"Assessing pesticide leaching at the regional scale : a case study for atrazine in the Dyle catchment/"

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ABSTRACT

The overall objective of this thesis is to better understand and assess pesticide leaching at the regional scale, using both the analysis of monitoring data and spatially distributed modelling. Atrazine contamination of the Brusselian aquifer (central Belgium) is poorly understood. Considerable uncertainty surrounds whether the pollution is agricultural or non-agricultural in origin. The spatial and temporal covariance of atrazine concentrations was studied by fitting semivariogram models to monitoring data. Correlation ranges were found to be 600 metres and 600-700 days. A non-parametric one-way ANOVA found a strong relationship between mean concentrations and land use, whilst other environmental variables were found to be less important. Higher levels of pollution were detected in areas dominated by urban land use suggesting that atrazine residues in groundwater resulted from non-agricultural applications. Modelling pesticide leaching at the regional scale (Dyle catchment) was used to assess groundwater vulnerability. Different approaches to process soil information were tested with both a linear (modified Attenuation Factor) and a non-linear (GeoPEARL) leaching model. The CI (calculate first, interpolate later) and IC (interpolate first, calculate later) approaches were identical for the linear model, but differences in the amount of leaching were found for the non-linear model. The CI approach would be expected to give better results than IC, but the CA (calculate alone) approach is probably the best method if no spatial output is required. Finally, a methodology was ...

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Chapter 3

Dyle Catchment: Description of the Study Area

In order to avoid redundancy in the subsequent chapters, the study area is described in this chapter.

The study area is the Walloon region part of the Dyle catchment (580 km^2) of central Belgium (Figure 3.1). This is a typical 'arbitrary' scale in the sense of Baveye and Boast (1999), i.e. not related to the physical processes occurring in the system under study; but it is entirely embedded in the hydrogeological catchment of a sandy aquifer, thus making this choice consistent. The climate is temperate maritime, with a mean annual temperature of 9.7°C and mean summer and winter temperatures of 16.4°C and 3.0°C, repectively. Average annual precipitation is 804 mm.

Figure 3.2 shows the main land uses in the Dyle catchment. Typical land uses are urban (generally located in the valleys; about 20% of land use in the study area), pasture and forests (found on valley slopes; about 16 and 18% respectively), and arable (silt and silty loam soils on the plateau). The simulations of atrazine leaching presented in the following chapters were restricted to arable land, which covers approximately 46% of the study area (*Système Intégré de Gestion Et de Contrôle* (SIGEC), 1999).

In chapter 4, the study area is extended to the whole Brusselian aquifer. This aquifer is located in tertiary sands overlain by a quaternary loess layer of variable thickness (0 to 15 m). This groundwater body is of primary importance for the regional supply of drinking water and has been classified

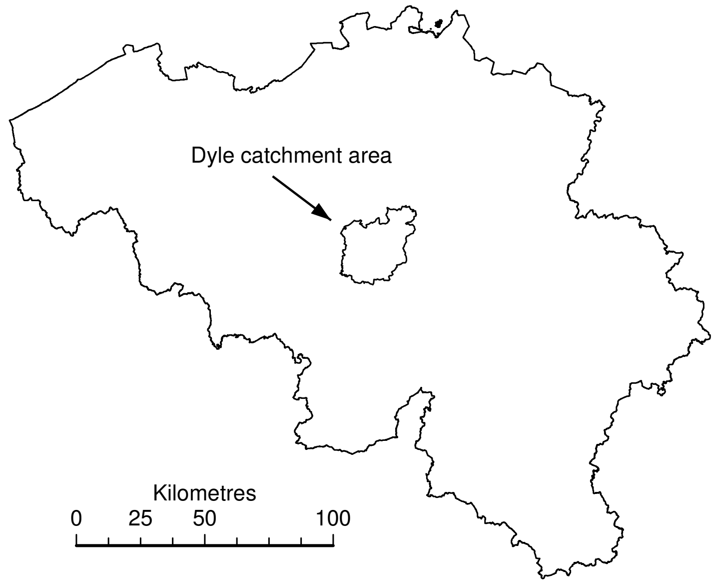

Figure 3.1: Location of the study area in Belgium.

as a ‘vulnerable area’, resulting from the implementation of the European Union Nitrate Directive (EEC, 1991). Figure 3.3 shows a hydrogeological section between Louvain-la-Neuve and Wavre (cf. section line in Figure 3.2). Figure 3.3 shows that the loess layer is mainly present on the plateau, while it is eroded in the valleys where the Brusselian sands appear. From this section it can be noticed that groundwater table depth varies from 0 to more than 30 metres[1].

