

WATER PROTECTION AGAINST NITRATE AND PESTICIDES FROM AGRICULTURAL SOURCES – HISTORY OF ACTIONS TAKEN AT FARM SCALE IN WALLONIA (BELGIUM) FOR 15 YEARS

Pascale PICRON, Armelle COPUS, Dimitri WOUEZ

PROTECT'eau, www.protecteau.be, BELGIUM

E-mail of corresponding authors: pascale.picron@protecteau.be, dimitri.wouez@protecteau.be

Keywords: Nitrate Directive, Plant Protection Products Directive, water pollution, National Action Plan

ABSTRACT

Founded into the frame of EU regulations regarding nitrate and pesticides management, the Walloon structure PROTECT'eau aims to give farmers professional advices to implement good farming practices in order to prevent diffuse water pollution. The taken actions are the result of a strong collaboration between professional advisors, who provide technical and administrative support to farmers, and scientific partners, who produce regional references. Communication to the sector is another core activity of PROTECT'eau. It is indeed essential to make the objectives clearly understood to ensure a large application of the measures and achieve significant results regarding the quality of groundwater.

CONTEXT AND LEGISLATIVE FRAMEWORK

Nitrates and Plant Protection Products (PPP) are admitted to be the most significant diffuse water contaminants from agricultural activities. Consequently, the European Union has adopted several directives which establish a common framework for Member States to reduce and prevent pollution from these sources. The EU guidelines for achieving these common results are mainly included in three major directives: (i) the "Water Framework Directive" (Directive 2000/60/EC), which allows the evaluation and the management of bodies of water regarding their ecological and chemical status (it includes, among others, the monitoring of a list of contaminants, including nitrate and PPP)(EC, 2000); (ii) the "Nitrate Directive" (Council Directive 91/676/EEC), which forms an integral part of the Water Framework Directive and aims to prevent nitrates from agricultural sources polluting ground and surface waters and to promote the use of good farming practices (EEC, 1991); and (iii) the "Plant Protection Products Directive" (Directive 2009/128/EC) which aims to achieve the sustainable use of pesticides (EC, 2009).

Both Nitrate and PPP Directives promote the adoption of National Action Plans to set up their objectives and measures. Guidelines and targeted topics are provided in the texts. Their transpositions in Wallonia led to the development of two specific action plans: (i) the Walloon Program of Sustainable Nitrogen Management in Agriculture; and (ii) the Walloon Program of Pesticide Reduction Use. In order to manage and monitor agricultural practices, measures are structured around (i) Technical support to farmers, (ii) Communication to the sector and (iii) Scientific validation. The coordination is made by a non-profit organization, named PROTECT'eau, which was founded by the public authorities specifically for this purpose.

WALLOON ACTION PLANS

The Program of Sustainable Nitrogen Management in Agriculture (PGDA)

The Nitrate Directive was first implemented in Wallonia in 2001 and is known as the Program of Sustainable Nitrogen Management in Agriculture (PGDA). The current action program, in force since June 2014 (AGW, 2014), is the third version. Measures apply on a voluntary or compulsory basis. Requirements also depend whether the farm is localized or not in the designated Nitrogen Vulnerable Zone (NVZ). NVZ represents 59 % of the

Walloon territory and concerns around 68 % of the farmers. Behind these range of measures, the public authority has also developed a control procedure at farm level. The principle is based on the measurement of the amount of nitrate present in the soil after the harvest in the fall period, when crops do not take nutrients for their growth anymore. That nitrogen is, indeed, highly susceptible to leach during the winter. On field measurements are then compared to crop-specific references which are yearly determined from a network of 35 reference farms. These farms are geographically spread in order to be representative of Walloon soil conditions and types, and to the seasonal characteristics. The concerned farmers follow an established fertilisation program, based on a balance between crops requirements and soil supplies (see here under). During the fall, 5 % of the farmers from the NVZ are randomly selected in order to sample the soil of three of their parcels for further nitrate lab-analysis. Farmers enter in an observance program if their results are unfavourable. This instrument, named “Potentially Leachable Nitrogen”, provides a control procedure based on the result.

Actions are divided into five topics and concern either legal Obligations (O), Voluntary good farming practices (V), led throughout Wallonia (W) or only in NVZ (NVZ). The legislation also rules the destruction and further management of permanent grasslands.

