The project 'Clean sources, now and in the future': a new approach results in stakeholder supported solutions for pesticide problems in water

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Abstract
In the Netherlands, pesticide pollution results in problems for the ecological and chemical quality of groundwater and surface water. Driven by European legislation such as the Plant Protection Products Directive, the Groundwater Directive and the European Water Frame Work Directive, the project ´Clean sources, now and in the future´ started in 2004. Aim of the project is to reduce water quality problems caused by agricultural use of pesticides.

Key feature of the project is the close cooperation of four stakeholders: drinking water suppliers, water boards, pesticide companies and farmers work together to tackle water quality problems. This makes it possible to view the problem from all different angles. For selected pesticides which are exceeding water quality standards, extended fact finding is conducted which consists of gathering all available data on monitoring, pesticide use, registration and environmental behaviour. Together with field experts of for instance research, regional projects, agricultural education and information services, the causes of the problem and possible solutions are discussed and prioritised. The acknowledgement, the interest and role of each stakeholder in the problem leads to new insights, consensus of the water quality issue and new feasible solutions.

Keywords: agriculture; pesticides; stakeholder cooperation; water quality

Introduction

Intensive crop growth systems with relative high use of pesticides are typical for Dutch agriculture. The advantage is that on a small surface high crop yields can be obtained. However, in a country with a high density of surface waters, shallow groundwater tables and a substantial precipitation surplus, a major disadvantage is the risk of pollution of groundwater and surface water. In the Netherlands drinking water is produced from groundwater (60%) and surface water (40%). The standard for pesticides in drinking water in the European Union is set at 0.1 μg/L. Therefore, mitigation is necessary for all surface water intakes and most of the vulnerable shallow groundwater pumping stations (Council of the European Union 1980, 1998). In some cases selective intake or reallocation can be a solution but more frequently installing purification through granulated active carbon, advanced oxidation or membrane filtration is inevitable. Furthermore, many of the Dutch aquatic ecosystems are insufficiently protected against pesticide pollution.

Since the pressure on the environment by the intensive pesticide use was recognised the Dutch government developed a series of policy plans to reduce it. In 1991 the long-term plan on crop protection was introduced which set reduction schemes in terms of kilograms (Ministry of Agriculture, Nature and Fisheries, 1991). During the 1990s stakeholders were battling in debates, in

the media and in court over the legitimacy of both policies and legal instruments. In order to settle arguments between the Dutch Federation of Agriculture and Horticulture (LTO) and the Netherlands Society for Nature and Environment (SNM), the Dutch minister of agriculture started negotiations which led to an agreement on crop protection. Figure 1 shows the signing of the agreement in March 2003 by the chairman of the Association of Dutch Water Companies (Vewin), the chairman of the Netherlands Society for Nature and Environment (SNM), the chairman of the Dutch Federation of Agriculture and Horticulture (LTO), the minister of Agriculture, Nature and Food Quality and the deputy minister of Housing, Spatial Planning and the Environment. At a later stage the Dutch crop protection organisation (Nefyto), the association of pesticide traders (AGRODIS) and the Dutch association for breeding, tissue culture, production and trade of seeds and young plants (PLANTUM NL) also signed the agreement.

Figure 1: Signing of the agreement on crop protection in March 2003. Photo by Mieke van Engelen.

Shortly after the agreement was signed the policy document on sustainable crop protection was published (Ministry of Housing, Spatial Planning and the Environment and Ministry of Agriculture, Nature and Food Quality, 2004). The document contains the new policy for sustainable use of plant protection products until 2010. Amongst several goals a reduction target was set at 95% for environmental impact in 2010 compared to the year 1998. This goal might seem ambitious, but the interim evaluation in 2005 shows it is feasible. The reduction in the environmental burden was 86%, well beyond the interim target of 75%. However, the target of no further exceedences of the environmental quality standards in surface waters in 2010 is not yet in sight. Also the quality of surface water as a source of drinking water has improved, but not enough to meet the interim target of 50% reduction in the number of drinking water problems. The evaluation concludes that without measures directly aimed at tackling substances of greatest concern and the sources of pollution arising from crop protection, the desired water quality will not be achieved by 2010 throughout the whole country (Netherlands Environmental Assessment Agency, 2006).
One of the actions set out in the agreement on crop protection of 2003 aims at specific attention for exceeding the water quality standard, both in terms of ecological impact as well as in terms of a sustainable drinking water production. The Association of Dutch Water Companies (Vewin) was

