

Agricultural and Food Policy Center  
Texas A&M University

March 2013

## **A COUNTY-LEVEL LAND RENT DATABASE FOR U.S. AGRICULTURE AND FORESTRY**



# **AFPC**

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# **A COUNTY-LEVEL LAND RENT DATABASE FOR U.S. AGRICULTURE AND FORESTRY**

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AFPC Research Report 13-1

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# 1 Introduction

The establishment and consideration of different policies and initiatives affecting land-use change have motivated numerous regional studies analyzing the impacts exerted on the economy and society. Hence, integrated assessment frameworks are needed and currently being developed to more carefully study the role of land under current policy settings. Until recently, the development of comprehensive economic regional models in the U.S. has been precluded by the lack of a consistent regional land resource database linked to underlying economic activity and land-use drivers. Hence, the accurate estimation of the most important link, land rents, becomes a critical component in the development of these assessment frameworks.

This report describes the procedure followed by Monge (2012) to estimate county-level land rent payments for different land-use categories (cropland, pastureland and forestland) from national and public databases sponsored by the U. S. Department of Agriculture (USDA). Subsequently, Monge (2012) matched these land-use categories with the IMPLAN activities related to agriculture and aggregated the county-level land rents to their respective Major Land Resource Area (MLRA) to account for land heterogeneity in a Computable General Equilibrium (CGE) model. The final matrix with land rents looks like figure 1.

According to the USDA 2007 Census of Agriculture, the four major land use categories for agricultural land in the U.S. are cropland, pastureland, forestland and land enrolled in the Conservation Reserve Program (CRP). Rents and acreage figures will be estimated for the first three categories. Acreage for cropland and pastureland will be divided into a finer disaggregation set following the IMPLAN classification system for activities. Cropland acreage will be estimated for the crops and IMPLAN activities listed in table 10. Pastureland acreage will be estimated for beef cattle and dairy cattle ranching. Forestland acreage will be estimated for privately-owned timberland, which is forestland that is producing or capable of producing more than 20 cubic feet per acre per year of wood and excludes reserved forestland.

## 2 Cropland

### 2.1 Cropland acreage

Harvested acreage figures were obtained from the USDA National Agricultural Statistics Service (NASS) through Quick Stats (NASS, 2011). As previously mentioned, the crops considered are listed in table 10.<sup>1</sup>

Harvested acreage (*CROPACRES*) was used instead of planted acreage since the rental rates are generated from the activity (or use) on a given parcel of land during the calendar year. Hence, by using harvested acreage the value of the land in production over the course of the entire year would be considered rather than just one season (i.e. double cropping).

### 2.2 Cropland rents

NASS provides cropland rent figures (\$/ac) per county on Quick Stats (NASS, 2011). These per-acre rent figures (*CROPRENT*) are provided for irrigated and non-irrigated cropland. To estimate a single cropland rental rate per county, a weighted average (*CROPRENTAVG*) was estimated using irrigated and non-irrigated cropland acreages (*CROPACRES*) as weights (*IRRWEIGHT*):

$$CROPRENTAVG_{state, county} = \sum_{irrig} CROPRENT_{state, county, irrig} * IRRWEIGHT_{state, county, irrig}, \quad (1)$$

$$IRRWEIGHT_{state, county, irrig} = \frac{CROPACRES_{state, county, irrig}}{\sum_{irrig} CROPACRES_{state, county, irrig}}, \quad (2)$$

---

<sup>1</sup>The majority of the acreage figures were obtained for 2008 and some for 2007. For some counties, acreage figures were not disclosed; hence, historical data was used to fill these gaps. Quick Stats provides acreage figures for the entire set of districts for 2008. County shares were estimated by district from the historical data and multiplied by the 2008 district-level totals. A VBA macro was created in MS Excel to fill these undisclosed figures.

		AGRICULTURAL ACTIVITIES									
Land use		Cropland					Pastureland		Forestland		
IMPLAN Industries		Oilseed	Grain	Tobacco	Cotton	Sugarcane and beet	All others	Beef	Dairy	Logging	
IMPLAN code		1	2	7	8	9	10	11	12	16	
<b>MAJOR LAND RESOURCE AREAS</b>	STATE 48	...	Land Rents								
		MLRA <sub>48,n</sub>									
		...									
		MLRA <sub>48,1</sub>									
		...									
		County <sub>48,n,n</sub>									
	...										
	...										
	...										
	...										
	...										
	County <sub>48,1,1</sub>										
STATE 1	...										
	MLRA <sub>1,n</sub>										
	...										
	MLRA <sub>1,1</sub>										
	...										
	County <sub>1,1,1</sub>										

Figure 1: Matrix Portraying Land Rent Payments from Different Land-Use Types to the Major Land Resource Areas (MLRA)

where *state* is a set including all the contiguous U.S. states, *county* is a set of counties in the U.S. and *irrig* is a set that includes irrigated and non-irrigated crop.

### 3 Forestland

#### 3.1 Forestland acreage

As previously mentioned, acreage was obtained for privately-owned timberland. Timberland is considered forestland that is producing or capable of producing more than 20 cubic feet per acre per year of wood. The Forest Inventory Data Online (FIDO) created by Forest Inventory and Analysis (FIA) National Program, part of the USDA Forest Service (FS), provides timberland acreage figures at the state level for four ownership categories: private, forest service, state and local government, and other federal (FS, 2010). Since NRCS reports land use using the term forestland, the term forest and timberland will be used interchangeably in this document. By estimating the share of private timberland at the state level and applying it to every county, acreage figures were obtained at the county level for private timberland (*FORACRES*).

