Computerized Agricultural Crop Flood Damage Assessment System

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Many of the more critical water resource problems in the Nation have been resolved by approved water resource projects or have been addressed by a feasibility analysis. These projects reflected the changing needs and demands of the American people in regard to water resources development and have contributed significantly to the increased economic growth of the country and the overall well-being of its people.

The need for water resources development continues, as evidenced by the recent flooding problems in the Mississippi Valley and the increased need for hydroelectric power. Civil works flood control planning will require closer scrutiny of future studies from the standpoint of economic feasibility.

Economic evaluation of the effects of flooding of agricultural areas has become an increasingly essential input in determining the feasibility of water resource projects. Major administrative and Congressional decision-making depends heavily upon the reliability of estimates of flood damages in an area as well as the estimated benefits realized from installation of water resource development projects. Decision-making is enhanced by improved calculation techniques, resulting in better estimates of damages and benefits for determining and selecting improvement projects. In addition, the current conditions of runaway inflation, devaluations of the dollar, and efforts to balance the Federal budget, as well as pressures to hold down Federal spending, increase the importance as well as the magnitude of determining the most productive investment of water resources monies.

Accurate assessment of flood damages to agricultural crops is a difficult task. The difficulty stems from the need to consider a number of factors, including the large number of crops produced in the flooded area, the critical timing of cultural practices involved in each crop production cycle, and the crop replanting and substitution alternatives available to farmers.

A program entitled "The Computerized Agricultural Crop Flood Damage Assessment System" is an attempt to more accurately evaluate flood damages to agricultural crops. The program utilizes historical flood data on a daily basis, current budget data, present cropping patterns and production techniques, including crop replanting and substitution, and other data to assess flood damages. Data from this program provide assistance in developing the Nation's water resources by improving the accuracy of economic evaluations, thus increasing their reliability for decision-making by the public, Congress, and the Federal agencies involved in the evaluation process.

The objectives of the CACFDAS system are as follows:

Develop computerized crop budgets that include current technology and allow flexible adjustments to yield levels, factor quantities and prices, and product quantities and prices.

Analyze the effects of physical factors such as depth, duration, and seasons of flooding on crop specific flood damages.

Develop a system for coupling the budget data to the crop flood damage analysis to allow close monitoring of flood dates and acres flooded, cultural practices or operations completed, and costs incurred for the typical set of crops found in the Alluvial Valley of the Mississippi River.

Develop procedures for allowing alternative crops to be installed to permit crop substitution when floods extend beyond usual or normal planting dates, when floods destroy an installed crop, or when any other existing condition prohibits production of an originally intended crop.

Develop the capability to partition floods into bands of inundation from daily gage recorded stage data and, therefore, allow for a more realistic quantification of damage-duration factors.

Accommodate digitized stage-area input data to the computer programming system.

Provide outputs of crop-specific damage per cleared acre flooded; total damage per cleared acre flooded; annual damages (total damages divided by number of years of historical record); total cleared acres flooded; and annual cleared acres flooded (total cleared acres flooded divided by number of years under analysis).

The CACFDAS is a complex system that utilizes initial crop distributions, computerized crop budget data, substitution of alternative crops, damage-duration data, and daily historic hydrological data to compute flood or inundation damage estimates to crops. The program utilizes historic gage (or equivalent gage) readings from the time of gage installation to the present. The CACFDAS analyzes these data and outputs estimated damages based on current technology, yield, and price levels. Specifically, the input to the system consists of the following:

Initial reach crop distribution data consisting of percentages of acres of initial crops that represent cropping patterns in each reach.

Expected net and gross returns for each crop. Expected net returns reflect the difference between expected gross revenues

and the total expected cost flows for each crop. Expected gross returns reflect total anticipated crop incomes.

Alternative crop data to allow substitution of some major crops created by floods extending beyond usual or normal planting dates, floods destroying an installed crop, or any other condition that prohibits production of an originally intended crop.

Last date of replanting data, which reflect the last possible date for each replant crop. These data are necessary for the program to systematically determine if all operations necessary for installing the crop (or alternative crop) have been performed.

Computerized crop budget data that include current technology as well as current yield levels, factor quantities and prices, and product quantities and prices for crops in each reach.

Itemized cultural or operation practices in crop-specific flood damage data form for crops in each reach, based on data from computerized crop budget data. These budget data (for the Vicksburg District area) utilize the budget generator system at Mississippi State University to provide flood damage data that represent the spectrum of production conditions in the Mississippi Delta. Each cultural or operation practice couples flood duration in days that result in flood damages.

Digitized stage-area data based on historical gage readings of flood data conditions that reflect the cleared acres flooded for each day of area inundation.

The crop damage program reads digitized stage-area data until a flood can be defined. This is accomplished by reading and storing digitized stage-area data until at least a 10-day "break" is reached in the data (10 days is assumed to be the dryout period between floods). The program divides the flood into bands of inundation (minifloods). A band is defined as the area over which the flood level decreased over a 1-day period based on the historical flooding elevations with at least a 10-day dryout period between flood peaks. The purpose of banding is to account for differential dryout periods associated with different elevations within a flooded area.

Damage assessment is crop-specific with crops falling into five different computational methods—spring crops, winter crops, pasture, hay, and wheat-soybean double crop. Damages assessed depend upon the acreage flooded, the duration of the flood, and the initial crop distribution. Damage calculations on reflooded acres on which crops have been *lost* (no available replant) result in the assessment of no additional damages. The critical duration data of the flood damage tables are used in assessing damages to crops. The program classifies land areas making up each band into initially flooded acres, replanted acres, lost acres, and damaged acres.

Lost acres consist of land on which crops have been lost and for which no alternatives are available. Once a land area is lost due to flooding, no additional crop losses can occur during the current year for that crop. Damaged acres is a category associated with forage crops, in which damages are assessed in terms of lost grazing or lost hay cuttings.

The program provides three options for output data format:

The "brief" mode of output reports damages per flood year and summarizes each reach.

The "normal" mode of output reports damages and other pertinent data for each flood, for each year, and for each reach summary.

The "debug" mode of output reports damages and other data for each flood, for each year, and for each reach summary plus detailed debugging information down to the "band" level within each flood. Specifically, these outputs include printouts of digitized stage-area data, background data for the development of flood bands, matrix dumps designed to monitor land use within flood bands and over flood years, flood reports, calendar year reports, and a reach report.

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