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THE AUXILIARY USE OF LANDSAT DATA IN ESTIMATING CROP YIELDS: RESULTS OF 1978 IOWA FEASIBILITY STUDY

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Each year from late May to early June, the Economics, Statistics, and Cooperatives Service (ESCS) of the U.S. Department of Agriculture conducts a nationwide June Enumerative Survey (JES), consisting of interviews with farm operators in randomly selected area-sample units called segments, which are typically one square mile in size. Later in the growing season, crop yields are estimated from biological measurements conducted in small plots of land only a few square meters in size, which have been selected by two-stage subsampling from JES segments. The first stage of the subsampling is for fields planted to the crop of interest; second-stage subsampling is for plots within first-stage selected fields.

In this paper a regression-like estimator is investigated as a method to use LANDSAT data to improve ESCS yield estimates for corn and soybeans. The estimator's primary variable, which is required to be known only for sampled fields, is estimated field-level yield computed from observed plot data. The estimator's auxiliary variables are field-level means of MSS radiometric values and/or various MSS vegetative indices. By definition auxiliary variables must be known over the entire population, which in this case is all land planted to the crop of interest within some target area. Since a pixel's population membership is not known however, for pixels exterior to JES segments, the set of all pixels classified to the crop of interest is used to define a pseudo-population for the estimator. This creates an estimator bias, which is estimated from labeled LANDSAT data coinciding with JES segments.

Evaluation of the developed estimator with 1978 unitemporal Iowa data produced mixed results in sub-state analysis areas. In some areas of Iowa, no yield estimation improvements from LANDSAT were indicated. In other parts of Iowa, yield estimation improvements were moderate for soybeans and marginal for corn. Haze correction was used to develop entire-state estimators. Entire-state estimation improvements were modest for both corn and soybeans.

MAPPING GROWING CONDITIONS OF CROPS FROM LANDSAT DATA

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ABSTRACT

An automatic method of mapping crop growing conditions from Landsat data has been developed. The method uses only current Landsat data and yield models derived from historical Landsat and crop phenology data. These models have been developed for spring and winter wheat in the Northern Hemisphere environment. The maps are useful to marketing, international service and relief organizations in estimating domestic and foreign yields of major crops.

Growing conditions of crops are often evaluated by ground observation of the density of plants in grain fields. Landsat data were used in this study to estimate these densities. The method is based on the fact that a dense or closed green-vegetative canopy absorbs more incident radiation in Landsat Band 5 and reflects more in Band 7 than an open or sparse canopy. The densities were determined quantitatively by comparing the ratio of Band 7 to Band 5 intensities in standardized Landsat digital data to standard values for canopies of different densities. A biomass index is then calculated to express quantitatively the vegetation density of a sample area (10 km^2). These biomass indices are translated into yield estimates for wheat using regression models.

Maps showing the distribution of growing conditions of spring and fall seeded wheat by 10 km^2 areas within five Crop Districts have been used to estimate composite yields for wheat in these districts for the past five growing seasons. These estimates were within ± 10% of the reported yield for each District. The yield estimates for the 10 km^2 sample areas were even closer to the reported yields for these areas.

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