#### 3.2 Forestland rents

Sohngen and Tennity (2004) and Sohngen et al. (2008) developed two different alternatives to estimate land rents per hectare per year. The first one represented a marginal hectare in a forest and was estimated from the rental function developed in Sohngen and Mendelsohn (1999, 2003, 2007). The second was obtained using a net present value (NPV) specification and was estimated for an average hectare in a forest. The NPV formulation is the following:

$$NPV = \frac{(P^{QA}) (V_t^M) (1 + r)^t - C}{(1 - (1 + r)^{-t})}, \quad (3)$$

where  $P^{QA}$  is the quality-adjusted net stumpage price,  $t$  is the rotation age,  $V_t^M$  is the merchantable yield of the timber type at age  $t$ ,  $r$  is the discount rate (5% is assumed), and  $C$  is the regeneration cost. According to Sohngen and Tennity (2004) and Sohngen et al. (2008), annual land rent figures (*FORRENT*) can be estimated using the following approximation:

$$FORRENT_{state} = r * NPV_{state}. \quad (4)$$

Sohngen and Tennity (2004) and Sohngen et al. (2008) note that the rental values estimated using the rental function would be higher than the ones derived with the NPV formulation. The rental rate for the average hectare in a forest is presently required; hence, we use the NPV specification. Sohngen (2013) provides the NPV values for 13 different timber types in the US in 2000 Dollars per hectare. By using the conversion rate of 0.4047 hectares per acre, NPV values on a per-acre basis were obtained. These figures are shown in table 1 along with their respective major timber categories.

Sohngen (2013) divided the U.S. into five different regions:

1. South,
2. Northeast,
3. Great Lakes,
4. West, and
5. Pacific Northwest.

Each region contains the states listed in table 2. They also aggregated the timber types into two major categories:

Table 1: **Timber Production and Net Present Values in 2000 Dollars (Source: Sohngen, 2013)**

Type	Description	Major category	Timber production (million m <sup>3</sup> /yr)	Net Present Value (\$/ac)
M1	Southern pine plantation	Softwood	70.49	738.59
M2	Southern natural pine	Softwood	56.51	492.39
M3	Southern upland hardwoods	Hardwood	77.74	151.92
M4	Southern bottomland hardwood	Hardwood	29.87	97.52
M5	Northeast softwood	Softwood	8.18	33.41
M6	Northeast Oak/Hickory	Hardwood	24.45	73.44
M7	Northeast Maple/Beech/Birch	Hardwood	19.27	24.05
M8	Great lakes softwood	Softwood	6.17	75.49
M9	Great lakes Oak/Hickory	Hardwood	8.28	15.40
M10	Great lakes Maple/Beech/Birch	Hardwood	23.90	27.59
M11	Western Pine	Softwood	30.22	27.86
M12	Western Hardwood	Hardwood	5.62	19.07
M13	Pacific Northwest Douglas-Fir	Softwood	59.30	285.57

1. softwood and
2. hardwood.

Table 2: **Timberland Regions Considered for the Regionalization of Rents**

South	Northeast	Great Lakes	West	Pacific Northwest
Alabama	Connecticut	Illinois	Arizona	Oregon
Arkansas	Delaware	Indiana	California	Washington
Florida	Maine	Iowa	Colorado	
Georgia	Maryland	Michigan	Idaho	
Kentucky	Massachusetts	Minnesota	Iowa	
Louisiana	New Hampshire	Wisconsin	Kansas	
Mississippi	New Jersey		Missouri	
North Carolina	New York		Montana	
Oklahoma	Ohio		Nebraska	
South Carolina	Pennsylvania		Nevada	
Tennessee	Rhode Island		New Mexico	
Texas	Vermont		North Dakota	
Virginia	West Virginia		South Dakota	
			Utah	
			Wyoming	

Each of these two major categories includes different subcategories depending on the region in the U.S. as shown in table 3.

Since forestland acreage information at the county-level was presented by forest-type group, the two major timber categories and their respective subcategories were more finely disaggregated by forest-type groups. There are 32 forest-type groups that include different tree species. These 32 forest-type groups with their respective major categories and subcategories are listed in table 4.



Table 3: Timber Categories and Subcategories by Regions

	South	Northeast	Great Lakes	West	Pacific Northwest
<b>Softwood</b>	Pine plantation and natural pine	Softwood	Softwood	Pine	Douglas-Fir
<b>Hardwood</b>	Upland and bottomland	Oak/Hickory and Maple/Beech/Birch	Oak/Hickory and Maple/Beech/Birch	Hardwood	

Table 4: Forest-type Group Aggregation by Major Timber Category

Major timber category		Forest-type groups
<b>Softwood</b>		White / red / jack pine group (100)
		Spruce / fir group (120)
		Longleaf / slash pine group (140)
		Loblolly / shortleaf pine group (160)
		Other eastern softwoods group (170)
		Pinyon / juniper group (180)
		Douglas-fir group (200)
		Ponderosa Pine group (220)
		Western white pine group (240)
		Fir / spruce / mountain hemlock group (260)
		Lodgepole pine group (280)
		Hemlock / Sitka spruce group (300)
		Western larch group (320)
		Redwood Group (340)
		Other western softwoods group (360)
	California mixed conifer group (370)	
	Exotic softwoods group (380)	
	Other softwoods group (390)	
<b>Hardwood</b>	Oak / Hickory	Oak / hickory group (500)
		Western oak group (920)
		Tanoak / laurel group (940)
		Tropical hardwoods group (980)
	Maple / Beech / Birch	Elm / ash / cottonwood group (700)
		Maple / beech / birch group (800)
		Aspen / birch group (900)
		Alder / maple group (910)
		Exotic hardwoods group (990)
Other hardwoods	Other hardwoods group (960)	
	Woodland hardwoods group (970)	
<b>Combined</b>		Oak / pine group (400)
		Oak / gum / cypress group (600)



### 3.2.1 Southern region

As shown in table 3, softwood in the Southern region was divided into two subcategories:

1. pine plantation and
2. natural pine.

Since the county-level shares of planted and natural pines could not be found, the acreage of natural stand and regenerated pines obtained in FIDO were used to estimate a state-level weighted average of the NPV ( $NPVSOUTH\ SOFT$ ) of the two subcategories ( $south\ soft$ ). The acreage of natural and regenerated softwood was obtained by summing the acreage of softwoods among the 32 forest-type groups as shown in the example for Alabama in table 5. The acreage and shares for the entire Southern region are listed in table 6. Hence, 13 different softwood NPV figures were estimated, one for each state in the South as shown in table 7:

$$NPV_{south,'soft'} = \sum_{south\ soft} NPVSOUTH\ SOFT_{south\ soft} * SOFTWEIGHT_{south,south\ soft}, \quad (5)$$

$$SOFTWEIGHT_{south,south\ soft} = \frac{\sum_{type} SOFTACRES_{south,south\ soft,type}}{\sum_{south\ soft} \sum_{type} SOFTACRES_{south,south\ soft,type}}, \quad (6)$$

where  $woodreg$  is a set including the timberland regions developed by Sohngen (2013),  $'soft'$  is an element of the major category set  $wood$ ,  $south$  is a subset of  $state$  containing the Southern states,  $south\ soft$  is a set that includes planted and natural softwoods, and  $type$  is a set including the forest-type groups listed in table 4.

