 6/1/01, and Nearest Features v. 3.6.

Microsoft Excel, Access, and Word were used for spreadsheet applications, database applications and document production. Graphics were exported using AV and then modified and enhanced using Microsoft Power Point.

Data Procedures

Digitized Market Sales

Individual market sales were digitized using Arcview 3.2 and the Common Land Unit (CLU) coverage available from Farm Service Agency. The CLU is a digitized coverage of all field boundaries for counties in North Dakota. To digitize individual market sales the legal description (township, range, section) of the sale was used to identify the particular parcel in the CLU. Each individual land sale was then identified in the CLU and when all market sales had been identified they were converted to a shape file containing only the boundaries of the market sales used in the study.

SSURGO Database

SSURGO was downloaded off the Natural Resource Conservation Service (NRCS) soil data mart page at http://soildatamart.nrcs.usda.gov/. County information was downloaded as a zip file and then extracted using NetZip Classic compression software, and saved in individual county folders.

In order to access the tables associated with each county a Microsoft Access SSURGO template was downloaded from http://nasis.nrcs.usda.gov/downloads/. This template was used to access the tables for each county used in the study. The mucropyld and component tables for each county were then converted to Excel files. The mucropyield contained the information regarding the crop yields and the component table had information regarding the range yields. Once these tables were converted into Excel files, all fields were removed except the crop yield fields and map unit key field of the mucropyld file and the range fields and map unit key field of the component file. The Excel files containing crop yields and range yields were then converted into database files.

In order to calculate the yields of both the JAS segments and the market sales the area of the SSURGO polygons (represented by map unit key number in the table) in each JAS segment or market sale had to be calculated. This procedure was performed in AI by utilizing the intersect command. The new coverage contained all the soil polygons contained within the JAS segments and market sales. To calculate the crop and range yields for each JAS segment and market sale the crop yields taken from the mucropyld file and the range yields taken from the component file were merged to the database file created by the intersect between the JAS segments (market sales) coverage and the SSURGO coverage based on the common field “mukey.”

The resulting database contains the crop and range yields for each map unit symbol and the number of acres of each map unit within each JAS segment and market sale. The final step was the calculation of the weighted average yield for crops and range within the JAS segment or market sale.

Crop and Pasture Acre Calculation

The 2002 Cropland Data Layer (CDL) from NASS was used to calculate the number of acres of crop and pasture within each market sale. The CDL is available as an image file but in order to access the required data the image files must be transformed into grid files. The first step is to open the CDL in AV as an image analyst data source. The next step is to open the legend editor and delete all records that had zero in the count field. From the AV tool bar under the theme drop down, the save image as function was utilized and grid was specified. Once converted to a grid the theme was then converted to a shape file using the convert to shape file command. The CDL shape file and the digitized market sale segments were overlaid and the intersect theme command was utilized to calculate the number of crop and pasture acres for each sale.

CRP Acre Calculation

CRP acres were calculated for market sales by overlaying sale boundaries on the 2003 National Agricultural Imagery Program (NAIP) digital ortho imagery photos. These photos are generated during the agricultural growing season each year through aerial photography. The photos were downloaded from http://gis1.state.nd.us/NAIP_2003/ by county.

All sales with pastureland acreage calculated from the CDL were overlaid on the photos and individually examined to locate acres of CRP. Photos of known areas of CRP and nearby pasture sales were examined to determine visible differences between the two. The cattle trails and watering holes apparent on the photographs often distinguished pasture sales. CRP was also found to be a much brighter green color than pasture acreage.

Wetland Acre Calculation

Wetland acres were converted to shape files from the CDL for the years 2001, 2002 and 2003 using the same methodology as was used to convert crop and pasture acres from the CDL. To remove seasonal variability in water acreage 2001 and 2002 market sales were intersected with water acreage that appeared in both the 2001 and 2002 CDL. 2003 market sales were intersected with water acreage that appeared in both the 2002 and 2003 CDL.

To obtain a water coverage that appeared in two consecutive years the 2001 CDL water shape file was overlaid on the 2002 CDL water shape file and the intersect command was used in AV. The resulting output theme contained only water appearing in both the 2001 CDL and the 2002 CDL. The intersect command was also used to obtain water acres that appear in both the 2002 CDL and the 2003 CDL. Using these "multiyear" water coverages the digitized market sales were overlaid and intersected to calculate the total water acres in the sale. For this study, only water acres were considered wetlands in pasture parcels (Figure 23). Past studies (Shultz et al.) have shown that permanent and temporary wetlands were not statistically significant to per acre sale prices. Wetland acres in cropland parcels were calculated by summing water acres and pasture acres (Figure 24).

