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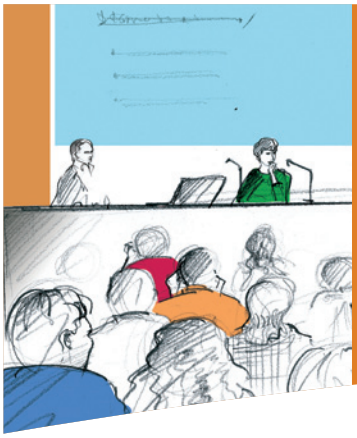

ONEMA
Meetings

Methods and tools to control agricultural nonpoint-source pollution for managers of water resources

A symposium organised by Onema and Astee, the Scientific and technical association for water and the environment.

Local governments are frequently confronted with the problem of managing agricultural nonpoint-source pollution. This type of pollution is one of the main causes of the degradation of water bodies in France and Europe. How can its management be improved and its impacts reduced? What are the tools and methods now available to water managers to effectively counter the pollution? The first edition of the national PollDiff'Eau symposium, held in Paris from 18 to 20 September 2013, was an occasion to present to some 260 participants the tools and methods developed by publicly funded research programmes. These tools and methods will serve to improve knowledge and diagnose local situations in view of achieving good water status, effectively protect abstractions and select the best sites for buffer zones. A review.

Legally speaking, "nonpoint-source pollution" is any pollution whose precise origin cannot be determined, but comes from a large surface area. Pollutant transfers of this type cause difficulties in precisely identifying the sources (pressures) and the factors explaining the pollution, and consequently in setting up effective measures other than simply reducing the quantities released to the environment.

Nonpoint-source pollution comprises essentially nitrates, phytosanitary products, phosphorous and eroded soil.

Widespread presence of nonpoint-source pollution has been noted in aquatic environments, over both time and space. Concentration levels impact both the ecological status of aquatic environments as per the WFD (Water framework directive) and the production of drinking water in terms of its health status.

The discussions during the symposium focussed primarily on agricultural non-point-source pollution.

Better local knowledge of the problem for better action

A local government in charge of distributing drinking water and confronted with non-point-source pollution must learn more about the problem before it can take suitable action. The first step is to identify the pollutants in question, how they function, the sources and impacts, then to assess the territory in order to set priorities for the areas requiring intervention (see Figure 1 on the next page). A number of tools are currently available to determine the local chemical and biological impact of nonpoint-source pollution in rivers. During the symposium, Irstea presented an analysis of some of the tools in question. For example, passive samplers and bioindicators such as diatoms and


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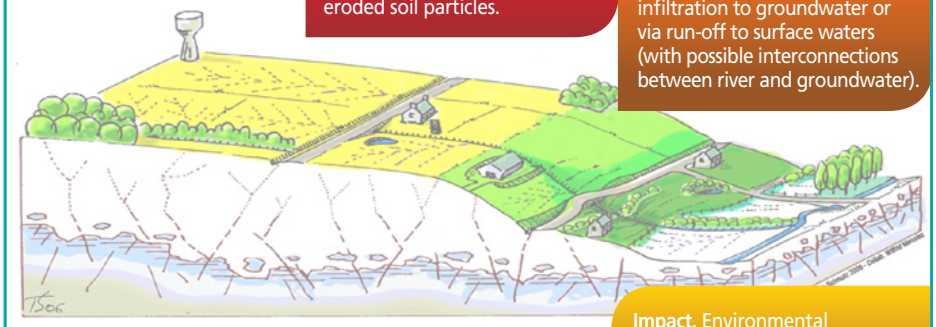


Figure 1. Source, mobilisation, transfer and impact of nonpoint-source pollution in a river basin.
(Agrotransfert - Thomas Schmutz, 2008 - Collab. Wilfrid Messiez)

François-Xavier Schott,
Lorraine regional chamber of agriculture

Among other features, the Agri-Mieux operations measure the pressures exerted by the use of phytosanitary products in agricultural areas using a number of pressure and impact indicators (treatment frequency index, quantity of active ingredient, units of dose). In assessing the agri-environmental operations, the Lorraine chamber of agriculture used the Guide tool. This decision-aid tool, used to select pesticide indicators for the water compartment, enabled us to reduce the number of risk indicators from 60 to 3!