Table 5: Acreage and Shares of Natural and Planted Softwood in Alabama in 2008

Forest-type group	Acres of stand origin		Total
	Natural	Planted	
White / red / jack pine group	3,026.00		3,026.00
Longleaf / slash pine group	767,974.00	359,737.00	1,127,711.00
Loblolly / shortleaf pine group	2,823,468.00	5,393,953.00	8,217,421.00
Other eastern softwoods group	51,595.00	12,717.00	64,312.00
<b>Total</b>	<b>3,646,063.00</b>	<b>5,766,407.00</b>	<b>9,412,470.00</b>
<b>Shares</b>	<b>0.39</b>	<b>0.61</b>	

For example, in the state of Alabama, included in the Southern timberland region, the shares of planted and natural pine stands are 0.61 and 0.39, respectively. The NPV estimates for the entire Southern region for planted and natural pine stands are \$738.59 and \$492.39 per acre, respectively. Using these four estimates, a weighted NPV for softwood for the state of Alabama of \$643.22/ac was obtained:

$$SOFTWEIGHT_{alabama,'planted'} = 5,766,407/9,412,470 = 0.61, \quad (7)$$

$$SOFTWEIGHT_{alabama,'natural'} = 3,646,063/9,412,470 = 0.39, \quad (8)$$

$$NPV_{alabama,'soft'} = (738.59 * 0.61) + (492.39 * 0.39) = 643.22. \quad (9)$$

Sohngen also divided the hardwood major category into two subcategories in the South:

1. upland species and
2. bottomland hardwood species.

Table 6: **Acres and Shares of Natural and Planted Softwood in the Southern Timberland Region**

Southern states	Acres		Shares	
	Natural	Planted	Natural	Planted
Alabama	3,646,063	5,766,407	0.39	0.61
Arkansas	3,003,105	2,644,050	0.53	0.47
Florida	2,727,343	4,534,693	0.38	0.62
Georgia	4,246,723	6,864,727	0.38	0.62
Kentucky	408,666	40,136	0.91	0.09
Louisiana	2,179,607	3,482,205	0.38	0.62
Mississippi	3,324,630	4,606,469	0.42	0.58
North Carolina	3,016,284	2,679,811	0.53	0.47
Oklahoma	511,708	585,072	0.47	0.53
South Carolina	2,880,016	3,052,570	0.49	0.51
Tennessee	689,774	495,381	0.58	0.42
Texas	2,643,974	2,519,509	0.51	0.49
Virginia	1,283,334	1,878,052	0.41	0.59

Since there were no upland and bottomland share figures at the state or county level and no mapping existed between tree species and hardwood subcategories, a weighted average of the NPV for the entire Southern region ( $NPV_{SOUTHARD}$ ) was estimated using timber production figures ( $PROD$ ) for every subcategory as weights ( $HARDWEIGHT$ ). The timber production figures are shown in table 1 and were estimated by Sohngen (2013). Hence, one hardwood NPV figure was estimated for all the states included in the entire Southern region ( $south$ ).

$$NPV_{south,'hard'} = \sum_{southard} NPV_{SOUTHARD}_{southard} * HARDWEIGHT_{south,southard}, \quad (10)$$

$$HARDWEIGHT_{south,southard} = \frac{\sum_{southard} PROD_{south,southard}}{\sum_{southard} PROD_{south,southard}}, \quad (11)$$

where  $PROD$  is timber production in million cubic meters and  $southard$  is a set that includes upland and bottomland hardwood species.

Hence, if the production figures of upland and bottomland hardwoods in the Southern region were 77.74 and 29.87 million cubic meters, the shares were 0.72 and 0.28, respectively. The NPV figures for upland and bottomland hardwoods are \$152 and \$98 per acre, respectively. Then, the regional average is approximately \$138.43/ac:

$$HARDWEIGHT_{south,'upland'} = 77.74/107.61 = 0.72, \quad (12)$$

$$HARDWEIGHT_{south,'bottomland'} = 29.87/107.61, \quad (13)$$

$$NPV_{REGAVG}_{south,'hard'} = (152 * 0.72) + (98 * 0.28) = 138.43. \quad (14)$$

### 3.2.2 Northeastern and Great Lakes regions

For the Northeastern and Great Lakes regions, there is only one subcategory for softwoods. However, Sohngen (2013) divided the hardwood major category into the:

1. Oak/Hickory subcategory and
2. Maple/Beech/Birch subcategory.

Table 7: Net Present Value for Softwood in the Southern Region in 2008

Southern States	Regional NPV (\$/ac)		Shares of pine		Weighted NPV for softwood (\$/ac)
	Planted	Natural	Planted	Natural	
Alabama	738.59	492.39	0.61	0.39	643.22
Arkansas	738.59	492.39	0.47	0.53	607.67
Florida	738.59	492.39	0.62	0.38	646.13
Georgia	738.59	492.39	0.62	0.38	644.50
Kentucky	738.59	492.39	0.09	0.91	514.41
Louisiana	738.59	492.39	0.62	0.38	643.82
Mississippi	738.59	492.39	0.58	0.42	635.39
North Carolina	738.59	492.39	0.47	0.53	608.22
Oklahoma	738.59	492.39	0.53	0.47	623.73
South Carolina	738.59	492.39	0.51	0.49	619.07
Tennessee	738.59	492.39	0.42	0.58	595.30
Texas	738.59	492.39	0.49	0.51	612.53
Virginia	738.59	492.39	0.59	0.41	638.65

To match these two hardwood subcategories with the forest-type groups at the county level, the forest-type groups that shared similar characteristics were aggregated according to Sohngen’s hardwood subcategories. The forest-type group aggregation is shown in table 4.

A simple average NPV between the Oak/Hickory and Maple/Beech/Birch subcategories was assigned to the woodland and other hardwoods forest-type groups.

