ABSTRACT

Quansah, Joseph E. Ph.D., Purdue University, December, 2007. Early Warning System for Water Quality Assessment within Agricultural Watersheds. Major Professor: Bernard A. Engel.

Globally, many natural and anthropogenic activities have resulted in immense environmental degradation and pollution. Over the years, such environmental degradation trends have resulted in droughts, floods, food insecurity, disease, extreme climatic events as well as water and air pollution. These incidents have health and economic impacts.

A review on Early Warning Systems (EWS) was conducted to evaluate the methods being utilized in identifying pollution and environmental degradation hot spots and stopping such trends or reducing their impact. The review showed that, globally, many advances have been made in terms of in-field and remote sensor technologies, institutional and global collaborations, information communication, as well as improved early warning response preparedness. However, there is still the need for improvement to reduce the impacts of disasters, such as deaths from hurricanes, earthquakes and hunger.

To establish the potential for EWS for water quality assessment, agricultural management activities, which contribute to agricultural nonpoint source pollution, were analyzed using remote sensing. Tillage trends were mapped from Landsat Thematic Mapper (TM) and the Moderate Resolution Imaging Spectroradiometer (MODIS) data using a Logistic Regression model. Landsat TM produced relatively accurate tillage maps while maps from MODIS data were less accurate with less sharp boundaries, due to the coarse spatial resolution of 500 m. The synergy of the two tillage products provide important information on tillage intensity and trends, which influences processes such as soil erosion and runoff in large watersheds, and could have direct and negative impact on agricultural chemical loss and water quality.

Mapped tillage data were successfully integrated, along with other agricultural management information, into the Soil and Water Assessment Tool (SWAT) model for

prediction of atrazine concentrations in the St. Joseph River watershed in northeastern Indiana. SWAT model performance for stream flow was good and comparable to results obtained by other researchers. Atrazine predictions were not as good a fit with measured data as were stream flows; however, the statistical results were similar to those obtained in SWAT simulations carried out by other researchers. The timing and location of atrazine applications remains a limitation in modeling atrazine losses. The general trends in simulated atrazine concentrations were reasonably predicted and similar to measured trends, confirming the suitability of the SWAT model for assessing water quality and nonpoint source pollution.

The SWAT results demonstrated the capability of modeling potential atrazine pollution trends, especially when accurate agricultural management scenarios are built into the model. If the SWAT model is parameterized with calibrated variables for specific watersheds, early warning information from potential pollution trends can be derived within a short time when ongoing seasonal agricultural activities are updated into the model and simulations carried out.