PESTEAUX: A project for building GIS-based tool for the assessment of water pollution risks at local scale due to pesticides

B. Bah[(1)], S. Noël[(2)*], D. Buffet[(1)], F. Henriet[(3)], O. Pigeon[(3)], B. Huyghebaert[(2)]*

(1) Biometry, Data management and Agrometeorology Unit, Walloon Agricultural Research Centre (CRA-W), 5030 Gembloux, Belgium
(2) Engineering Department, Walloon Agricultural Research Centre (CRA-W)
(3) Pesticide Research Department, Walloon Agricultural Research Centre (CRA-W)

**Corresponding authors: b.bah@cra.wallonie.be ; noël@cra.wallonie.be*

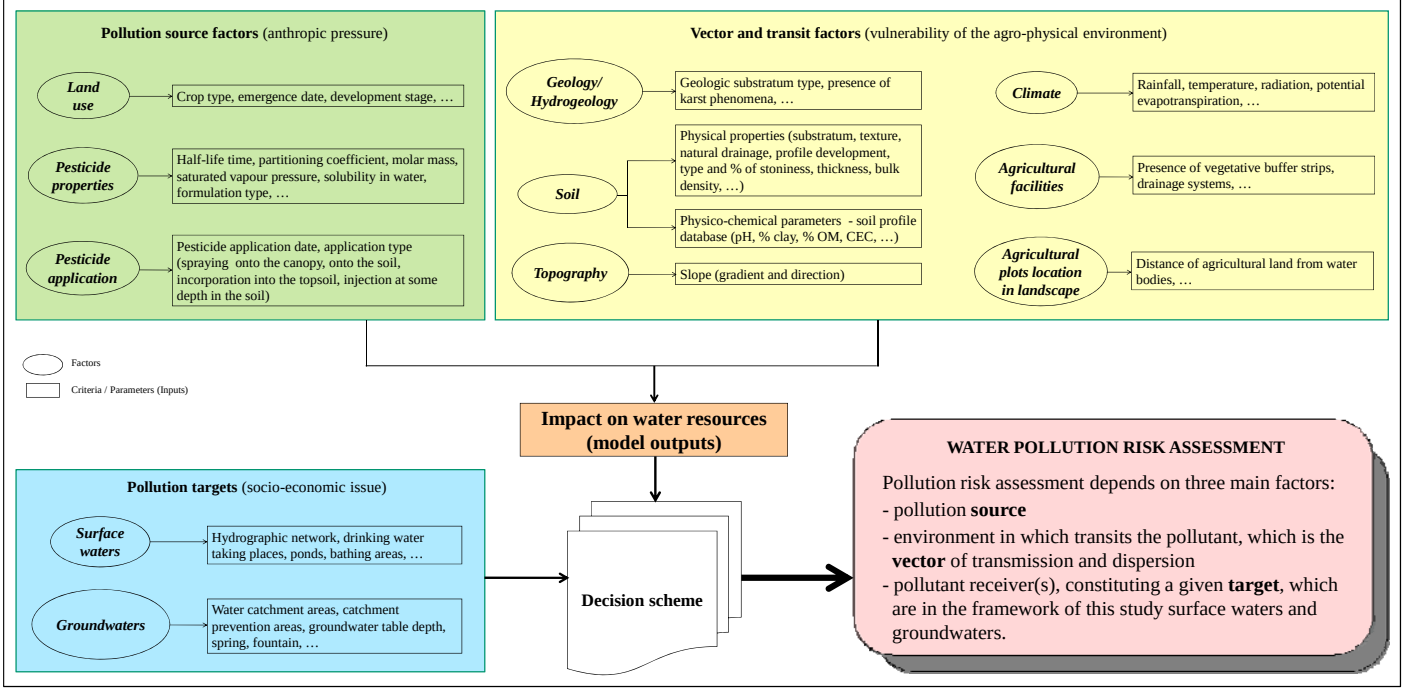
Introduction and objectives

Nowadays, pollution of drinking water resources and aquatic systems by pesticides is a key point of the European Policy with the implementation of the **Water Framework Directive** (Directive 2000/60/EC) and the **Thematic Strategy on the Sustainable Use of Pesticides**. According to these legislations, Member States are supposed to take measures to limit environmental and toxicological effects caused by pesticides uses.

This project initiated by the Walloon Agricultural Research Centre (CRA-W) is aimed at implementing a decision support system based on a Geographic Information System (GIS) tool to assess diffuse (non-point sources) pollution risks of water resources (surface water and groundwater) by pesticides.

Contrary to most of the existing tools which usually work at a wider scale (watershed or regional level), the innovative aspect of the approach is the possibility to generate risk maps on the basis of a decision scheme in order to identify pollution risks at local scale (agricultural parcel level). Another originality of the tool will be the possibility to estimate pollution risks by taking into account worst-case scenarios and highlight sensitive areas.

Schematic overview of main factors involved in the pollution processes and risks assessment



Pollution source factors

The type of pollution source considered in this study is diffuse (non-point sources) pollution source. This pollution is characterized by parameters related to **land use** (crop type, …), **pesticide properties** (particularly half-life time, partitioning coefficient, sorption coefficient, solubility in water, …) and **pesticide application modalities** (date, type, quantity).

Modeling tool

Modeling is used for more than thirty years for pesticide runoff and leaching assessment, thus to assess the field vulnerability to pollutants propagation.

