Summary Final Report
South Carolina Independent Colleges and University

A Study Of Landuse And Its Relation To Nutrient Fluxes In Saluda And Reedy River Basins Of South Carolina

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Algal blooms are a serious concern caused by excessive nutrient flow into lakes and rivers. The increased nutrient load is caused by point and non-point sources such as waste water treatment plants, industrial discharge sites, and different land cover areas. Lake Greenwood in the lower piedmont of South Carolina is an outlet for two major rivers (Saluda and Reedy). The lake has shown algal blooms on the Reedy side of the lake but not on Saluda side. The study done in 2005 involving analysis of water samples identified treated effluent from waste water treatment plants (point sources) located along the Reedy River to be one of the main sources of higher nutrient load in to the lake.

Present study focused on understanding the non-point source contribution of nutrients using GIS based water quality modeling approach and comparing model predicted results to the observed values. The modeling based approach to understand nutrient loads in river systems provides the ability to simulate or predict loads based on various land cover scenarios. For this study, land cover and soil data, digital elevation model, and weather data were used with Soil and Water Assessment Tool (SWAT) to model the non-point source contribution of nutrients from different hydrologic response units (sub-watersheds) into Lake Greenwood. Results from the model for both Saluda and Reedy Rivers showed an increasing nitrate concentration trend from head waters towards Lake Greenwood. However, model predictions were opposite of what was observed with respect to the algal bloom. In the Reedy River, model predictions were generally much lower than the observed values at each of the outlet locations. A likely reason for the contrasting results obtained between the model prediction and field observation is lack of consideration of nutrient discharge contribution from point sources in the model prediction. Our next step will be to extend our modeling effort to include discharges from point sources, such as waste water treatment facilities, that make up a majority of stream flow at certain times of the year. We also would like to calibrate the model predictions using the water chemistry data (from previous studies) and actual stream flow data (from USGS) to improve model predictions.

This project resulted in two products apart from scientific understanding of the relationship between land cover and nutrient concentrations in rivers. The first is the generation of land cover data from Landsat (30 m resolution) and SPOT (20 m resolution) satellite data. Erdas Imagine image processing system was used to process the raw satellite data to separate spectral classes and convert them into information classes (land cover classes). The accuracy of land cover classification was verified using ground truthing through aerial photographs and field visits. The accuracy assessment showed an overall accuracy of 82% for the data derived from Landsat. The final classification had seven land cover classes: urban, forest, water, agricultural, pasture, residential, and commercial. This data was then exported into GIS grid format for further use. The second is the generation of NDVI (normalized density vegetation index) data for Reedy and Saluda watersheds that is useful in understanding the influence of vegetation on the river water chemistry. The NDVI value for each grid cell was calculated by processing select bands (red and near infrared bands) from raw satellite data and performing the following calculation: NDVI = (Band 3 - Band 4) / (Band 3 + Band 4). This ratio shows healthy vegetation with positive values and areas with lack of vegetation with negative values. This data will be used in the future as we start looking at the contribution from individual subwatersheds towards nutrient loads in the streams.

The land cover data and NDVI data generated from this project have already been used by several other researchers at Furman University (including Dr. Brannon Anderson of Earth and Environmental Sciences Department and Dr. Greg Lewis of Biology Department) to answer critical questions related to their own research. The findings of this research have been accepted for presentation (citation below) at the regional meeting of the Geological Society of America to be held in Savannah, GA.

Irizarry, I., and Muthukrishnan, S., 2007 (April). GIS based water quality assessment of the Saluda and Reedy river basins using SWAT model. SE GSA, Savannah, GA