appointed the lead role in this action while the Ministry of Agriculture, Nature and Food Quality and the Ministry of Housing, Spatial Planning and the Environment provided 50% of the funding. The other 50% of the funding was brought together by Vewin and its project partners: the Association of Dutch Water Boards (Unie van Waterschappen), the Dutch crop protection organisation (Nefyto) and the Dutch Federation of Agriculture and Horticulture (LTO). To stimulate the project, the process is managed by an independent project team. The 'Clean sources, now and in the future' project was started in 2004 after the project proposal by Schuttelaar & Partners was accepted (Schuttelaar & Partners, 2004). The main goal of the project is to reduce the number of exceedences of water quality standards by focusing on the major problems caused by the agricultural use of pesticides. A project logo was designed, shown in figure 2, and a website was launched (http://www.schonebronnen.nl/).

Figure 2: The project logo

Strategy

The first phase of the project ran from 2004 until the end of 2005 and started by bringing together all water quality monitoring data. The data was then analysed by the project partners and five specific substances of concern were jointly selected: Bentazone, Carbendazim, Isoproturon, Methomyl and Terbutylazine. The selection process took into account the number and height of exceeding water quality standards, data on the use of the pesticide such as the crop it is used on, the pest it is used against and the contribution of neighbouring countries. For instance the use of Isoproturon in the Netherlands only contributes for a small part to the concentration in the river Rhine in 2001 and 2002 as it already contained levels of over 0.1 µg/L when entering the country. The effect of measures taken in the Netherlands had to be significant in order not to frustrate the effort of those working to address the problem. The pesticides atlas proved to be a useful tool in the geographical analyses of water quality data (De Graaf et al., 2003). An example of the geographical information from the pesticide atlas is shown in figure 3.

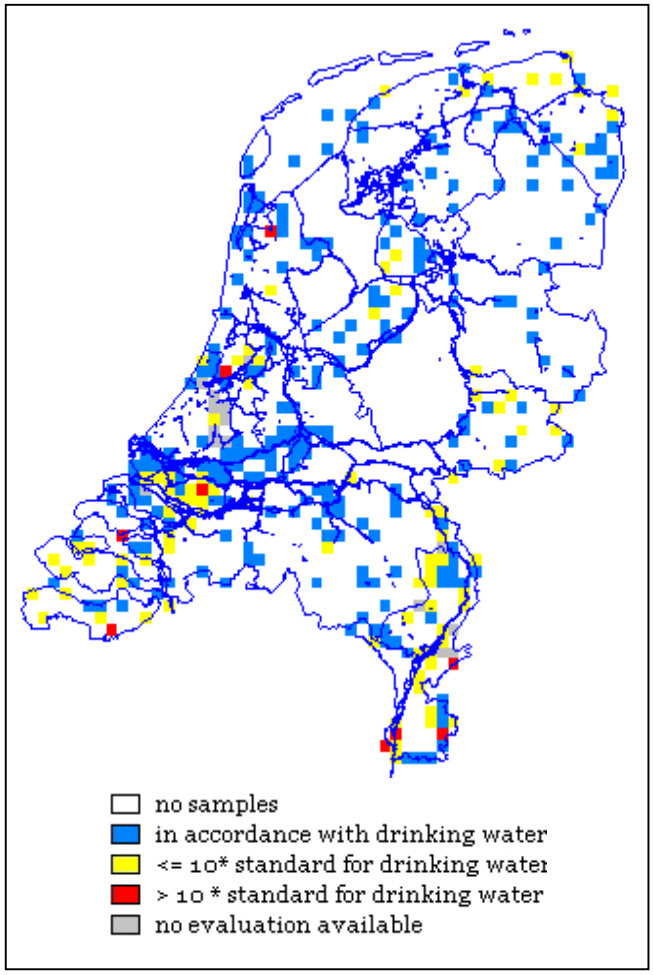

Figure 3: Geographical projection of surface water monitoring data for Isoproturon in 2003-2004 (source: http://www.pesticidesatlas.nl/).

After the selection of substances the next steps are made in chronological order:

- Expert meetings were held for each substance, bringing together all the available knowledge about the substance of the chemical industry, pesticide traders, crop protection advisors, farmers, water boards, contractors, drinking water companies, agricultural and water quality research. Emission routes are identified and possible solutions drafted and prioritised.

- The steering committee of the project selects the most feasible solutions per substance to be worked out in a program of approach.
- When the programs are approved by the partners in the agreement on crop protection they are published on the project website (http://www.schonebronnen.nl/).
- The actions in the programs of approach are monitored during the following years and progress reports are discussed in the project's steering committee and the working group of the agreement on crop protection.

The whole process is being repeated in 2006 and 2007 for five new substances of concern: 2,4-D, Dichlobenil, Dimethenamid-p, MCPA and Pirimifos-methyl (Schuttelaar & Partners, 2006).

An important aspect of the overall strategy is bringing together all parties with a role in chemical crop protection. Followed by meeting each other and create understanding for everyone's role. In this way mutual understanding and a basis is created for the solutions. Furthermore, the chance is larger that the solutions are accepted without using compulsive measures. Table 1 shows the members of the steering committee and their role and interest.

Table 1: Members of the steering committee, their role and interest

Member	Role	Interest
Association of Dutch Water Companies (Vewin)	Responsible for high drinking water quality in accordance with the Drinking Water Directive	Clean sources to keep treatment levels as low as possible and keep high consumer confidence
Dutch Federation of Agriculture and Horticulture (LTO)	Responsible for growing highest quality crops at the lowest possible price in accordance with legislation and consumer demands	Availability of sufficient plant protection products and working on a better image for farmers by showing their compliance efforts
Association of Dutch Water Boards (Unie van Waterschappen)	Responsible for surface water quality management in accordance with the Water Framework Directive	Cleaner surface water with higher ecological potential
Dutch crop protection organisation (Nefyto)	Responsible for placing plant protection products on the market in accordance with the Plant Protection Products Directive	Keeping plant protection products on the market by avoiding water quality problems in their application phase as a part of product stewardship

Results and discussion

The project will not result immediately in reduction of concentrations of pesticides in ground- and surface water. Effects in surface water can be expected in three or four years time while tangible results in groundwater might take more than ten years to be detected if any. The first results of the project are of a different nature. Raising awareness throughout the entire chain from pesticide production to water quality monitoring is of great importance. By working together it has become possible to share a joint view on the nature of the problem; where as in the past two sides seemed only to be communicating their views through the media and court. Sharing information by all the project partners created an atmosphere in which it became possible to focus on tackling the causes of water quality problems rather than tackling each others view on the problem. An example of how mutual sharing of all information helps to build a better picture of the problem at hand was in the

Bentazone case. Bringing all the information together showed that most of the actions to prevent leaching to groundwater had already been taken by the industry and authorisation board. This made it easier to immediately focus on details such as avoidance of use or to use low dose application systems in certain crops in very vulnerable groundwater protection areas. Figure 4 shows a picture from the advisory brochure of BASF for Bentazone use in specific vulnerable ground water protection areas. The brochure is distributed by pesticide traders.

Figure 4: Picture from the advisory brochure of BASF for Bentazone use in specific vulnerable groundwater protection areas.