### 3.2.3 Western and Pacific Northwestern regions

The Western region is simply divided into the two major timber categories. Hence, a county-level weighted average NPV was estimated using acreage figures for softwoods and hardwoods as weights. The Pacific Northwestern region only includes the softwood major category since this is the predominant timber type; however, Western hardwood NPV figures were used for the regions that included hardwood species.

### 3.2.4 Combined forest-type groups

The 2 forest-type groups that combine hardwood and softwood are the:

1. Oak/Pine group and
2. Oak/Gum/Cypress group.

Since the pine and cypress species are softwoods, the softwood shares of both of these groups were needed. The forest-type groups are a composition of tree-specie groups; hence, the latter are more disaggregated. Hence, the softwood share was estimated from the Oak/Pine and Oak/Gum/Cypress groups using tree-volume figures from the tree-species groupings.

The state-level net tree volume figures (in cubic feet) by tree-specie and forest-type groups were obtained from FIDO (FS, 2010). From the tree-specie groups, the “exact” shares of softwood and hardwood were obtained at the state level and then applied to the state-level forest-type groups.

### 3.2.5 State-level estimates

The state-level NPV figures for hardwood, softwood, Oak/Pine, Oak/Gum/Cypress, Oak/Hickory, and Maple/Beech/Birch are listed in table 11 in 2000 Dollars. As previously noted, the state-level weighted NPV averages had to be multiplied by an interest rate of 5% to obtain annualized forestland rent figures as listed in table 12. These rent figures were adjusted for inflation by considering a 1.05 percent change in the Producer Price Index from 2000 to 2008 for the forestry sector.

### 3.2.6 County-level estimates

To obtain the average annual forestland rents ( $NPVCNTAVG$ ) at the county level, the state-level rents previously estimated were disaggregated. The procedure used by Lubowski (2002) was followed using acreage weights ( $WOODWEIGHT$ ) to estimate weighted averages for every county as formulated in equation (15). The weights used to disaggregate the state-level rents were the county-level acreage figures ( $WOODACRES$ ) for the different forest-type groups ( $type$ ) in the U.S. as shown in equation (16). These figures were estimated by the USDA's FS and presented in FIDO (FS, 2010).

$$FORRENTAVG_{state, county} = \sum_{wood} FORRENT_{state} * WOODWEIGHT_{state, county, wood}, \quad (15)$$

$$WOODWEIGHT_{state, county, wood} = \frac{\sum_{type} WOODACRES_{state, county, wood, type}}{\sum_{wood} \sum_{type} WOODACRES_{state, county, wood, type}}, \quad (16)$$

where  $wood$  is a set including softwood and hardwood species.

For example, Autauga county in Alabama has 158,917 acres of softwood; 84,929 acres of hardwood; 23,706 acres of Oak/Pine; and 24,648 acres of Oak/Gum/Cypress. The state-level, per-acre rent figures for Alabama are \$36.64 for softwood, \$7.24 for hardwood, \$16.74 for Oak/Pine, \$8.92 for Oak/Gum/Cypress. Hence, the weighted average per-acre rent for Autauga county, Alabama is \$22.51/acre:

$$WOODWEIGHT_{alabama', 'autauga', 'soft'} = 158,917/292,200 = 0.54, \quad (17)$$

$$WOODWEIGHT_{alabama', 'autauga', 'hard'} = 84,929/292,200 = 0.29, \quad (18)$$

$$WOODWEIGHT_{alabama', 'autauga', 'oak/pine'} = 23,706/292,200 = 0.08, \quad (19)$$

$$WOODWEIGHT_{alabama', 'autauga', 'oak/gum/cypress'} = 24,648/292,200 = 0.08, \quad (20)$$

$$\begin{aligned} FORRENTAVG_{alabama', 'autauga'} &= (36.64 * 0.54) + (7.24 * 0.29) \\ &\quad + (16.74 * 0.08) + (8.92 * 0.08) \\ &= 22.51. \end{aligned} \quad (21)$$

The majority of the per-county acreage information obtained was from 2008. There were 7 states for which previous years were used and 3 for which future years were used.<sup>2</sup>

## 4 Pastureland

### 4.1 Pastureland acreage

Pasture and rangeland acreage figures were obtained from NASS's Quick Stats (NASS, 2011). Acreage figures presented on Quick Stats were obtained from the 2007 Census of Agriculture. These include cropland and timberland pastured.

To divide pastureland acreage demand among its main consumers, county- and state-level inventory figures (number of heads) were obtained from NASS's Quick Stats for: cattle (including calves), cattle on feed, beef cows, dairy cows, replacement dairy heifers, beef heifers, calves, bulls, steers, goats, sheep, horses, mules, alpacas, bison, deer, elks, and llamas. All these figures were obtained from the 2007 Census of Agriculture for the inventories recorded at the end of December.

<sup>2</sup>Previous years' figures were used for Florida (2007), Louisiana (2005), Mississippi (2006), North Carolina (2007), Nevada (2005), New Mexico (1999) and Wyoming (2000). Future years' estimates were used for California (2009), Oregon (2009) and Washington (2009).

#### 4.1.1 Beef cattle

Besides consuming grain and other supplements, a great percentage of the beef cattle’s diet is grazed pasture, making this activity the main consumer of pastureland. To identify the average number of beef cattle heads per year using pastureland, the following formula was used:

$$PASTBEEF_{county} = CAT_{county} - FEEDCAT_{county} - DAICOW_{county} - DAIHEIF_{county}, \quad (22)$$

where *PASTBEEF* represents pasture-grazing beef cattle, *CAT* represents overall cattle inventories (including calves), *FEEDCAT* is beef cattle on feed, *DAICOW* represents dairy cows and *DAIHEIF* represents replacement dairy heifers. Hence, *PASTBEEF* includes calves, steers, beef heifers, beef cows and bulls on pasture and neither on feed nor part of the dairy activity.

Since the inventory figures for replacement dairy heifers (*DAIHEIF*) are not published at the county level, the state-level figures (*DAIHEFST*) were used to estimate a percentage of the dairy cow’s state total and were applied to the county level:

$$DAIHEF_{county} = (DAICOW_{county}) \left( \frac{DAIHEFST_{state}}{DAICOWST_{state}} \right). \quad (23)$$

#### 4.1.2 Dairy cattle

Dairy cattle’s diet is also partially based on grazed pasture, mainly for dry cows and small dairy operations (MacDonald et al., 2007). Hence, a small percentage of the dairy activity depends on pastureland. To identify this percentage at the county level, dairy-cow inventory figures categorized by the operation size were obtained from Quick Stats from the 2007 Census of Agriculture (NASS, 2011). For each operation size, a percentage of grazing dairy cattle was estimated using percentages published by the Wisconsin Agricultural Statistics Service and obtained through a survey performed in Wisconsin (Wisconsin Agricultural Statistics Service, 2005). These percentages are shown in table 8. Hence, the number of dairy cows on pasture is estimated like the following:

$$PASTDAI_{county} = \sum_{operation} DAICOW_{county,operation} * \%PASTDAI_{operation}, \quad (24)$$

where *operation* is a set that includes the different operation sizes shown in table 8, *PASTDAI* represents grazing dairy, and *%PASTDAI* are the percentages obtained from the Wisconsin report and shown in table 8.

Table 8: Wisconsin Grazing Dairy Herd, 2009

Herd Size	Grazing Herds
1-29	31%
30-49	27%
50-99	11%
100-199	8%
200-499	1%
500+	0%

#### 4.1.3 Pastureland demand (animal unit)

Since the livestock inventory distribution was different for every county, the animal-unit (AU) concept was used to obtain a representative distribution of the pastureland rents paid by each livestock activity in each county. The AU is “a convenient denominator for use in calculating relative grazing impact of

different kinds and classes of domestic livestock and of common wildlife species” (NRCS, 1997).<sup>3</sup> Hence, by multiplying the number of heads in the inventory by the AU, an approximate estimate of the pastureland demanded by each category was obtained. Table 9 shows the different AU equivalents for the livestock categories included in this study (NRCS, 1997).

Table 9: **Animal Units Equivalents Guide**

Categories	NRCS class	AU equiv.
Beef cattle		
Beef cow	Cow, dry	0.92
Bull	Bull, mature	1.35
Calf	Cattle, 1 year old	0.60
Heifer and steer	Cattle, 2 years old	0.80
Dairy cattle		
Dairy cow	Cow, with calf	1.00
Heifer and steer	Cattle, 2 years old	0.80
Sheep <sup>a</sup>		0.18
Goat <sup>b</sup>		0.13
Deer <sup>c</sup>		0.18
Horse		1.25
Elk		0.60
Bison		1.00
Alpaca <sup>d</sup>		0.10
Llama <sup>e</sup>		0.20

<sup>a</sup> Average of sheep (0.20) and lamb (0.15)

<sup>b</sup> Average of goat (0.15) and kid (0.10)

<sup>c</sup> Average of white-tailed (0.15) and mule (0.20)

<sup>d</sup> Same as a kid (0.10)

<sup>e</sup> Same as a sheep (0.20)

As listed in table 9, the beef and dairy cattle categories contained several subcategories. Hence, a single AU had to be estimated for each, beef and dairy, cattle category. Since *PASTBEEF* includes calves, steers, beef heifers, beef cows and bulls, a single animal-unit figure was estimated for the beef cattle category for every state. The same applied to *PASTDAI* since it included dairy cows and replacement dairy heifers. Inventory figures for calves, steers, beef heifers, dairy heifers and bulls were only found at the state level in Quick Stats (NASS, 2011).

Hence, a state-level weighted average AU figure (*AU*) was estimated for the beef cattle category using the inventory (*BEEFINVENT*) figures as (*BEEFWHEIGHT*) weights:

$$AU_{state,'beef'} = \sum_{beefcateg} BEEFAU_{beefcateg} * BEEFWHEIGHT_{state,beefcateg}, \quad (25)$$

$$BEEFWHEIGHT_{state,beefcateg} = \frac{BEEFINVENT_{state,beefcateg}}{\sum_{beefcateg} BEEFINVENT_{state,beefcateg}}, \quad (26)$$

where '*beef*' is an element of the set *livestock* representing the beef cattle category, *livestock* is a set including all the livestock categories that depend on pastureland, *beefcateg* is a set including the AU subcategories included in the beef cattle category as presented in table 9, *BEEFAU* represents the AU of the beef cattle's subcategories.

<sup>3</sup>The standard animal unit has been generally defined as one mature cow of approximately 1,000 pounds and a calf as old as 6 months.

The same procedure was applied to dairy cattle. A state-level weighted average AU figure ( $AU$ ) was estimated for the dairy cattle category using the inventory ( $DAIRYINVENT$ ) figures as weights ( $DAIRYWEIGHT$ ):

$$AU_{state,'dairy'} = \sum_{dairycateg} DAIRYAU_{dairycateg} * DAIRYWEIGHT_{state,dairycateg}, \quad (27)$$

$$DAIRYWEIGHT_{state,dairycateg} = \frac{DAIRYINVENT_{state,dairycateg}}{\sum_{dairycateg} DAIRYINVENT_{state,dairycateg}}, \quad (28)$$

where ' $dairy$ ' is an element of the set  $livestock$  representing the dairy cattle category,  $dairycateg$  is a set including the different AU subcategories included in the dairy cattle category as presented in table 9,  $DAIRYAU$  represents the AU of the dairy cattle's subcategories.

As listed in table 13, an AU estimate was assigned to every category that depends on pastureland ( $livestock$ ), except for the beef and dairy categories, since each had an estimate for every state. The following formula was used to separate pastureland acreage for every category for every county:

$$\%ACRES_{state,county,livestock} = \frac{INVENT_{state,county,livestock} * AU_{state,livestock}}{\sum_{livestock} INVENT_{state,county,livestock} * AU_{state,livestock}}, \quad (29)$$

where  $livestock$  is a set that includes all the livestock activities that depend on pastureland,  $\%ACRES$  represents the percentage of pastureland used by every category in every county, and  $INVENT$  is the number of heads in inventory for every category where for the beef and dairy cattle categories:

$$INVENT_{state,county,'beef'} = PASTBEEF_{state,county}, \quad (30)$$

$$INVENT_{state,county,'dairy'} = PASTDAI_{state,county}. \quad (31)$$

The number of heads in inventory for each state is listed in table 14.

