Summary

Increased demand for water in the Lake Altus drainage basin requires better estimates of water use for irrigation in the drainage basin. The U.S. Geological Survey, in cooperation with the Bureau of Reclamation, investigated new techniques to improve estimates of irrigation water use in the Lake Altus drainage basin. Empirical estimates of reference evapotranspiration, crop evapotranspiration, and crop irrigation water requirements for nine major crops were calculated for the 2000 growing season, September 1999 to October 2000 using a solar radiation-based evapotranspiration model and estimates of irrigated crop acres.

Landsat 7 ETM+ imagery was used to map land use and irrigated crop acres during the 2000 growing season. Land use was mapped using a supervised clustering algorithm based on statistical signatures for 25 pixel classes. Irrigated crop acres were determined using a ratio vegetation index that consisted of a near infrared band divided by a visible red band. A total of 78,612 acres were determined to be irrigated. Beckham County had the greatest number of irrigated crop acres in Oklahoma counties, followed by Roger Mills, Greer, Kiowa, and Washita. Carson County had the largest number of irrigated crop acres in Texas counties, followed by Gray, Wheeler, Potter, and Donley Counties. Seventy-four percent of the total irrigated crop acreage in the drainage basin occurred in Texas counties. One hundred percent of irrigated corn, sorghum, and soybeans in the drainage basin occurred in Texas. Eighty-nine percent or 38,677 acres of irrigated wheat occurred in Texas. Eighty-one percent or 13,768 acres of irrigated alfalfa and 71 percent or 1,583 acres of irrigated peanuts occurred in Oklahoma.

Reported estimates of irrigated crop acres were compiled and summarized for the 2000 growing season from the OWRB and TWDB. A total of 98,322 acres were determined to be irrigated. Beckham County had the greatest number of irrigated crop acres in Oklahoma counties, followed by Greer, Kiowa, and Roger Mills. Carson County had the greatest number of irrigated crop acres in Texas counties, followed by Gray, Wheeler, Potter, Donley, and Randall. Ninety-four percent of the total irrigated crop acres were in Texas counties. One hundred percent of irrigated sunflowers and soybeans, 99 percent of wheat, 98 percent of sorghum and corn, and 91 percent of irrigated cotton in the drainage basin occurred in Texas. Only irrigated alfalfa and irrigated peanuts had more acreage in Oklahoma than in Texas.

According to irrigation water use calculated from the remotely sensed irrigated acres, there was an estimated 154,920 acre-feet of water used for irrigation in the Lake Altus drainage basin during the 2000 growing season. Seventy-four percent of the irrigation water use in the drainage basin occurred in Texas counties. Irrigation water use was greatest for wheat with an estimated 80,692 acre-feet, or 52 percent of the total irrigation water use in the drainage basin. Irrigation water use for alfalfa was 39,011 acre-feet, or 25 percent of the total irrigation water use. Irrigation water use for corn, sorghum, soybeans, and wheat was greatest in Carson County, Texas; whereas, most of the irrigation water use for alfalfa and peanuts occurred in Beckham County.

According to irrigation water use calculated from the state reported irrigated acres, there was an estimated 196,026 acre-feet of water used for irrigation in the Lake Altus drainage basin during the 2000 growing season. Ninety-four percent of the total irrigation water use occurred in Texas. Irrigation water use was greatest for wheat with an estimated 90,955 acre-feet, or 46 percent of irrigation water use in the drainage basin. Irrigation water use for corn was 30,329 acre-feet, or 15 percent of the irrigation water use. Irrigation water use for alfalfa, corn, sorghum, soybeans, sunflowers, and wheat was greatest in Carson County, Texas; whereas, irrigation water use for cotton and hay was greatest in Wheeler County, Texas. Irrigation water use for peanuts was greatest in Beckham County, Oklahoma.

