2015 KANSAS LAND COVER PATTERNS
PHASE II - FINAL REPORT

Kansas Applied Remote Sensing Program
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Credits

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Executive Summary

The 2015 Kansas Land Cover Patterns III map represents an update of the 2005 Kansas Land Cover Patterns map. The update, designed to be explicitly comparable to the 1990 and 2005 Kansas Land Cover Patterns maps, uses the similar source data (Landsat and MODIS), classification scheme (Modified Level III), classification approach (supervised classification), and spatial resolution (minimum mapping unit (MMU)). Using a similar methodology to produce the 2015 Kansas Land Cover Patterns map allows end-users to identify and examine changes in the Kansas landscape.

The Modified Level III map was produced from multi-seasonal Landsat 8 and MODIS NDVI imagery acquired during the 2014 and 2015 growing seasons. The map contains seventeen land use/land cover classes and has a positional accuracy and spatial resolution appropriate for producing 1:50,000 scale maps. The MMU varies by land cover class and ranges between 0.22 to 5.12 acres.

The 2015 Kansas Land Cover Patterns map represents PhaseII of a two-phase mapping initiative occurring over a three-year period. During Phase 2, subclasses were mapped to produce a Modified Level III map of Kansas using a combination of 250-meter resolution time-series MODIS NDVI imagery, Landsat imagery and the 2015 Cropland Data Layer.

Digital versions of the map, metadata, and accuracy assessment can be accessed from the Data Access and Support Center (DASC) website of the Kansas Geological Survey (http://www.kansasgis.org/).

Introduction

The Next-Generation Statewide Land Cover Mapping Initiative was co-funded by the Kansas State GIS Policy Board and Kansas Department of Wildlife, Parks and Tourism. Work on the mapping initiative was split into two phases. The work and products described in this report correspond to Phase I of the land cover mapping initiative.

The modified Anderson Level III (Anderson *et al.*, 1976) land cover map developed in Phase II was generated to make land cover data comparable to previous land cover maps created by the Kansas Applied Remote Sensing Program of the Kansas Biological Survey. The four other statewide land cover maps were (1) Kansas Land-Use Patterns: Summer 1973 (non-digital, hard copy only) (KARS, 1973), (2) the 1990 Kansas Land Cover Patterns map (KARS, 1997; Whistler *et al.*, 1996), (3) the 1992 Kansas Vegetation Map created for the Gap Analysis Program (Egbert *et al.*, 2001; KARS, 2002), and (4) the 2005 Kansas Land Cover Patterns map (KARS, 2009).

Methods

The land cover map contains ten land use/land cover (LULC) classes and was designed to be explicitly comparable to the 1990 and 2005 Kansas Land Cover Patterns database. A three-stage generalization technique was used to refine the map classes to their specified minimum mapping units. A formal accuracy assessment was conducted using both existing databases and high-resolution digital aerial photography (using manual photo interpretation techniques) as ground reference data.

Mapping Standards and Data Sources

Table 1 summarizes the mapping standards used and data products developed for this land cover mapping initiative. The primary data source for map development was the 2015 Cropland Data Layer. The land cover map has thematic detail based on an Anderson Modified Level I classification scheme and a minimum mapping unit that varies by class type. The goal for overall map accuracy was 85% or greater. The map is distributed as a statewide digital database as Erdas Imagine file format (.img).

Table 1. Mapping standards, data sources and products for the 2015 Kansas Land Cover Patterns map.

Item	Standard or Product
Primary Data Source	Landsat Thematic Mapper (30m resolution)
Thematic Detail	Anderson Modified Level III; 17 classes total
Minimum Mapping Unit (MMU)	Varies by LULC class (0.2224 to 5.115 acres)
Spatial Reference	Albers Conic Equal-Area (A Kansas Projection Standard) Spheroid GRS 1980 Datum NAD83 Latitude of 1st standard parallel: 29:50:00 N Latitude of 2nd standard parallel: 45:50:00 N Longitude of central meridian: 96:00:00 W * Latitude of origin of projection: 23:00:00 N * * National projection parameters
Spatial Accuracy	15 meters (0.5 pixels)
Thematic Accuracy	As determined through accuracy assessment; goal 85% or greater
Tiling Scheme	Statewide database
Format	Erdas Imagine Raster
Product	Digital land cover database

Data Sources:

The data sources in Table 2 were used to generate the 2015 KLCP.