With the previous equations, the pastureland acreage demand by category by county was obtained, as well as the rent per acre and total rent for every county:

$$PASTACRES_{state,county,livestock} = \%ACRES_{state,county,livestock} * TOTPASTACRES_{state,county}, \quad (32)$$

where  $TOTPASTACRES$  represents total pastureland acreage per county and total pastureland demand by livestock category per county in acres is represented by  $PASTACRES$ .

For example, the pastureland acreage demanded by the beef and dairy cattle categories in Grant County, Wisconsin is the following:

$$\%ACRES_{wisconsin','grant','beef'} = \left( \frac{79,371 * 0.74}{69,943} \right) = 0.84, \quad (33)$$

$$\%ACRES_{wisconsin','grant','dairy'} = \left( \frac{4,456 * 0.93}{69,943} \right) = 0.06, \quad (34)$$

$$PASTACRES_{wisconsin','grant','beef'} = 0.84 * 167,908 = 141,474, \quad (35)$$

$$PASTACRES_{wisconsin','grant','dairy'} = 0.06 * 167,908 = 9,962. \quad (36)$$

## 4.2 Pastureland rents

County-level, per-acre pasture and rangeland rent figures ( $PASTRENT$ ) were obtained from NASS's Quick Stats (NASS, 2011) and came from an annual survey performed in 2008.



## 5 County-level land rents

To obtain the matrix previously shown in figure 1, the per-acre county-level land rents estimated for cropland, pastureland and forest land were multiplied by the acreage figures estimated for each IMPLAN agricultural activity in the following manner:

$$CROPSTRENT_{state, county, crop} = CROPRENTAVG_{state, county} * CROPACRES_{state, county, crop}, \quad (37)$$

$$PASTSTRENT_{state, county, past} = PASTRENT_{state, county} * PASTACRES_{state, county, past}, \quad (38)$$

$$FORSTRENT_{state, county, logg} = FORRENTAVG_{state, county} * FORACRES_{state, county, logg}, \quad (39)$$

where *crop* is a set including the crops listed in table 10, *past* is a set including only the beef and dairy cattle categories, *logg* is a set including only private commercial timberland.

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Table 10: Total of County-level Recorded Acreage of Crops in 2008

IMPLAN Code	IMPLAN Industries	% of Acres recorded	Crop	% of Acres recorded	County Acreage	National Acreage
1	Oilseeds	98%	Canola	93%	924,440	989,000
			Flaxseed	97%	328,581	340,000
			Soybean	99%	74,080,516	74,641,000
			Sunflower	77%	1,856,337	2,396,000
			Mustard	41%	29,217	71,500
			Safflower	34%	67,159	195,000
			Rapeseed	90%	954	1,060
			Sesame	52%	2,596	4,978
2	Grains	98%	Corn Grain	100%	78,425,062	78,570,000
			Corn Silage	87%	5,176,837	5,965,000
			Barley	98%	3,721,051	3,779,000
			Beans Dry Edible	87%	1,256,177	1,445,200
			Oats	91%	1,275,587	1,400,000
			Rice	99%	2,955,900	2,976,000
			Rye	81%	216,675	267,361
			Sorghum Grain	97%	7,060,754	7,271,000
			Sorghum Silage	87%	391,879	450,041
			Wheat	97%	54,193,521	55,699,000
			Pea Dry Edible	85%	722,220	847,300
			Cowpea	58%	10,664	18,544
			Lentils	65%	169,900	261,000
			Buckwheat	63%	15,568	24,760
			Popcorn	76%	153,286	201,623
			Wild Rice	46%	26,109	57,204
7	Tobacco	89%	Tobacco	89%	317,232	354,490
8	Cotton	99%	Cotton Upland	99%	7,304,839	7,400,000
			Cotton Pima	100%	168,700	168,700
9	Sugarcane and beets	99%	Sugarbeets	100%	1,004,000	1,004,500
			Sugarcane Sugar	99%	815,472	821,600
			Sugarcane Seed	82%	41,563	50,722
10	All others	78%	Hay	78%	46,832,789	60,152,000
			Peanuts	93%	1,402,943	1,507,000
			Alfalfa	74%	89,762	121,467
			Birdsfoot	80%	811	1,014
			Crimson Clover	80%	2,801	3,496
			Red Clover	66%	14,135	21,387
			White Clover	60%	2,453	4,059
			Lespedeza	18%	862	4,909
			Vetch	63%	1,026	1,618
			Bahia Grass	30%	5,215	17,326
			Bentgrass	94%	6,374	6,809
			Bermuda Grass	7%	2,768	37,750
			Bluegrass	80%	121,100	151,299
			Bromegrass	23%	1,218	5,287
			Fescue	84%	323,217	386,122
			Ochardgrass	90%	19,365	21,517
			Ryegrass	97%	299,120	307,722
			Sudangrass	61%	7,189	11,867
			Timothy	56%	2,181	3,882
			Wheatgrass	56%	11,823	21,214
			Guar	83%	4,956	5,946
Hops	74%	22,907	31,145			
Mint Oil	68%	60,737	89,783			

