A Land Use and Land Cover Classification System for Use with Remote Sensor Data

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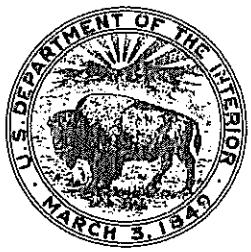
A revision of the land use classification system as presented in U.S. Geological Survey Circular 671



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boats themselves, can be detected on high-altitude photographs. Although each of these activities is detectable at some time using remote sensing, many other multiple-use situations cannot be interpreted with the same degree of success. The example of the reservoir does provide insight into another facet of the problem's solution, however, and that is the possibility and need for acquiring collateral data to aid in the understanding of a multiple-use situation.

The vertical arrangement of many uses above and below the actual ground surface provides additional problems for the land use interpreter. Coal and other mineral deposits under croplands or forests, electrical transmission lines crossing pastures, garages underground or on roofs of buildings, and subways beneath urban areas all exemplify situations which must be resolved by individual users and compilers of land use data.

The size of the minimum area which can be depicted as being in any particular land use category depends partially on the scale and resolution of the original remote sensor data or other data source from which the land use is identified and interpreted. It also depends on the scale of data compilation as well as the final scale of the presentation of the land use information. In some cases, land uses cannot be identified with the level of accuracy approaching the size of the smallest unit mappable, while in others, specific land uses can be identified which are too small to be mapped. Farmsteads, for example, are usually not distinguished from other agricultural land uses when mapping at the more generalized levels of the classification. On the other hand, these farmsteads may well be interpretable but too small to be represented at the final format scale. Analogous situations may arise in the use of other categories.

When maps are intended as the format for presenting land use data, it is difficult to represent any unit area smaller than 0.10 inch (2.54 mm) on a side. In addition, smaller areas cause legibility problems for the map reader. Users of computer-generated graphics are similarly constrained by the minimum size of the computer printout.

CLASSIFICATION CRITERIA

A land use and land cover classification system which can effectively employ orbital and high-altitude remote sensor data should meet the following criteria (Anderson, 1971):

1. The minimum level of interpretation accuracy in the identification of land use and land cover categories from remote sensor data should be at least 85 percent.
2. The accuracy of interpretation for the several categories should be about equal.
3. Repeatable or repetitive results should be obtainable from one interpreter to another and from one time of sensing to another.
4. The classification system should be applicable over extensive areas.
5. The categorization should permit vegetation and other types of land cover to be used as surrogates for activity.
6. The classification system should be suitable for use with remote sensor data obtained at different times of the year.
7. Effective use of subcategories that can be obtained from ground surveys or from the use of larger scale or enhanced remote sensor data should be possible.
8. Aggregation of categories must be possible.
9. Comparison with future land use data should be possible.
10. Multiple uses of land should be recognized when possible.

Some of these criteria should apply to land use and land cover classification in general, but some of the criteria apply primarily to land use and land cover data interpreted from remote sensor data.

It is hoped that, at the more generalized first and second levels, an accuracy in interpretation can be attained that will make the land use and land cover data comparable in quality to those obtained in other ways. For land use and land cover data needed for planning and management purposes, the accuracy of interpretation at the generalized first and second levels is satisfactory when the interpreter makes the correct interpretation 85 to 90 percent of the time. For regulation of land use activities or for tax assessment purposes, for example, greater accuracy usually will be required. Greater accuracy generally will be attained only at much higher cost. The accuracy of land use data obtained from remote sensor sources is comparable to that acquired by using enumeration techniques. For example, postenumeration surveys made by the U.S. Bureau of the Census revealed that 14 percent of all farms (but not necessarily 14 percent of the farmland) were not enumerated during the 1969 Census of Agriculture (Ingram and Prochaska, 1972).

In addition to perfecting new interpretation techniques and procedures for analysis, such as the various types of image enhancement and signature identification, we can assume that the resolution capability of the various remote sensing systems will also