Table 2. Ancillary data sets used to create the 2015 statewide land cover map.

Data Set	Source	Purpose
2015 Cropland Data Layer	USDA NASS	General Classification Scheme
2005 KLCP	KBS/KARS	Classification QAQC and modifications.
2015 FSA National Agriculture Imagery Program (NAIP)	USDA	Create Urban Mask, Classification QAQC, and Accuracy Assessment
2015 Common Land Unit (CLU) Database	USDA/NRCS	Training Data and Accuracy Assessment
Field-Level Boundaries	KARS/NASS	Generalization
Kansas State Highway System	KDOT	Generalization
Kansas Public Land Survey System (PLSS)	KGS	Accuracy Assessment
Kansas GAP Vegetation Database	KBS/KARS	Accuracy Assessment

Thematic Detail:

The classification scheme was designed to be explicitly comparable to the 1990 and 2005 Kansas Land Cover Patterns database (Table 3).

LULC Class Code and Name	Level II	Level III
10, Urban	11, Urban Commercial/Industrial	110, Urban Commercial/Industrial
	12, Urban Residential	120, Urban Residential
	13, Urban Openland	130, Urban Openland
	14, Urban Woodland	140, Urban Woodland
	15, Urban Water	150, Urban Water
20, Cropland	21, Summer Crop	211, Corn
		212, Soybeans
		213, Sorghum
	22, Spring Crop	221, Winter Wheat

	23, Alfalfa	231, Alfalfa
	24, Fallow	240, Fallow
	25, Double-Crop	250, Double-Crop
30, Grassland	32, Warm-Season Grassland	320, Warm-Season Grassland
	33, Cool-Season Grassland	330, Cool-Season Grassland
40, Woodland	40, Woodland	400, Woodland
50, Water	50, Water	500, Water
60, Other	60, Other	600, Other

The seventeen mapped classes are defined as:

(110) Commercial/Industrial - commercial/industrial land consists of areas of intensive use with much of the land covered by structures or other hard surfaces. These areas are used predominantly for the manufacture and sale of products and/or services. This category includes the central business districts of cities, towns, and villages; suburban shopping centers and strip developments; educational, governmental, religious, health, correctional and institutional facilities; industrial and commercial complexes; and communications, power, and transportation facilities. The main buildings, secondary structures, and areas supporting the basic use are all included - office buildings, warehouses, driveways, parking lots, landscaped areas, streets, etc. Highways or interstate systems running through the core of urban areas are also included in this class.

(120) Residential - residential land consists of areas of medium density housing characterized by a more or less even distribution of vegetative cover and houses/garages, to high density housing characterized by multi-unit structures such as apartment complexes. Linear residential developments along transportation routes extending outward from urban areas are included. Rural subdivisions not directly connected to the core of an urbanized area are also included. The main buildings, secondary structures, and immediate surrounding landscape are all included (i.e., houses, apartment complexes, streets, garages, driveways, parking areas, lawns, trees, etc.).

(130) Urban-Openland - urban-openland consists primarily of areas of open grassland, sometimes mixed with trees, with uses such as golf courses, zoos, urban parks, cemeteries, and undeveloped land within an urban setting. Low density rural residential areas may also be included in this category. This category also includes tracts of land that have been zoned residntial or commercial, but have yet to be developed.

(140) Urban-Woodland - urban-woodland consists of wooded tracts within a town or city. These wooded tracts maybe associated with golf courses, zoos, urban parks, and other undeveloped land.

(150) Urban-Water - urban-water consists of any open surface water within a town or city. This includes ponds, lakes, sewage settling ponds, etc.

(211) Corn - land used for the production of corn.

(212) Soybeans - land used for the production of soybeans.

(213) Sorghum - land used for the production of sorghum.

(221) Winter Wheat - land used for the production of winter wheat.

(231) Alfalfa - land used for the production of alfalfa.

(240) Fallow - land used for the production of crops that are idle for no more than 2 years. Typically these areas are bare soil or stubble, or have a low percentage of vegetative cover, either voluntary crop plants or pioneer herbaceous species.

(250) Double-Crop - land used for the production of two or more crops during one growing season. Typical double-cropping in Kansas consists of planting and harvesting Winter Wheat followed by Soybeans during the same growing season.

(320) Warm-Season Grassland - this class includes native prairies (i.e. tallgrass, mixed-grass, and shortgrass prairie) that are dominated by warm-season grasses and areas planted to warm-season dominated grasslands (e.g. mitigation areas). This class includes warm-season grasslands used for pasture (hayed land) and rangeland or Conservation Reserve Program (CRP) land.

(330) Cool-Season Grassland - this class includes grasslands dominated by introduced or non-native cool season grassland species, primarily smooth brome and tall fescue. This class includes cool-season grasslands used for pasture (hayed land) and rangeland.

(400) Woodland - this class includes any wooded areas having a canopy closure of 50% and greater.

(500) Water – this class consists of all open water bodies, including reservoirs, lakes, ponds, rivers and streams. Ephemeral streams may not be represented.

(600) Other - the "other" class is used to identify land cover / land use classes not previously defined. In general, this class is used for exposed, bare ground other than cropland. Examples include rock quarries, sand and gravel pits, sandbars, and built-up areas less than 40 acres.

Table 4. Minimum mapping units by LULC class.

LULC Class	Landsat Pixels	Acres
Urban Commercial/Industrial	15	3.11
Urban Residential	15	3.11
Urban Openland	15	3.11
Urban Woodland	3	0.67
Urban Water	1	0.22
Cropland	23	5.12
Grassland	23	5.12
Rural Woodland	3	0.67
Rural Water	1	0.22
Other	15	3.11

Generalization Procedures

Introduction

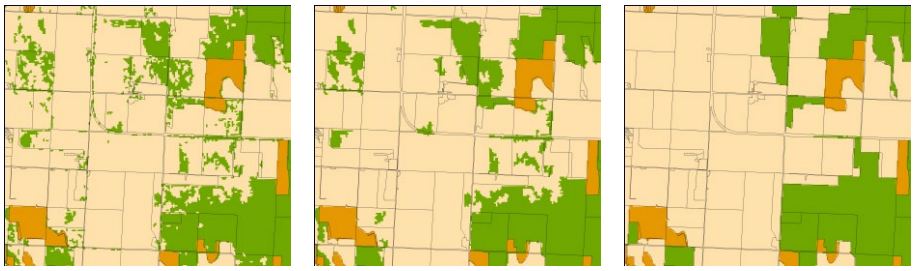
Thematic generalization of the land cover was performed to align thematic classes to match the 1990 and 2005 classification schemes. Cartographic generalization of the land use/land cover data was performed to eliminate "noise" in the classification and simplify the map. Noise is comprised of either extraneous misclassified pixels or small clumps of pixels that are insignificant at the suggested mapping scale of the map (1:50,000) (Figure 1a). Noise tends to create visual confusion and obscure overall patterns. Before designing and running the generalization procedures, the minimum mapping unit (MMU) was chosen for each land use/land cover class. The MMU size, or smallest number of contiguous pixels, chosen for a particular class was based on the following factors:

1) Is the class reliably detected by the classification?
2) Is the class accurately represented?
3) What level of thematic detail (i.e., how small an area) should be preserved at the suggested mapping scale?
4) MMUs that would be comparable to the 1990 and 2005 Kansas Land Cover Patterns databases.

Taking these factors into account, the MMU for each land use/land cover class was established. MMUs are listed in Table 4 (above).

Overview of the Generalization Procedure

Generalization was accomplished in two stages. In the first stage, conventional automated generalization procedures were used to simplify the manually cleaned classification by removing misclassified or spatially insignificant clumps of pixels (Figure 1b). During this stage, the objective was to achieve the MMU standard for the individual classes. In the secondthird stage, the field-level database was used to fit the Cropland and Grassland classes from the mosaic into fields delineated in the field-level database (Figure 1c). The objective was to utilize the spatial precision of field boundaries provided by combining multi-years of CLU data and manual splits of fields to better depict the spatial extent of Cropland and Grassland.