“Soil Binding Rate” and “Spreading contracts” (O, W): In order to monitor, as required, the amount of livestock manure applied to the land at farm-level, the public authority calculates yearly a “Soil Binding Rate” for each unit. This indicator attests that the amount of livestock manure valued as fertiliser does not exceed the specified amount of organic nitrogen per hectare. It takes into account organic nitrogen produced by the livestock and shipments of manure from one farm to another, through the establishment of “Spreading contracts”. The specified quantities of organic nitrogen per hectare are fixed regarding the land use. It amounts to 115 kg N/ha for croplands and to 230 kg N/ha for pastures, with a maximum mean of 170 kg/ha at farm level in NVZ. The use of spreading contracts improved the geographical spread of livestock manures.

Spreading periods and conditions (O, W): The application of fertiliser should occur when crops require nitrogen, in order to prevent nutrient losses in water. The Walloon regulation provides periods when land application is prohibited. The calendar depends on the type of fertiliser, and, more particularly, on the basis of the fast-release nitrogen content of the product, the land localisation (in or out the vulnerable zone) and the land use (cropland or pasture). Land application of organic or chemical fertiliser is forbidden to water-saturated, flooded, frozen or snow-covered ground, for distance less than 6 meters from water courses, to steeply sloping (more than 15 %) or bare ground, and prior, during or after a legume culture (peas, beans, etc.). Some exceptions apply in non-NZV. They concern the application of solid manure to frozen, bare or steeply sloping grounds.

Manure storage capacities (O, W): Each farm needs sufficient manures storage capacities in order to spread them during periods that allow an optimum valorisation and to avoid their application during environmentally hazardous periods. In Wallonia, the minimum required storage capacity was fixed to six months of production. Every breeder has to meet these standards, which required sector investments. Regulation also rules temporary on field storage of solid manure.

Sustainable fertilisation practices (V, W): Among measures that rely to “Good farming practices”, farmers are strongly advised to plan fertiliser application in order to maximize nutrient uptake and to minimize losses. One measure of improvement concerns the

application itself. Optimum climatic conditions such as a cloudy, humid, fresh and calm weather, associated with efficient machineries (surface spreaders or sub-soil injectors), contribute significantly to reduce volatilisation and to uniformize the application. The spreading should, moreover, occur in periods during which crops development allows optimal nutrients uptake. “Sustainable fertilisation assessment” is another tool established and promoted to farmers. Fertilisation assessment is based on the balance between the foreseeable nitrogen requirements of crops and the nitrogen supply to the crops from the soil, corresponding to the amount of nitrogen present in the soil at the end of the winter, the supply through net mineralization of the reserves of organic nitrogen in the soil and of winter catch crops decomposition, in addition to nitrogen from livestock manure and other fertilisers (ECC, 1991). To be relevant, advices must rely on specific “Nitrogen supply factors” regarding the regional soil conditions and types, climate, land use and catch crop nature. A specific Walloon frame of reference is thus being built since the first program. Nitrogen fertilisation (organic + chemical) may not exceed 250 kg N/ha on croplands and 350 kg N/ha on pastures, with respect of the other legal dispositions.

Catch crop management (O, NZV; V, Non-NVZ): The maintenance of a vegetation cover during cold and rainy periods, allows to take up the surplus of nitrogen that remains in the soil after harvest which could otherwise be leached. The reasons why such excess appear have to be found in (i) the fact that the efficiency of fertilisation practices is not close to 100 %; (ii) an excessive fertiliser application due to a miss-evaluation of the requirements of the crops and/or the supplies from the soil (see here over); and/or (iii) a cultural accident that caused a drop in the expected yields. Catch crops sowing is obligatory for 15 years in NVZ. If that measure was first foreseen as an additional constraint, winter cover crops are now acknowledged for their numerous interests behind nitrogen catching, such as additional forage production, “green manure” effect, action on the soil structure, soil organic pool maintenance, erosion and weeds control, etc.

The Walloon Program of Pesticide Reduction Use (PWRP)

The European Directive aiming to achieve the sustainable use of PPP was transposed in the Belgian and Walloon legislations in 2013 (AR, 2013; AGW, 2013). The legal framework is, nevertheless, still in progress. The chapter regarding Integrated Pest Management came into force in January 2017 (AGW, 2016b, AM, 2017). The action plan includes the following major points:

Training: Professional users, distributors and advisors must be in possession of a valid “phytolicence” issued by the federal state afterwards initial or continuing training. Recognized training sessions are thus organised throughout the territory (AGW, 2016a).