Gammarus (ubiquitous small crustaceans acknowledged as useful bioaccumulators of organic pollutants), though still perfectible, are nonetheless innovative tools that can be used first to assess the contamination of surface waters by phytosanitary products more precisely than the discrete sampling techniques commonly used today in France, and secondly to link the contamination to its biological impacts.

The Arpeges method, developed by Irstea and Onema and used nationwide, provides for each body of surface water (WFD definition) an estimate of the risk of contamination by the phytosanitary products used in the basin upstream of the water body. Maps showing the risks of contamination were drawn up in June 2012 (see Figure 2).

Finally, the Guide tool comprises a complete list of risk indicators for the impact of pesticides on either of the two water compartments (surface water and groundwater). A total of 46 indicators have been inventoried and the tool enables users to select those best suited to their particular context on the basis of the criteria entered and to consult data sheets for each indicator.

Methods and tools to protect abstractions

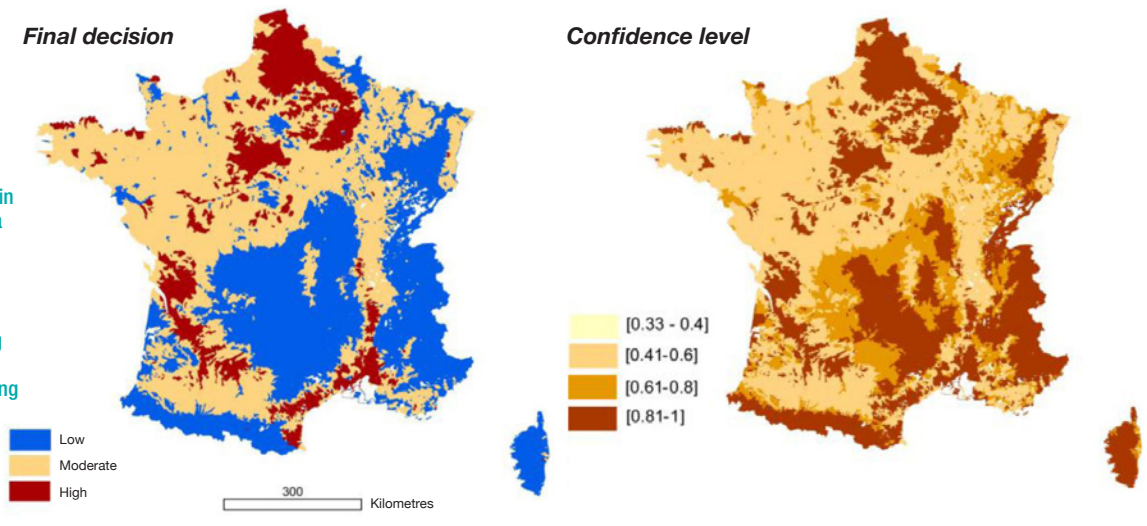
Requests for assistance and for technical and decision-aid tools in setting up tailored action plans are particularly numerous for abstractions, which figured prominently in the Grenelle environmental law and were listed by the environmental conference as high-priority zones in managing nonpoint-source pollution.

A social-economic assessment in addition to the territorial assessment (hydrogeological and agronomic) assists in making decisions. By identifying the local issues and stakeholders, and their relations, the social-economic assessment paves the way for greater consensus and fills out the more "physical" territorial assessment. It thus serves to facilitate the implementation and the local acceptance of action plans.

Figure 2. *Example of the results produced by the Arpèges method (presented as a map).*

On the **left** is the most probable risk level of contamination (low to high) in a given river basin (the data shown are for a period of the year).

