REMOTE SENSING FOR CROP ACREAGE ESTIMATES

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The National Agricultural Statistics Service (NASS) is occasionally asked why it does not use satellite imagery to replace or enhance its present program of crop acreage estimates. The short answer is that NASS does use satellite imagery to enhance, but not replace, its program of crop acreage estimates and has for the last two decades. There are two major applications of remote sensing with respect to crop acreage estimates. First is the operational construction of the nation's area sampling frame for agricultural statistics, which has used satellite imagery as a major input since 1978. The area sampling frame is the statistical foundation for providing agricultural estimates with complete coverage of American agriculture. Crop acreage estimation is only one part of this system. The second application, which has been generally limited to a few States per year, has been the use of satellite imagery to directly and substantially improve the statistical precision of crop acreage estimates in those States.

There are several factors which comprise the limits of remote sensing in the context of crop acreage and contribute to decisions which have been made in NASS. This paper will discuss those factors and provide an overview of the NASS remote sensing capabilities, current applications of satellite imagery, and future research plans.

AREA SAMPLING FRAME CONSTRUCTION

Since 1978, satellite imagery has been the major input into stratification of land based on broad land cover definitions. Previously, aerial photography mosaics were used. Current satellite imagery provided a much better base for strata boundaries than the aerial photo mosaics obtained from flights several, sometimes many, years prior to the year of the new frame. This has led to improved statistical precision of numerous area frame-based estimates, including coverage estimates for major probability surveys and the 1997 Census of Agriculture. In addition, beginning in 1978 and continuing today, area sampling frames have been converted from paper-based products, subject to fire and loss, to digital versions which are more accurate and better protected from loss. New area sampling frames for Puerto Rico and all but nine States have been built since 1978 using these improved methods due primarily to satellite imagery.

CROP ACREAGE ESTIMATION

The second crop related application mentioned is the use of Landsat satellite imagery, along with an area frame based ground data sample, for direct crop acreage estimation in a limited number of States. The reasoning for the limitations, such as timing of the estimates, cloud cover, image delivery schedules uniqueness (or lack thereof) of spectral signatures for crops will be presented next in more detail as well as the benefits for the States included.

CONTINUED CROP IDENTIFICATION RESEARCH

One major area of study in Arkansas and North Dakota has been the feasibility of improving estimates of county level crop acreage. The same crop training and computer classification procedures have been used, but results are summarized at the county level. Thus, NASS is able to borrow training data from other counties in the same scene to improve the estimates for a particular county. The Arkansas and North Dakota State Statistical Offices have found these indications quite valuable in supplementing their current survey indications for setting official county estimates.

NASS has done more specific applications such as classifying all land on two specific Native American reservations in Montana for a proof of concept effort. NASS normally concentrates on creating statistical estimates from the classified pixels, but has done some mapping of classification results. When mapping has been done, those maps have not been felt to violate data confidentiality since all data points depicted on the final map are "as classified" – even pixels in the fields that were originally used for training the classifier. The latest product, which has been very popular with a wide variety of groups, has been to create digital data layers suitable for direct GIS input.

An important partnership was developed between NASS and USDA's Foreign Agricultural Service and Farm Service Agency in 1996. Joint use of Landsat imagery for the continental U.S. and sharing of outputs has benefitted the programs of all three Agencies.

CURRENT PROGRAM STATUS

Since NASS has state of the art processing and analytical capabilities but not the total funding and staffing to create remote sensing-based estimates and GIS data layers for many States each year, it has recently begun formal partnerships with other USDA agencies and State governments and universities to jointly increase the number of States involved. The partnership with the Foreign Agricultural Service and the Farm Service Agency in sharing Landsat data has been instrumental in expanding the number of States NASS can address. In addition, all NASS field offices operate through Federal-State cooperative agreements with State Departments of Agriculture and land grant universities. NASS conducted a search of these cooperators to identify those interested in joint ventures to provide products useful to both organizations through cost and resource sharing arrangements. This triangular arrangement involving NASS, FAS/FSA, and State governments or land-grant universities is a win-win-win situation and is enabling more States to benefit from these applications. In addition, NASS continues to partner with the Agricultural Research Service to evaluate new sensors for crop monitoring.

These new cooperative agreements were started in 1999 and analysts in five States have been trained (New Mexico, Arkansas, North Dakota, Mississippi, and Illinois). Details of the arrangements vary in each case, but the cooperating organization is essentially providing extra staffing. The State governments of Illinois and Mississippi are formal partners for those States. In the New Mexico example, the National Resources Conservation Service is sharing in the funding and the identification of projects.