The acknowledgement of all those working with pesticides that even the slightest loss due to for instance spray drift, leaching or surface run-off can cause exceedences of water quality standards, helps to tackle the problem. The success of the projects programs of approach entirely depends on the way pesticides are handled by the ones that use them.

Two of the complicating factors that influence the behaviour of farmers using pesticides were recognised to be out of the control of all project partners. Levels of pesticides in surface water might already be exceeding standards when rivers enter the country, which was the case for Isoproturon in the Rhine in the early 2000s. Also the agreement on crop protection focuses solely on the agricultural use of pesticides while sometimes other uses lead to exceeding levels in surface water (Bannink, 2004). This is the reason why Glyphosate was not selected as a substance of concern in the project. The use in public greens is a complicating factor in addressing the problems caused by Dichlobenil. The water quality problems caused by these types of applications are not addressed under the agreement but under a specific part of the policy document on sustainable crop protection. Specific projects were started and legislation was put into force to tackle these problems (Kempenaar et al., 2007).

One concrete result of the project is the development of a training program for pesticide applicators in close cooperation with another project by Wageningen University and Research Centre. The training program deals with emission routes of pesticides to surface- and groundwater. There are modules for different sectors such as arable farming, flower bulbs and arable contracting. In the Netherlands, users of pesticides are obliged to have a license for spraying pesticides. A way to keep this license valid is by following the training program about emission routes. Subjects that are discussed in the training program are for example: product choice, storage, cleaning and emission after harvesting.

Certain solutions in the programs of approach were recommendations for more research. Therefore, the project ‘Clean sources, now and in the future’ asked Wageningen University and Research Centre to study on two different items: quantification and purification of rest water flows. The

research program about quantification of rest water flows focuses on several crops. The first results for the different crops are available:

- From the study about concentrated forces and rest water flows in bulb growing seems that contractors and growers are uncertain about the regulations concerned draining rest fluids and wash water. Growers and contractors want to be kept informed about these regulations. The rest water flows can be divided in bulb cleaning, for example Carbendazim, and water from reel basins and condensate of cold storages (Pirimifos-methyl) (Van der Lans, 2007).
- For fruit growing it is concluded that the risk for concentrated force on surface water varies for each region, because of the large differences in the presence of surface water. The possibility of run-off from the farmyard is high when a drain collection unit is missing. There are hardly any practical purification techniques for rest water flows (Wenneker, 2007).
- For crops produced in green houses will be researched in what way concentrated forces of pesticides can be reduced. An example of a substance that is taken into account is Carbendazim in growing roses and chrysanthemums (Van der Maas, 2007).
- In corn growing the size and degree of concentrated forces is influenced by the type of farmyard, gradation of run-off, distance between cleaning area and sewer well or surface water (Van Zeeland et al., 2007).

The research on rest water flows is continued in two projects, one for open ground crops and another for green houses. The research on purification of rest water flows shows an overview of techniques that purify water with pesticides and its main properties. Six purification methods are described: bio beds, constructed wetlands, active carbon filters, active carbon filtration combined with flocculation, oxidation and photochemical conversion and membrane filtration. Biological purification methods are less suitable for mobile pesticides, since they leach sooner. In general, biological purification methods have the advantage that they need less maintenance. Technical purification methods (active carbon, oxidation and membrane filtration) are not season dependent and produce an effluent with a constant quality. However, technical methods need specified knowledge and maintenance (Vulto and Beltman, 2007).

For implementing all solutions of the different programs of approach the steering committee realized that more partners were needed. Therefore, several stakeholders were asked to join in the shape of an intensive cooperation. With this intensive cooperation all parties recognised each others interests: knowledge, network, experience, commitment and possibility to address everyone's responsibility. The parties that joined the intensive cooperation are contractors, research, information services, plant breeding, pesticide traders and the project 'Growing with future'. The meeting 'Clean sources, also your interest' was the kick-off moment of an intensive cooperation.

To spread the message of the project among stakeholders, members and supporters of the project partner organisations a day named 'Clean sources, meeting each other and sharing knowledge' was organised. During this day participants realized that bottlenecks can be solved when everyone from drinking water companies, water boards, pesticide producers till farmers take their responsibility. Some participants learned to look beyond their own framework and became aware that clean water is important to all involved parties. Another goal was to strengthen the relation between different parties so it became possible to handle water quality problems pro-actively instead of re-actively.

It is important to enlarge the awareness of a farmer about his own contribution to cleaner water, while this group plays a large role in keeping water clean. A way to increase awareness is to show regional monitoring data. It has more impact when a farmer hears about an exceedence of the standard in his own ditch than somewhere else in the Netherlands. The project joined already meetings of different agricultural sectors to discuss regional monitoring data with farmers and water

boards. Another subject presented in an interactive way (quiz) was concentrated emissions. A concentrated emission is a situation when pesticides reach directly the surface water at one point. A rough estimation is that half of the emissions to surface water originate from concentrated emissions. A concentrated emission can happen during careless working while filling or cleaning the spraying machine. The quiz about concentrated emissions uses examples to make farmers aware of the consequences of emissions at one point and how to prevent them.

A result that is more specified to the substance Terbutylazine is the cooperation between the project 'Clean sources, now and in the future' and some admission holders to reduce the emission of this substance. The admission holders (BASF Netherlands and Syngenta Crop Protection) requested at the Board for the Authorisation of Pesticides to change the label of Terbutylazine. The request was honoured and the following drift reducing measure was added on the label: 'On plots that border to water courses the application is only allowed with capsules of drift reducing classes of at least 75%'. The admission holders decided to go one step further and ended the registration of Terbutylazine in solo-formulation. Since September 2007 it will not be possible to (over) use Terbutylazine in solo-formulation in the Netherlands. After that this substance is only available in a pre-mix formulation.

It was an unpleasant surprise when during the cause of the project the legal water quality standard for one of the substances of concern changed so drastically that it was no longer a substance of concern. This happened because more up to date information about the behaviour and effects of the substance in the environment became available and was assessed in the standard deriving process. In order to prevent such a surprise in the future of the project a letter was drafted asking for the reassessment of a number of potential substances of concern that were identified in the early stages of the second phase of the project. Acting as the responsible project partner the Association of Dutch Water Boards send the letter to the Ministry of Housing, Spatial Planning and the Environment. In their answer the ministry announced several new water quality standards to be set ultimately in April 2008.

Conclusions

While working on the project it became clear that the project helps to comply with the goals of the Water Framework Directive even though that had not been the reason to initiate it (European Parliament, 2000). This is why the focus in the project is shifting more and more towards implementing and compliance with the Water Framework Directive. Keeping in close contact with related projects in the Netherlands helps consolidating the results of the individual projects. such as:

- 'Growing with future' (http://www.telenmettoekomst.nl/) ;
- 'Pure water from the Bommelerwaard region' (http://www.zuiver-water.nl/);
- Reduction of the emissions of pesticides by the glasshouse horticulture industry to the environment, a project in which water boards, Bayer CropScience BV and Wageningen University and Research Centre cooperate;
- 'Clean water' (Verheijden et al., 2006) (http://www.schoon-water.nl/).

It is important to all stakeholders that communication about the project results is not contradictive.

The interim evaluation in 2005 of the policy document on crop protection shows that crop protection methods in the Netherlands have become more sustainable since 1998 as a result of efforts made by growers. However, the evaluation concludes also that the desired water quality in the Netherlands will not be achieved by 2010, without measures directly aimed at tackling the substances of greatest concern and the sources of pollution arising from crop protection (Netherlands Environmental Assessment Agency, 2006). This gives the project 'Clean sources, now and in the future' a new impulse. The project focuses on substances of greatest concern and sources

of pollution arising from crop protection in agriculture. Due to the close cooperation of the steering committee and other involved stakeholders it is possible to tackle water quality problems. The acknowledgement, the interest and role of each stakeholder leads to new insights, consensus of the water quality issue and feasible solutions.

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