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WETENSCHAPPEN



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**PREDICTING RIVER CONCENTRATIONS OF PESTICIDES
FROM BANANA PLANTATIONS UNDER DATA-POOR
CONDITIONS**

**VOORSPELLING VAN PESTICIDENCONCENTRATIES UIT
BANANENPLANTAGES IN RIVIEREN ONDER
GEGEVENSARME OMSTANDIGHEDEN**

door

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SUMMARY

Ecuador has a tradition built on banana production. Nowadays, more than 30% of the exportable items correspond to bananas. This banana cultivation has led to an environmental concern on other sectors that share land in some river basins across the country. In 1994, the shrimp sector claimed that a disease occurring at some shrimp farms had been caused by pesticide pollution from the banana sector. Based on that situation, Escuela Superior Politécnica del Litoral (ESPOL), an Ecuadorian University, began a research project to tackle potential solutions to environmental conflicts in Ecuadorian river basins. The present Ph. D. thesis is one of the results obtained in this project.

The thesis briefly shows the differences between Ecuadorian Water Quality Law and acceptable environmental standards across the world regarding pesticide pollution. It also presents the common pesticide management inside an Ecuadorian banana plantation. The pesticides mostly used in banana farms are propiconazole, thiabendazole and imazalil.

By applying screening models, it is shown that the aquatic compartment is more affected by imazalil and thiabendazole. On the other hand, based on screening model runs propiconazole tends to affect the soil compartment significantly more.

The main difficulty in this research was the data gathering process and the subsequent model calibration and application. Ecuador is a poor developing country where environmental data are not recorded on a continuous basis affecting any assessment outcome done on environmental issues such as pesticide pollution. To solve this problem, the first part of the research proposed a methodology for such data-poor conditions to gather and process information to be used for pesticide fate evaluation. The methodology will be useful for future related research in gathering information in an efficient and understandable way for developing countries like Ecuador. The gathered data were then converted to a ready-to-use format to be imported in models and Geographical Information Systems.

The second part of the research evaluated the AGNPS and SWAT models as potential tools to assess non-point pollution problems in Ecuadorian river basins. The Chaguana river basin was selected as a case study. Banana farms cover around 30% of the total surface area of 32000 Ha, humid forest 26% and shrimp farms 6%. The banana farms are mainly located at the downstream section of the river basin, while shrimp farms are located near the outlet.

Four sampling campaigns were performed to collect data for model calibration (water quality and flow data) at 13 sampling sites along the river during different weather conditions throughout one year. Lab results showed that the majority of the environmental parameters did not show levels above the Ecuadorian standards. Pesticide concentrations were below 6 ppb, which is significantly lower than the reported No-Observed Effect Levels for shrimp and other aquatic organisms. However, the measured concentrations are higher than the European and American maximum residue levels in water for human consumption. Therefore, the Chaguana basin is showing to be a main concern for human health as around 7000 people are settled on the river banks, and they do not have potable water services.

For the model evaluation, the calibration process was done in three steps:

1. Flow calibration of the river basin with (only) three existing gauging stations.
2. Calibration of suspended sediment loadings performed with the sampling campaign results.
3. Calibration of environmental concentrations on the river with the sampling campaign results.

Both models predicted environmental pesticide concentrations on a monthly basis within the expected ranges. Differences between observed and predicted values were not significant. In conclusion, the developed data gathering process and model application proved to be useful for the prediction of pesticide concentrations in a data-poor environment.
