CS-167 DEVELOPMENT OF A GIS FOR THE HYDROLOGIC ANALYSIS OF AGNO RIVER BASIN, PHILIPPINES

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1. INTRODUCTION

With the advancement of computer technology, application of distributed mathematical models to simulate hydrologic processes in river catchments is becoming possible. A limitation for such applications is the difficulty of obtaining vast amount of data required for the setting up of model at realistic scales. Especially , in the developing countries, availability of spatial data sets is limited, and it become necessary to extract all available data from limited resources to construct an adequate information base. Geographic information system (GIS) is a very practical and useful tool for this type of analysis and can be used as a data base to store, manipulate and integrate many different kinds of data and information , to derive parameters for model application. This paper describe some details of development of a GIS based database for mathematical modeling of AGNO river basin, the Philippines in the Luzon island.

2. STUDY AREA

The study area is the Agno river basin, the third largest river in the Philippines and is located in the western portion in the central part of Luzon from 120°00' to 121°00' east longitude and from 15°00' to 16°45' north latitude with a drainage area of 5.952 sq. km. The estimated annual runoff for the basin.is about 6,654 million cu.m. and annual average rainfall varies from 2,000 mm in the south-eastern part of the basin to more than 4,000 mm in the northern mountainous area. However, the area covered by this study is limited to a part of the basin covering an area of 1,700 sq. km (Fig. 1), above carmen gauging point.

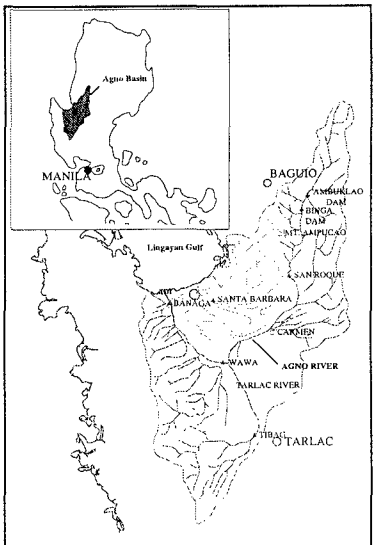

Fig. 1 Location Map of Study Area

3. GIS FOR THE CATCHMENT

The main data sets required for distributed hydrologic modeling are topographic data, landuse data, soil hydraulic property distribution, geologic and groundwater information and the stream network information. In addition, rainfall data and parameters for estimating potential evaporation are required. These data sets, prepared from information gathered from a number of sources, are stored in three different formats, I) vector data, ii) raster data and iii) point data. Raster data layers are generated from digitized vector layers in different grid scales to be used in mathematical models for grid networks of different sizes. All the layers are corrected and rectified to UTM coordinate system so that they can be integrated to generate a raster database in which each cell contains the information of all the layers.

3.1 LANDUSE DATA

Spot image of satellite data of 20m pixel size is used for classification of land use pattern in the catchment which is essential in the modeling to determine the surface roughness in surface flow computations and in evapotranspiration estimation. Supervised classification of image was carried out with training areas prepared in the GIS and handled by RS software through dynamic linking with GIS software.

3.2 SOIL DATA AND AQUIFER INFORMATION

Three sources are used to develop the soil hydraulic property data base, 1) The national soil map prepared by the Bureau of Soils and Water Management, the Philippines, which is a landform classification rather than a soil type classification, 2) Engineering measurements carried out by JICA studies of limited areas, 3) Spot soil test data classification carried out by the Bureau of Soils and Water Management, the Philippines. Three soil type layers were generated from these information and merged to provide a soil property data set, and verification tests carried out at 3 sites. Aquifer information was generated from sparse well log data from the National Water Resources Council, Philippines, ground water well data base.

3.2 TOPOGRAPHIC DATA AND STREAM NETWORK

Digital Elevation Model for the catchment was generated by digitizing 1:50,000 scale contour maps. The available digitized contour map is shown in Fig. 2. DEM of 50, 100 and 200 mesh sizes were made from the digitized data sets and were used to compute the surface slopes, flow directions and stream network. All three different data sets gave similar stream networks, with high resolution data providing smoother river profile. To check the validity of the elevation model, the generated stream network was compared with that obtained from the satellite image (fig. 3). From the figure it can be seen that the generated rivers agree well in the mountainous areas while it differs very much in the lower flat area. This results from the sparseness of available source data in the area as shown in fig. 2. Kriging technique was used to generate a uniformly distributed dataset from the semi-variogram estimated by incorporating additional 216 spot elevations obtained from other sources. Fig. 4 shows the comparison of regenerated river system from the DEM generated by this new data set.

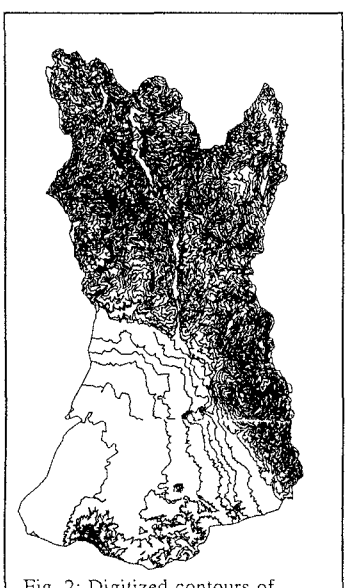

Fig. 2: Digitized contours of minimum 10m interval

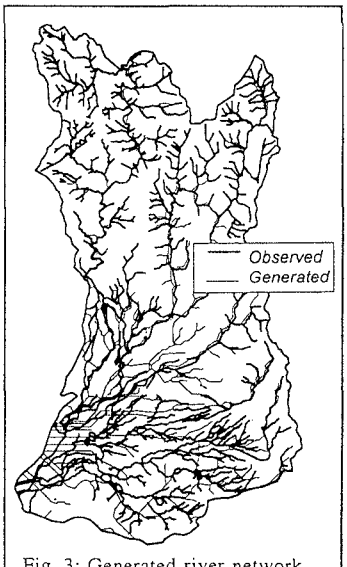

Fig. 3: Generated river network in GIS (with digitized river network)

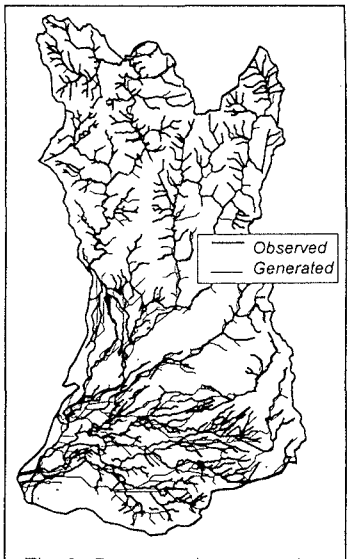

Fig. 3: Generated river network using GIS and Kriging of spot elevations.

4. CONCLUSION

In this study, GIS methodology has been effectively used to handle a large amount of data, their processing, management, manipulation for the development of a database for hydrologic analysis of the catchment.