Figure 3.4 displays a map of the main soil types Dyle catchment. This map results from a reclassification of the 1:20,000 soil map, using texture and drainage properties, profile development and the presence/absence of a change of substrate.

Silt is clearly the dominant soil type in the area, especially on the plateau in the east, south-east and south-west of the catchment. Silt with no profile development corresponds to alluvial deposits in the small depressions. In

[1]The hydrogeological mapping project from which this section was obtained is still under development, and maps were not available for the whole study area at the time this thesis was undertaken

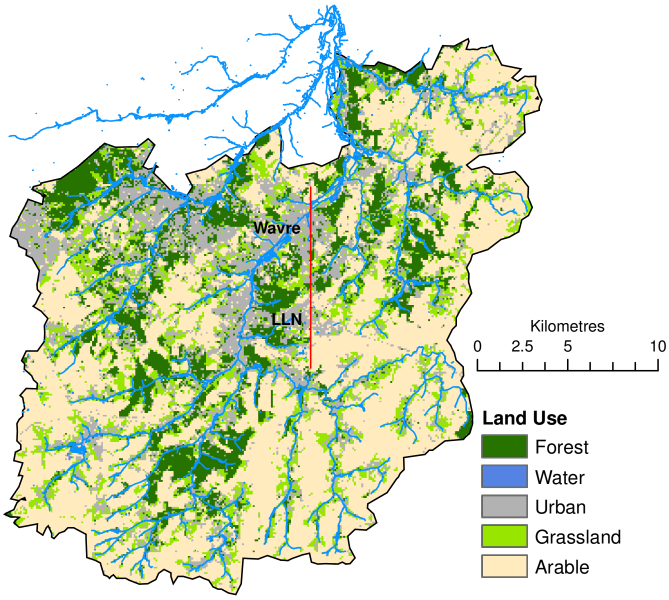

Figure 3.2: Land use in the Dyle catchment. Sources: SIGEC (1999) and Landsat TM image (1999). The red line shows the location of the hydrogeological section displayed in Figure 3.3.

the valleys, the loess layer has been partially to completely eroded, leaving shallow soils on a sandy substrate or even the Brusselian sands uncovered.

A mask over non-arable areas was added to Figure 3.5. This shows that arable land use is almost exclusively located on silty soils, thus reducing the variability of soil properties for the simulations presented in chapters 6 to 8.

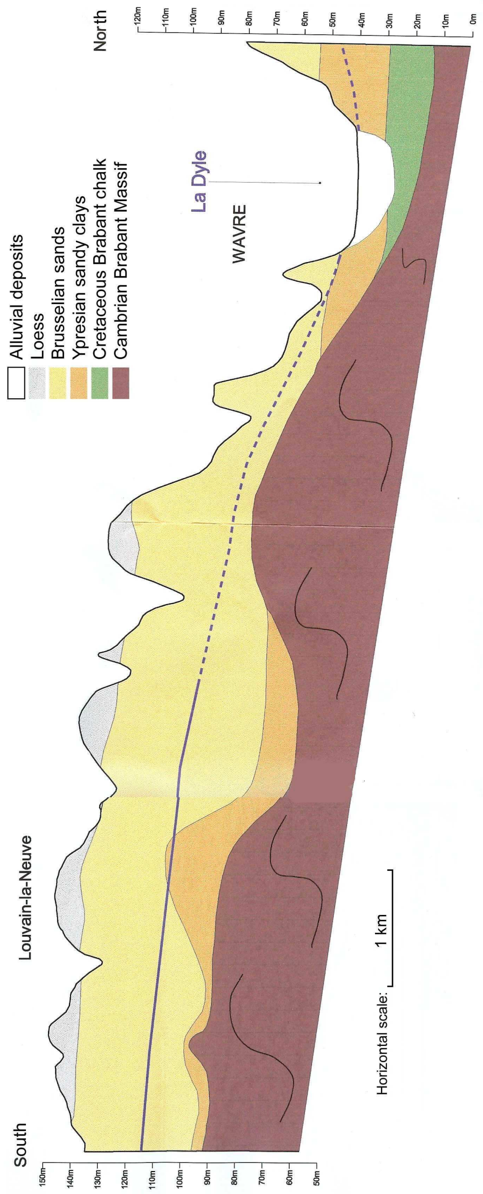

Figure 3.3: Hydrogeological section between Louvain-la-Neuve and Wavre. Source: DGRNE (2002).