The pesticide leaching to groundwater and drainage/runoff to surface water model named GeoPEARL (Tiktak *et al.*, 2003) has been chosen after a state-of-the-art. GeoPEARL consists in a GIS coupled to a one-dimensional, dynamic, multi-layered model (PEARL: *Pesticide Emission Assessment at Regional and Local scales*) of the fate of pesticides and relevant transformation products in the soil-plant-atmosphere system.

Model input parameters are mainly extracted from the existing databases of pesticide properties (source) and environmental characteristics (vector/transit). Parameters not directly available in existing databases, such as bulk density, hydraulic conductivity, … will be derived from pedotransfers functions. Relevant parameters, such as karst phenomena, … not taken into account by the model, will be considered in the decision scheme.

Vector and transit factors

The main pesticide propagation way is water, through runoff to surface waters and infiltration into the soil to groundwaters. Pesticide transfer from the soil to water depends on several parameters: (i) environmental characteristics (**geology** and **hydrogeology**, **soil**, **topography** and **climate**), determining the vulnerability to pollutants penetration and migration; (ii) **agricultural facilities**, such as protection means (vegetative buffer strips, …), established by farmers to limit pesticide transportation into water, or drainage systems, which can have opposite effects by draining pesticides rapidly into surface waters; and (iii) **agricultural plots location in landscape** with regard to water bodies.

One of the core data source of the local risk assessment is the Digital Soil Map of Wallonia (Fig. 1), implemented from the Belgian "paper" Soil map at the scale of 1/20,000, which provides detailed geomorphopedologic information at parcel level.

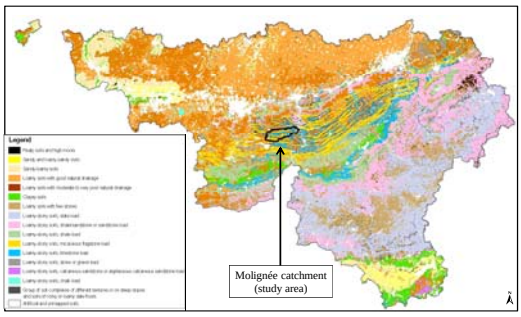


Fig. 1 – Generalisation of the Digital Soil Map of the Belgian Walloon region (Bah et al., 2006, FUSAGx – DGA, MRW), considered as Main Soil types of Wallonia (southern part of Belgium).

Pollution targets

Pollution targets are, in the framework of this study, water resources (**surface waters** and **groundwaters**). Thus, the spatial and monitoring databases (Table 1) on surface waters (hydrographic network, ponds, …) and groundwaters (water catchment, …) are also considered.

Table 1 – Extract of surface waters monitoring database, named AQUAPHYC (DGRNE, Personal communication).

Orroir	Rhosnes	86193	161125	630	Chlorfenvinphos	2005	6	< 0,01	< 0,01	< 0,01	< 0,01	µg/l
Enquelmes	Sambre	132100	110443	3080	Chlorfenvinphos	2005	12	< 0,01	< 0,01	< 0,01	< 0,01	µg/l
Antoing	Escaut	83972	157008	707	Chlorobenzène	2005	13	< 0,2	< 0,2	< 0,2	< 0,2	µg/l
Dave	Meuse	186462	121207	701	Chlorobenzène	2005	13	< 0,2	< 0,2	< 0,2	< 0,2	µg/l
Hérinnes	Escaut	79133	157025	708	Chlorotoluron	2005	13	< 0,02	0,0423	< 0,02	0,3	0,09	µg/l
Pottes	Escaut	80778	158023	400	Chlorotoluron	2005	13	< 0,02	0,0608	0,04	0,17	0,12	µg/l
Bleharies	Escaut	82927	134321	369	Chlorotoluron	2005	13	< 0,02	0,0592	0,05	0,14	0,12	µg/l
Comblain-au-Pont	Amblève	236744	138820	4430	Dichlobénil	2005	12	< 0,005	0,0168	0,0085	0,025	0,025	µg/l
Moelingen	Berwinne	244873	161556	4690	Dichlobénil	2005	6	< 0,005	0,0138	0,011	0,031	0,031	µg/l
Yvoir	Bocq	188307	114262	40039	Dichlobénil	2005	12	< 0,005	0,0148	0,0095	0,053	0,026	µg/l
Hérinnes	Escaut	79133	157025	708	Dichloroanilines (	2005	13	0,06	0,06	0,06	0,06	0,06	µg/l
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Validation of results

Validation will be conducted in pilot/test areas, where monitoring data on surface waters and groundwaters are available. The first study area selected is the Molignée watershed (Fig. 1), in the Condroz region. Molignée watershed is a geomorphopedological contrasted area. Several relevant hydrogeologic, pedologic and hydrologic studies (DGRNE, 2000) have been conducted in this area and therefore constitute significant source of information that will be used to validate the pollution risk assessment system.

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Département Génie rural, Centre wallon de Recherches agronomiques, Chaussée de Namur 146, B-5030 Gembloux, Belgium
Tel : ++ 32 (0) 81 62 65 76 – 62 71 70 – Fax : ++ 32 (0) 81 62 65 59 – 61 58 47 – e-mail : b.bah@cra.wallonie.be ; noel@cra.wallonie.be – http://cra.wallonie.be