(a) **(b)** **(c)**

Figure 1. An example of a map (a) prior to generalization, (b) following generalization using traditional techniques and (c) following generalization using CLU data.

Stage I Generalization – Manual Cleanup of Woods and Water

Manual cleanup was performed using ArcGIS. The procedure was initiated by displaying the map and corresponding 2015 NAIP imagery and the 2005 KLCP map. The 2015 map was then examined by an analyst who looked for classification errors. For the woodland and water map components, the analyst focused on eliminating errors of commission and delineating areas of omission that were correctly mapped in the 2005 map. When errors were found, the analyst would digitize the misclassified pixels and assign an attribute to indicate if it was an error of omission or commission. Upon investigation, the CDL had a high omission error. Digitizing all existing omission of water would be extremely time-consuming, therefore omitted water that was classified in the 2005 KLCP was added to the 2015 water class. The digitized locations of omission and commission were used in model builder to reassign pixels accordingly.

Stage II Generalization – Eliminating Small Clusters of Pixels

Generalization – Water

There was no generalization of the water class.

Generalization – Woodland

The generalization of the woodland class was accomplished using two functions in ERDAS Imagine 2015. The first step utilized the CLUMP function to identify all contiguous pixels (i.e., clumps) of woodlands using the eight connected neighbors rule. The second step used the ELIMINATE function to remove clumps with less than three pixels.

Generalization – Urban Classes

The generalization of the Urban classes Industrial/Commercial, Residential, and Openland was accomplished using two functions in ERDAS Imagine 2015. The first step utilized the CLUMP function to identify all contiguous pixels (i.e., clumps) of each class using the four connected neighbors rule. The second step used the ELIMINATE function to remove clumps with less than 15 pixels. Woods and water were added back and the EXPAND function in ArcGIS 10.4 was used to fill remaining Zero areas. This function fills the Zero area with surrounding class value(s) excluding Woodland and Water. This step is run iteratively until Zero areas are filled.

Recode any remaining Zero areas (e.g., areas embedded in Woodland, a class that was not allowed to expand in the previous step), as Woodland.

Generalization – Cropland, Grassland, and Other Classes

The generalization of the classes Cropland, Grassland, and Other was accomplished using a S functions and running under ArcGIS 10.4 and ERDAS Imagine.2015. The following outlines the generalization procedure for these classes.

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1. Recode the Cropland around 4-lane highways to Grassland. Use a 45m buffer around the highway's centerline (90m total; 3 TM pixels wide) to delineate the recode area.
2. Use the CLUMP function to identify all contiguous areas of Grassland and Cropland.
3. Use the ELIMINATE function to remove clumps less than the MMU for Grassland, Cropland, and Other.
4. Add Water and Woodland to the Cropland/Grassland map.

Mosaic of Stage II Generalizations

Stage III Generalization – Fitting to CLU Boundaries

To conduct the Stage III generalization, multi-year field-boundary dataset consisting of multiple years of CLU data and manual splits of fields were converted to a raster grid and used to create a field-level representation of rural land cover. Output raster cells were assigned the feature identifier (FID) of the shapefile during the conversion to a grid because the value was unique and thus could be used to identify unique zones. The following outlines the procedures for the Stage III generalization.

1. Create a Cropland/Grassland grid by recoding all values other than Cropland (20) and Grassland (30) on the Stage I generalization to NODATA.
2. For each Zone in the CLU grid, calculate the ZONALMAJORITY for the Cropland/Grassland grid.

3. Using the Stage I generalization grid, write all values other than Cropland and Grassland to a new output grid, recoding Cropland and Grassland areas to Zero (0)
4. Write the ZonalMajority values from Step 2 to the new grid, filling only Zero areas.

Results

The end product for Phase I of the 2015 Kansas Land Cover mapping project is an updated digital Level III land cover map of Kansas (Figure 2). A summary of the land cover types, their area mapped in square meters, and the percent of the total area in Kansas represented by each type is presented in Table 5.

Table 5. Modified Anderson Level I land cover classes, their area mapped (acres and sq. km.), and the percent of the State's total area represented by each land cover class.