Buffer zones and pesticide application equipment: The region established minimum buffer zones, near water courses (6 m) or road equipment to collect rain water (1 m). These buffer zones are additional to constraints regarding specific application obligation, determined by the Public Health authority while delivering the market authorization. Sprayers must be adequate, in good working order and minimize spray-drift.

Specific practices and uses: Aerial spraying is now forbidden and equipment's to minimize spray-drift are strongly recommended in some situations.

Handling and storage of pesticides: The legislation describes the main compulsory steps regarding the handling and storage of PPP.

- Storage: Storage has to occur in a specific room or closet, complying with security standards such as the record of an inventory with a close description of the products, the installation of retention facilities, the presence of pictograms, etc.
- Handling, dilution and mixing of products before application, filling and cleaning of the equipment: these steps have to occur either (i) on field, (ii) on a surface covered with grass, or (iii) on a surface covered with a waterproof material, mechanically and chemically resistant, with a specific drainage system to collect water contaminated with pesticides. Waste water must, finally, be treated in a proper treatment equipment. Every caution must be used during the filling of the tank in order to avoid any water backflow from the tank to the water source and any overflowing.
- Handling and remnants recovery: empty packaging must be rinsed, cleaned and dried before being stored in a closed bag, outside the storage room. Expired products must be clearly identified before recovery. Recovery is organised by approved agencies.
- Rinsing and disposal of tank mixtures: remaining tank mixtures might be spread on the concerned field or on a surface covered with grass, with respect of a minimum dilution of 1/100th.

Integrated pest management (IPM): This approach promotes low pesticide-input pest management, giving priority, whenever possible, to non-chemical methods (EC, 2009). Eight principles must be respected (AM, 2017): the application of good farming practices, the consideration of sanitary warnings, the respect of intervention thresholds, the use in priority of alternative control strategies, a careful choice of PPP, the re-consideration of doses and treatment frequencies, the application of anti-resistance strategies, the monitoring and the reporting of the success rate of the set of measures applied and the implementation of their traceability. Specialized professional organisations support the agricultural sector in Wallonia by monitoring crops for sanitary state. Their teams follow crops development in reference fields spread throughout the territory and determine the impact of climatic conditions and pest pressure on the cultivation. For each of their plots, they count and characterise the number of sick plants and check bugs traps. Regarding the results, sanitary warnings and intervention thresholds are published. Among all the IPM measures, none of them is totally new, except for the obligation regarding traceability.

DESCRIPTION OF ACTIONS MANAGED AT FARM SCALE

Nitrate and Pesticide action plans may somehow be seen as a long list of constraints. To ensure a large application of the program, it is therefore essential to strongly communicate and give technical support to the sector, so that they understand the objectives and the way to implement these measures. This is part of the missions of PROTECT'eau.

PROTECT'eau is one of the management structures created in the frame of the Walloon action plans. Founded in 2001 as a non-profit organisation, it is funded by the public authorities. Its General Assembly brings together representatives of the agricultural, environmental and water sectors, in addition to the public authority. The operational organisation is, on the other hand, structured around three spheres of competence: (i) Technical support, (ii) Communication, and (iii) Scientific validation.

Technical support for farmers

PROTECT'eau is divided into 4 local units, each covering a specific geographical zone of Wallonia. Local technical support teams are composed of 3 professional advisors.

Both programs contain a lot of measures which details are sometimes difficult to handle. PROTECT'eau is a key partner to clarify these points. Most questions come over spreading calendar, catch crops obligations, buffer zones, etc. Administrative support mainly concerns the calculation of the Soil Linked Rate (see here over) and the completion of spreading contracts on the internet. Technical advices refer more often to the selection of the best available catch crops and the assessment of fertilisation levels. The lab-determination of plant-available nitrogen in the spring is used as an input in the calculation. At the end of the cultivation campaign, the "Potentially Leachable Nitrogen" is measured as an indicator of the accuracy of the past fertilisation level. Competences of PROTECT'eau also focus on storage facilities. Technical advisors help farmers to quantify their needed storage capacities, either for PPP waste water or livestock manure. Advice is made regarding the need of the farmer and the costs of the facilities. Advices also concern waste water treatment equipment and the use of spray-drifts.