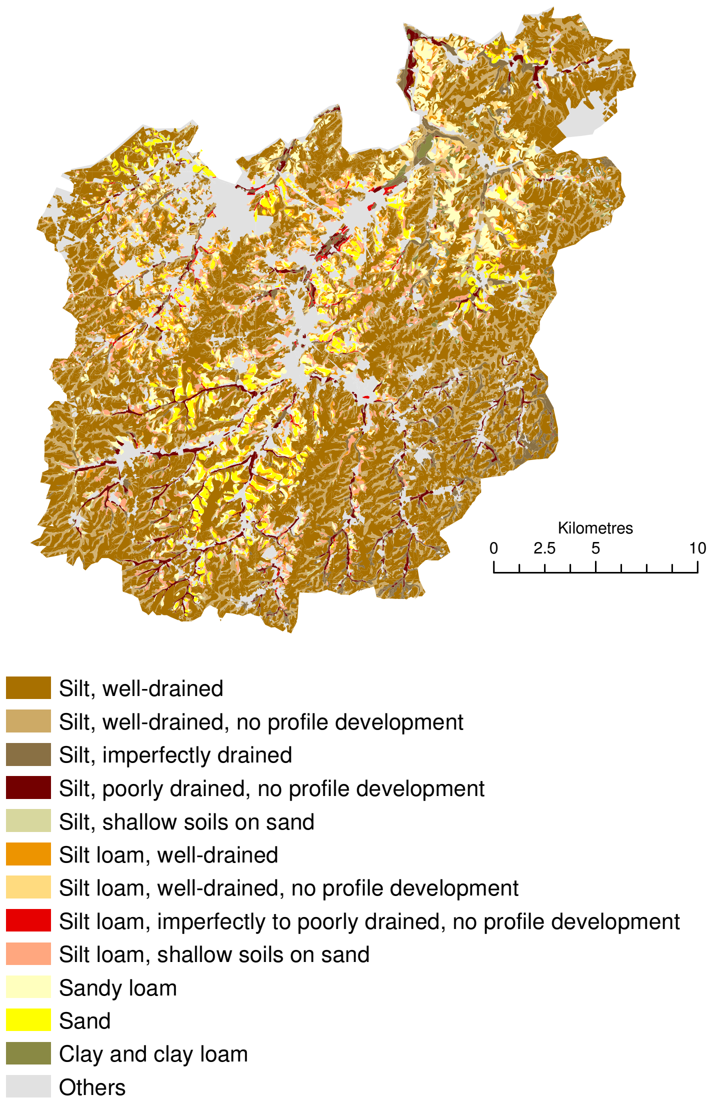

Figure 3.4: Soil types in the Dyle catchment (scale 1:20,000).

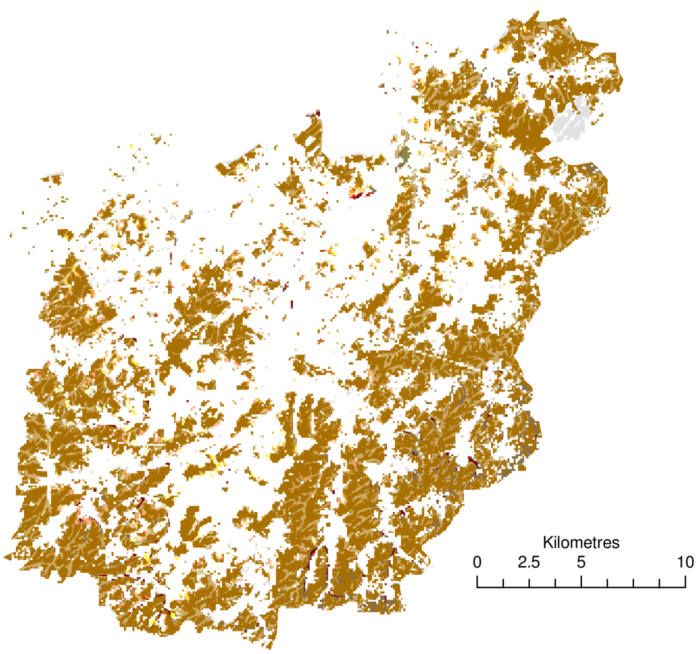

Figure 3.5: Soil map with a white mask on non-arable areas.