LULC Class	LULC Code	Pixel Count	Percent Mapped	Area (sqmet) Mapped
Commercial/Industrial	110	682,595	0.29	151,805
Residential	120	1,928,812	0.81	428,957
Urban Openland	130	1,456,502	0.62	323,918
Urban Woodland	140	287,123	0.12	63,855
Urban Water	150	68,852	0.03	15,312
Corn	211	19,758,626	8.34	4,394,210
Soybean	212	14,369,788	6.07	3,195,762
Sorghum	213	12,977,941	5.48	2,886,223
Winter Wheat	221	44,488,130	18.79	9,893,915
Alfalfa	231	1,664,229	0.70	370,115
Fallow	240	13,170,046	5.56	2,928,946
Double-Crop	250	4,321,326	1.83	961,039
Warm-Season Grass	320	91,976,326	38.85	20,455,029
Cool-Season Grass	330	14,881,474	6.29	3,309,558
Woodland	400	12,253,521	5.18	2,725,116
Water	500	2,425,008	1.02	539,308
Other	600	64,845	0.03	14,421
Total		***236,775,144***	***100.00***	***52,657,490***

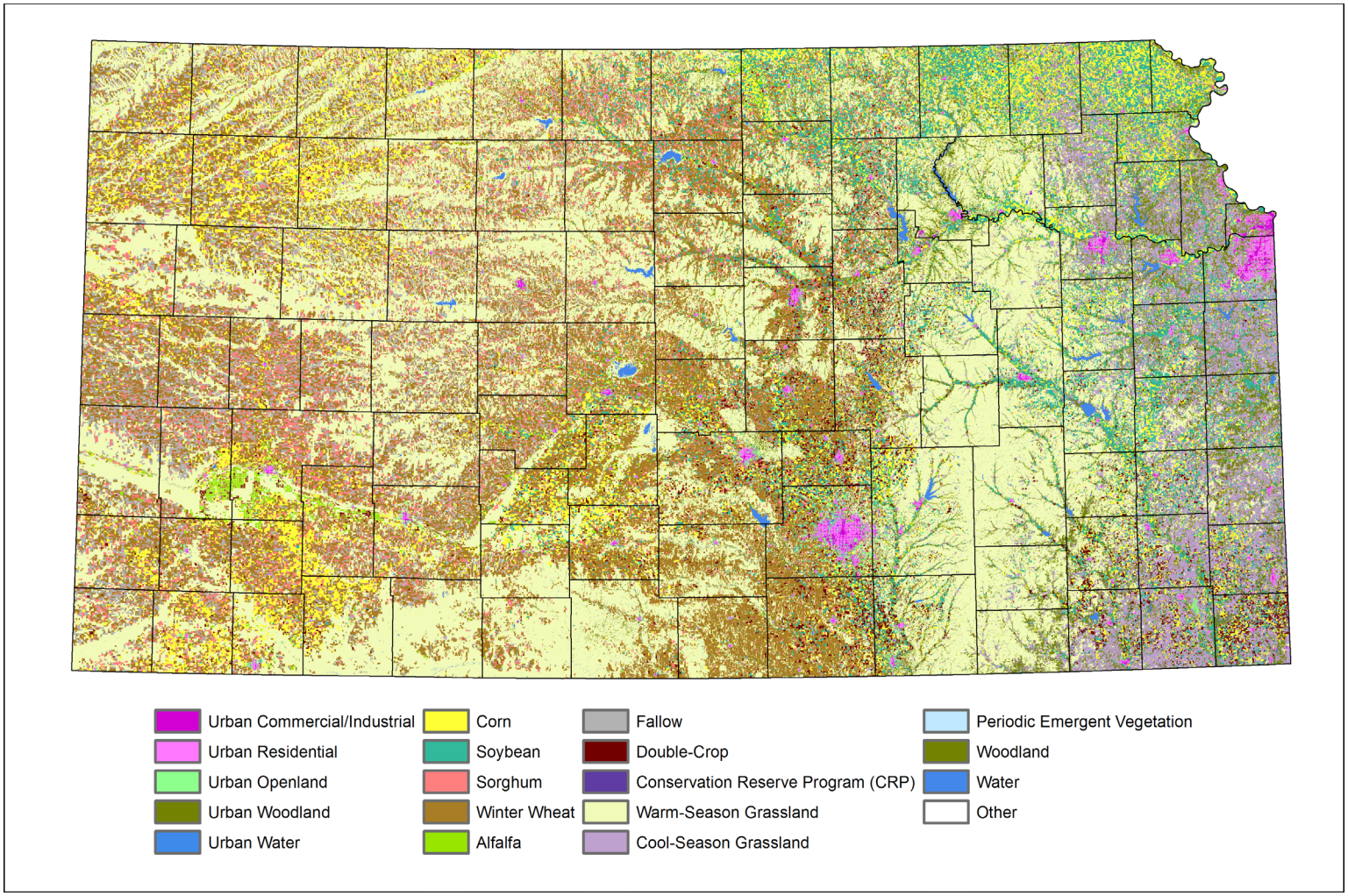

Figure 2. The 2015 Kansas Land Cover Patterns-Level III map developed using the Cropland Data Layer, Random Forest classifier of Landsat and MODIS data and ancillary data sources.

Accuracy Assessment

Field campaigns for accuracy assessments can be costly and time-consuming endeavors. Rather than conducting an independent field campaign for the accuracy assessment, two existing databases were used to assess the accuracy of the 2015 land cover map. The 2015 Common Land Unit (CLU) dataset was used to assess the accuracy of mapped grassland and cropland and the Kansas GAP vegetation database was used to assess the accuracy of mapped woodlands. The Kansas GAP vegetation database is a digital database of sample sites used for training and validation of the Kansas Vegetation Map (Egbert *et al.*, 2001). Urban and water databases were unavailable, and therefore, manual photo interpretation of high-resolution digital aerial photography was used to assess the accuracy of these land cover classes.

Accuracy Assessment Results

The overall accuracy level for the Level III map was 81% and KAPPA was equal to .80. User's and Producer's Accuracies for each Level of mapping are presented in the Table 6.

