# Utilization of Thematic Mappers Data for the Comparison of Methods to Create Watersheds

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## Abstract

Delineation of watersheds is one of the most basic steps for water resource management and National Park management. The purpose of this study is to investigate how to utilize Thematic Mappers scenes to compare watersheds created by running a model with those produced by digitizing topographic maps of Keum River basin. A methodology is designed and tested using Geographic Information Systems (GIS) and remote sensing to map areas with various thematic maps. A CAD data on watersheds from the Decision Support system for Water Quality is converted into GIS format. The digital elevation model with 100-meter resolution is used to create watershed by cumulative watershed method. TM scenes are also classified by new procedures including stacking method, NDVI, NDWI, and unsupervised classification methods. To evaluate the relative correctness Kyerongsan National Park was studied intensively whose area was divided into 6 watersheds in both cases. The boundaries of watershed from the model are less correct than those of the topographic maps. This result shows that automated watershed creating system needs higher-resolution digital elevation model than 100-meters.

Keywords: cumulative flow, automated watershed program, Thematic Mappers, Kyeryongsan National Park.

## Introduction

Definition and setting boundaries of watersheds is one of the most basic steps for water resource management in quantity and water quality(Wickham). In a nation scale, the Ministry of Environment Korea has developed Decision Support System for Water Quality, which is called AQUA. Seven hundred fifty two watersheds which were digitized into CAD

format from 1:50,000 topographic maps needs to prove to be verified. National Park Authorities also have tried to monitor and control the water quality of National Park in Korea.

It is important to build a map of unit of watersheds for various purposes such as water resource management for agriculture and range management, flood control, scenarios of water quality policy, habitat assessment, policy of land management(Chou and Chou; Ha; Jensen and Dominigue; Mongkolsawat et al; Pike et al; Warwick et al). GIS (Geographic Information System) and remote sensing is one of the most extensively used to solve the setting a watershed. The errors of classification in land use have been reported on the base of field test and other data like topographic maps. In this article, we approach the opposite way, that is to say, to test the possibility to use a classified image to verify the delineation of watersheds.

Three ways to create maps of watershed have been used: the first one is a traditional way, which is digitizing paper maps with some guidelines of the tentative size of watershed. This method is not popular as the data quality depends on the skills of digitizing. Rather scientific and objective way were preferred to this method. The second way is to using commercial software which dealing with digital elevation data. The create water flow maps by comparison of elevation assuming that one drop of water flow to lower adjacent point. The user's decision of the size of cumulative water flow determines the number of watershed. The logic was given in Figure 1. However it is necessary to remove abnormal peaks and sinks by checking with topographic maps as well as to make additional program to avoid the repeating routine for this automatic process. The third way to determine the boundary of watershed is to use an algorithm, which is using digital elevation line in topographic maps.

Here we test the potentiality of remotely sensed data to compare the first two methods. We used Thematic Mappers data with 30-meter resolution of temporal resolution. If Electro Optic Camera data with 5.6-meter resolution is available, the possible usage to verification of smaller watershed will be achieved.

## Data and Methods

CAD data and Thematic Mappers data taken on April 1997 from the Ministry of Environment were used in this study. The all the features of dgn file format for MicroStation (Bentley) were converted into GIS coverage format for ArcInfo and shape format for ArcView (ESRI). The attributes of each polygons and lines were added with many ancillary data such as reports and maps produced by KOWACO and Ministry of Environment.

ArcInfo (version 7.2) grid module was used to create watershed maps. 100-meter resolution Digital Elevation Model data were used with 128 degree as a primary meridian,

Transverse Mercator Projection with Tokyo datum. We used the number of 150 for the accumulative flow values to make the average size of watershed similar to the targeted watershed in dgn file after testing several values. DEM data of Keum River Basin was processed at a time for the half-automated programs.

Preprocessing such as radiometric correction and geometric correction was done with less than 0.5 pixel error using eight Ground Control Point for each scene. Basically we classified images by stepwise methods combining unsupervised classification and supervised classification into six categories which are mountains, rice pads, dry field, urban, waterbodies, unclassified. The reason for selecting the categories was that the purpose of classification was to aim the water quality modeling processes. Imagine (version 8.2, Erdas) was used for the image processing. Detailed processed are shown in figure 2. Kyerongsan National park was chosen to verify the correctness of watersheds created in two methods.