On the **right** is the confidence level for the final decision concerning the risk level, i.e. the probability that the ranking is correct (the darker the colour, the higher the probability).



Fanny Barré,
Plateau Picard municipal association

The abstraction in Saint-Just-en-Chaussée was designated a priority abstraction due to the presence of nitrates. The town, which manages the abstraction, brought in the Plateau Picard municipal association to carry out the study on the abstraction supply zone because it had the necessary technical know-how. A social-economic assessment was included in the study on an array of pressures. The qualitative approach was selected to question farmers on their contacts with other stakeholders, their products, etc. A number of mayors were questioned on how town land is managed. This approach was filled out by a review of the literature on the other stakeholders in the area. In spite of a lack of economic data and the absence of the main sociological data (number of inhabitants and population distribution), the familiarity with the area within the municipal association and the excellent relations established by the agricultural and water officers during direct contacts with stakeholders made it possible to propose projects in line with the territorial situation and needs.

Once the assessments are finished, it is time to formulate an action plan. The Co-click'eau tool was presented as an example of tools available to help in preparing agricultural action plans for abstraction supply zones. After setting up a database on the types of crops, the farming systems employed and the local environment, the tool produces potential scenarios and simulates the impact of changes in work habits on a certain number of indicators (treatment frequency index, margins, etc.). The results indicate where there is manoeuvring room for solutions and the types of action that could fulfil the needs of each stakeholder.

Once the most suitable and effective scenarios have been selected and the action plan implemented, it is necessary to monitor and assess the effectiveness of the action plan in terms of improving or preserving water quality. Which data should be taken into account? A presentation by BRGM provided answers to this question by noting first of all that an effective action plan is one that directly or indirectly contributes to improving or preserving water quality. Unfortunately, assessments encounter numerous difficulties, e.g. the wide array of possible interventions against nonpoint-source pollution, the lack of an acknowledged method to organise complex analyses of effectiveness, the need to gather and analyse large quantities of data. A number of tools and lines of research are nonetheless deployed, e.g. by monitoring three types of indicators:

> indicators on the action plan itself, e.g. total surface areas for organic farming as a percentage of the total usable farm area;
> pressure indicators, e.g. the overall treatment frequency index;
> indicators on the quality of water at the abstraction, e.g. the maximum concentration of nitrates. The latter indicators on quality status depend directly on the type of monitoring carried out at the abstraction (frequency of analyses, measured parameters, etc.).

It is occasionally difficult to link the indicators on system response directly to implementation of the action plan. To fill out this rather simplified approach to indicators, it is also possible to measure the reactivity of the environment in order to better understand its evolution. BRGM recommends:

> adapting the sampling frequency to the reactivity of the environment;
> adapting the measured parameters to the results of the assessment on pressures;
> drawing up time lines for the action plans and comparing them with changes in water quality;
> comparing water quality with the discharge rates of the abstracted springs or river, or the well piezometric data, and with the climate data;
> carrying out hydrochemical analyses in addition to the analyses on nitrates and phytosanitary products (e.g. boron).

For more information on abstractions
See http://captages.onema.fr.

This internet platform is dedicated to technical and regulatory tools, and to feedback from projects to protect abstractions.

Aline Antoine,
Development board for the Vesle river basin (SIABAVE)

Indicators on water uses and practices can reveal changes in a territory in cases where it is not possible to obtain quantitative results on water resources. It is important to encourage projects in spite of the inertia of environments.

When and how should buffer zones be set up?

Buffer zones have undergone considerable study for extensive treatments of wastewater, however their use in the field of nonpoint-source pollution is fairly recent (with the exception of grassy strips along rivers). The use of buffer zones should be seen as a means to complement other techniques in the management of agricultural non-point-source pollution (reduction of inputs, soil covers, etc.).

