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## Measuring Land Use Changes on USDA Photographs

**ABSTRACT:** *Aerial photography taken for the U. S. Department of Agriculture in 1944 and 1960 was used to evaluate land use changes in Clarke County, Georgia. For this case study, six land use classes were interpreted and measured by means of dot grids. During the 16-year period spanned by photographic coverage, the economy of this county in the Piedmont Plateau of Northeast Georgia has changed from rural-agricultural to an urban-industrial complex.*

**I**N ANALYZING the economic development of any area, land utilization provides one of the more valuable indicators of rural, urban, and industrial growth. Sequential aerial photography makes it feasible for a trained interpreter to evaluate land use patterns at two or more distinct points in time. This report describes the basic procedures used in studying the changing land patterns in Clarke County, Georgia.

### OBJECTIVES

The principal objectives of this case study were:

1. To determine which land use classifications might be consistently and reliably recognized on 1:20,000 USDA panchromatic aerial photographs taken at 16-year intervals.
2. To measure land utilization changes in a test

county where sequential photographic coverage was available for 1944 and 1960.

3. To formulate reasonable explanations for land use changes detected during the course of the study.

Clarke County is situated about 60 miles northeast of Atlanta in the rolling hills of Georgia's Piedmont Plateau. In terms of land area (125 square miles), it is the smallest of the State's 159 counties, but its 1960 population of 45,360 placed it fourteenth in county population rankings. The principal urban area of Athens is the locale of The University of Georgia, a state-supported institution that had a 1960 enrollment of approximately 9,000 students.

### LAND USE CLASSES

Panchromatic photography taken in 1944 and 1960 for the USDA's Agricultural Stabilization and Conservation Service was available for this project (Figure 1). Six land use classes were chosen after preliminary interpretation and several ground verification checks. While greater refinements in land delineations might have been desirable, several proposed categories had to be rejected, because they could not be consistently recognized. The restrictions imposed on the selection of such classes are obvious when one realizes that accurate field checks cannot be made for 1944 photography.

Trial-and-error experimentation resulted in the selection of these six definitive classifications:

*Cultivated land:* Land used for growing agricultural crops or apparently cultivated during the growing season preceding photography. Also included were improved pasture lands, because



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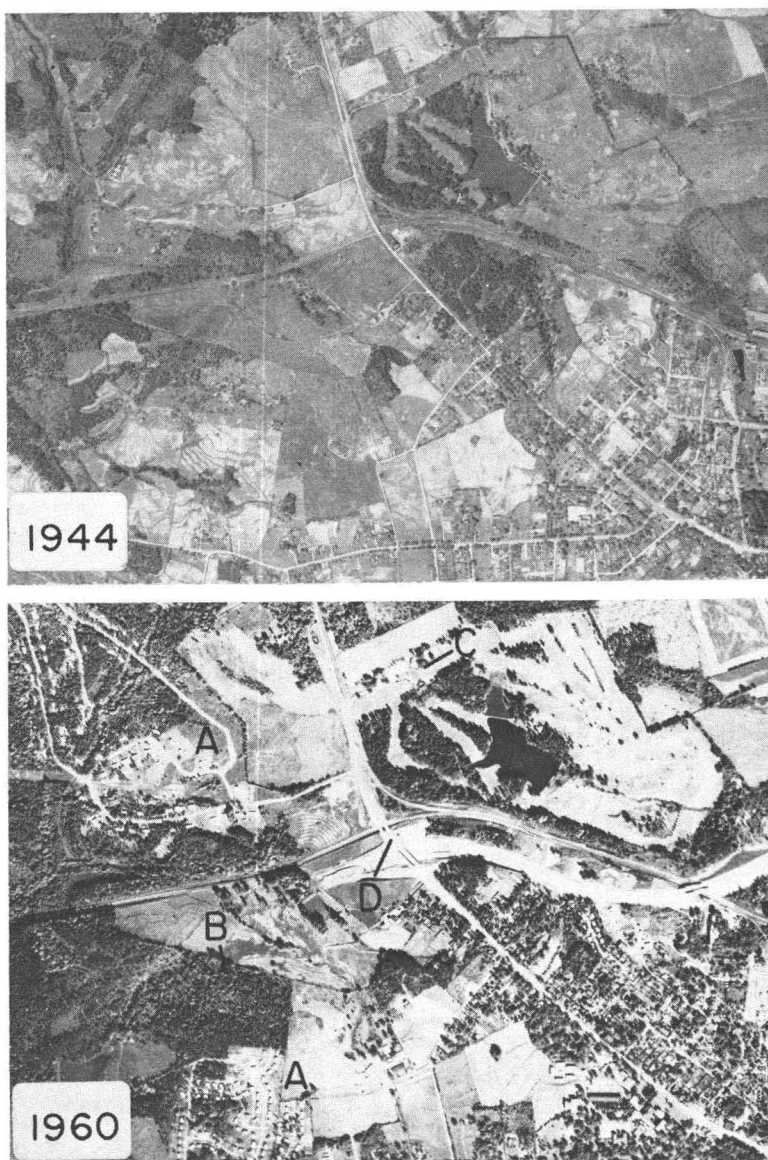


FIG. 1.—Sample of aerial photographs from Clarke County, Georgia. On the 1960 print, new residential areas may be seen at (A), land reverting to forest cover at (B), improvements in a country club and golf course at (C), and construction of a new highway at (D). Scale is 1:20,000 or about 1,700 feet per inch.

such lands were not always distinguishable from cropland on the photographs available.

