



## Drinking-water abstractions and nonpoint-source pollution Operational solutions for source supply zones of priority water abstractions

*A symposium organised by the scientific group «Large-scale farming offering high economic and environmental performance», with Onema.*

Protection of drinking-water abstractions from nonpoint-source agricultural pollution was already a major health issue 30 years ago and has today become an urgent regulatory problem. In parallel with the Water framework directive, which set goals for good water status by 2015, the Grenelle environmental agreement identified 500 «priority» abstractions for which action plans must be set up by 2012. To that end, over 200 professionals from the water sector, including research, agriculture, water management and local governments, attended the symposium held on 3 February 2011. The wide-ranging discussions produced a vast array of information on people's experiences, technical solutions, opinions and questions. A review.

The 33 000 drinking-water abstractions in continental France and their supply zones are characterised by great diversity in their hydrogeological contexts and in surface areas ranging from a few hectares to several thousand hectares.

### Benoît Réal, Arvalis-Institut du végétal

*«In the Fontaine du Theil catchment (136 hectares) in Brittany, the presence of herbicides was noted and the farmers were advised on chemical weeding for grain crops and corn, and received training on how to adjust the settings on their sprayers. A series of practical projects was carried out, including the creation of buffer zones, recreating hedgerows, replacing chemical treatments along the stream with mechanical means, etc. On the basis of 15 000 analyses between 1998 and 2006, the results showed a drop in the number of samples in which active ingredients could be quantified, from 22% in 1998-1999 to 5% in 2005-2006. The threshold of 5 µg/litre for all substances combined has not been exceeded since 2000.»*

In the areas immediately surrounding the abstractions, all activities, including agricultural, are governed by the 1992 Water law and protection perimeters are mandatory. The basic elements in efforts to protect abstractions are an assessment of territorial vulnerability, a diagnosis of the existing pressures and action plans based on discussions with local stakeholders. Following the 2006 Law on water and

aquatic environments and the creation of zones with environmental restrictions, the prefects have additional means to facilitate the protection work. In 2009, the attribution of the «Grenelle» priority label to over 500 abstractions was a further step in the long-standing protection efforts, which took the form on the local level of numerous projects involving the agricultural sector and water managers.



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## Lessons learned from past and present projects

The first result of the meeting was to draw lessons from past and current projects. Benoît Réal from the Arvalis-Institut du Végétal presented a number of projects carried out since 1997 in contaminated river basins, where the procedure was identical each time. First, a spatial diagnosis on pollution sources and transfer, then preparation of action plans, followed by monitoring of indicators on water status and the progress made. This approach was suitable for a small catchment (see box on previous page), but also for a much larger basin, e.g. the Péron basin in the Aisne department (14 648 hectares, including 82% of useable farm land). The Agriper'Aisne programme, now underway and involving all the agricultural stakeholders in the department, may soon be expanded beyond the Péron basin to cover the entire department.

Other projects were also presented. In the Champagne-Berrichonne section of the Cher department, the Epis Centre co-op has spent the last 20 years trying to modify how nitrogen-based fertilisers are used, by setting up advisory services for volunteer farms, based on monitoring and analysis of the farmers' work habits. The result has been effective change in how nitrogen-based fertilisers are used (Jean-Marie Larcher, Axeréal). Unfortunately, that has not produced a clear improvement in water quality in

### Manon Zakeossian, Eau de Paris

*«One of the keys to success is the continuation of the financial measures provided to farmers. The five-year AEM contracts would appear to be insufficient to stabilise changes in farm practices over the long term. In addition, the increasing regulations for SSZs require local governments to assume responsibility for managing abstraction-protection projects. But local governments are not yet included in the design of AEMs.»*

abstractions. The results are satisfactory for fairly shallow abstraction wells, but in the deep «Porche 2» well, for example, nitrate concentrations are still in the 65 to 70 mg/litre range.

Another example is the Eau de Paris municipal service that, since 2007, has focussed its efforts on three strategic source supply zones (SSZ) surrounded by large-scale farming operations (see box). The municipal service works on providing technical advice via partnerships with local organisations, setting up agri-environmental measures (AEM) and even making land purchases. The results are very encouraging in terms of the commitments made by farmers to reduce inputs or to convert to organic farming, but require more long-term analysis to confirm any real impact on water quality.

More generally, the debates held during the 2011 Meeting identified a number of conditions for success in

effectively protecting abstractions. On the scientific and technical front, there are of course significant expectations in terms of operational and field-ready tools. It is necessary first to delimit the SSZs, then identify any transfers and the most vulnerable zones, and finally determine the most useful action, notably through optimisation of farming practices and the creation of the necessary installations.

