

UNIVERSITY OF HOHENHEIM

Institute of Soil Science and Land Evaluation
Department of Biogeophysics



Thesis for the M.Sc. Program
“Environmental Protection and Agricultural Food Production”

**Assessing the potential Risk
of Groundwater polluting Pesticides
in a Watershed in Northern Vietnam**

submitted by Karina Schumacher

Reviewer:	Prof. Dr. rer. nat. Thilo Streck
Co-Reviewer:	Prof. Dr. rer. nat. Karl Stahr
Supervisor:	Dr. agr. Marc Lamers

This work was financially supported by the Eiselen Foundation Ulm.

Hohenheim, February 2011

“Assessing the potential risk of groundwater pollution by pesticides in a watershed in Northern Vietnam”

Abstract

Agrochemicals are beneficial for agricultural production in general. They stabilize yields and secure the farmers' income generation. However, since they are developed to be toxic and persistent, the chemicals potentially endanger human health and environmental quality.

This study was conducted in the wake of the so called Uplands Program, a Collaborative Research Project (Sonderforschungsbereich, SFB 564) funded by the German Research Foundation (DFG). It aimed at detecting temporal and spatial groundwater pollution patterns with pesticides in order to develop recommendations concerning pesticide handling and water consumption. The field work period comprised two sampling campaigns in the spring and summer rice cropping season 2010. Ground water samples were collected weekly from 16 wells and a natural spring serving as domestic and drinking water sources for the rural population in a mountainous region of Northern Vietnam.

During the spring season, the pesticides were solid phase extracted in the field laboratory and stored frozen on C₁₈ cartridges until further processing in the cooperating laboratory in Hanoi. In the summer season, the samples were transported aqueous to Hanoi. The samples were analysed by gas and liquid chromatography mass spectrometry (GS-MS/LC-MS) for the five most commonly applied pesticides within the study area to reveal temporal and spatial pollution patterns. Subsequently, the dataset was processed statistically in order to relate the detected pesticide concentrations to influencing factors. Field surveys among the farmers were conducted to gain insight on agrochemical knowledge, risk perception and application patterns as well as water consumption habits.

Of the 66 (105) analysed samples, 21.2 % (38.1 %) showed concentrations of pesticides above 0.05 µg·L⁻¹ with 16.7 % (32.4 %) of the samples exceeding the threshold of 0.1 µg·L⁻¹. The maximum concentrations amounted to 1.1 µg·L⁻¹ (4.0 µg·L⁻¹), caused by imidacloprid in both seasons. The overall contamination averaged to 0.16 µg·L⁻¹ (0.10 µg·L⁻¹). The values are given for the spring season with the concentrations of the summer sampling campaign in parentheses.

Subsequently to the statistical analysis the pollution patterns were related to potentially influencing factors. A distinct relation between the contamination and elevation of the wells could not be shown. The polluted wells tended to be deeper than the ones without any detected pesticide concentrations above 0.05 µg·L⁻¹. The influence of water exchange was assumed to be related to contamination levels. Wells with a higher amount of water used or influenced by streaming surface water showed lower pesticide concentrations. The wells' distances to the paddy field area could not explicitly proved to have an influence, however all wells located in more than 12 meters distance to the paddy fields were shown to be unpolluted. The temporal patterns of pollution could tendentially be related to peak application periods, but no distinct causality could be proved.