Estimates of irrigation water use calculated from remotely sensed irrigated acres were different than those determined from the state reported irrigated acres. The total volume of water used for irrigation calculated from remotely sensed acres was 154,920 acre-feet; whereas, irrigation water use calculated from the state reported irrigated acres was 196,026 acre-feet, a 23 percent difference. Irrigation water use for Carson County calculated from the remotely sensed acres was 58,555 acre-feet, whereas, irrigation water use calculated from irrigated crop acres reported from the state reported irrigated acres was 138,180 acre-feet, an 81 percent difference. Irrigation water use for alfalfa calculated from the remotely sensed irrigated crop acres was 39,011 acre-feet; whereas, irrigation water use for alfalfa calculated from irrigated crop acres reported from the state reported irrigated acres was 5,635 acre-feet, a 150 percent difference.

Differences between the two irrigation water use estimates result from differences between the remotely sensed irrigated acres and the state reported irrigated acres from the OWRB and the TWDB. By having to determine irrigated acres for a specific growing season and having to acquire imagery as close as possible to maximum greenness for individual crops on a cloud free day, few images are available that could be used to determine irrigated crops.

Even with correct date selection, limitations to using Landsat multispectral satellite imagery include spectral range and spatial resolution. Some agricultural crops or vegetation species are too spectrally similar to be differentiated by Landsat. Hyperspectral sensors with broader spectral ranges and resolutions may enable greater distinction of vegetation classes. With an increased spectral range and resolution, it is possible to identify subtle changes in chlorophyll absorption that relate to different vegetation species and health of a vegetation species. Presently (2002), there are two high spatial-resolution satellites (IKONOS and QUICKBIRD) with 4-meter multi-spectral sensors.

Selected References

Blazs, R.L., Walters, D.M., Coffey, T.E., Boyle, D.L., and Wellman, J.J., 2001, Water resources data, Oklahoma, water year 2000, Volume 2. Red River Basin and ground-water wells: U.S. Geological Survey Water-Data Report OK-00-2, 193p.

Blumer. S.P., 1985, Oklahoma – Surface-Water Resources in National Water Summary 1985: Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, p. 375-382.

Daly, C., Neilson, R.P., and Phillips, D.L., 1994, A statistical-topographic model for mapping Climatological precipitation over mountainous terrain: Journal of Applied Meteorology, v. 33, 140-158 p.

Doorenbos, J., and Pruitt, W.O., 1977, Guidelines for predicting crop water requirements, Irrigation and Drainage Paper No. 24, (2d ed.): Food and Agricultural Organization of the United Nations, Rome, Italy, 156 p.

Fenneman, N.M., and Johnson, D.W., 1946, Map of physical divisions of the United States: U.S. Geological Survey special map: accessed on July 26, 2001, at http://water.usgs.gov/lookup/getspatial?physio

Hart, D.L., Jr., Hoffman, G.L., and Goemaat, R.L., 1976, Geohydrology of the Oklahoma Panhandle, Beaver, Cimarron, and Texas Counties: U.S. Geological Survey Water-Resources Investigations Report 25-75, 62 p.

Havens, J.S., Marcher, M.V., and Schuelein, J.W., 1985, Oklahoma - Ground-Water Resources in National Water Summary 1984: U.S. Geological Survey Water-Supply Paper 2275, p. 347-354.

Heimes, F.J., and Luckey, R.R., 1982, Method for estimating historical irrigation requirements from ground water in the High Plains in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming: U.S. Geological Survey Water-Resources Investigations Report 82-40, 64 p.

Howell, T.A., Bucks, D.A., Goldhammer, D.A., and Lima, J.M., 1986, Trickle irrigation for crop production, in Nakayama, F.S., and Bucks, D.A., eds, Development in Agriculture Engineering 9, Elsevier, NY, 241-279 p.

Lurry, D.L., and Tortorelli, R.L., 1996, Estimated freshwater withdrawals in Oklahoma, 1990: U.S. Geological Survey Water-Resources Investigations Report 95-4276, 2 sheets

McDaniels, L.L., 1960, Consumptive use of water by major crops in Texas: Texas Board of Water Engineers, Bulletin 6019, 21 p.

Oklahoma Water Resources Board (OWRB), 1990, Oklahoma Water Atlas: 360 p.

——, 2000, Oklahoma Water News, Lugert-Altus District, Oklahoma Water Resources Board Study Irrigation Water Losses: Oklahoma Water Resources Board March-April Bimonthly Newsletter, 9 p.

Oklahoma Climatological Survey, 2001, Oklahoma Mesonet Homepage: accessed March 5, 2001, at http://www.ocs.ou.edu/

Qi, S.L., Litke, D.W., Konduris, A., and Dupree, J., 2002, Classification of irrigated land using satellite imagery, the High Plains Aquifer, nominal date 1992: U.S. Geological Survey Water-Resources Investigations Report 02-423 31 p.

Research Systems, Incorporated, 2001, ENVI User's Guide: Boulder, Colorado, Research Systems Incorporated, September 2001 edition, 864 p.

Rundquist, D.C., Jensen, J.R., Nyquist, M., Owens, T.W., 2002, Selected examples of remote sensing projects in Manual of Geospatial Science and Technology: New York, Taylor & Francis Inc., p.365-388.

Stegman, E.C., 1988 Corn crop curve comparisons for the Central and Northern Plains of the U.S., Applied Engineering in Agriculture: American Society of Agricultural Engineering v. 4, no 3: p. 226 – 233.

Solley, W.B., Pierce, R.R., and Perlman, H.A., 1998, Estimated use of water in the United States in 1995: U.S. Geological Survey Circular 1200 71 p.

Texas Water Development Board, 2000, Detailed On-Farm Irrigation Water Use Estimates for the 2000 growing season: accessed July 12, 2001, at http://www.twdb.state.tx.us/assistance/conservation/ASPApps/Survey.asp

University of California, Davis, 2002, Percent Error and Percent Difference described, Physics Lab 9: accessed July 15, 2001 at http://www.physics.ucdavis.edu/Classes/Physics9Lab/Phy9CLab/-9ASupplements.pdf

U.S. Department of Agriculture, 1970, Soil Conservation Service, Irrigation Water Requirements, Technical Release no. 21 88 p.

——, 1993, Natural Engineering Handbook Part 623, Irrigation water requirement, Chapter 2: Natural Resources Conservation Service, 284 p.

——, 1998, Natural Agricultural Statistics Service, Agricultural Handbook Number 628: accessed November 14, 2001 at http://usda.mannlib.cornell.edu/reports/nassr/field/planting/uph97.html

——, 1998, National Engineering Handbook Part 652, Irrigation Guide, Oklahoma Supplement: Natural Resources Conservation Service, 23 p.

——, 2000, Census of Agriculture 1997, State and County Highlights: accessed November 14, 2001 at
http://www.nass.usda.gov/census/census97/highlights/ag-state.htm

——, 2001, Agricultural Research Service, Texas North Plains Evapotranspiration Network Home page: accessed on March 14, 2001, at http://amarillo2.tamu.edu/nppet/petnet1.htm

U.S. Department of Commerce, 1949 to 1978, Census of Agricultural: Bureau of the Census, agricultural data for 1949, 1954, 1959, 1964, 1969, 1974, and 1978 for Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming.

——, 1977 Climatic Atlas of the United States: Environmental Sciences Services Administration, Environmental Data Services, 80 p.

U.S. Geological Survey, 1996, Aggregate Water Use Data System (AWUDS of USGS): accessed July 16, 2000, at: http://water.usgs.gov/watuse/wuawuds.html

——, 2002a, Enhanced Thematic Mapper Plus (ETM+) Product Description: accessed August 12, 2002, at http://edcwww.cr.usgs.gov/products/satellite/landsat7.html

——, 2002b, National Land Cover Dataset 1992 (NLCD): accessed August 12, 2002, at http://edc.usgs.gov/products/

Weeks, J. B., 1978, Plan of study for the High Plains regional aquifer system analysis in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming: U.S. Geological Survey Water-Resources Investigations Report 78– 70 28 p.

Appendixes

Appendix 1. Remote sensing classification categories shown with number of pixels and acres for the part of Beckham County, Oklahoma, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	9,883	1,984	0
Water	2	5,282	1,060	0
Clouds	3	235	47	0
Fallow	4	66,745	13,396	2
Grass	5	941,516	188,973	33
Trees	6	164,691	33,055	6
Sunflowers	7	0	0	0
Oat	8	46	9	0
Peanuts	9	21,111	4,237	1
Soybeans	10	0	0	0
Rye	11	4,612	926	0
Cotton	12	1,757	353	0
Sorghum	13	28	6	0
Alfalfa	14	93,383	18,743	3
Corn	15	0	0	0
Wheat	16	213,310	42,814	7
Unknown irrigated crop	17	48,758	9,786	2
Irrigated soybeans	18	1	0	0
Irrigated peanuts	19	4,021	807	0
Cowpeas	20	16,065	3,224	1
Unknown crop	21	7,815	1,569	0
Irrigated alfalfa	22	46,320	9,297	2
Irrigated wheat	23	17,390	3,490	1
Hay/Pasture	24	157,108	31,533	5
Irrigated corn	25	0	0	0
Irrigated sorghum	26	0	0	0
Null	0	1,076,588	216,083	37
Image total		**2,896,665**	**581,393**	**100**

Appendix 2. Remote sensing classification categories shown with number of pixels and acres for the part of Carson County, Texas, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	37,910	7,609	1
Water	2	15,312	3,073	1
Clouds	3	2,044	410	0
Fallow	4	209,717	42,093	7
Grass	5	274,841	55,164	9
Trees	6	198	40	0
Sunflowers	7	23,985	4,814	1
Oat	8	0	0	0
Peanuts	9	0	0	0
Soybeans	10	6,334	1,271	0
Rye	11	13,104	2,630	0
Cotton	12	22	4	0
Sorghum	13	61,544	12,353	2
Alfalfa	14	0	0	0
Corn	15	31	6	0
Wheat	16	294,222	59,054	10
Unknown irrigated crop	17	40,672	8,163	1
Irrigated soybeans	18	11,756	2,360	0
Irrigated peanuts	19	0	0	0
Cowpeas	20	0	0	0
Unknown crop	21	2,881	578	0
Irrigated alfalfa	22	4	1	0
Irrigated wheat	23	97,904	19,650	3
Hay/Pasture	24	189,949	38,125	6
Irrigated corn	25	27,766	5,573	1
Irrigated sorghum	26	9,451	1,897	0
Null	0	1,625,226	326,201	55
Image total		**2,944,873**	**591,069**	**100**

Appendix 3. Remote sensing classification categories shown with number of pixels and acres for the part of Donley County, Texas, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	276	55	0
Water	2	501	101	0
Clouds	3	0	0	0
Fallow	4	1,800	361	0
Grass	5	20,358	4,086	1
Trees	6	0	0	0
Sunflowers	7	232	47	0
Oat	8	0	0	0
Peanuts	9	0	0	0
Soybeans	10	0	0	0
Rye	11	0	0	0
Cotton	12	9	2	0
Sorghum	13	2,136	429	0
Alfalfa	14	0	0	0
Corn	15	0	0	0
Wheat	16	3,662	735	0
Unknown irrigated crop	17	2,512	504	0
Irrigated soybeans	18	328	66	0
Irrigated peanuts	19	0	0	0
Cowpeas	20	0	0	0
Unknown crop	21	0	0	0
Irrigated alfalfa	22	0	0	0
Irrigated wheat	23	273	55	0
Hay/Pasture	24	2,293	460	0
Irrigated corn	25	994	200	0
Irrigated sorghum	26	5	1	0
Null	0	2,746,372	551,228	99
Image total		**2,781,751**	**558,329**	**100**

Appendix 4. Remote sensing classification categories shown with number of pixels and acres for the part of Gray County, Texas, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	13,205	2,650	0
Water	2	31,256	6,273	1
Clouds	3	1,734	348	0
Fallow	4	89,254	17,914	3
Grass	5	1,761,917	353,637	59
Trees	6	43,566	8,744	1
Sunflowers	7	13,629	2,736	0
Oat	8	0	0	0
Peanuts	9	0	0	0
Soybeans	10	9,104	1,827	0
Rye	11	12,936	2,596	0
Cotton	12	3	1	0
Sorghum	13	37,820	7,591	1
Alfalfa	14	0	0	0
Corn	15	859	172	0
Wheat	16	143,573	28,817	5
Unknown irrigated crop	17	8,918	1,790	0
Irrigated soybeans	18	7,008	1,407	0
Irrigated peanuts	19	0	0	0
Cowpeas	20	0	0	0
Unknown crop	21	0	0	0
Irrigated alfalfa	22	934	187	0
Irrigated wheat	23	59,719	11,986	2
Hay/Pasture	24	99,635	19,998	3
Irrigated corn	25	13,910	2,792	0
Irrigated sorghum	26	743	149	0
Null	0	617,894	124,018	21
Image total		**2,967,617**	**595,634**	**100**

Appendix 5. Remote sensing classification categories shown with number of pixels and acres for the part of Greer County, Oklahoma, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	487	98	0
Water	2	15,429	3,097	1
Clouds	3	0	0	0
Fallow	4	13,089	2,627	1
Grass	5	63,475	12,740	4
Trees	6	20,409	4,096	1
Sunflowers	7	0	0	0
Oat	8	29	6	0
Peanuts	9	2,504	503	0
Soybeans	10	0	0	0
Rye	11	1,257	252	0
Cotton	12	21	4	0
Sorghum	13	6	1	0
Alfalfa	14	12,847	2,579	1
Corn	15	0	0	0
Wheat	16	36,735	7,373	2
Unknown irrigated crop	17	4,764	956	0
Irrigated soybeans	18	0	0	0
Irrigated peanuts	19	1,119	225	0
Cowpeas	20	3,942	791	0
Unknown crop	21	4,906	985	0
Irrigated alfalfa	22	8,564	1,719	1
Irrigated wheat	23	2,985	599	0
Hay/Pasture	24	45,017	9,035	3
Irrigated corn	25	0	0	0
Irrigated sorghum	26	0	0	0
Null	0	1,454,766	291,988	86
Image total		**1,692,351**	**339,674**	**100**

Appendix 6. Remote sensing classification categories shown with number of pixels and acres for the part of Kiowa County, Oklahoma, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	103	21	0
Water	2	15,089	3,029	3
Clouds	3	26	5	0
Fallow	4	8,592	1,725	1
Grass	5	33,530	6,730	6
Trees	6	11,653	2,339	2
Sunflowers	7	0	0	0
Oat	8	0	0	0
Peanuts	9	1,383	278	0
Soybeans	10	0	0	0
Rye	11	96	19	0
Cotton	12	384	77	0
Sorghum	13	4	1	0
Alfalfa	14	4,817	967	1
Corn	15	0	0	0
Wheat	16	53,878	10,814	9
Unknown irrigated crop	17	6,261	1,257	1
Irrigated soybeans	18	0	0	0
Irrigated peanuts	19	1,086	218	0
Cowpeas	20	2,803	563	0
Unknown crop	21	3,933	789	1
Irrigated alfalfa	22	3,443	691	1
Irrigated wheat	23	2,193	440	0
Hay/Pasture	24	12,069	2,422	2
Irrigated corn	25	0	0	0
Irrigated sorghum	26	0	0	0
Null	0	425,050	85,312	72
Image total		**586,393**	**117,696**	**100**

Appendix 7. Remote sensing classification categories shown with number of pixels and acres for the part of Potter County, Texas, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	31,399	6,302	3
Water	2	2,738	550	0
Clouds	3	1,007	202	0
Fallow	4	36,225	7,271	3
Grass	5	52,846	10,607	4
Trees	6	25	5	0
Sunflowers	7	599	120	0
Oat	8	0	0	0
Peanuts	9	0	0	0
Soybeans	10	619	124	0
Rye	11	698	140	0
Cotton	12	6	1	0
Sorghum	13	5,127	1,029	0
Alfalfa	14	0	0	0
Corn	15	0	0	0
Wheat	16	39,696	7,967	3
Unknown irrigated crop	17	380	76	0
Irrigated soybeans	18	209	42	0
Irrigated peanuts	19	0	0	0
Cowpeas	20	0	0	0
Unknown crop	21	0	0	0
Irrigated alfalfa	22	5	1	0
Irrigated wheat	23	11,153	2,239	1
Hay/Pasture	24	17,034	3,419	1
Irrigated corn	25	5	1	0
Irrigated sorghum	26	37	7	0
Null	0	1,035,745	207,886	84
Image total		**1,235,553**	**247,990**	**100**

Appendix 8. Remote sensing classification categories shown with number of pixels and acres for the part of Roger Mills County, Oklahoma, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	446	90	0
Water	2	2,372	476	0
Clouds	3	5	1	0
Fallow	4	46,842	9,402	2
Grass	5	267,012	53,592	13
Trees	6	21,000	4,215	1
Sunflowers	7	0	0	0
Oat	9	0	0	0
Peanuts	9	6,322	1,269	0
Soybeans	10	0	0	0
Rye	11	6	1	0
Cotton	12	2,436	489	0
Sorghum	13	8	2	0
Alfalfa	14	30,045	6,030	1
Corn	15	0	0	0
Wheat	16	35,067	7,038	2
Unknown irrigated crop	17	10,348	2,077	1
Irrigated soybeans	18	2	0	0
Irrigated peanuts	19	1,567	315	0
Cowpeas	20	326	65	0
Unknown crop	21	1,623	326	0
Irrigated alfalfa	22	9,978	2,003	0
Irrigated wheat	23	2,343	470	0
Hay/Pasture	24	34,260	6,876	2
Irrigated corn	25	0	0	0
Irrigated sorghum	26	0	0	0
Null	0	1,573,612	315,842	77
Image total		**2,045,620**	**410,579**	**100**

Appendix 9. Remote sensing classification categories shown with number of pixels and acres for the part of Washita County, Oklahoma, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	0	0	0
Water	2	0	0	0
Clouds	3	0	0	0
Fallow	4	21	4	0
Grass	5	4,421	887	1
Trees	6	0	0	0
Sunflowers	7	0	0	0
Oat	8	2	0	0
Peanuts	9	474	95	0
Soybeans	10	0	0	0
Rye	11	2	0	0
Cotton	12	124	25	0
Sorghum	13	0	0	0
Alfalfa	14	115	23	0
Corn	15	0	0	0
Wheat	16	3,034	609	0
Unknown irrigated crop	17	190	38	0
Irrigated soybeans	18	0	0	0
Irrigated peanuts	19	57	11	0
Cowpeas	20	3,356	674	0
Unknown crop	21	4	1	0
Irrigated alfalfa	22	289	58	0
Irrigated wheat	23	49	10	0
Hay/Pasture	24	575	115	0
Irrigated corn	25	0	0	0
Irrigated sorghum	26	0	0	0
Null	0	809,145	162,405	98
Image total		**821,858**	**164,956**	**100**

Appendix 10. Remote sensing classification categories shown with number of pixels and acres for the part of Wheeler County, Texas, in the Lake Altus drainage basin during the 2000 growing season

[Null, part of the image that is outside the portion of the drainage basin in the county]

Class name	Code	Pixels	Acres	Percent image
Urban	1	16,772	3,366	1
Water	2	5,001	1,004	0
Clouds	3	49,108	9,857	2
Fallow	4	77,356	15,526	3
Grass	5	1,390,894	279,168	48
Trees	6	430,251	86,356	15
Sunflowers	7	94	19	0
Oat	8	4	1	0
Peanuts	9	5,195	1,043	0
Soybeans	10	8,107	1,627	0
Rye	11	2,144	430	0
Cotton	12	459	92	0
Sorghum	13	47,654	9,565	2
Alfalfa	14	35,649	7,155	1
Corn	15	132	26	0
Wheat	16	103,652	20,804	4
Unknown irrigated crop	17	26,993	5,418	1
Irrigated soybeans	18	4,795	962	0
Irrigated peanuts	19	3,221	646	0
Cowpeas	20	2,681	538	0
Unknown crop	21	8,827	1,772	0
Irrigated alfalfa	22	14,956	3,002	1
Irrigated wheat	23	23,653	4,747	1
Hay/Pasture	24	70,080	14,066	2
Irrigated corn	25	1,325	266	0
Irrigated sorghum	26	75	15	0
Null	0	577,827	115,976	20
Image total		**2,906,905**	**583,449**	**100**