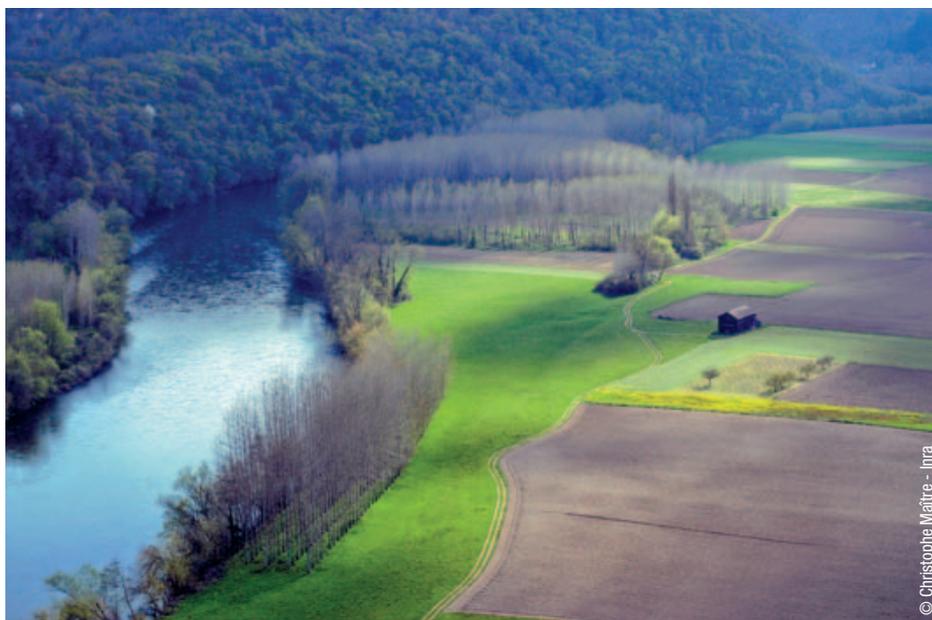
The capacity to mobilise all stakeholders in favour of an action plan is also an essential condition for success. The diagnosis must be understood and approved by all concerned and the project leadership must ensure that a consistent message is transmitted by all the participants in the advisory system.

Another key factor noted during the discussions was the need to maintain projects over time. The efforts made may require several years to improve the quality of water in abstractions and any results must be maintained over time. AEMs are extensively used to launch and accompany projects, but their contract duration is only five years. That may result in problems down the line when efforts must be maintained beyond the contract duration. Finally, an evaluation of the impact of action plans on the water quality of abstractions must be systematically included in protection projects.

## Integrated decision-aid tools for diagnosis and action

The procedure to protect an abstraction logically begins by setting the SSZ perimeter, which in itself requires significant knowledge in hydrogeology. For groundwater abstractions, BRGM published in 2007 a methods guide that presents in detail, for each type of aquifer, the techniques used to determine the part of the water table supplying the abstraction well and the corresponding surface area.

Once the SSZ has been set up, the analysis of its inherent vulnerability and the evaluation of the local pressures are the means to determine the transfer



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risks. To ensure their effectiveness and remain compatible with competitive farming activities, action plans must be adapted to the level of risk in each area and target at least those surfaces identified as the most sensitive. In some cases, this complex analysis may call on digital models combining agronomic and hydrogeological aspects. Worthy of mention here is the method to prioritise zones for action based on modelling of transfers in each cadastral unit (Thibaut Constant, InVivo) or the distributed approaches, such as the TNT2 model developed by INRA to predict the effects of measures to reduce nonpoint-source nitric pollution in abstraction water (Patrick Durand, UMR 1069, INRA-Agrocampus Ouest).

**«Within a source supply zone, action plans must target the most sensitive areas.»**

These models, generally complex and intended in some cases for research, would appear unsuitable in some cases for large-scale operational use in that they require qualified personnel and difficult parameter setting. More integrated systems have been developed as a result. For example, the solutions proposed by the Footways company are now used for a number of SSZs in France. The method simulates surface transport of pesticides taking into account any particular features, e.g. hedgerows, grass buffer strips, and can be used on

different spatial scales. The results can be presented via decision-aid tools such as histograms, graphs, maps, etc.

Concerning nitrates, another useful tool was developed by Suez Environnement. Called Nitrascope™, this simplified model tests the effectiveness of various preventive-action scenarios in view of reducing nitrate concentrations in drinking-water abstractions (Julie Paille, Suez Environnement).