## Results and Conclusions

The results of watershed of the Keum river basin by digitsing is more accurate than automatedly produced ones based on the field works. The false-color composite showed the better quality to verify the delineation than the output of new classification schemes. As EOC camera data with 5.6-meter resolution has higher resolution than TM data, the possible usage to verification of smaller watershed will be achieved. This result shows that automated watershed creating system needs higher-resolution digital elevation model than 100-meters.

## Discussion

The significance of wrong delineation of drainage boundary may lead the inappropriate direction of water quality policy when pollutant regulation based on not concentration but on total amount of emissions. It is necessary for verify the watershed maps and to aware of potential risk or systematic errors from the automatically generated maps based on DEM. Limitation and systematic errors of drainage analysis based on the 100-meter resolution of DEM data has reported in United States: drainage patterns are systematically biased east-west direction and ragged pattern showed by north-south direction (Garbrecht, J and Starks). Hunter and Goodchild pointed out that the elevation of first cell is the most critical factor to evoke the variance of results and created the potential maps for errors along the slopes; rather lower undulated area in elevation has higher probability of error than steep areas.

Therefore the application of automated grid module will be applicable to National Parks with higher resolution of DEM as most of Korean National Parks are located in Mountainous Areas. Still 100-meter resolution is not better than traditional digitizing method.