*Pine forest:* Woodlands having a tree crown density of ten percent or more, with pine species comprising 51 percent or more of the dominant (visible) crown canopy.

*Hardwood forest:* Woodlands having a tree crown density of ten percent or more, with deciduous tree species comprising 51 percent or more of the dominant (visible) crown canopy.

*Urban land:* All residential and industrial areas within the city limits of incorporated towns were included in this classification.

*Idle land:* All open wild lands having a tree crown density of less than ten percent and not classed as cultivated. Also included were unimproved pastures, i.e., unfenced grazing areas not sown with forage crops.

*Water:* Lakes and ponds larger than 2 to 3 acres and river channels 200 feet wide or more were included in this category.

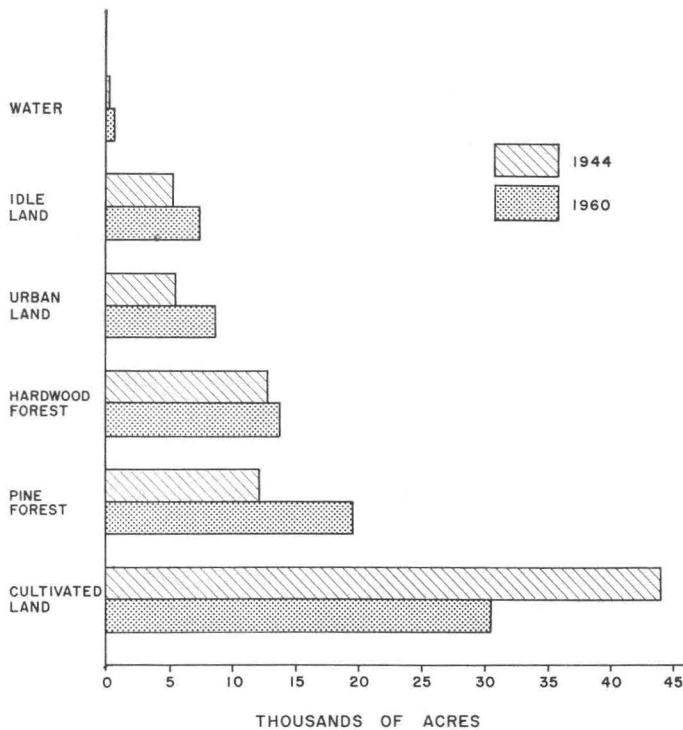


FIG. 2. Land use changes in Clarke County, Ga., 1944-1960.

#### AREA DETERMINATIONS

Areas of each land use class were obtained by dot grid counts on 9- by 9-inch contact prints. By using the non-overlapping portions of alternate prints in each flight line, only 35 prints were required for complete county coverage. With a grid having 16 dots per square inch, each dot represented approximately four acres at the nominal photo scale of 1:20,000. However, because of slight scale differences in the 1944 and 1960 prints, acreages of each classification were determined proportionally by the following relationship:

$$\text{Type acreage} = \frac{\text{No. of dots in type}}{\text{Total dots counted}} \times 80,000 \text{ (county area in acres)}$$

TABLE 1.—SUMMARY OF LAND USE CHANGES IN CLARKE COUNTY, GEORGIA, 1944-1960.

Land Use	1944		1960	
	Acres	Percent	Acres	Percent
Cultivated land	44,000	55.0	30,400	38.0
Pine forest	12,000	15.0	19,200	24.0
Hardwood forest	12,560	15.7	13,840	17.3
Urban land	5,680	7.1	8,400	10.5
Idle land	5,600	7.0	7,600	9.5
Water	160	0.2	560	0.7
Totals	80,000	100.0	80,000	100.0

Acreages and percent of county area occupied by each type during 1944 and 1960 are shown in Table 1. Land use changes are presented graphically in Figure 2. It will be noted that the area of cultivated land decreased by 13,600 acres during the 16-year interval; all other classifications increased in size, with the largest gains evident in urban areas and pine forest land. These significant changes are vividly illustrated by paired

TABLE 2.—PRINCIPAL OCCUPATIONS OF PERSONS EMPLOYED IN CLARKE COUNTY, GEORGIA<sup>1</sup>

Type of occupation	Number of persons
Services	6,048
Manufacturing	3,674
Wholesale; retail	3,121
Construction	914
Transportation; communications	744
Public administration	656
Agriculture	406
Forestry	28
Mining	9
Total	15,600

<sup>1</sup> Source: Georgia Statistical Abstract, 1960.

