Texas RuralLands

Trends and Conservation Implications for the 21st Century

An overview of the Rural Land Fragmentation Project conducted
by The Texas A&M University System in partnership with American Farmland Trust

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About this report

This report describes the key findings of an analysis of the status and recent changes in ownership size, land use and property values of private farms, ranches and forestlands in Texas. The goal of this work is to provide public and private decision makers with the data they need to plan for the conservation of working rural lands in Texas. Included in this report are four summaries describing results of technical analyses upon which many of our conclusions are based. Our primary data sources were the Texas State Comptroller of Public Accounts (who provided a 1992-2001 annual compilation of land use and land value data from 1,032 independent school districts), and the U.S.D.A. Agricultural Statistics Service. We also obtained data from the U. S. Census Bureau, U.S.D.A. Natural Resources Inventory, and the U. S. Department of Commerce/Bureau of Economic Analysis–Regional Economic Information System. We used Geographic Information Systems (GIS) base maps obtained from the Texas Natural Resources Information System (TNRIS). This work was made possible by grants to American Farmland Trust from the Meadows Foundation and Houston Endowment, Inc.

Our specific objectives were to:

- Assess the current status and recent trends in rural land ownership size, land use and property values in Texas;
- Determine relationships among land size, land use and property values;
- Develop a map-based simulation model for projecting future trends in rural lands, and use this model to explore the implications of initiating a Purchase of Development Rights program;
- Encourage the development of policies for conserving productive rural lands and wildlife habitats in Texas; and
- Provide public access to these data using a Web site with interactive mapping and custom data queries.

Contents

Executive summary

In 2001, the Governor's Task Force on Conservation concluded that the fragmentation of large family-owned farms and ranches poses the greatest single threat to wildlife habitat and the long-term viability of agriculture in Texas. The task force recommended that Texas initiate a statewide private lands conservation program called a Purchase of Development Rights program. The Rural Land Fragmentation Project summarized here provides public and private leaders with the baseline data needed to develop and evaluate policies to slow the loss and fragmentation of farms, ranches and wildlife habitat in Texas.

In Texas, privately owned farms, ranches and forestlands account for 144 million acres or about 84 percent of the state. The percentage of private land in Texas is greater than in any other state. Since 1970 about 1,000 new farms and ranches have been established in Texas each year, even though the total area in farms and ranches has declined by almost 3 million acres over that time. About 78 percent of our farms and ranches are smaller than 500 acres and these account for 14 percent of the state's farm and ranch acreage. Only 6 percent of all farms and ranches exceed 2,000 acres, but these account for about 63 percent of Texas' farm and ranch acreage.

Trends in Ownership Size. During the 1990s the amount of land in mid-size farms and ranches (500 to 2,000 acres) declined at a rate of about 250,000 acres per year. Most of the loss occurred as mid-sized ownerships were fragmented into smaller ownerships, though some were consolidated into larger operations. If this change continues at the same rate for the next 2 decades, much more of the land in the south, central and east-central portions of the state will become fragmented, while some ownerships in portions of the High Plains will increase in size. Maps and figures accompanying this report show the areas most "at risk" of fragmentation should historical trends continue.

Trends in Land Use. From 1992 to 2001 the most notable land use trend was the conversion of native rangelands and croplands to nonnative "improved pastures." This represents a significant loss of important wildlife habitats, especially in the central and eastern portions of the state. Trends in land use are associated with changes in ownership size. Areas that remain in large ranches (more than 2,000 acres), are more likely to remain native rangelands. In areas of mid-sized farms (500 to 2,000 acres), cropland is more likely to remain as cropland. In areas fragmented into smaller farms and ranches (less than 500 acres), lands are more likely to be converted to nonnative pastures. The strength of these trends depends on the ecological region. It seems likely that land use conversions will continue to deplete the habitats of native wildlife, especially those animals that depend on native grasslands in the eastern and central portions of the state.

Trends in Land Values. In 2001 the average appraised market value of farm and ranch land in Texas was $624 per acre. Values have increased at an average annual rate of 2.7 percent since 1992. Market values are highest in the areas surrounding the major

metropolitan areas of Dallas-Fort Worth, San Antonio, Austin, Houston, El Paso and Brownsville. From 1992 to 2001 market values increased dramatically in the central portion of the state–86 percent in the Llano Uplift and more than 50 percent in the Edwards Plateau. Areas along the Gulf Coast had significant declines in market value. Some rural lands surrounding Houston, for example, declined in market value by 8 to 12 percent.

In 2001 the average agricultural value for farm and ranch land was $80 per acre. Valuations were closely related to ecological region, with the highest values in the East Texas Piney Woods and the lowest in the west. Since 1992 average statewide agricultural values have increased by only 0.4 percent annually.

The trend in the portion of total appraised land value not accounted for by agricultural value–the "nonagricultural" land value (consisting of recreational and development value)–is a relatively good predictor of trends in land fragmentation. Trends in this predictor suggest that some rural areas in the Panhandle and north-central Texas may soon face land fragmentation pressures. Our work shows that there is a relationship between nonagricultural value and the break-up of larger farms and ranches. The nonagricultural component of appraised land values can be used as an early indicator of potential land fragmentation. Some land fragmentation might be avoided by offering landowners financial incentives not to sell or subdivide their lands, or by providing them with ways of transferring property without subdividing it.

A Purchase of Development Rights Program. Purchase of Development Rights (PDR) programs are used in other states to slow the conversion and fragmentation of farms, ranches and wildlife habitats. PDR programs buy development rights from willing landowners, thus compensating them for conserving wildlife, water and open landscapes rather than selling lands for development. We used simulation modeling to explore the implications of establishing a PDR program in Texas. Our simulation models demonstrate that a PDR program for Texas would reduce fragmentation the most if it focused on areas where relatively large ownerships (more than 2,000 acres) are under fragmentation pressure. Over the next 10 years, a PDR program in Texas will result in greater benefit if the program begins immediately than if it is delayed 5 years, even if the funding rate now is half the funding rate of a delayed program.

A database, Web site, technical reports, and a set of statewide maps for ranking fragmentation risks were produced for the Rural Land Fragmentation Project.

Introduction

Privately owned rural lands in Texas make up 84 percent of our state. Thus, land use in Texas has historically been dominated by farming, ranching and timber production. These are working lands that produce agricultural commodities, support rural economies, provide wildlife habitat, and offer recreational opportunities for Texans. These lands include historic family ranches rich with history, tradition and legend. Much of the native flora and fauna on these lands is of national and even international significance.

Rural lands in Texas are undergoing a fundamental change, one that has implications for our rural economies, our agricultural security, and the conservation of our natural resources. Our natural landscape is increasingly threatened by suburbanization, rural development, and land fragmentation. According to the U. S. Department of Agriculture, from 1982 to 1997 more than 2.2 million acres of rural land in Texas was converted to urban uses, and the annual rate of conversion from 1992-97 was nearly 30 percent higher than in the previous 10 years. Texas leads all other states in the loss of rural farming and ranching lands.

Millions more rural acres become fragmented as large properties are divided into smaller parcels. These properties are too small for traditional farming, ranching and forestry uses so they no longer contribute as much to rural economies. Land fragmentation also leads to the loss of open space, a decline in wildlife habitat, water quality problems caused by increased erosion and run-off, and a higher demand for county services in rural areas. Land fragmentation is the single greatest threat to wildlife and the long-term viability of agriculture in Texas.

Key findings

Farm and Ranch Ownership Size

Small ownerships. About 78 percent of Texas farms and ranches are smaller than 500 acres, but their total area makes up only 14 percent of the state (Fig.1). About 42 percent of all Texas farms and ranches are less than 100 acres in size, but these operations account for only 2 percent of the state's rural lands. Farms and ranches less than 100 acres are confined largely to the eastern one-third of the state (Fig. 3). In recent years the number of small ownerships has increased by more than 80,000 acres per year (Fig. 2). Operations ranging from 100 to 500 acres are concentrated in the forested regions of East Texas and dominate the landscape in many of the nonindustrial private forestlands of the Piney Woods (Fig. 5).

Mid-sized ownerships. Ownerships of 500 to 2,000 acres account for about 23 percent of the state's rural land. This is the dominant property size in many major row crop areas, including the High Plains. The number of mid-sized properties has declined dramatically in recent years. Every year, about 250,000 acres of mid-sized farms and ranches are lost. They are either subdivided into smaller ownerships or consolidated into larger farms and ranches.

Large ownerships. Most Texas farm and ranch acreage (63 percent) is in ownerships of 2,000 acres or more, but only 6 percent of properties are in this size category. The number of large ownerships varies greatly from one region to another, from 98 percent of rural land in the Trans Pecos to only 20 percent of rural land in the Piney Woods of East Texas. The fragmentation of large ownerships also varies by ecoregion. The Trans Pecos, Edwards Plateau, South Texas Brush Country and Coastal Sand Plains are all dominated by large ownerships but these areas, combined, have been losing more than 235,000 acres of large ownerships each year (Fig. 6). Other regions have varying levels of localized fragmentation, but the trend there is consolidation into larger ownerships, at a rate of about 318,000 acres per year. If the historical rate of change continues for the next 2 decades, the consequence will be greater land fragmentation in the south, central and east-central portions of the state and the consolidation of some ownerships in portions of the High Plains (Fig. 4). A set of maps and figures accompanying this report provides a ranking of those areas most "at risk" for fragmentation of larger ownerships should historical trends continue.

"Only 6 percent of farms and ranches are 2,000 acres or larger, but they account for 63 percent of farm and ranch acreage."

"Every year about 250,000 acres of mid-sized farms and ranches are subdivided into small ownerships or consolidated into larger ones."