Table 6. User's and Producer's Accuracy levels by Level III land use/land cover class.

Level III LULC Class Name	LULC Code	Producer's Accuracy	User's Accuracy
Corn	211	75.9%	80.8%
Soybean	212	79.6%	80.9%
Sorghum	213	71.7%	63.6%
Winter Wheat	221	77.5%	87.3%
Alfalfa	231	70.6%	36.9%
Fallow	241	79.8%	62.4%
Double-Crop	251	80.7%	61.2%
Warm-Season Grassland	320	92.4%	88.9%
Cool-Season Grassland	330	84.2%	89.3%

Grassland Mapping:

Grassland accuracy levels are reported by the processing unit, Landsat WRS2 path/row (e.g. 2732 or 2733) and combined. Accuracy levels by path/row was to determine priority rankings for the mosaic process.

2732	32	33	Total	User's
32	**10**	7	17	58.8%
33	31	**221**	252	87.7%
Total	41	228	269	*Overall*
Producer's	*24.4%*	*96.9%*		*85.9%*

2733	32	33	Total	User's
32	**3054**	328	3382	90.3%
33	629	**3442**	4071	84.5%
Total	3683	3770	7453	*Overall*
Producer's	*82.9%*	*91.3%*		*87.2%*

2734	32	33	Total	User's
32	**4067**	520	4587	88.7%
33	770	**3609**	4379	82.4%
Total	4837	4129	8966	*Overall*
Producer's	*84.1%*	*87.4%*		*85.6%*

2832	32	33	Total	User's
32	**954**	83	1037	92.0%
33	44	**361**	405	89.1%
Total	998	444	1442	*Overall*
Producer's	*95.6%*	*81.3%*		*91.2%*

2833	32	33	Total	User's
32	**2504**	145	2649	94.5%
33	85	**344**	429	80.2%
Total	2589	489	3078	*Overall*
Producer's	*96.7%*	*70.3%*		*92.5%*

2834	32	33	Total	User's
32	**3618**	221	3839	94.2%
33	17	**186**	203	91.6%
Total	3635	407	4042	*Overall*
Producer's	*99.5%*	*45.7%*		*94.1%*

2634	32	33	Total	User's
32	**115**	36	151	76.2%
33	213	**1468**	1681	87.3%
Total	328	1504	1832	*Overall*
Producer's	*35.1%*	*97.6%*		*86.4%*

Total	32	33	Total	User's
32	**14322**	1340	15662	91.4%
33	1789	**9631**	11420	84.3%
Total	16111	10971	27082	*Overall*
Producer's	*88.9%*	*87.8%*		*88.4%*

Table 8. Error matrix for the Level III 2015 Kansas Land Cover Patterns map. The error matrix is a cross-tabulation between the map and ground reference data and is used to calculate accuracy levels.

		Reference Data									
LULC Name	**LULC Cod**	**Corn**	**Soybean**	**Sorghum**	**Winter Wheat**	**Alfalfa**	**Fallow**	**Double**	**Warm-Season**	**Cool-Season**	***Row Total***
		211	**212**	**213**	**221**	**231**	**240**	**250**	**320**	**330**	
Corn	**211**	**7,494**	1,035	193	458	27	65		4	2	*9,278*
Soybean	**212**	1,302	**9,784**	362	572	30	37		6	4	*12,097*
Sorghum	**213**	287	428	**2,818**	701	10	103	78	6		*4,431*
Sm Grains	**221**	333	407	260	**12,070**	67	233	443	9	2	*13,824*
Alfalfa	**231**	110	67	40	343	**369**	17	48	5		*999*
Fallow	**241**	131	42	104	806	4	**1,833**	10	6		*2,936*
Double	**251**	213	521	155	616	16	10	**2,428**	1	7	*3,967*
Warm-Season	**320**								**12,966**	1,625	*14,591*
Cool-Season	**330**	5	2		1			2	1,033	**8,727**	*9,770*
Column Total		*9,875*	*12,286*	*3,932*	*15,567*	*523*	*2,298*	*3,009*	*14,036*	*10,367*	71,893

References

Anderson, J., E. Hardy, J. Roach, and R. Witmer. 1976. A Land Use and Land Cover Classification System for Use with Remote Sensor Data, *Geological Survey Professional Paper # 964*, USGS, Washington, D.C.

Cohen, J. 1960. A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, Vol. 20(1): 37-40.

Congalton, R. G. and K. Green. 1999. *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices*. Lewis Publishers: Boca Raton, Florida.

Egbert, S.L., D.L. Peterson. A.M. Stewart, C.L. Lauver, C.F. Blodgett, K.P. Price, and E.A. Martinko. 2001. The Kansas GAP land cover map final report. *Kansas Biological Survey Report #99*, University of Kansas, Lawrence, Kansas.

Jensen, J.R. 1996. *Introductory Digital Image Processing*. Prentice-Hall, Upper Saddle River, NJ.

KARS (Kansas Applied Remote Sensing). 1973. *Kansas Land Use Patterns*. Lawrence, Kansas: Kansas Biological Survey, University of Kansas.

KARS. 1997. *Kansas Land Cover Patterns*. Lawrence, Kansas: Kansas Biological Survey, University of Kansas.

KARS. 2002. *Kansas Vegetation Map*. Lawrence, Kansas: Kansas Biological Survey, University of Kansas.

Whistler, J., M.E. Jakubauskas, S.L. Egbert, E.A. Martinko, D.W. Baumgartner, and R. Lee. 1995. Kansas Land Cover Mapping Project: Regional Scale Land Use/Land Cover Mapping Using Landsat Thematic Mapper Data. *ACSM/ASPRS Annual Convention and Exposition Technical Papers*, Vol. 3, pp773-785.

List of Acronyms and Abbreviations

CDL	Cropland Data Layer
CLU	Common Land Unit
DASC	Data Access and Support Center
DTC	Decision Tree Classifier
FID	Feature ID
FSA	Farm Service Agency
KARS	Kansas Applied Remote Sensing Program
KBS	Kansas Biological Survey
KGS	Kansas Geological Survey
KDOT	Kansas Department of Transportation
KDWPT	Kansas Department of Wildlife, Parks and Tourism
LULC	Land Use / Land Cover
MMU	Minimum Mapping Unit
MODIS	Moderate Resolution Imaging Spectroradiometer
NAIP	National Agriculture Imagery Program
NDVI	Normalized Difference Vegetation Index
NRCS	Natural Resources Conservation Service
PLSS	Public Land Survey System
USDA	US Department of Agriculture