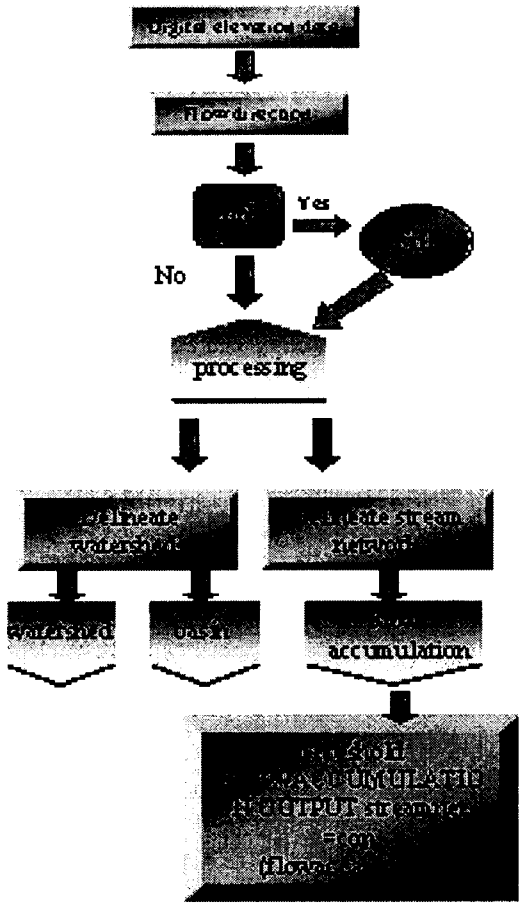


FIG 1. The Logic of extraction watershed from DEM

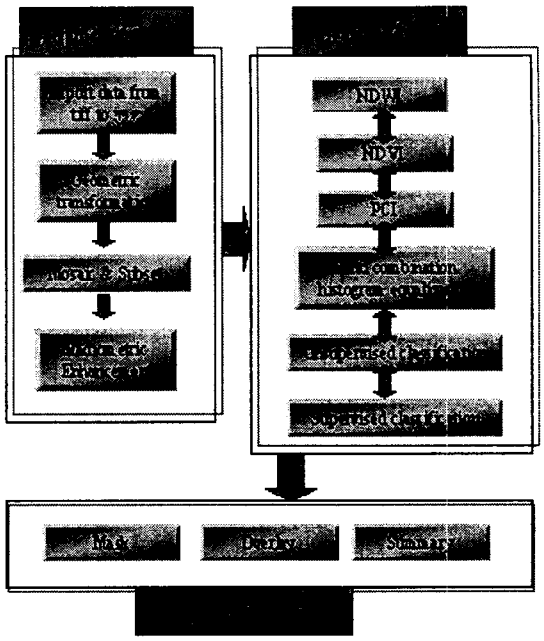


FIG 2. The Work Flow of Image Processing

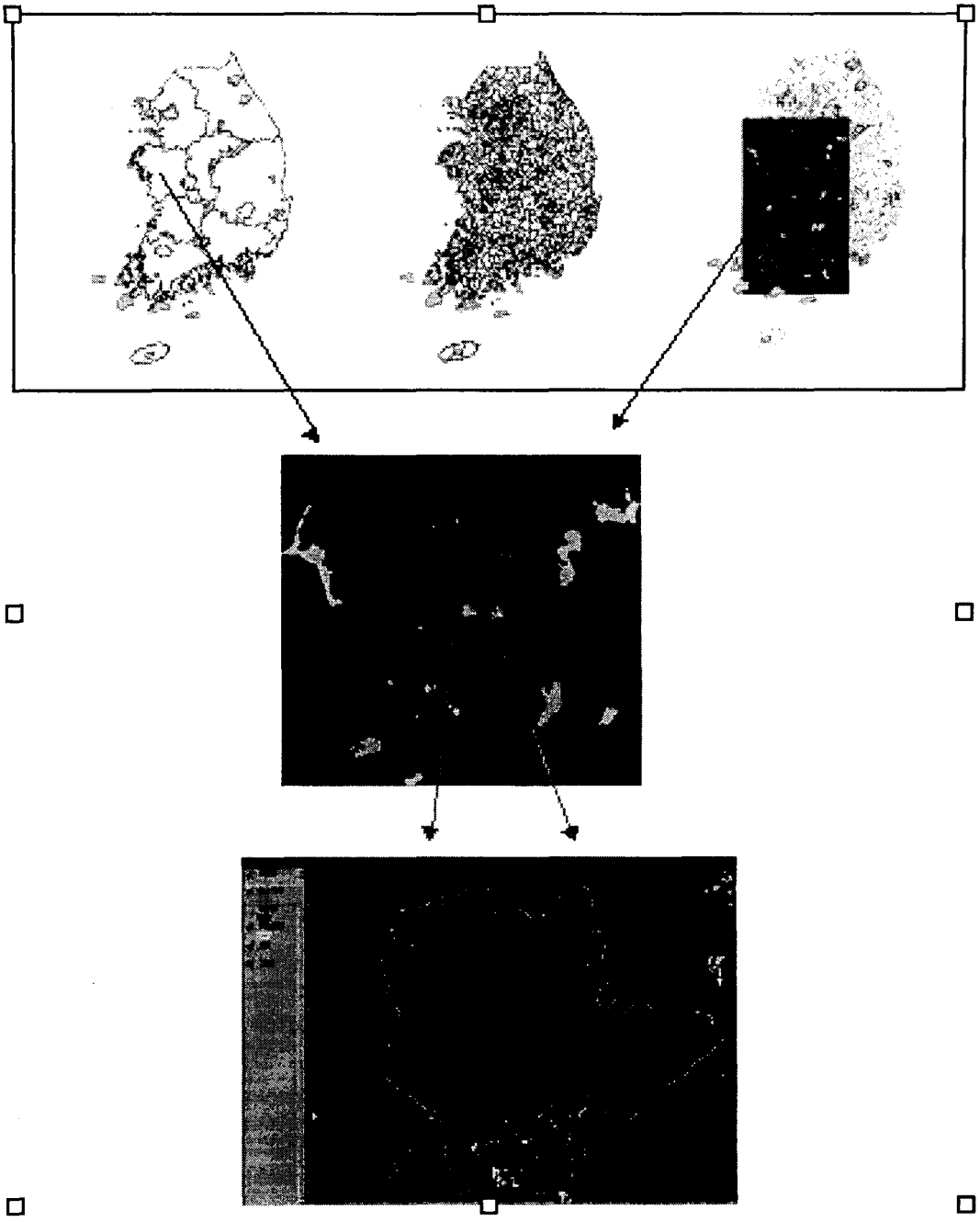

FIG 3. Thematic Maps of National Parks and Watersheds in Korea with the Processed Image

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