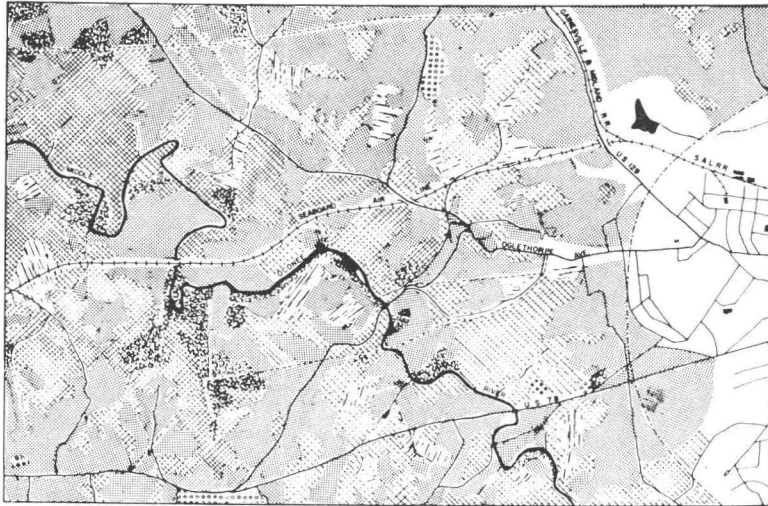


FIGURE 3 -- LAND USE MAP OF ATHENS AREA

CLARKE COUNTY, GEORGIA

FOR 1944



- PINE FOREST
- HARDWOOD FOREST
- IDLE LAND
- CROPLAND, PASTURE
- ORCHARDS
- URBAN - RESIDENTIAL
- LAKES OR PONDS
- BUILDINGS

MAPPED FROM 1944 AERIAL PHOTOGRAPHS BY *Conroy Stagers*

- DIVIDED HIGHWAY
- HIGH-TYPE PAVEMENT
- CONNECTING STREETS
- RAILROADS
- RIGHTS-OF-WAY
- CITY LIMITS
- PERENNIAL STREAMS
- INTERMITTENT STREAMS



FIGURE 4 -- LAND USE MAP OF ATHENS AREA

CLARKE COUNTY, GEORGIA

FOR 1960



- PINE FOREST
- HARDWOOD FOREST
- IDLE LAND
- CROPLAND, PASTURE
- ORCHARDS
- URBAN - RESIDENTIAL
- LAKES OR PONDS
- BUILDINGS

MAPPED FROM 1960 AERIAL PHOTOGRAPHS BY *Conroy Stagers*

- DIVIDED HIGHWAY
- HIGH-TYPE PAVEMENT
- CONNECTING STREETS
- RAILROADS
- RIGHTS-OF-WAY
- CITY LIMITS
- PERENNIAL STREAMS
- INTERMITTENT STREAMS

land use maps of the Athens area prepared from the photographs used in this study (Figures 3 and 4).

#### *Explanation of Changes*

Clarke County has become a major university site and regional trade center during the past two decades. Thus urban growth has had a major effect on available farm acreage. Residential areas have emerged where forests and cotton farming once dominated the landscape. During the 1940-1950 period alone, the number of people engaged in farming dropped by 40 percent. Thus the agricultural pattern of this county has shifted

from a heavy emphasis on cotton to poultry production, livestock, and farm woodlot management.

A postwar influx of new manufacturing and processing plants in the Athens area has provided primary or supplementary sources of income to many "part-time farmers." The result has been a decrease in farm production, a gradual reversion of cropland to forest land, and an increase in the over-all economy of the county. As indicated by the occupational pursuits listed in Table 2, Clarke County had been effectively transformed from an agricultural to an urban-industrial region by 1960.

#### ACTIVITIES OF SUSTAINING MEMBER

##### DAVID W. MANN COMPANY

A third dimension—that of optical density or image transmittance—has been added to photographic data reduction by the David W. Mann Co. of Burlington, Mass., a division of GCA Corporation, through their line of microdensitometers. Mann microdensitometers combine a two-coordinate precision linear comparator with a highly sensitive microphotometer to measure optical density as a function of  $X$  and  $Y$  coordinates. Digital readout is provided on magnetic tape.

Recently developed by the Mann Company is the trichromatic microdensitometer for color film. It has been chosen by a major trade magazine as among the top 100 new products of 1964.

The Mann Company has specialized for 30 years in the development and manufacture of precision screw type measuring instruments.

Because of its pioneering role in this field, Mann instruments are used throughout the United States and abroad in a cross-section of scientific laboratories, research organizations and industry where the utmost in precision and accuracy are imperative.

Mann's contributions to comparator technology, for example, have increased the effectiveness of these instruments in missile and satellite tracking, ballistics research, space measurements involving both time and precision, medical and chemical research, mapping and photo-reconnaissance. One micron precision is characteristic of these comparators, some of which have formats greater than 18 in.  $\times$  18 in.

Other Mann products include microphotographic equipment used in making semiconductor photomasks; and high precision lens test benches of the nodal slide type.