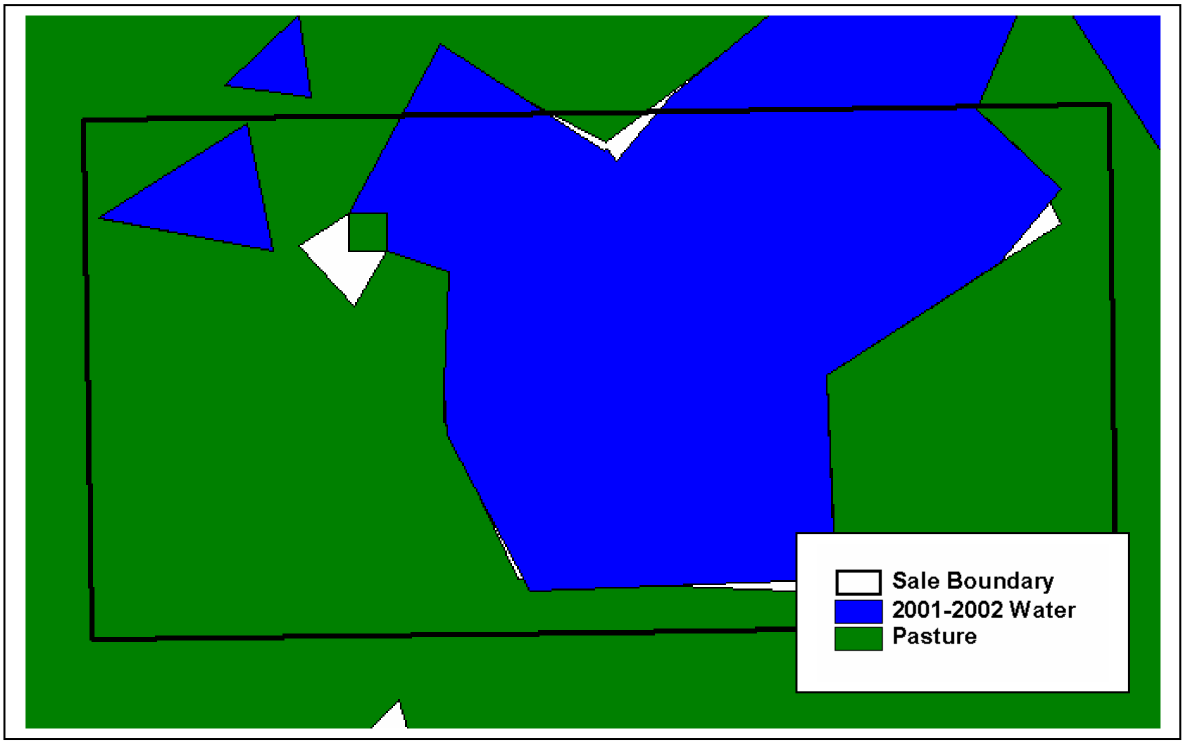

Figure 23. Market sale with CDL pasture and water coverage.

Distance Between JAS Segment and Market Sale

Distance (dist) between JAS segments and market sales were calculated using the AV extension Nearest Features v. 3.6. Distances were calculated using the distance to closest edge feature, which gave the closest distance between the edges of the JAS segments to the edge of the three nearest market sales. The extension was set to search a maximum distance of 48,280 meters (30 miles) from each JAS segment.

North Dakota Land Value Survey Questions

The North Dakota Land Value Survey is a simple one-page questionnaire asking farmers and ranchers to estimate the average agricultural land cash rents and values in their locality. The wording of the survey is as follows:

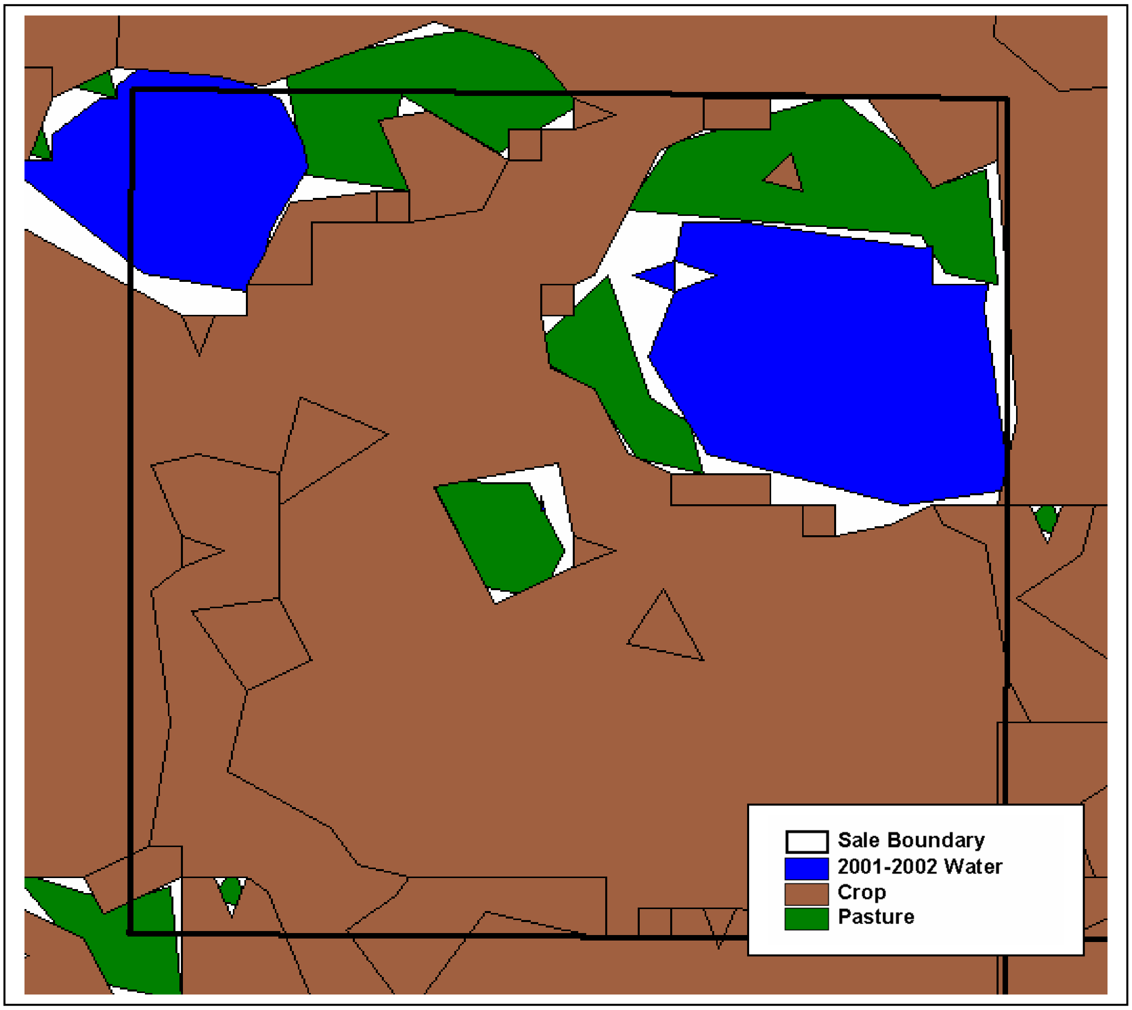

Figure 24. Market sale with CDL crop, pasture, and water coverage.

Instructions: Please provide **YOUR ESTIMATE** of average **CASH RENTS** and **MARKET VALUES** per acre of **NON-IRRIGATED** land rented for cash in your **locality**. Exclude share rents and leasing by AUMs or AUs.

Land Type

1) CROPLAND RENTED for CASH (per acre) ________

2) PASTURE or GRAZING LAND RENTED for CASH (per acre) ________

3) ALFALFA and ALFALFA-GRASS MIXTURES to be cut for hay (exclude CRP) (per acre) ________

4) OTHER TAME HAYLAND (exclude grain hay and wild hay) (per acre) ________

5) WILD or PRAIRIE GRASS to be cut for hay (per acre) ________

June Agricultural Survey Questions

Tract Acres - Land Values

Now I would like to ask about the market value of the land **inside the blue tract boundary**. By "market value," I mean the value at which the land could be sold under current market conditions.

1) For acres reported within this blue boundary, I need your best estimate of the market value of these acres by type of land. This value should exclude the value of all dwellings and building.

   1a. Cropland (Include fruit, nut, berry, vineyard and nursery land.) (dollars per acre)

   1d. Permanent pasture, grazing or grassland (dollars per acre)

2) What is the most likely use of this land if it were sold under current market conditions for the value reported above:

   Agricultural Use Only ________

   Immediate Development (Residential or Commercial) ________

   Expected Future Development (Residential or Commercial) ________

   Other (Specify: ________________)

Entire Farm – Cash Rents

For the **Total Rented Acres reported in Section E**, how many acres are **rented from others for cash** and what is the **cash rent per acre** by type of land.

Cropland (Include fruit, nut, berry, vineyard and nursery land.)

Permanent pasture, grazing or grassland