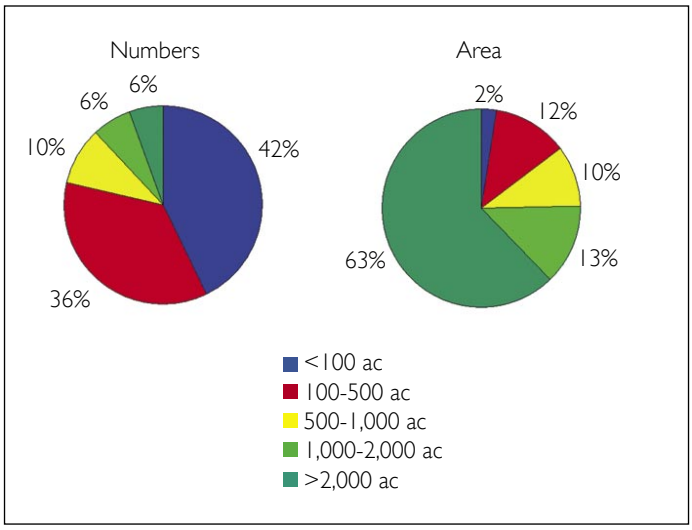


Figure 1. Farms and ranches by ownership size, statewide.

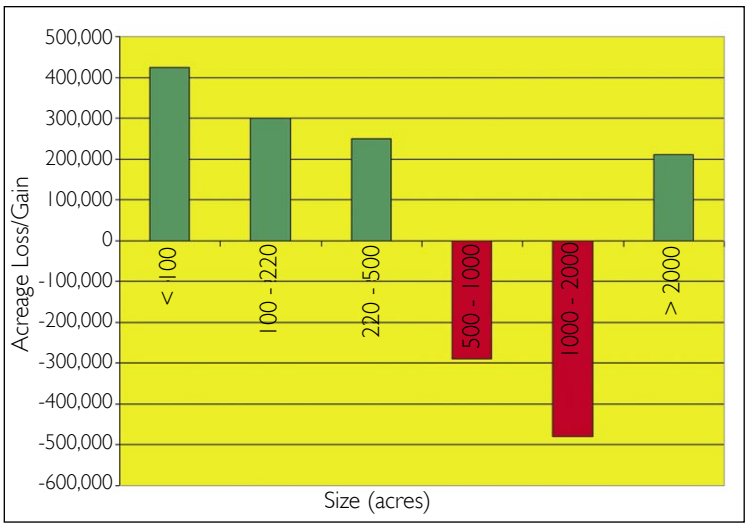


Figure 2. Statewide change in acreage by ownership size (1992-97).

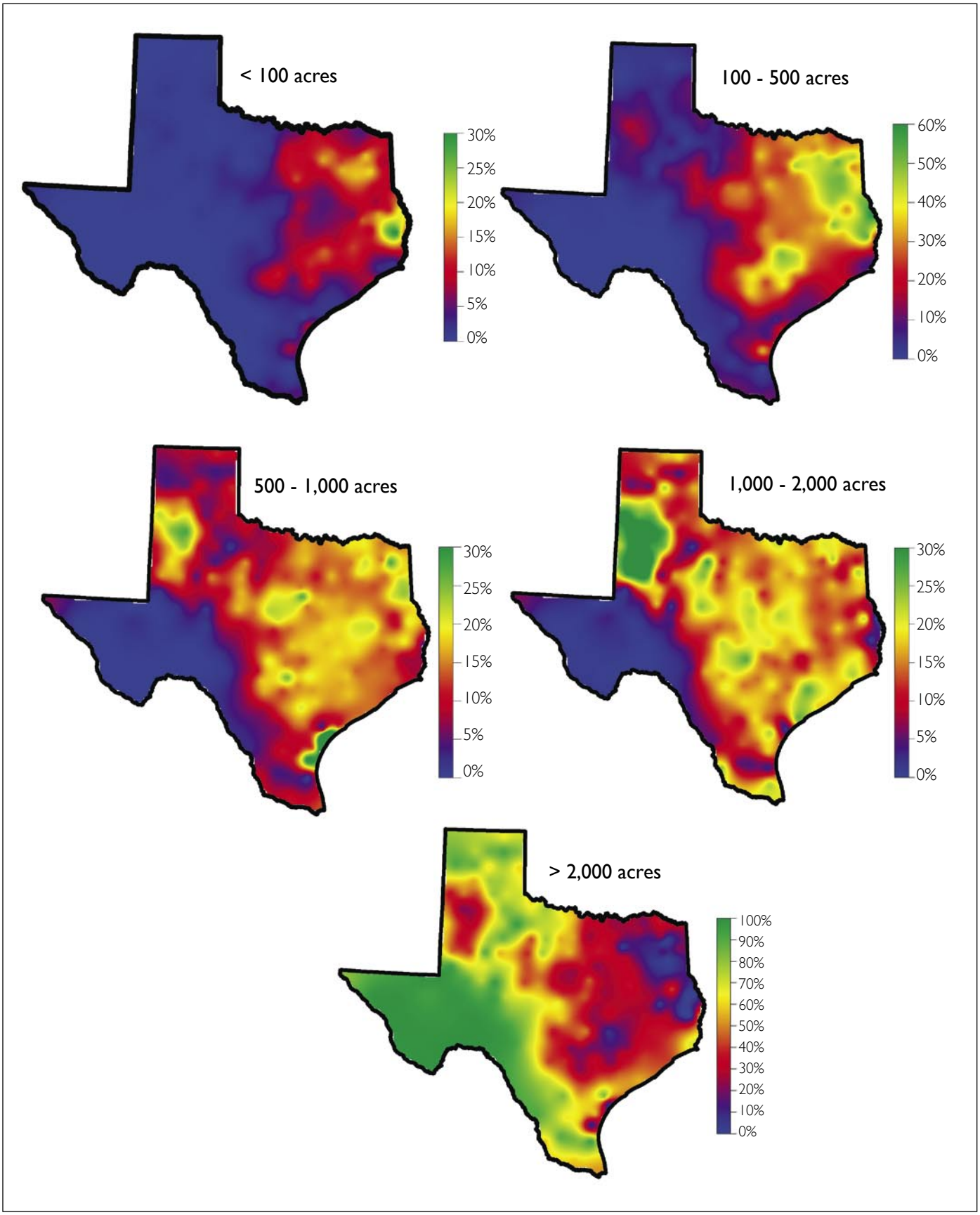


Figure 3. Status of farm and ranch ownership sizes across Texas.

"If the historical rate of change continues, there will be greater land fragmentation in south, central and east-central Texas, and some consolidation of ownerships in the High Plains."

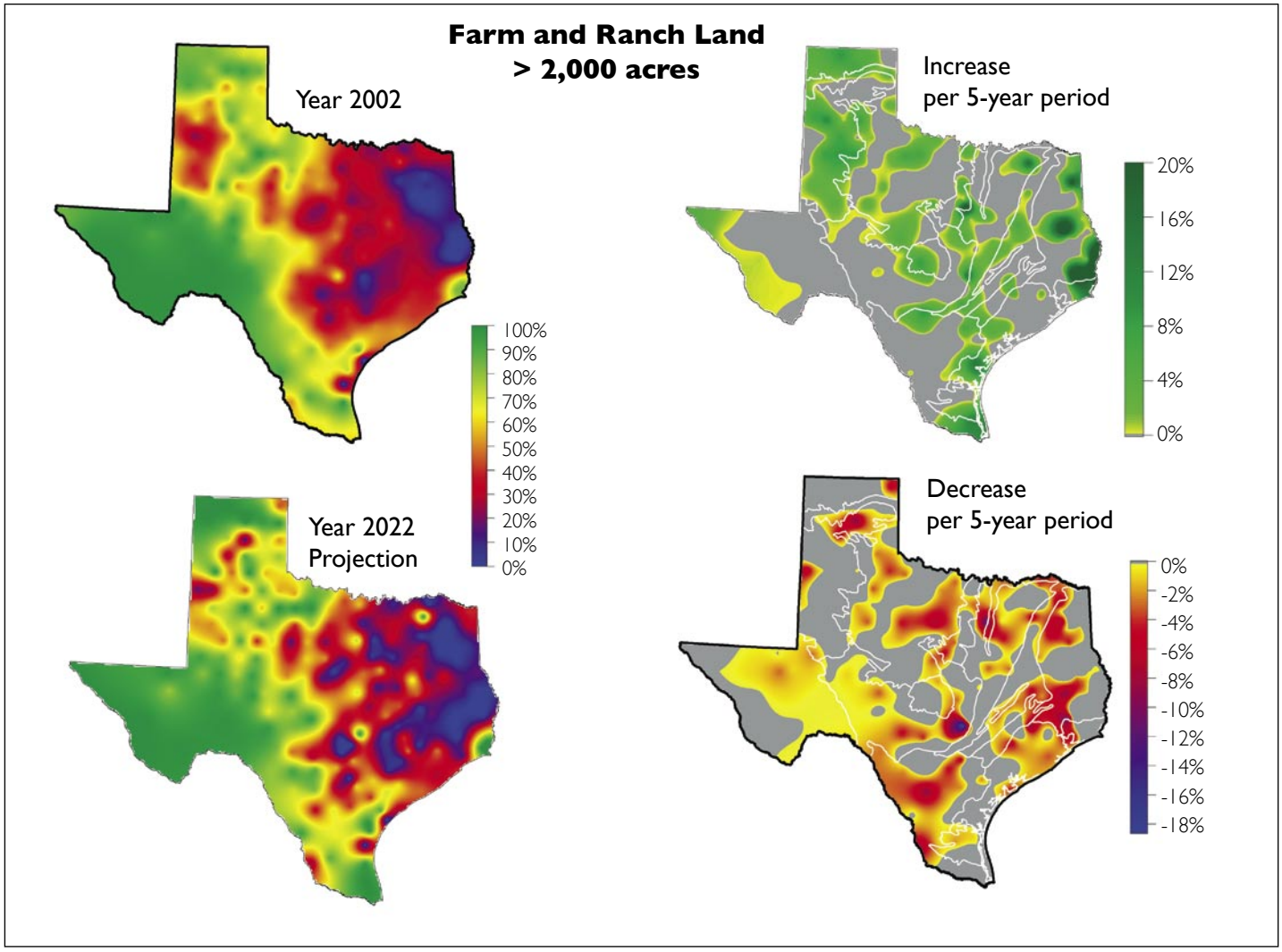


Figure 4. Distribution of large farms and ranches in 2002 and projected for 2022; change in area represented by large farms and ranches.

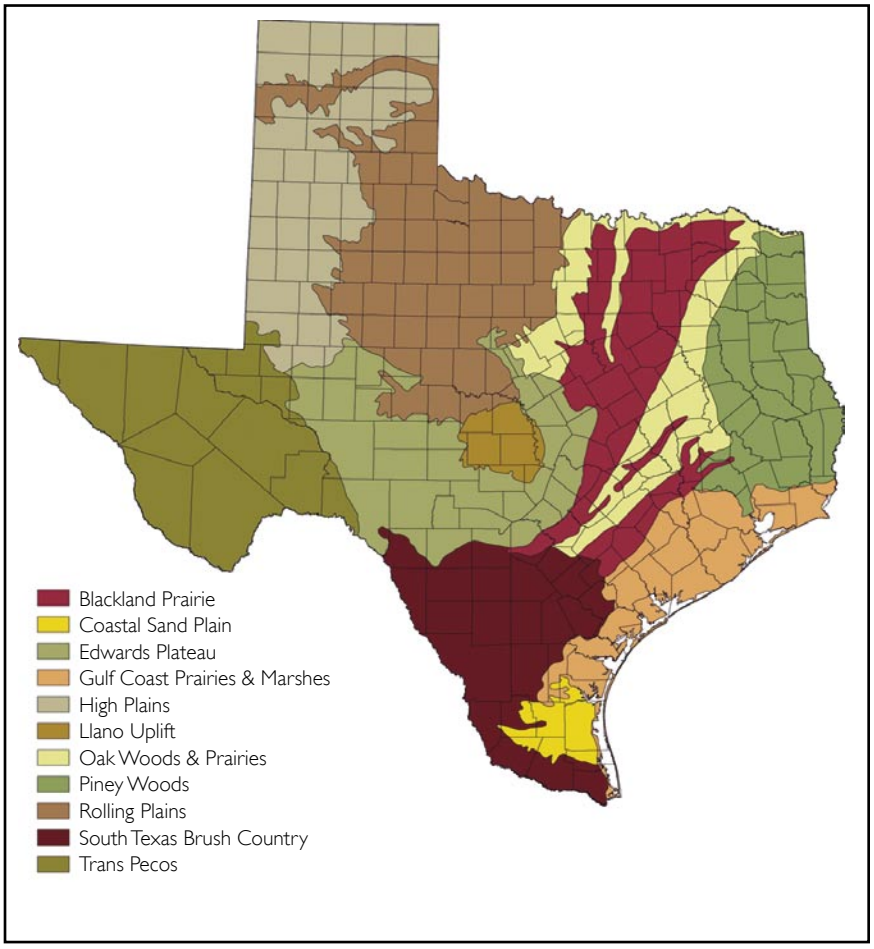


Figure 5. Ecological regions of Texas.

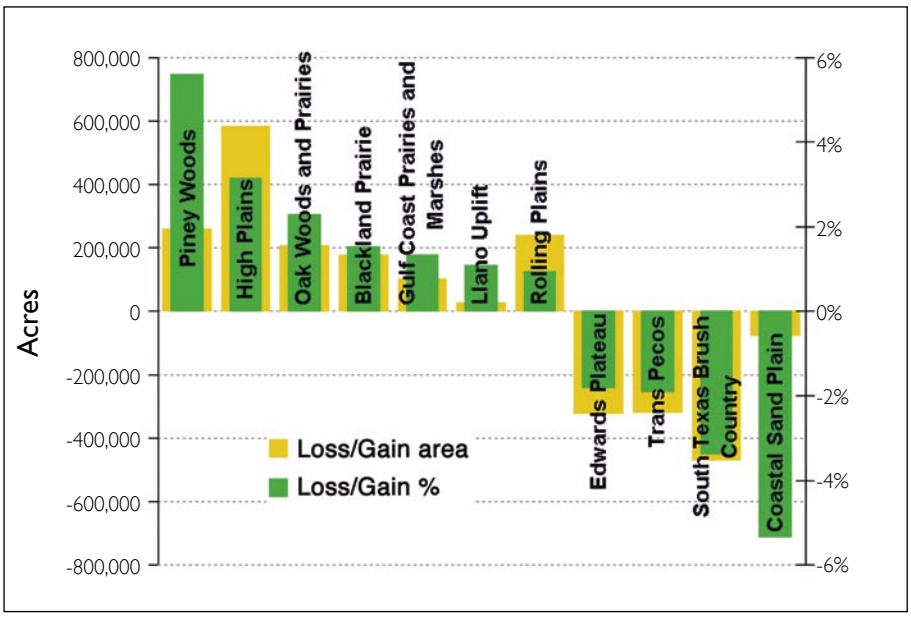


Figure 6. Change in acreage and percent change in large farms and ranches (>2,000 acres), 1992-97.

"The Trans Pecos, Edwards Plateau, South Texas Brush Country and Coastal Sand Plain have been losing more than 235,000 acres of large ownerships each year."

Land Use

As shown in Figure 7, more than 96 percent of Texas' rural lands are dedicated to one of five major agricultural uses: native rangeland (65 percent); dry cropland (15 percent); improved pasture (7 percent); forestland (5 percent); and irrigated cropland (4 percent). The soil, geology, climate and ground water availability in each region determine which of these agricultural uses is most suitable there. For example, the Blackland Prairie and High Plains are dominated by row crop agriculture, whereas native rangeland dominates the South Texas Brush Country, Rolling Plains, Edwards Plateau and Trans Pecos, and forestlands dominate the Piney Woods of East Texas.

Land use trends, 1992-2001:

- In the East Texas Piney Woods, the area of improved pasture increased by more than 30 percent (425,000 acres); this was mostly due to a 17 percent (446,000 acre) loss of already depleted native rangelands (Table 2). The conversion of native rangeland to nonnative pasture grasses (e.g., bermudagrass) for grazing and hay production has likely contributed to the loss of wildlife species–such as bobwhite quail and other birds–that depend on grassland habitats.

- In the Oak Woods and Prairies, the conversion of land to improved pastures and newly designated native rangelands accounted for a 13 percent loss of dry cropland and a 5 percent loss of forestland. Because much of these newly designated native rangelands were formerly croplands, they are dominated by invasive species and do not constitute high quality wildlife habitat.

- The Blackland Prairie lost more than 180,000 acres of farm and ranch land, mainly to urban expansion (Table 1). Much of this loss occurred at the advancing edges of the Dallas/Fort Worth Metroplex and along the I-35 corridor.

- The Edwards Plateau was the only region that increased its cropland area and this likely accounted for some of the loss in improved pastures in the region. The loss of native rangeland along with the corresponding increase in "wildlife management " and "barren wasteland" designations probably indicates less of a physical conversion of land use than a change in management emphasis.

- In the three ecological regions of South Texas there was an overall loss of cropland, with corresponding increases in native rangeland and improved pasture. This trend was most pronounced in the Gulf Coast Prairies and Marshes, which has lost more than 12 percent of its irrigated cropland in the past 10 years. The conversion of many Gulf Coast lands to nonnative grasses has resulted in a 15 percent increase in improved pasture.

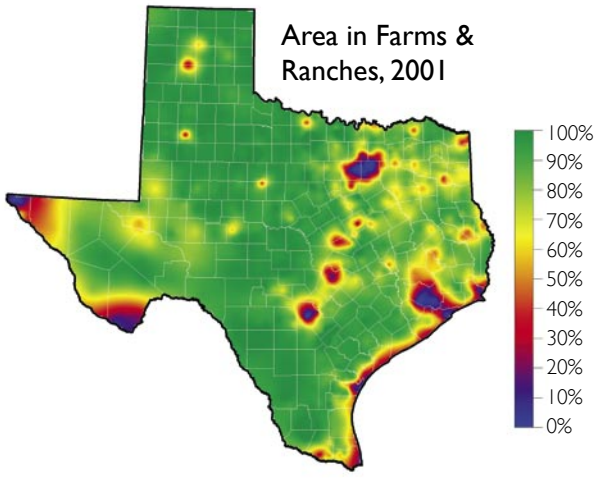
- The High Plains and Rolling Plains both had small decreases in dryland cropland, small increases in irrigated cropland, and corresponding increases in native rangeland. The High Plains also showed a moderate acreage gain in improved pastures.

- Most urbanizing areas of the state had heavy losses of farm and ranch land (see maps in pocket). When ranked by loss of farm and ranch lands, the top 10 percent of counties lost more than 580,000 acres of agricultural lands, mostly to urbanization. This loss of agricultural land and wildlife habitat is likely permanent.

From 1992 to 2001 the most notable land use trend was the conversion of native rangelands and croplands to nonnative "improved pastures." Thus, significant amounts of important wildlife habitat were lost, especially in the central and eastern portions of the state.

One significant change in land use classification was the 1996 addition of wildlife management as a designated agricultural land use. The amount of land designated for wildlife management increased from 91,000 acres in 1996 to more than 480,000 acres in 2001, an increase of more than 60 percent.

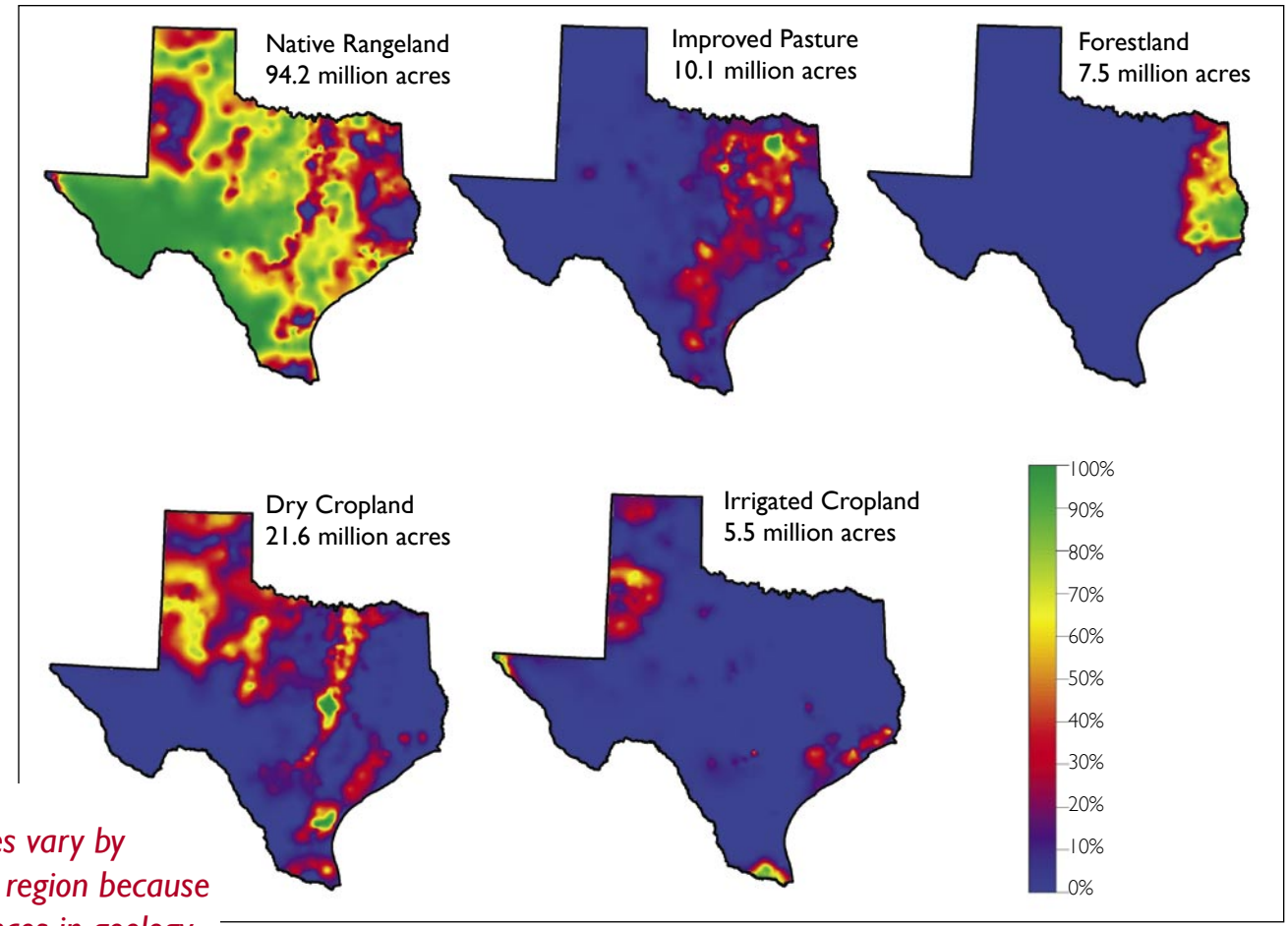
Table 1. Area in farms and ranches, by ecological region, (2001) and change since 1992.



Ecological region/ land area (acres)	Farm and Ranch Land 2001 acres	% of region	Change since 1992 (acres)
Blackland Prairie (15,734,513)	12,041,123	76.5	-183,413
Coastal Sand Plain (2,993,631)	2,570,578	85.9	-1,183
Edwards Plateau (18,582,857)	16,120,095	86.7	-117,725
Gulf Coast Prairies & Marshes (13,123,658)	8,123,573	61.9	-46,756
High Plains (22,651,009)	20,977,689	92.6	69,419
Llano Uplift (3,340,081)	3,102,702	92.9	1,795
Oak Woods & Prairies (13,137,447)	10,654,155	81.1	131,379*
Piney Woods (14,758,922)	11,030,982	74.7	-103,616
Rolling Plains (26,809,322)	25,419,176	94.8	139,191
South Texas Brush Country (16,730,977)	15,702,562	93.9	93,211
Trans Pecos (23,537,100)	18,158,556	77.1	425,443*
State Total (171,399,517)	143,901,191	83.7	

* Figures suggesting increase since 1992 in Trans Pecos and Oak Woods and Prairies were largely from one-time additions of lands to the appraisal records in a small number of districts. These were likely due to changes in property tax designations rather than any actual increase in farm and ranch land.

"From 1992 to 2001, the most notable land use trend was the conversion of native rangelands and crop lands to nonnative improved pastures."



"Land uses vary by ecological region because of differences in geology, soil, climate and water availability."

Figure 7. Land use designations for agricultural lands in Texas.

Table 2. Area in 2001, and change in area since 1992, for each of nine land use classifications used for land value appraisals, by ecological region.

Ecological region	Native range			Improved pasture			Dryland crop		
	2001 (acres)	Change since 1992 acres	%	2001 (acres)	Change since 1992 acres	%	2001 (acres)	Change since 1992 acres	%
Blackland Prairie	6,267,913	134,385	2.2	2,584,328	-141,860	-5.2	2,919,162	-112,790	-3.7
Coastal Sand Plain	2,007,507	95,582	5.0	104,970	-38,108	-26.6	222,030	-12,366	-5.3
Edwards Plateau	13,609,821	-865,387	-6.0	415,035	-150,303	-26.6	690,942	45,980	7.1
Gulf Coast Prairies & Marshes	4,329,199	231,508	5.6	549,545	71,021	14.8	1,723,564	-139,397	-7.5
High Plains	9,233,432	98,307	1.1	140,758	34,990	33.1	8,156,201	-77,975	-0.9
Llano Uplift	2,708,877	309,075	12.9	142,004	16,835	13.4	124,087	-9,544	-7.1
Oak Woods & Prairies	6,623,718	230,954	3.6	2,314,335	68,976	3.1	694,241	-104,575	-13.1
Piney Woods	2,181,300	-446,029	-17.0	1,827,271	425,253	30.3	74,631	-16,906	-18.5
Rolling Plains	17,846,079	99,197	0.6	464,389	-21,883	-4.5	5,962,025	-310,673	-5.0
South Texas Brush Country	11,774,262	49,615	0.4	1,527,053	61,712	4.2	1,056,480	-157,528	-13.0
Trans Pecos	17,637,464	143,519	0.8	0	-12,501	-100.0	113	113	
Grand Total	94,219,572	80,726	0.1	10,069,688	314,132	3.2	21,623,476	-895,661	-4.0

Ecological region	Irrigated cropland			Forestland			Orchard		
	2001 (acres)	Change since 1992 acres	%	2001 (acres)	Change since 1992 acres	%	2001 (acres)	Change since 1992 acres	%
Blackland Prairie	18,666	-9,727	-34.3	34,704	-10,231	-22.8	13,859	6,606	91.1
Coastal Sand Plain	64,367	-8,574	-11.8	0	0		9,704	2,201	29.3
Edwards Plateau	187,258	7,794	4.3	0	0		10,958	255	2.4
Gulf Coast Prairies & Marshes	919,364	-127,562	-12.2	223,183	17,282	8.4	7,404	-3,873	-34.3
High Plains	3,199,670	15,418	0.5	0	0		1,593	-131	-7.6
Llano Uplift	11,901	1,052	9.7	0	0		6,443	95	1.5
Oak Woods & Prairies	66,953	-428	-0.6	485,699	-25,634	-5.0	31,524	3,250	11.5
Piney Woods	7,169	-9,040	-55.8	6,781,010	21,287	0.3	6,079	951	18.5
Rolling Plains	264,242	55,547	26.6	0	0		5,272	872	19.8
South Texas Brush Country	506,434	-55,212	-9.8	0	0		30,385	-9,448	-23.7
Trans Pecos	242,553	44,337	22.4	0	0		8,647	1,429	19.8
Grand Total	5,488,577	-86,395	-1.5	7,524,596	2,704	.04	131,868	2,207	1.7

Ecological region	Wildlife management			Barren wasteland			Other uses		
	2001 (acres)	Change since 1992 acres	%	2001 (acres)	Change since 1992 acres	%	2001 (acres)	Change since 1992 acres	%
Blackland Prairie	49,049	49,049	n/a	91,712	-70,838	-43.6	61,730	-28,007	-31.2
Coastal Sand Plain	0	0	n/a	112,224	62,709	126.6	49,776	-102,627	-67.3
Edwards Plateau	184,374	184,374	n/a	713,130	472,783	196.7	308,577	186,779	153.4
Gulf Coast Prairies & Marshes	22,899	22,899	n/a	238,854	18,239	8.3	109,561	-136,873	-55.5
High Plains	0	0	n/a	190,219	-45,388	-19.3	55,818	44,200	380.4
Llano Uplift	35,061	35,061	n/a	68,349	-14,822	-17.8	5,980	-335,957	-98.3
Oak Woods & Prairies	39,545	39,545	n/a	187,966	-50,114	-21.0	210,174	-30,595	-12.7
Piney Woods	13,366	13,366	n/a	24,079	-25,106	-51.0	116,077	-67,392	-36.7
Rolling Plains	11,909	11,909	n/a	812,046	301,491	59.1	53,214	2,731	5.4
South Texas Brush Country	66,336	66,336	n/a	205,732	-99,901	-32.7	535,880	237,637	79.7
Trans Pecos	60,206	60,206	n/a	120,938	99,989	477.3	88,635	88,351	na
Grand Total	482,745	482,745	n/a	2,765,249	649,042	30.7	1,595,422	-141,753	-8.2

"As farms and ranches are fragmented, native rangelands and croplands are converted to nonnative improved pastures."

Relationships Between Ownership Size and Land Use

Are trends in ownership sizes related to trends in land use? They seem to be. If so, the result could be long-term, large-scale changes in the state's rural landscape. Such changes will influence not only wildlife habitats, but also wildlife-related recreational enterprises (e.g., hunting) and rural economies.

For all 254 counties, we compared farm and ranch ownership sizes to the proportion of the county in various major land uses. We looked at these relationships at both the state and regional levels. There are significant statistical relationships between farm and ranch size and major categories of land use.

In general, the more small ownerships (<500 acres) there are, the less native rangeland and cropland there is and the more improved pasture and forestland. While much of this variation is due to the differences among ecological regions, there are some important relationships within those regions.

- The closest relationships appear to be in the High Plains, Trans Pecos and South Texas–regions lacking the strong influence of metropolitan areas. Across these regions, the most consistent trend was for the amount of native rangeland to rise with increases in the percent of area represented by large ranches. Likewise, as the amount of land in smaller ownerships increases, the total amount of native rangeland decreases.

- The amounts of "improved pasture" appear strongly tied to the proliferation of smaller properties, particularly in South Texas but also in the highly fragmented Blackland Prairies and Oak Woods and Prairies regions.

- In all regions the amount of cropland rises when the number of mid-sized ownerships (500 to 2,000 acres) increases. This relationship is particularly strong in the High Plains, Rolling Plains and South Texas. In the Gulf Coast Prairies and Marshes, the amount of cropland is negatively correlated to the area of small ownerships.

- In the East Texas Piney Woods, the amount of forestland tended to increase in areas dominated by smaller ownerships.

Our results reveal some general trends in land use associated with changes in ownership size:

1. In areas that remain in large ranches (more than 2,000 acres), lands are more likely to remain as native rangelands.
2. In areas of mid-sized properties (500 to 2,000 acres), croplands are more likely to remain as cropland.
3. In areas fragmented into smaller farms and ranches (less than 500 acres), lands are more likely to be converted to nonnative improved pastures.

The strength of these trends depends on the ecological region. These trends are probably related to the efficiency of certain land use practices relative to operating size. For example, few smaller ownerships can afford the equipment and infrastructure required for row crop farming, but they can more easily manage nonnative pasture grasses for grazing or hay production.

Given land fragmentation trends, the future landscape of Texas will likely be even less suitable for wildlife habitat. However, these trends can probably be altered by appropriate landowner incentives, public policies or changing economic conditions.

Gonzalez, E. A., M. E. Kjelland, W. E. Grant and R. N. Wilkins. Relationships between farm and ranch size distribution and land use in Texas. Working paper. Land Fragmentation Studies. Texas A&M University. (Available in full project report.)

Rural Land Values

Market values for rural agricultural lands are based on recent sales of farms and ranches and are a direct reflection of the demands in the rural land market. Appraisals of market value vary according to location, land use, property size and other characteristics. Trends in market values are often linked to the desirability of property for recreation and/or wildlife and scenic beauty, and these factors are related; but market values are also highly influenced by the proximity to major population centers (i.e., location). In contrast, agricultural values are based on the utility of land for producing specific agricultural crops, timber or livestock. Appraisals of agricultural value vary according to land use, land productivity, and the commodity markets for crops, livestock and timber. Unlike changes in market values, the year-to-year changes in agricultural values tend to be gradual. Agricultural value can generally be viewed as a measure of the land's present and future economic productivity. The gap between market and agricultural values represents the value of land for uses such as recreation and rural home sites, along with the value of property rights of subdivision and transfer.

During the past decade, the gap between agricultural and market values for rural land has widened in most areas of the state. The "nonagricultural value" (the market value less the agricultural value of land) reflects this gap and appears to be a good early indicator of changes in land ownership size.

Market Value. In 2001, the average market value of rural land in Texas was $624 per acre. Valuations were highest in the areas surrounding the major metropolitan areas of Dallas-Fort Worth, San Antonio, Austin, Houston, El Paso and Brownsville. In fact, much of the state's market value in rural land is contained within a triangle extending from Dallas-Fort Worth to Houston to San Antonio. Since 1992, the market values of farm and ranch land have increased in most areas of the state. The overall annual increase averaged 2.7 percent.

- Average market values varied from $77 per acre across the Trans Pecos to more than $1,600 across the Blackland Prairie. However, in any region, proximity to a metropolitan area can push the average market value to $3,000 per acre or more (Fig. 8).

- 2001 market values were highest in the Blackland Prairie ecoregion, averaging $1,682 per acre (Fig. 9). These high land values are largely due to the concentration of major metropolitan areas and the I-35 corridor running from San Antonio to Dallas-Fort Worth.

- Market values increased dramatically in the central portion of the state. In the Llano Uplift of the Central Texas Hill Country, a region without a metropolitan area, average market values increased by more than 86 percent or $514 per acre (Fig. 10)–this is for land with an average agricultural value of $62 per acre.

- Likewise, market values in the Edwards Plateau increased by more than 50 percent, largely because of the inflation in value of those lands on the eastern edge of the Hill Country.

- Average market values in the four-county area surrounding Austin-San Marcos doubled, increasing at an annual rate of $136 per acre (Fig. 11).

- Market values for the ranchland surrounding the Killeen-Temple area increased by more than 14 percent annually–a higher percentage increase than in any other part of the state.

- Land along the Gulf Coast declined in market value. The rural land in the metropolitan regions surrounding Houston, for example, declined in market value by 8 to 12 percent.

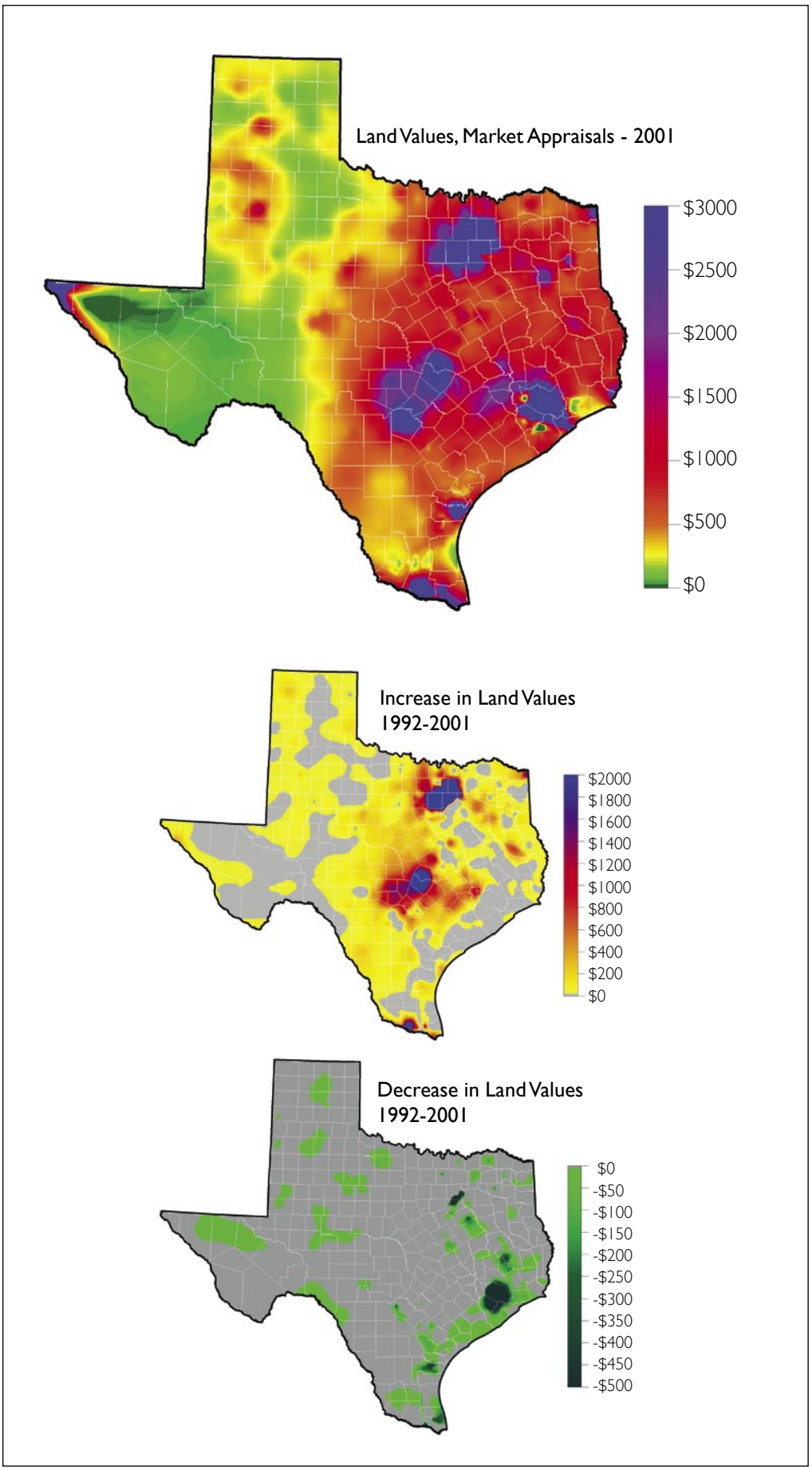


Figure 8. Market values (dollars per acre) for farm and ranch land in Texas, 2001; change in market values, 1992-2001.

"Trends in market values are linked to the desirability of property for recreation, wildlife and scenic beauty, and also to the proximity to urban areas."

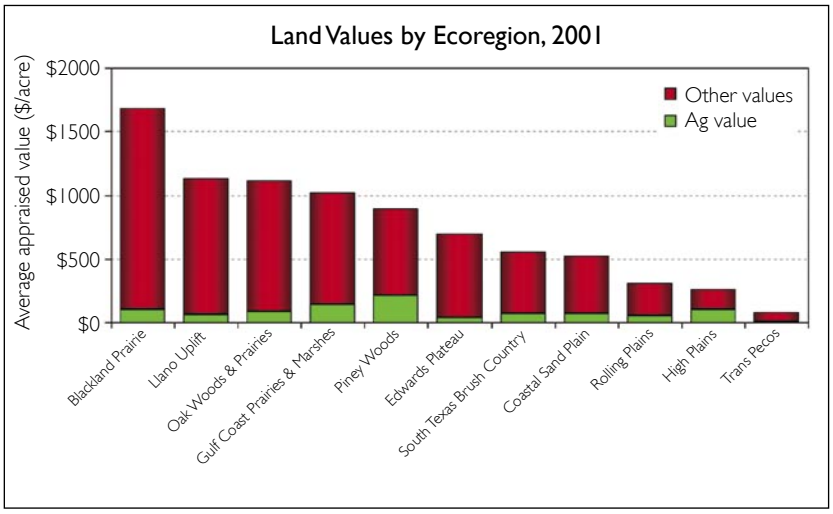


Figure 9. Disparity between agricultural values and other values, by ecoregion.

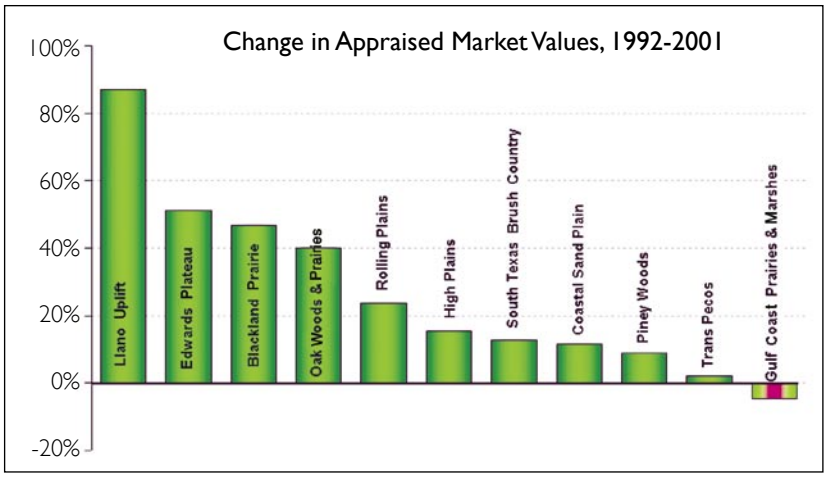
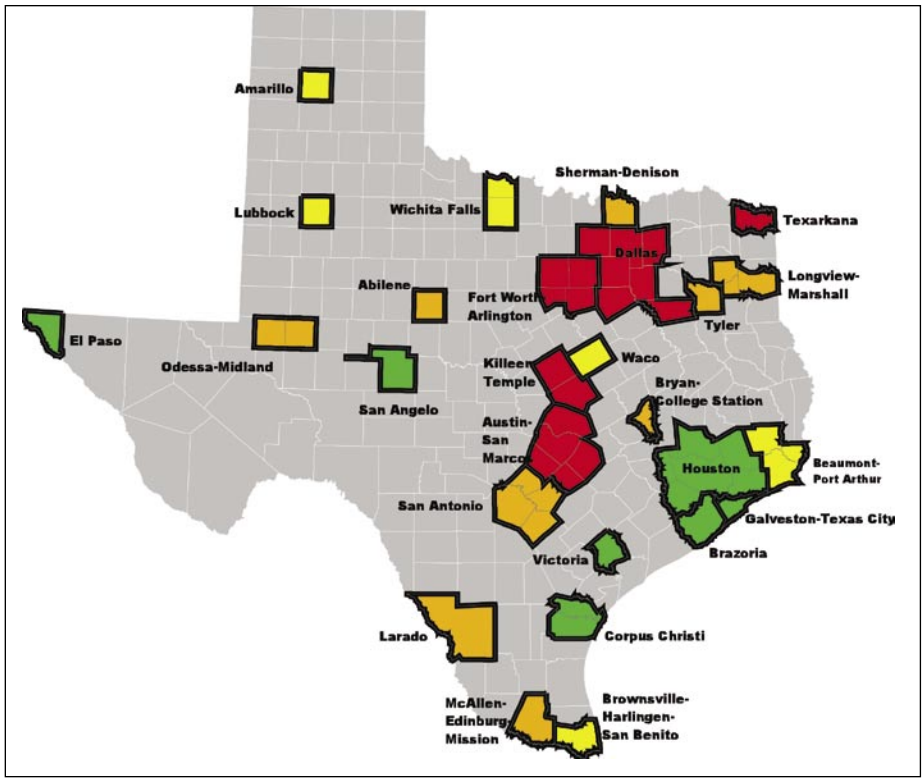


Figure 10. Ten-year change in farm and ranch market values, by ecoregion, 1992-2001.



"Much of the state's market value in rural land is contained within a triangle extending from Dallas-Fort Worth to Houston to San Antonio."

Figure 11. Metropolitan Statistical Areas (MSAs) in Texas. Figures in table are ranked by 2001 market value of farm and ranch lands within MSA boundary. Color codes refer to 10-year percent change in market value, 1992-2001.

Increase			
>50%	10-50%	0-10%	Decrease

Metropolitan Area	Market value 2001 ($/acre)	Change 1992 - 2001 $/acre	Change 1992 - 2001 %
Dallas	$3,807	1,272	50.2
Austin-San Marcos	$2,695	1,361	102.1
Fort Worth-Arlington	$2,645	1,506	132.2
Galveston-Texas City	$2,338	-347	-12.9
Houston	$1,852	-166	-8.2
San Antonio	$1,834	194	11.8
McAllen-Edinburg-Mission	$1,781	415	30.4
Brownsville-Harlingen-San Benito	$1,775	15	0.8
Tyler	$1,517	212	16.2
Bryan-College Station	$1,484	356	31.5
El Paso	$1,441	-40	-2.7
Sherman-Denison	$1,332	293	28.2
Corpus Christi	$1,027	-125	-10.9
Brazoria	$1,024	-91	-8.2
Texarkana	$1,001	386	62.8
Longview-Marshall	$848	81	10.5
Killeen-Temple	$804	473	142.7
Beaumont-Port Arthur	$752	11	1.5
Victoria	$652	-45	-6.4
Lubbock	$612	48	8.5
Waco	$572	7	1.2
Abilene	$550	170	44.8
Laredo	$417	84	25.1
San Angelo	$415	-4	-1.1
Wichita Falls	$378	22	6.0
Amarillo	$269	20	8.0
Odessa-Midland	$207	54	35.6
Non-Metropolitan Areas	$459	90	24.3

"Among counties that lost agricultural land, the top 10 percent lost more than 500,000 acres to urbanization."

Agricultural Values. In 2001 the average agricultural value of farm and ranch land was $80 per acre. Since 1992, average statewide agricultural values have increased by only 4 percent. Valuations were closely related to ecological region, with the highest values in the East Texas Piney Woods and the lowest in West Texas (Fig. 12).

- The forested regions of East Texas maintained the highest agricultural values, averaging $210 per acre.

- Land used for row crop production had somewhat higher agricultural values than land used for other purposes. Within a region, cropland generally receives a higher agricultural appraisal than does native rangeland. As a result, land in the Blackland Prairie and High Plains has higher agricultural values than land in the adjacent Trans Pecos, Rolling Plains, Edwards Plateau or Oak Woods and Prairies, all of which are dominated by native rangelands.

- As a proportion of overall market value, the agricultural values in the High Plains are the highest (Fig. 13), accounting for 40 to 60 percent of average market value. Due to inflated market values, some of the greatest disparity between agricultural and market values is in the Edwards Plateau and Llano Uplift.

- Increasing timber prices in the mid 1990s caused the agricultural valuations of land in the Piney Woods to increase by more than 25 percent from 1992 to 2001. Most of the $73 per acre increase in Piney Woods market values can be accounted for by a $44 per acre increase in agricultural value.

- In some regions (e.g., High Plains and Coastal Sand Plain), an overall loss in agricultural values can be largely attributed to shifting land use. Because grassland uses (native rangeland and improved pasture) generally receive lower agricultural appraisals than cropland uses, agricultural values decreased in those areas with substantial shifts from cropland to grassland.

- An area west of Houston lost agricultural value primarily because of the shift from cropland to pastureland since 1992.

Trends in Nonagricultural Value. The nonagricultural value of rural land is the factor that has varied the most over the last decade. The inflationary trend of nonagricultural value could be the most sensitive indicator of future land fragmentation. Using this key indicator, we can predict that ownership fragmentation may soon be a serious threat in some rural areas of the Panhandle and north-central Texas (Fig. 14). Since 1992, some land along the tributaries of the Canadian and Red Rivers in the Panhandle has had a tremendous increase in nonagricultural value. Parts of the Cross Timbers (e.g., Montague and Wise Counties) also have seen land values more than double during that period. Other areas at risk of fragmentation include parts of the Central Texas Hill Country.

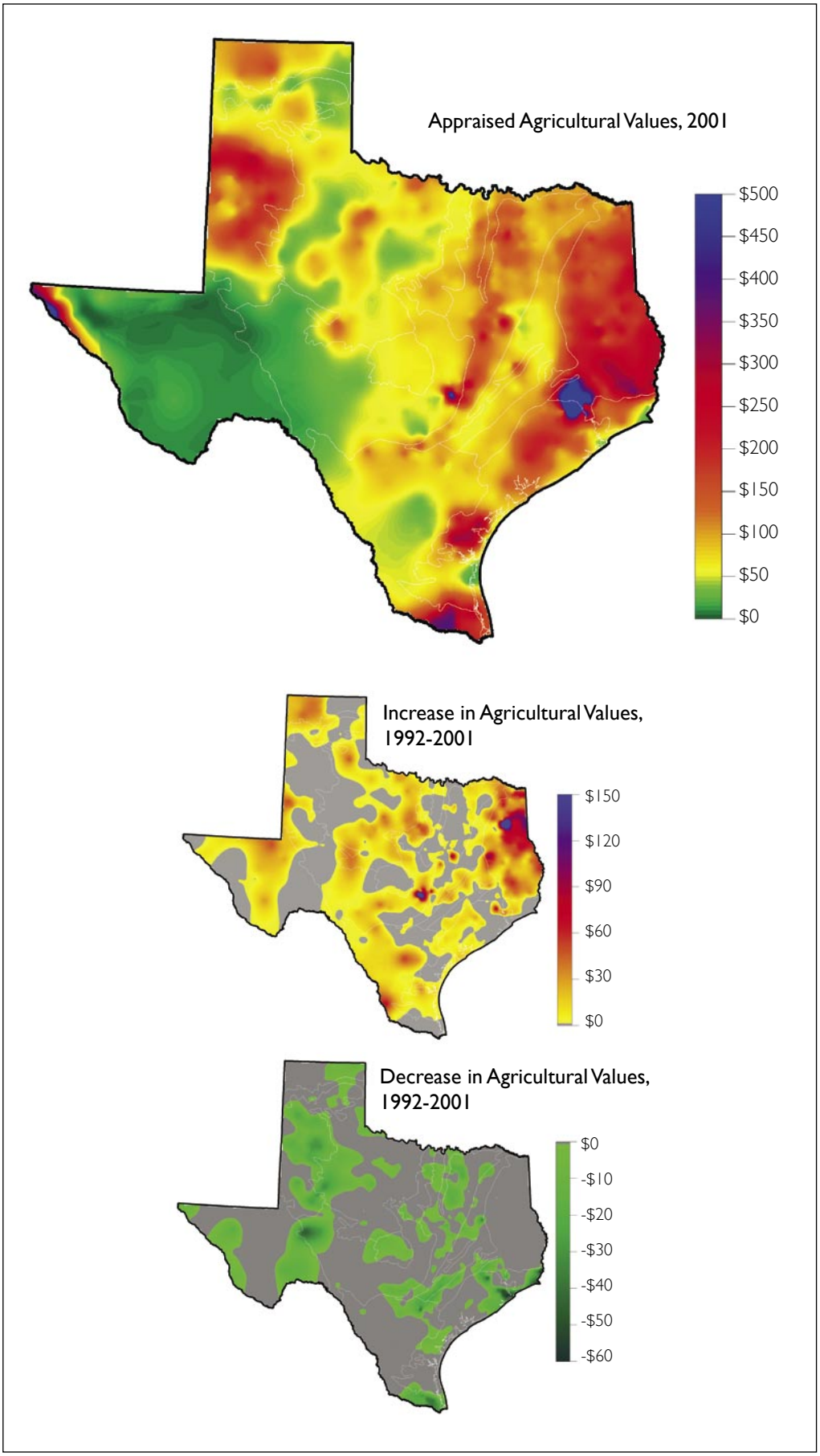


Figure 12. Appraised agricultural "productivity" value (dollars per acre) of farm and ranch land in 2001; change from 1992-2001.

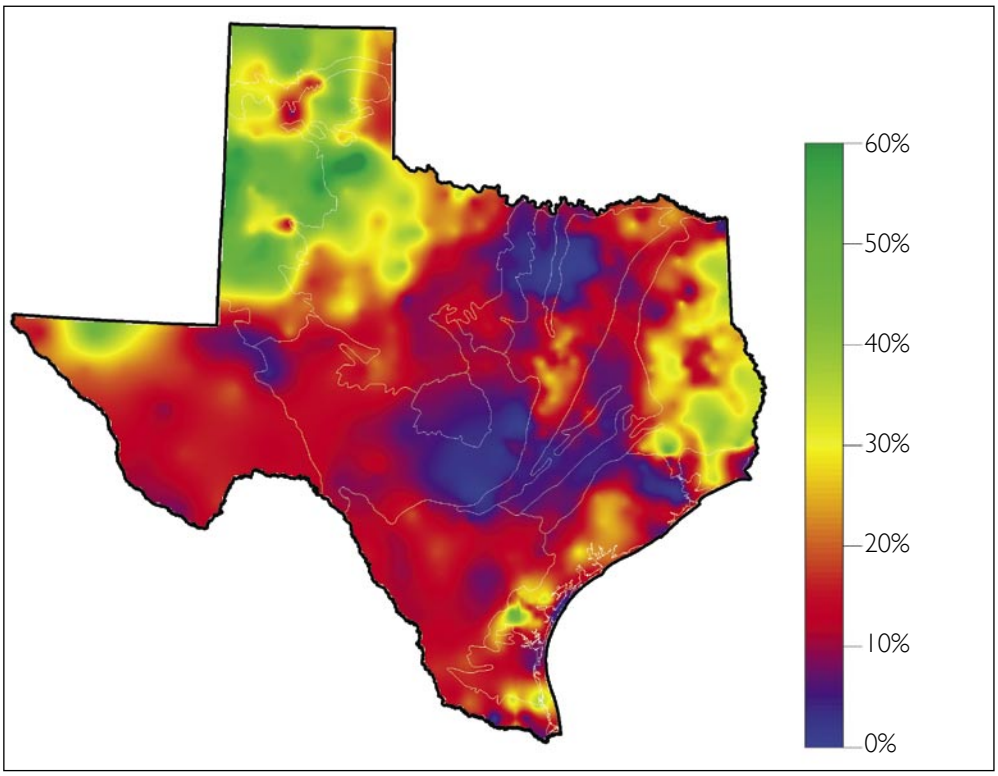


Figure 13. Agricultural value as a percent of total market value for rural lands, 2001.

"The gap between agricultural and market values is widening in most areas of Texas. The nonagricultural value (the difference between those two) reflects this gap and can predict changes in ownership size."

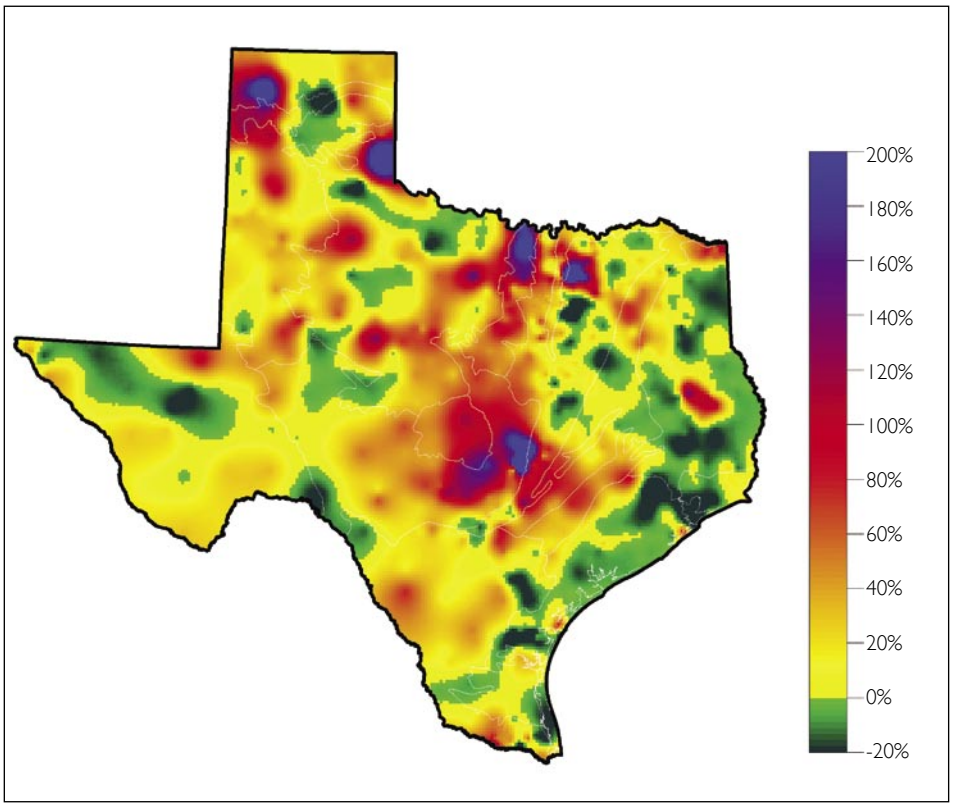


Figure 14. Percent change in the "nonagricultural" land value of rural lands, 1992-2001.

"As farms and ranches are fragmented, some wildlife habitats are fragmented."

The Effects of Changing Property Sizes on Landscape Structure

Much of the alarm about rural land fragmentation is caused by the assumption that the break-up of large farms and ranches will cause undesirable changes in rural landscapes, primarily the fragmentation of wildlife habitats. We tested this assumption by looking at the correlation between the density of farm and ranch ownerships and habitat fragmentation, using Bastrop County as our case study. We used 1981 and 1997 property ownership boundaries and made statistical comparisons to satellite imagery from similar time periods (1984 and 1999). The numbers and sizes of habitat patches were used as measures of fragmentation. To see if any of the relationships between ownership size and fragmentation changed when considered at different scales, landscapes were examined at four different scales–6,178, 12,355, 24,170 and 49,420 acres (2,500, 5,000, 10,000 and 20,000 hectares). This is what we found.

- In areas where the number of ownerships increased over time, landscapes became more fragmented (i.e., there were more habitat patches per unit area).
- Over time, the proliferation of smaller properties led to greater fragmentation of native rangeland habitats.
- Land fragmentation was related to an overall loss of native rangelands through conversion to improved pastures in areas of low-density rural development.
- The relationship between the number of small properties and the integrity of pine-oak forestlands in the "Lost Pines" region was complex. The area of pine-oak forestland decreased by about 7 percent from 1984 to 1999. At the scale of these analyses, the fragmentation of pine-oak forestland was not correlated with an increase in ownership density. Instead, it appears that the overall growth and development of pine forest was suppressed in areas of increased rural subdivision.

These results suggest that landscape characteristics across the case study area were influenced by ownership fragmentation (the subdivision of farms and ranches); those relationships were strong enough to be detected in satellite imagery with consistency.

The loss of native rangeland associated with increased land fragmentation is consistent with our results at the statewide and regional scales. These results further imply that not only is native rangeland lost through conversion to improved pastures, but that the remaining native rangeland habitats are fragmented into increasingly smaller patches as fragmentation progresses. This trend eventually destroys the habitat of wildlife species that require relatively large patches of rangeland habitat. While these results cannot be directly applied across the entire state, they do confirm that the relationship between ownership size and landscape character, for a given region, are somewhat predictable.

Engle, J. A. and R. N. Wilkins. Relationships between land ownership size and landscape structure: a case study in central Texas. Manuscript submitted. *Landscape Ecology*. (Available in full project report.)

"Some fragmentation might be prevented by incentives that enable landowners to transfer property without subdivision."

Relationships Among Land Values, Ownership Size and Population Density

Because the nonagricultural value of farm and ranch land has changed so much recently, it probably reflects one of the main factors driving land fragmentation–the demand for rural land for reasons other than traditional agriculture. In previous sections we established some correlation between ownership size and land use, and between ownership size and landscape characteristics for a case study area. Those correlations suggest that land use and landscape characteristics do respond to changes in ownership size and vice versa. To further understand what drives those large-scale changes, we examined the relationship between ownership size and land value, and how this relationship is influenced by changes in population.

We used spatial analysis techniques to explore the relationships between relatively short-term changes in farm and ranch sizes, population density, and land values. For the land value analyses, we focused on the nonagricultural component of land value, as this is the most variable component of total land value across the state.

- During the 1990s, the nonagricultural component of rural land value tended to change in concert with changes in population density. However, this relationship was not so strong as to suggest that population density was the only factor influencing the nonagricultural value of land.

- The size and number of large farms and ranches tend to decrease as the nonagricultural component of land value increases. Likewise, as nonagricultural values increase, the number of small ownerships increases. While these associations are more or less consistent across the state during any single time period, they are most compelling when considering the changes from one time period to another, even over a 5-year period.

In summary, these results suggest that trends in nonagricultural land value are relatively good predictors of trends in land fragmentation. If, in fact, these associations represent a functional relationship between nonagricultural value and the break-up of larger farms and ranches, then the nonagricultural component of appraised land values can be used as an early indicator of land fragmentation. These relationships further imply that the ability to subdivide rural land may represent a substantial portion of the present or future nonagricultural value of larger farms and ranches. If so, then some land fragmentation might be avoided through incentives that either remove landowners' needs or desires to sell, or provide them with ways of transferring property without subdivision. In the next section we explore the potential of one such incentive program, a Purchase of Development Rights (PDR) program aimed at conserving larger farms and ranches in areas under intense fragmentation pressure.

Kjelland, M. E., E. A. Gonzalez, W. E. Grant and R. N. Wilkins. An analysis of agricultural land ownership fragmentation and consolidation in Texas: spatial relationships between land ownership size and land value. Working paper. Land Fragmentation Studies. Texas A&M University. (Available in full project report.)

Establishing a Purchase of Development Rights Program in Texas

For the past 25 years, Purchase of Development Rights (PDR) programs nationwide have slowed the conversion and fragmentation of farms, ranches and wildlife habitat. PDR programs buy development rights from willing landowners, thus compensating them for conserving wildlife, water and open landscapes rather than selling lands for development. Under a PDR program, willing landowners are paid for the right to subdivide and develop their land. The landowner usually retains all other rights of ownership, including the right to use the land for agriculture, hunt, prevent trespass, sell, bequeath or otherwise transfer the land to others. The agency or organization purchasing the development rights then has the right and responsibility to limit subdivision and development of the property as described in provisions of the agreement.

For several years, Texas has been exploring the possibility of establishing a statewide Purchase of Development Rights program. In this study we explored several ways such a program might be applied to private lands in Texas and what its conservation implications might be. To do this, we created a simulation model for projecting future changes in rural lands across Texas.

The Model. The simulation model represents changes in ownership size, land use and land values for each of 6,933 parcels, each representing an area of 6.2 by 6.2 miles (10 km by 10 km), or 24,710 acres. Rural land variables in each of the parcels were estimated by interpolating from known values in all adjacent counties or independent school districts. This was accomplished through a spatial modeling process known as kriging (the same process used for creating many of the maps in this report). The simulation model describes historical patterns of change in each rural land variable over the 10-year period of 1992 to 2001. By assuming various annual rates of change, the model simulates the Texas rural landscape over the next decade.

The Scenarios. We projected the influence of initiating nine generalized versions of a PDR program, with three different assumptions of annual rates of change in ownership size from 2002 to 2011. These rates were one-half the historic rate of change, the historic rate of change, and two times the historic rate of change. Thus, we generated 27 simulations that differ according to when the PDR program was initiated (2002 vs. 2007), the total annual funding dedicated to the PDR program ($50 million vs. $100 million),* and the objective driving the selection of areas for PDR focus. We used this latter variable to look at the difference between focusing on areas that are experiencing the break-up of large ownerships (more than 2,000 acres) as opposed to those experiencing an increase in small ownerships (less than 500 acres). For simulation purposes, we used the nonagricultural value of rural land to represent the purchase price of development rights.

The Results. These simulations revealed some dynamics useful for guiding the structure of a PDR program:

- A PDR program will slow fragmentation more if it focuses on areas with the greatest trends in fragmentation of large ownerships as opposed to focusing on those areas where the proliferation of smaller ownerships is greatest. The distinction is subtle but important. According to our simulations, by purchasing development rights in areas with the highest break-up of large farms and ranches, the total financial resources of a PDR program are spread across a wider area, more total land area is conserved, and overall fragmentation into small ownerships is lessened. By focusing on landscapes with the highest increase in small ownerships, the loss of mid-sized ownerships is reduced but with lesser cumulative benefits. However, the total area of development rights purchased was slightly greater when focusing on small ownerships.

- All else being equal, waiting 5 years to begin the program decreased the possible benefit by 60 to 75 percent by the end of 10 years, depending on the assumed rate of future change. Assuming the 1992-2001 rates of change will continue through the next decade, the consequence of a 5-year delay is a 71 percent decrease in the amount of large ownership areas protected from fragmentation.

* These figures were chosen to illustrate the relative influence of changes in funding level. However, they do represent the range of funding levels of PDR programs in other states.

- Assuming historical rates of change, if the program were to begin immediately, the consequences of a 50 percent reduction in funding (funding the program at $50 million rather than $100 million) is a 51 percent decrease in the amount of large ownership areas protected from fragmentation.

- While reduced funding did reduce the conservation of large ownerships, the effect was not as large as the effect of a 5-year delay in initiating funding. With reduced funding and immediate implementation, 82 percent more large ownership land would be conserved than with a 5-year delay in the program. In addition, our simulations suggest that the funds would be distributed over a larger geographic area.

Results of these simulations are presented in the full report. Because the analyses were simulated, these results are not definitive. In practice, a PDR program may need to take a combination of approaches to maximize conservation potential. Therefore, these results are most useful as guidelines for analyzing alternatives in program development. The greatest value of this model will be its future use in analyzing "real" scenarios–i.e., those actually under consideration. Also, the model is built so that it can be used to simulate changes in land use and land values.

Wilkins, R. N., W. E. Grant, M. E. Kjelland and E. A. Gonzalez. A spatially explicit simulation model of farm and ranch size distribution under a purchase of development rights (PDR) program. Working paper. Land Fragmentation Studies. Texas A&M University. (Available in full project report.)

Annotation of project reports and products

In addition to the following reports and products, the policy implications from this project are available from American Farmland Trust at *http://www.farmland.org.*

1. *Trends in Texas Rural Lands: Land Conservation Implications for the 21st Century.*

- Summary and key findings: An overview of the project, including key findings and implications.
- Land fragmentation risk rankings: A set of maps illustrating the status and trends of four important factors relating to rural land conservation.

2. *Database Delivery.*

- Internet data exploration and mapping system: *http://landinfo.tamu.edu/frag.* A Web-based tool for exploring the various data sets used for analyses, including a mapping system that allows users to create maps and analyze data from a spatial perspective. A tutorial is included in the final report.
- Database CD: The full data set is available as an Access® database. A full set of variable descriptions, and a data tracking document, are available in the final report.

3. *Technical Reports:* A set of papers describing the technical analyses upon which many of the conclusions of the project are based. These reports are in various stages of preparation for submission to peer-reviewed scientific journals. The following technical reports are available in the full project report.

- Engle, J.A. and R.N. Wilkins. Relationships between land ownership size and landscape structure: a case study in central Texas. Manuscript in Review. *Landscape Ecology.*
- Gonzalez, E.A, M.E. Kjelland, W.E. Grant and R.N. Wilkins. Relationships between farm and ranch size distribution and land use in Texas. Working Paper. Land Fragmentation Studies. Texas A&M University.
- Kjelland, M.E., E.A. Gonzalez, W.E. Grant and R.N. Wilkins. An analysis of agricultural land ownership fragmentation and consolidation in Texas: spatial relationships between land ownership size and land value. Working Paper. Land Fragmentation Studies. Texas A&M University.

4. A *simulation model* for projecting changes in ownership size, land use and land values in Texas. The initial version of this model was used to simulate the possible influence of a Purchase of Development Rights (PDR) program on ownership sizes across Texas through the next decade.

- Wilkins, R.N., W.E. Grant, M.E. Kjelland and E.A. Gonzalez. A spatially explicit simulation model of farm and ranch size distribution under a purchase of development rights (PDR) program. Working Paper. Land Fragmentation Studies. Texas A&M University.

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