Table 11: State-level Forestland Net Present Value (NPV) in 2000 Dollars

States	Soft	Hard	Oak / Hickory	Maple / Beech / Birch	Oak / Pine	Oak / Gum / Cypress	Other hard
Alabama	643.22	138.43			320.04	170.48	138.43
Arkansas	607.67	138.43			340.69	193.48	138.43
Florida	646.13	138.43			440.05	314.72	138.43
Georgia	644.50	138.43			313.04	201.30	138.43
Kentucky	514.41	138.43			514.41	205.45	138.43
Louisiana	643.82	138.43			217.96	251.19	138.43
Mississippi	635.39	138.43			248.11	166.05	138.43
North Carolina	608.22	138.43			362.64	181.05	138.43
Oklahoma	623.73	138.43			396.49	138.43	138.43
South Carolina	619.07	138.43			299.86	184.77	138.43
Tennessee	595.30	138.43			525.06	216.96	138.43
Texas	612.53	138.43			180.37	191.40	138.43
Virginia	638.65	138.43			390.68	172.03	138.43
Connecticut	33.41		73.44	24.05	33.41	73.44	48.74
Delaware	33.41		73.44	24.05	72.35	73.43	48.74
Maine	33.41		73.44	24.05	33.41		48.74
Maryland	33.41		73.44	24.05	67.92	72.35	48.74
Massachusetts	33.41		73.44	24.05	33.41	73.44	48.74
New Hampshire	33.41		73.44	24.05	33.41		48.74
New Jersey	33.41		73.44	24.05	33.41	73.44	48.74
New York	33.41		73.44	24.05	33.41		48.74
Pennsylvania	33.41		73.44	24.05	33.41		48.74
Rhode Island	33.41		73.44	24.05	33.41		48.74
Vermont	33.41		73.44	24.05	33.41		48.74
Ohio	33.41		73.44	24.05	35.41	73.32	48.74
West Virginia	33.41		73.44	24.05	33.41		48.74
Illinois	75.49		15.40	27.59	43.27	21.00	21.49
Indiana	75.49		15.40	27.59	55.45	15.40	21.49
Iowa	75.49		15.40	27.59	75.49		21.49
Michigan	75.49		15.40	27.59	75.49	15.40	21.49
Minnesota	75.49		15.40	27.59	75.49		21.49
Wisconsin	75.49		15.40	27.59	75.49		21.49
Arizona	27.86	19.07					19.07
California	27.86	19.07					19.07
Colorado	27.86	19.07					19.07
Idaho	27.86	19.07					19.07
Kansas	27.86	19.07			27.86	19.07	19.07
Missouri	27.86	19.07			26.25	19.07	19.07
Montana	27.86	19.07					19.07
Nebraska	27.86	19.07			23.08		19.07
Nevada	27.86	19.07					19.07
New Mexico	27.86	19.07					19.07
North Dakota	27.86	19.07					19.07
South Dakota	27.86	19.07					19.07
Utah	27.86	19.07					19.07
Wyoming	27.86	19.07					19.07
Oregon	285.57	19.07					19.07
Washington	285.57	19.07					19.07

Table 12: State-level Forestland Rents in 2008 Dollars

States	Soft	Hard	Oak / Hickory	Maple / Beech / Birch	Oak / Pine	Oak / Gum / Cypress	Other hard
Alabama	33.64	7.24			16.74	8.92	7.24
Arkansas	31.78	7.24			17.82	10.12	7.24
Florida	33.79	7.24			23.01	16.46	7.24
Georgia	33.71	7.24			16.37	10.53	7.24
Kentucky	26.90	7.24			26.90	10.75	7.24
Louisiana	33.67	7.24			11.40	13.14	7.24
Mississippi	33.23	7.24			12.98	8.68	7.24
North Carolina	31.81	7.24			18.97	9.47	7.24
Oklahoma	32.62	7.24			20.74	7.24	7.24
South Carolina	32.38	7.24			15.68	9.66	7.24
Tennessee	31.13	7.24			27.46	11.35	7.24
Texas	32.04	7.24			9.43	10.01	7.24
Virginia	33.40	7.24			20.43	9.00	7.24
Connecticut	1.75		3.84	1.26	1.75	3.84	2.55
Delaware	1.75		3.84	1.26	3.78	3.84	2.55
Maine	1.75		3.84	1.26	1.75		2.55
Maryland	1.75		3.84	1.26	3.55	3.78	2.55
Massachusetts	1.75		3.84	1.26	1.75	3.84	2.55
New Hampshire	1.75		3.84	1.26	1.75		2.55
New Jersey	1.75		3.84	1.26	1.75	3.84	2.55
New York	1.75		3.84	1.26	1.75		2.55
Pennsylvania	1.75		3.84	1.26	1.75		2.55
Rhode Island	1.75		3.84	1.26	1.75		2.55
Vermont	1.75		3.84	1.26	1.75		2.55
Ohio	1.75		3.84	1.26	1.85	3.83	2.55
West Virginia	1.75		3.84	1.26	1.75		2.55
Illinois	3.95		0.81	1.44	2.26	1.10	1.12
Indiana	3.95		0.81	1.44	2.90	0.81	1.12
Iowa	3.95		0.81	1.44	3.95		1.12
Michigan	3.95		0.81	1.44	3.95	0.81	1.12
Minnesota	3.95		0.81	1.44	3.95		1.12
Wisconsin	3.95		0.81	1.44	3.95		1.12
Arizona	1.46	1.00					1.00
California	1.46	1.00					1.00
Colorado	1.46	1.00					1.00
Idaho	1.46	1.00					1.00
Kansas	1.46	1.00			1.46	1.00	1.00
Missouri	1.46	1.00			1.37	1.00	1.00
Montana	1.46	1.00					1.00
Nebraska	1.46	1.00			1.21		1.00
Nevada	1.46	1.00					1.00
New Mexico	1.46	1.00					1.00
North Dakota	1.46	1.00					1.00
South Dakota	1.46	1.00					1.00
Utah	1.46	1.00					1.00
Wyoming	1.46	1.00					1.00
Oregon	14.94	1.00					1.00
Washington	14.94	1.00					1.00
2000-2008 PPI change =		1.046					
Interest rate =	0.05						



Table 13: State-level Animal Units (AU) for Different Categories

States	Beef cattle	Dairy cattle	Goats	Sheep	Horses and mules	Alpacas	Bisons	Deer	Elks	Llamas
Alabama	0.83	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Alaska	0.87	0.95	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Arizona	0.81	0.96	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Arkansas	0.83	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
California	0.76	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Colorado	0.83	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Connecticut	0.75	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Delaware	0.80	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Florida	0.85	0.95	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Georgia	0.83	0.96	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Hawaii	0.84	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Idaho	0.81	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Illinois	0.82	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Indiana	0.80	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Iowa	0.82	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Kansas	0.81	0.92	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Kentucky	0.84	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Louisiana	0.85	0.95	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Maine	0.77	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Maryland	0.80	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Massachusetts	0.79	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Michigan	0.77	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Minnesota	0.78	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Mississippi	0.84	0.95	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Missouri	0.83	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Montana	0.89	0.92	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Nebraska	0.84	0.95	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Nevada	0.86	0.95	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
New Hampshire	0.78	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
New Jersey	0.82	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
New Mexico	0.84	0.95	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
New York	0.75	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
North Carolina	0.82	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
North Dakota	0.86	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Ohio	0.80	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Oklahoma	0.82	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Oregon	0.85	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Pennsylvania	0.75	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Rhode Island	0.84	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
South Carolina	0.83	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
South Dakota	0.85	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Tennessee	0.83	0.92	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Texas	0.83	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Utah	0.85	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Vermont	0.72	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Virginia	0.82	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Washington	0.82	0.94	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
West Virginia	0.84	0.95	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Wisconsin	0.74	0.93	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20
Wyoming	0.87	0.92	0.13	0.18	1.25	0.10	1.00	0.18	0.60	0.20

