MIADS - A New Tool In Water Resources Management

by

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INTRODUCTION

In River Basin and PL 566 watershed planning, we are rapidly moving from an era of generalization into a new era of quantification. We are moving into quantification because today's problems can no longer be solved with generalized evaluations or planning. Today's problems are complex, and require intensive inventories, sound analyses, accurate projections and intensive planning for their solution.

MIADS is an important new tool which is aiding us in solving today's problems in water resource management. MIADS is an acronym for Map Information Assembly and Display System developed by Elliot L. Amidon. 1/ We are using this system in the inventory, analysis, projection and planning phases of our work.

THE MIADS SYSTEM

First, let me briefly present how we use MIADS, and then I will discuss other possible applications. In River Basin Planning, using available data, we stratify our watersheds by soils, vegetation, slope, land use, land ownership, or other factors having significant effects upon soil erosion, sediment production, runoff, land management, and program development. Specific combinations of these factors are strata. This is the inventory phase of our work.

MIADS is used to stratify the watershed. MIADS produces a category map and tables containing the area of each strata and the total area of the watershed. This system converts conventional map data into a two character code system. The codes are alphanumeric symbols. The code has a left and a right hand character. In our category maps, the left hand character might describe soils, slope and land ownership, while the right hand character could represent vegetation and land use. This code system is capable of describing approximately 2,200 different strata.

The coded map data is recorded on a transparent grid which is laid over the base maps. The grid contains cells which represent a specific acreage. The coder evaluates the map data under each cell, determines

1/ Amidon, Elliot L. 1966. MIADS... An Alphanumeric Map Information Assembly and Display System for a large computer. Berkeley, Calif., Pacific SW Forest and Range Exp. St. 12pp. illus. (U.S.Forest Service Res. Paper PSW-38) the predominant characteristics and records the appropriate codes in the cells. The coded grids are taken to the key punch operator where the coded map data is punched into data cards. The MIADS data cards are run through the computer which produces a printout of the category map and tables containing the area of each strata. The cell acreage governs the scale of the map produced by the computer.

Our field sampling is based upon the MIADS category map and tables. The tables tell us which strata are large or important enough to require sampling, and the map tells us where the strata occur. The strata are sampled by transects to determine their vegetation, ground cover, erosion, sediment production, runoff, land management and remedial program characteristics.

Our watershed analysis is based upon field data. We determine for each strata soil erosion, sediment production and runoff rates, timber volumes, management problems, remedial measures and costs, etc. These rates are assigned to strata codes and MIADS develops tables displaying the products of strata areas times strata rates. For example, the computer can produce tables displaying the sediment production by strata and the total sediment production for the watershed.

Another table that MIADS develops is the products proportion table which contains the percentage of the total watershed production yielded by each strata, for example, sediment production. This table is very useful in identifying which strata are problems that need attention. For example, strata AB yields 15 percent of the total sediment while strata CC yields only one percent. This table focuses our attention on strata AB for planning corrective programs.

MIADS has an option whereby we can print out a map displaying areas of interest. For example, the products proportion table tells us that strata AB is a high sediment producer and needs corrective action. The planner knows from the area table that there are 20 square miles of strata AB, but where is it? This option prints out a map showing the location of strata AB. The rest of the codes are not printed. This option allows the planner to show the potential user of the plan where the problem occurs. Thus, the plan is easier to implement.

A companion program with MIADS is the COMBINS program which can combine two MIADS maps. This adds great flexibility in the use of MIADS data. For example, we have stratified a watershed using soils, vegetation and land use. Another person may be interested in our stratification, but wants to add another factor, such as land ownership. All that the second person needs to do is to code the land ownership for the watershed. The COMBINS program will combine the land ownership map with our stratification and produce a new map displaying the new stratification plus the appropriate tables.

As conditions change within a watershed, the MIADS system provides an easy method for updating maps and records. Some examples of changing conditions are new reservoirs, plantations, cropland and urbanization. Updating is accomplished by recoding the affected area and running the revised data through MIADS.