Technical support teams and farmers rely on handy tools to provide advices or implement actions in a harmonized way. The staff works therefore continually, in collaboration with the scientific partners and the communication unit, on the development of new tools and technical sheets. To this day, PROTECT'eau has produced about 50 technical sheets, three technical guides and developed two online application. Since it was created in 2001, PROTECT'eau accompanied 8400 farmers and visited 19,000 farms. About 450 farmers were followed for fertilisation management in 2016, which represents 27,500 ha.

Communication

It is essential to widely and clearly communicate to the farmers in order to explain the objectives of the required measures and give advice for their best implementation. That work is done by the communication staff. Frequent agricultural press releases remind major scheduled points of the regulation. PROTECT'eau also releases twice a year its own magazine. Other events are organised such as information meetings, continuing training sessions, on field technical demonstrations. Public communication is also implemented in order to value efforts accomplished by farmers. In 2016, 61 press articles were published while 6 demonstrations days and 49 farmers meetings were, among others, organised.

Scientific validation

Scientific partners develop specific and regionally based, references and indicators. These regional data and information are then used as input in the technical sheets and tools developed by the technical support and communication staffs. The scope of their researches includes experiments on catch crop in order to determine best sowing rate and date, forage value, best destruction techniques, nitrogen restitution dynamics, etc.; yearly monitoring of potentially leachable nitrogen throughout a network of reference farms; determination of fertilisation value of livestock manure; determination of the efficiency of treatments with sprayer equipped with spray-drifts; development of new PPP waste treatment equipment's; etc.

WATER QUALITY EVOLUTION

Due to the slow nitrate lixiviation rate (about 1 m per year) and the depth of groundwater bodies, the evolution of water quality is a very slow phenomenon. Nevertheless, the Nitrate action plan could be fully tested on a small catchment zone, in Arquennes. After 10 years of observation, while 6 were made of farmers technical support, the amount of

nitrate in the groundwater body had diminished by 15 to 20 mg/l (Deneufbourg et *al.*, 2010). Eleven similar localised actions are in progress. They also aim to monitor the evolution of PPP concentration.

CONCLUSIONS

The evolution of water quality is a very slow phenomenon. Nevertheless, the application of the Nitrate and PPP action plans in, among others, catchment zones, with a close supervision of PROTECT'eau, has demonstrated the efficiency of the measures, when their application is generalized, and the relevance of the support of PROTECT'eau.

REFERENCES

- AGW (2013). Arrêté du Gouvernement wallon du 11 juillet 2013 relatif à une application des pesticides compatible avec le développement durable et modifiant le Livre II du Code de l'Environnement, contenant le Code de l'Eau et l'arrêté de l'Exécutif régional wallon du 5 novembre 1987 relatif à l'établissement d'un rapport sur l'état de l'environnement wallon. M.B., 05.09.2013.
- AGW (2014). Arrêté du Gouvernement wallon du 13 juin 2014 modifiant le Livre II du Code de l'Environnement, contenant le Code de l'Eau en ce qui concerne la gestion durable de l'azote en agriculture. M.B., 12.09.2014.
- AGW (2016a). Arrêté du Gouvernement wallon du 28 avril 2016 relatif à la formation initiale et continue, et à l'évaluation des connaissances nécessaires pour l'obtention d'une phytolicense. (M.B. 12.05.2016)
- AGW (2016b). Arrêté du Gouvernement wallon du 10 novembre 2016 relatif à la lutte intégrée contre les ennemis des cultures. M.B., 09.12.2016.
- AM (2017). Arrêté ministériel du 26 janvier 2017 portant exécution de l'arrêté du Gouvernement wallon du 10 novembre 2016 relatif à la lutte intégrée contre les ennemis des cultures
- AR (2013). Arrêté royal du 19 mars 2013 pour parvenir à une utilisation des produits phytopharmaceutiques et adjuvants compatible avec le développement durable. M.B., 16.04.2013.
- Deneufbourg M., Vandenberghe C., Gaule D., Khalidi M., Bolly P.-Y., Hupin F., Marcoen J.M. (2010). Programme d'actions pour la protection des captages contre les contaminations d'origine agricole. Bassins pilotes d'Arquennes. Rapport d'activités final. Convention S.P.G.E. – Nitrawal a.s.b.l., 28p.
- EC (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.
- EC (2009). Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides.
- EEC (1991). Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC).