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AgRISTARS DCLC APPLICATIONS PROJECT:
1982 WINTER WHEAT AREA ESTIMATES FOR
COLORADO, KANSAS AND OKLAHOMA

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I. ABSTRACT

This paper summarizes the work performed under the 1982 AgRISTARS (Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing) DCLC (Domestic Crops and Land Cover) Project in Colorado, Kansas and Oklahoma. The objective of providing timely, more precise year-end state and substate crop area estimates with reduced sampling errors for the Statistical Reporting Service (SRS) was accomplished. Some factors which affected the results were clouds, data quality, missing data on some bands and data delivery. Average data delivery was about four weeks after satellite overpass.

II. BACKGROUND AND OBJECTIVE

AgRISTARS is a cooperative effort of the Department of Agriculture (USDA), the National Aeronautics and Space Administration (NASA), the Department of Commerce (USDC), the Department of the Interior (USDI), and the Agency for International Development (AID). DCLC is one of eight projects under the AgRISTARS program. During 1982 the Applications Section of the Remote Sensing Branch (RSB) and the Colorado, Kansas, Illinois, Oklahoma and Iowa State Statistical Offices (SSO's) of SRS implemented the 1982 AgRISTARS DCLC Applications Projects.

Landsat data were combined with SRS ground-gathered survey data to provide timely, year-end major crop area estimates with reduced sampling errors in selected States. A regression estimator as described in Cochran (sections 7.1-7, third edition)¹ was used. A description of the regression estimator as used by the RSB can be found in a report by Hanuschak and others.² The DCLC project

initially started with two States in 1980. Kansas and Iowa were chosen as the first two states. Missouri and Oklahoma were added in 1981. In 1982, Colorado and Illinois were added to the Applications projects, while Missouri was dropped from the Applications projects and added as a research project.

The objective of providing timely, year-end state and substate crop area estimates with reduced sampling errors, using ground-gathered data in combination with Landsat data, was accomplished. Winter wheat planted area estimates and winter wheat harvested area estimates for Kansas and Oklahoma were provided to the SRS Crops Branch and the SSO's on October 27, 1982. Estimates for Colorado were provided on November 8, 1982. The data were reviewed by the Crops Branch and SSO's in their final end of season Annual Crops Summary.

III. STATE STATISTICAL OFFICE CONTRIBUTION

The SRS SSO's played an integral part in the outcome of the DCLC project. Part of their role was to be the primary ground data collectors. In their role as the primary collectors of ground data the SSO's provided field boundary, acreage, crop and land cover type data for the randomly selected SRS area segments. These data were collected during the June Enumerative Survey (JES). The data were used to establish training fields for computer classification of Landsat digital data and again for estimation. After collecting the ground data, an intensive field level edit was made by each state. After segments were edited in Kansas and Oklahoma segment field boundaries were digitized. The Colorado SSO traced segment field boundaries on clear acetate. The Colorado segments were then digitized by RSB Support

Staff. The other major role of the SSO's was interpretation of the final state and substate level estimates which were generated at the end of the project.

IV. LANDSAT DATA ACQUISITION

In 1982, the following Landsat products were used: 1:1,000,000 scale black and white transparencies (bands 5 and 7), 1:250,000 scale paper products (bands 5 and 7) and computer compatible tapes (CCTs). Delivery of these products involved two phases. The data were first transmitted from satellite to NASA Goddard where it was processed and sent via DOMSAT to the EROS Data Center (EDC). EDC in turn processed the data, filled the data order, and shipped the products to SRS. While data delivery was improved, the 21 day requirement for delivery after satellite overpass was not met. Average data delivery was about four weeks after satellite overpass.

V. DATA PROCESSING

Prior to processing the Landsat data, analysis districts were determined. Analysis districts consisted of counties partially or completely contained in one of more scenes of the same Landsat pass. Areas overlapping two scenes were assigned to a specific scene after considering cloud cover, data quality, imagery dates, and areas of scene overlap.

Several data processing centers were utilized in processing the JES and Landsat data to calculate regression estimates. The Martin Marietta Data System (MMDS), Bolt, Beranek and Newman (BBN), Washington Computer Center (WCC), and the CRAY-1S computer at NASA Ames were used. The major software package employed was EDITOR.³ EDITOR is an interactive and comprehensive data analysis system for processing Landsat and JES data. EDITOR runs on a modified DEC System-10 computer and is available at BBN in Cambridge, Massachusetts.

VI. ESTIMATION RESULTS

Estimation results for 1982 are in Tables 1-6. Relative efficiency measures the degree of improved precision obtained from using the Landsat data in addition to the randomly selected JES segment data. The figure obtained indicates the factor by which the sample size for the JES would have to be increased to equal the precision obtained using Landsat

data in conjunction with the ground data. The state level relative efficiencies for the three states ranged from 1.7 to 3.4. Relative efficiencies at the Landsat analysis district levels ranged from 1.8 to 10.2. A relative efficiency of about 2.5 is one measure of cost effectiveness.⁵ Factors which had an adverse effect on the relative efficiencies were missing Landsat data in some areas due to clouds, failure to achieve 21-day delivery of all Landsat data to SRS from time of satellite overpass and some missing data on some of the CCTs.

VII. SUMMARY

More precise and timely estimates of crop area were provided using Landsat data in conjunction with ground-gathered data for Colorado, Kansas and Oklahoma. Winter wheat planted area estimates and winter wheat harvested area estimates for Kansas and Oklahoma were provided to the SRS Crops Branch and the Kansas and Oklahoma SSO's on October 27, 1982, while those for Colorado were made available on November 8, 1982.

The SSO's played a key role in the project by performing field level edits, preparing tracings, digitizing, and evaluating regression estimates at the state and substate levels.

Failure to obtain data within 21 days after satellite overpass hampered the project. Average data delivery was about four weeks after satellite overpass.

VIII. ACKNOWLEDGEMENTS

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Table I.
1982 AgRISTARS DCLC Winter Wheat Planted Acreage Estimates For Colorado

Analysis District	Imagery Date	<u>JES DIRECT EXPANSION</u>		<u>LANDSAT REGRESSION</u>		Relative Efficiency
		Estimate (Acres)	Standard Error	Estimate (Acres)	Standard Error	
AD34GHI	7/15	894,000	100,000	881,000	73,000	1.9
AD35FGH	4/17	1,239,000	181,000	1,017,000	59,000	9.5
AD36FG	3/13	543,000	54,000	533,000	40,000	1.8
ADDEE	----	35,000	32,000	35,000	32,000	1.0
ADDEW	----	557,000	86,000	557,000	86,000	1.0
State		3,422,000	241,000	3,023,000	137,000	3.1

Table II.
1982 AgRISTARS DCLC Winter Wheat Harvested Acreage Estimates For Colorado

Analysis District	Imagery Date	<u>JES DIRECT EXPANSION</u>		<u>LANDSAT REGRESSION</u>		Relative Efficiency
		Estimate (Acres)	Standard Error	Estimate (Acres)	Standard Error	
AD34GHI	7/15	819,000	103,000	803,000	65,000	2.6
AD35FGH	4/17	1,209,000	177,000	994,000	55,000	10.2
AD36FG	3/13	496,000	56,000	492,000	40,000	2.0
ADDEE	----	35,000	32,000	35,000	32,000	1.0
ADDEW	---	474,000	69,000	474,000	69,000	1.0
State		3,154,000	224,000	2,798,000	121,000	3.4

Table III.
1982 AgRISTARS DCLC Winter Wheat Planted Acreage Estimates For Kansas

Analysis District	Imagery Date	<u>JES DIRECT EXPANSION</u>		<u>LANDSAT REGRESSION</u>		Relative Efficiency
		Estimate (Acres)	Standard Error	Estimate (Acres)	Standard Error	
AD29HI	4/11	857,000	163,000	1,051,000	90,000	3.2
AD30GHI	4/12	1,114,000	126,000	1,115,000	78,000	2.6
AD31GHI	4/13	3,998,000	184,000	3,682,000	84,000	4.8
AD32GHI	4/14	2,466,000	151,000	2,307,000	99,000	2.3
AD33GHI	5/3	2,234,000	207,000	2,337,000	95,000	4.8
ADDD	----	784,000	96,000	784,000	96,000	1.0
ADDE	----	2,911,000	174,000	2,911,000	174,000	1.0
State		14,344,000	418,000	14,187,000	298,000	2.0

Table IV.
1982 AgRISTARS DCLC Winter Wheat Harvested Acreage Estimates For Kansas

Analysis District	Imagery Date	<u>JES DIRECT EXPANSION</u>		<u>LANDSAT REGRESSION</u>		Relative Efficiency
		Estimate (Acres)	Standard Error	Estimate (Acres)	Standard Error	
AD29HI	4/11	840,000	164,000	1,038,000	90,000	3.3
AD30GHI	4/12	1,055,000	116,000	1,045,000	78,000	2.2
AD31GHI	4/13	3,883,000	175,000	3,594,000	85,000	4.2
AD32GHI	4/14	2,453,000	150,000	2,306,000	100,000	2.2
AD33GHI	5/3	2,164,000	207,000	2,272,000	93,000	4.9
ADDD	----	760,000	96,000	760,000	96,000	1.0
ADDE	----	2,849,000	172,000	2,849,000	172,000	1.0
State		14,028,000	413,000	13,864,000	297,000	1.9

Table V.
1982 AgRISTARS DCLC Winter Wheat Planted Acreage Estimates For Oklahoma

Analysis District	Imagery Date	<u>JES DIRECT EXPANSION</u>		<u>LANDSAT REGRESSION</u>		Relative Efficiency
		Estimate (Acres)	Standard Error	Estimate (Acres)	Standard Error	
AD29 IJK	4/11	166,000	43,000	151,000	31,000	1.9
AD30 IJK	4/12	1,109,000	103,000	955,000	45,000	5.3
AD30 JA	5/18	371,000	39,000	389,000	29,000	1.8
AD31 IJ	4/13	1,707,000	121,000	1,398,000	73,000	2.7
AD31 JK	4/13	1,128,000	77,000	1,077,000	53,000	2.1
AD32 IJ	4/14	525,000	86,000	507,000	31,000	7.6
AD33 I	4/15	411,000	66,000	395,000	33,000	4.1
ADDEE	----	961,000	122,000	961,000	122,000	1.0
ADDEW	----	1,675,000	118,000	1,675,000	118,000	1.0
State		8,156,000	316,000	7,507,000	246,000	1.7

Table VI.
1982 AgRISTARS DCLC Winter Wheat Harvested Acreage Estimates For Oklahoma

Analysis District	Imagery Date	<u>JES DIRECT EXPANSION</u>		<u>LANDSAT REGRESSION</u>		Relative Efficiency
		Estimate (Acres)	Standard Error	Estimate (Acres)	Standard Error	
AD29 IJK	4/11	151,000	41,000	134,000	27,000	2.2
AD30 IJK	4/12	1,023,000	103,000	870,000	47,000	4.7
AD30 JA	5/18	339,000	46,000	363,000	30,000	2.4
AD31 IJ	4/13	1,439,000	113,000	1,155,000	56,000	4.0
AD31 JK	4/13	1,047,000	78,000	996,000	56,000	1.9
AD32 IJ	4/14	436,000	81,000	418,000	30,000	7.1
AD33 I	4/15	378,000	66,000	363,000	31,000	4.5
ADDEE	----	806,000	112,000	806,000	112,000	1.0
ADDEW	----	1,468,000	108,000	1,468,000	108,000	1.0
State		7,201,000	295,000	6,572,000	222,000	1.8