Table 14: Estimated Average Annual Number of Pasture-grazing Heads for each Category, 2007

States	Beef cattle	Dairy cattle	Goats	Sheep	Horses	Mules	Alpacas	Bisons	Deer	Elks	Llamas
Alabama	1,178,483	78	80,436	14,500	87,111	10,829	378	250	971	76	870
Alaska	13,553	27	352	408	1,850	45	196	246	-	217	44
Arizona	640,082	40	42,141	112,368	68,745	1,984	1,357	21	108	-	786
Arkansas	1,782,065	1,049	50,579	14,609	78,968	7,647	92	189	235	19	688
California	2,459,005	3,011	130,771	569,290	180,723	7,144	7,669	1,081	260	-	6,779
Colorado	1,502,276	622	48,616	397,146	119,040	4,946	7,709	9,854	10	2,403	7,452
Connecticut	18,239	1,020	4,578	5,767	11,510	428	1,052	8	56	-	615
Delaware	11,698	376	3,530	903	3,964	106	79	-	-	-	63
Florida	1,573,139	211	57,613	11,763	120,498	6,233	1,220	237	1,980	-	850
Georgia	1,037,544	1,209	83,757	10,025	76,706	8,877	686	307	36	-	1,263
Hawaii	151,473	1	9,169	744	6,547	209	-	-	-	-	-
Idaho	1,261,360	2,442	16,822	189,237	74,029	3,748	2,144	844	229	2,346	2,889
Illinois	779,642	6,281	33,653	51,771	79,481	4,364	2,102	202	1,467	44	1,974
Indiana	562,235	9,008	47,090	48,792	81,155	4,374	1,822	332	2,252	370	2,590
Iowa	1,961,011	14,266	55,144	199,026	71,994	4,166	240	306	2,978	471	1,999
Kansas	4,450,630	2,543	48,195	77,495	89,898	4,381	827	2,659	18	332	2,208
Kentucky	2,248,065	9,751	98,128	36,294	175,434	11,800	1,332	393	-	-	2,329
Louisiana	843,507	1,474	21,550	8,077	60,487	4,740	63	57	1,906	-	121
Maine	36,742	1,995	5,902	10,918	12,157	389	1,758	65	2,976	-	614
Maryland	104,048	4,334	16,889	22,143	30,747	1,113	1,917	416	-	-	756
Massachusetts	22,730	1,165	8,184	11,555	20,553	976	1,556	28	127	-	1,308
Michigan	399,015	14,326	27,741	80,457	101,138	4,385	3,812	1,970	16,393	1,758	3,539
Minnesota	1,055,196	35,715	36,752	136,206	90,140	3,690	1,016	3,993	6,829	5,419	2,371
Mississippi	963,042	725	30,399	7,243	65,277	7,001	119	60	1,621	110	283
Missouri	4,067,398	10,213	96,396	76,261	149,165	11,979	1,465	1,808	4,043	570	3,096
Montana	2,530,334	485	9,631	266,083	105,243	4,356	536	5,601	-	855	2,435
Nebraska	4,000,118	1,307	32,846	68,587	65,624	2,468	33	5,795	6	63	1,122
Nevada	425,253	10	11,894	37,398	18,396	392	439	76	-	-	831
New Hampshire	15,938	727	3,616	7,671	9,900	703	1,537	80	919	230	586
New Jersey	23,275	742	10,555	14,767	29,993	1,179	2,226	-	150	-	708
New Mexico	1,036,678	83	35,665	126,773	53,616	1,889	1,457	427	-	-	1,507
New York	440,957	38,589	39,834	63,119	84,997	2,814	6,939	738	5,200	863	2,363
North Carolina	754,773	1,314	98,241	26,088	78,377	8,512	1,137	124	105	21	1,571
North Dakota	1,722,403	1,524	3,461	76,450	44,750	773	36	9,631	289	2,708	208
Ohio	711,522	22,760	69,505	123,161	119,198	6,605	10,188	848	6,206	19	4,501
Oklahoma	5,112,345	2,490	125,303	76,215	165,555	12,411	478	2,004	3,885	823	3,845
Oregon	1,132,244	1,635	38,070	206,507	89,420	4,762	7,760	751	33	168	9,380
Pennsylvania	635,962	59,230	59,152	96,762	116,332	9,750	5,427	1,769	21,803	2,084	2,932
Rhode Island	3,371	5	543	1,459	3,486	86	123	-	-	-	123
South Carolina	379,804	48	43,589	6,787	43,283	4,541	418	60	64	-	424
South Dakota	3,095,120	2,470	9,366	335,534	70,225	1,743	57	20,661	15	138	676
Tennessee	2,017,310	3,846	130,867	28,324	141,860	18,328	896	263	647	53	2,205
Texas	10,868,029	2,259	1,134,156	906,478	438,827	60,724	1,908	4,379	120,452	3,727	11,977
Utah	693,501	1,514	13,915	273,567	59,783	1,922	1,115	530	72	1,055	1,411
Vermont	66,362	8,151	6,593	13,925	13,285	948	1,435	-	195	-	694
Virginia	1,400,532	5,297	63,059	76,821	90,363	6,739	4,119	482	6	80	3,696
Washington	645,261	2,114	32,840	53,220	89,739	3,793	13,117	1,069	145	-	8,126
West Virginia	395,134	940	27,789	37,934	37,728	2,684	814	34	1,038	-	673
Wisconsin	1,192,622	107,641	55,500	89,452	119,963	5,711	3,088	3,815	8,290	4,875	6,513
Wyoming	1,247,758	161	7,575	390,271	80,476	2,245	387	3,295	-	-	1,340