MIADS is a versatile system. The user can be intensive by coding fractions of an acre, or extensive by coding units larger than 1,000 acres. During coding, maps with different scales can be reduced to a common scale. If a MIADS map for a large area is properly constructed, data can be produced for portions of the area, for example, counties, small watersheds, states, or congressional districts. You can get out of MIADS anything that you put in, plus interpretations based upon the data put into it. It is a data bank that can supply answers quickly.

EXAMPLES OF USE

Let us visualize an hypothetical problem. We are planning a multi-purpose reservoir for recreation, irrigation and flood control. The water will be used for irrigating rice and row crops of corn, cotton and soybeans. In the reservoir, the water will be used for boating, fishing and swimming. All the uses require high quality water. However, the watershed yields poor quality water because of eroding lands in the headwaters.

To solve these problems, we must identify the sources and the causes of sediment production and flood runoff above the dam, determine how much water is needed for irrigation, and how large a service area can be serviced with water from the reservoir.

To answer these questions, we must evaluate the watershed conditions above the dam and the water requirements below the dam. By using MIADS, we can make this evaluation efficient and revealing. Above the dam we would design our stratification to detect the sources and cause of sediment production and flood runoff. Below the dam it would be designed to determine the area presently in agriculture, the area that could be converted to agriculture, and the water requirements for agriculture.

We could stratify the watershed above the dam using soils, vegetation types, land uses, crops, slope classes, and types of ownership. Next we would determine for each strata runoff and sediment production rates, management problems and remedial measures to reduce runoff and sediment production. Then MIADS will compute the sediment production for each strata, identify and map strata needing remedial measures, and compute the total sediment production from sheet and gully erosion for the watershed. With this information, the planner can develop a remedial program and set priorities.

Also, the planner can use MIADS to compute the total program cost. The planner merely determines the cost to treat an acre of each category needing attention, and the computer will compute the treatment cost for each category and for the whole watershed.

The remedial program might have recommendations that certain strata not be used for some purposes. For example, a soil might not be suitable for grazing because when grazed, it cannot support an adequate grass sod to prevent erosion and sediment production. The planner can use MIADS to produce a map showing the distribution of this soil and recommend that grazing be excluded from this area. In other words, the planner can identify and recommend the uses that should be permitted on various strata, and display where such uses can be permitted without damaging the soil and water resources.

Below the dam, the planner can use MIADS to determine how large a service area, with various crop mixtures, can be supplied by the reservoir. The potential service area could be stratified using soils, vegetation types, land uses, crops, slope classes and ownerships. This stratification would describe the present conditions and provide a basis for projecting future conditions with the reservoir.

The MIADS data can be used to determine which areas can produce rice and which areas can produce row crops. It can identify and compute the area that is unavailable for crop production because of land ownership, land use, slope or urbanization. MIADS can identify and compute the area of pasture and forest land which is potential crop land.

The next step is to determine the water requirements for the potential service area. MIADS data has identified the area available and suitable for crops. Now the planner can determine the water requirements to produce each crop by soil type. For example, rice might require 12, 24, and 36 inches of water to produce a crop on soils A, B, and C, respectively. Then, corn might need supplemental irrigation of 6, 8, and 10 inches on C, D, and E soils, respectively. The planner would develop these rates for cotton and soybeans, too.

Then, the planner would project what the expected crop mixture will be with the reservoir using local knowledge and trends in agriculture. He would assign rice, corn, cotton and soybean water use rates to those categories expected to be in these respective crops. Then, MIADS would compute the expected water requirements for a proposed service area. Now, the planner can determine if the reservoir can supply the water needed by the proposed service area.

If the water supply and the water requirements do not match, there are several alternatives available to the planner. If the supply is too small, he can use MIADS data as an input to linear programing to recommend optimum crop mixtures to produce the greatest economic return with the available water, or recommend that service area be reduced. Conversely, if the water supply is larger than demand, he can recommend that the service area can be increased and/or that the crop mixtures be optimized to produce the greatest economic return with the available water.

CONCLUSION

MIADS is a versatile new tool which helps us in the inventory, analysis, projection and planning phases of our work. It quantifies problems which were previously treated in generalized terms. It allows us to make more intensive analyses and develop more intensive remedial programs with the same amount of time, money and manpower.