In a given river basin, buffer zones may be present in many different forms. Their role may be to protect against product drift during treatments and to limit contaminant transfer to aquatic environments. In this case, they are positioned to intercept run-off and/or subsurface concentrated flows that may contain contaminants.

The positioning within a territory requires preliminary study. Research by Irstea has shown that the effectiveness of buffer zones varies over time (local climate, hydraulic residence time in the buffer zone, etc.) and space (slope, type of soil, etc.). This variability makes quantitative approaches more difficult, but argues in favour of first running an in-depth assessment of the territory and producing a status report on existing buffer zones and on their operation.

The Irstea reseachers in Lyon have developed a method to size a grassy or wooded buffer zone, taking into account the specific characteristics of each site. The method can be used to calculate the optimum size of the buffer zone, depending on the reduction in flow desired by the user.

Then Irstea and the Hydrology and geochemical laboratory in Strasbourg (LHYGES) presented two guides:
> the Guide on designing and installing new retention and remediation systems presents a number of tools and methods for two types of studies:
- how to rework an existing storm drain where the goal of the project is not only to retain a volume of water under run-off conditions, but also to reduce contamination levels;
- how to install new retention and remediation systems sized for entire river basins, i.e. ranging from a few hectares to several square kilometres;
> the Technical guide on creating artificial-wetland buffer zones to reduce the transfer of nitrates and pesticides in drainage water, the case of the Seine-et-Marne department presents the practical sequence of recommended steps to set up an artificial-wetland buffer zone (AWBZ) using the Seine-et-Marne example (a drained environment), including the hydrological assessment, positioning, design, regulations and funding, construction, planting and maintenance. The latter guide will be filled out with a section on system sizing in 2015.

Jacques Oustric,
Chamber of agriculture in the Gard department

Four main constraints confront the creation of buffer zones, in particular in the wine-growing sector, namely regulations, land ownership, management and funding of both the preliminary studies and the construction. For the past eight years, the Chamber of agriculture in the Gard department has worked on informing and raising the awareness of farmers concerning buffer zones. It is proud to announce the creation of a first retention and remediation system following these efforts in 2014.

Finally, the Regional association for the study and improvement of soil (AREAS) presented buffer zones as means to limit the transfer of contaminants such as pesticides and nitrates to water resources, but also as a means to:
> limit incision, soil pick-up and ravining (grassy buffer zones or pools);


© Astee
An artificial-wetland buffer zone in Rampillon (Seine-et-Marne department).

> limit the transfer of suspended matter by provoking sedimentation of particles and sand due to a reduction in flow velocities (e.g. by hedgerows);
> encourage re-infiltration of run-off water and consequently reduce discharges and the transport and incision capacity (hedgerows, grassy or wooded strips).

For more information on buffer zones
A platform presenting tools and feedback from projects has also been set up for buffer zones.
See http://zonestampons.onema.fr.

The large number of participants during the symposium is a sign not only of their interest, but also that people in the field effectively want and need technical support and operational tools in their work to protect water resources. The purpose of this symposium was to transfer a number of tools and methods developed by research teams to water managers and the next step will be to continue studying whether the tools in fact correspond to the operational needs in the field. This will require further analysis and sharing of feedback from projects. That will be the topic of the next PollDiff'Eau symposium. ■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Poster session during the 2013 PollDiff'Eau symposium.

For more information

- The presentations and abstracts of the meeting may be found on the Astee site at http://www.astee.org/agenda/compte_rendu/accueil.php?niv=1.4.4
- Onema will publish a document in its *Knowledge for action* series, which presents in an accessible style the results of recent research programmes on the management of agricultural nonpoint-source pollution.
- In the fall of 2014, the Astee review *Techniques, Sciences et Méthodes (TSM)* will devote a special section to the management of agricultural nonpoint-source pollution, in which more in-depth information will be presented on the tools and methods discussed during the symposium.

Symposium organisation

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Astee : Solène Le Fur and Célia de Lavergne

ONEMA
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