It should be noted that in addition to efforts to optimise agricultural practices, increasing attention is being paid to «buffer zones» (see box). Buffer zones can be simple features of the natural landscape that limit pollutant transfers, e.g. earth banks, hedgerows, lines of trees. For drained fields, abundant research has been carried out on the potential of artificial-wetland buffer zones, positioned at the output of the collector drain. Cemagref (Julien Tournebize, Cemagref) reviewed 54 articles presenting results on the effectiveness of artificial-wetland buffer zones, in addition to his own experimental results. It would appear that such zones can reduce the transfer of substances (nitrates and pesticides) to water resources by 50% on average.

### Julien Tournebize, Cemagref

*«By monitoring two artificial-wetland buffer zones positioned at the output of a catchment, we acquired experimental data thanks to the collaboration with the agricultural sector and assistance from the Water agency, Onema and the Life ArtWET project. Though they are not 100% effective, buffer zones do significantly reduce annual contaminant flows (nitrates and pesticides). They result in the development of a natural ecosystem that can not only retain contaminants, but is also a favourable factor for general biodiversity. These real-life situations are very useful in showing farmers that they can play an active role in the partnership to manage water resources.»*

### Mobilise and organise stakeholders for an SSZ

An SSZ involves many different participants (farmers, land owners, local governments, water companies, etc.) and it is necessary to precisely analyse their relations in order to set up a coordinated plan of action that is understood and approved by everyone. With that in mind, a study by AgroParisTech-INRA SADAPT looked at the farmers involved in the Varaize, Fraise and Anais SSZs (Charente-Maritime department) and at the positions of the Water service in the city of La Rochelle and the Chamber of agriculture, based on surveys in which experts and local stakeholders were questioned (Luc Bossuet, AgroParisTech).



An experimental, artificial-wetland buffer zone.

This work revealed the different attitudes of farmers with respect to AEMs, which can be grouped into three types of reactions. A majority adopt a «wait and see» attitude. In the absence of any legal obligations, they prefer to observe the results and techniques employed by those participating in the project. For others, AEMs are nonsensical because their priority is to control their production in a context of fluctuating costs. Finally, the last group comprises the farmers that have opted for organic or «integrated» agriculture and are open to the proposed AEMs.

**«It is essential to mobilise all the local stakeholders.»**

At the priority Harol abstraction in the Vosges region, an interesting project is underway to coordinate the local players. A group comprising primarily the local stakeholders, including the farmers, was created in 2009 by INRA researchers and the Chamber of agriculture. Its first step was to propose a shared view of the territory in the form of a diagram showing local interactions. The diagram highlighted the role of indirect actors (technicians, suppliers, land owners) who until now have not always been included in the discussions of the steering committee. It also showed the importance of the SSZ borders which determine the number of farmers involved and the impact of the adopted measures on their farms. The project will now proceed with the collaborative formulation of scenarios for territorial reorganisation and an evaluation of the scenarios' impact on water quality.

Generally speaking, the success of an action plan depends on proposing

**Anne-Louise Guilmain, Seine-Normandy water agency**

*«Our agricultural socio-economic diagnostic procedure is based on discussions with farmers and other stakeholders. The analysis of the data and relations between stakeholders contributes to the work of defining the action plan. Our work in this field enabled us to identify the key steps in the preparatory phase, in which the project manager must play an active role. Acceptance of the conclusions by each stakeholder is facilitated by, among other aspects, agreement on the initial goals, regular progress reports in meetings with the steering committee, a meeting to present the project to the public and, generally speaking, consistent efforts to communicate on the project.»*

measures that are effective in terms of water quality, applicable and acceptable in the local context. With that in mind, the Seine-Normandy water agency is now developing an agricultural socio-economic diagnostic procedure that is carried out between the vulnerability/pressures assessment and the drafting of an action plan. The agency ran a study (see box) to produce a guide on how to carry out the diagnosis and the latter is now a standard component in its abstraction-protection procedure. This technique is a means to work through difficult situations and to produce innovative and durable solutions.

The diversity and the quality of the viewpoints expressed by scientists in the 27 contributions, managers and technical institutes are a clear signal that society as a whole has mobilised to address this issue. However, we must now go further and subject past

and present projects to critical analysis. The debates during the meeting are a contribution to that end.



**For more information...**  
 A more comprehensive review (64 pages) is available at [www.onema.fr/IMG/EV/cat7a.html](http://www.onema.fr/IMG/EV/cat7a.html).

**Nicolas Domange - Onema -DAST) :** [nicolas.domange@onema.fr](mailto:nicolas.domange@onema.fr)  
**Stéphanie Potok (GC HP2E) :** [stephanie.potok@paris.inra.fr](mailto:stephanie.potok@paris.inra.fr)

**Meeting organisation :**

**Adrien Guichaoua (GC HP2E) and Nicolas Domange, scientific officer for nonpoint-source pollution in the Research and development department at Onema.**



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